

NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Mapping Aquifer Characteristics of the Lewis and Clark NRD using Aero Electromagnetics.

PRIMARY CONTACT INFORMATION

Entity Name: Lewis and Clark Natural Resources District

Contact Name: Annette Sudbeck

Address: 608 N. Robinson Ave, PO Box 518, Hartington, NE 68739

Phone: 402-254-6758

Email: asudbeck@lcnrd.org

Partners / Co-sponsors, if any: University of Nebraska – Conservation and Survey Division (UNL-CSD), Eastern Nebraska Water Resources Assessment (ENWRA)

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

Grant amount requested. \$ 61,200

Loan amount requested. \$ 0.00

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 <input checked="" type="checkbox"/>	Obtained: YES <input type="checkbox"/>	NO <input type="checkbox"/>
USACE (e.g., 404 Permit)	N/A <input checked="" type="checkbox"/>	Obtained: YES <input type="checkbox"/>	NO <input type="checkbox"/>
Cultural Resources Evaluation	N/A <input checked="" type="checkbox"/>	Obtained: YES <input type="checkbox"/>	NO <input type="checkbox"/>
Other (provide explanation below) Click here to enter text.	N/A <input checked="" type="checkbox"/>	Obtained: YES <input type="checkbox"/>	NO <input type="checkbox"/>

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.
\$ 0.00

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 eastern third of Nebraska was impacted by multiple stages of glaciation, resulting in highly variable aquifer characteristics and unpredictability in aquifer existence across the Lewis and Clark Natural Resources District (referred to as Lewis and Clark NRD or LCNRD). Because of this variability the source of groundwater also varies across the District, and wells can be developed in the Missouri River Alluvium, un-differentiated sands and gravel, Niobrara Bedrock Formation, the Dakota Bedrock Formation, as well

as several other minor sources and are utilized for domestic, stock, irrigation, municipal, and industrial/commercial applications. Mapping the poorly understood, diverse groundwater aquifer setting of the district will substantially improve the ability to answer critical questions associated with groundwater sustainability in a time of increased demand. The specific plan developed for this for project is based on a previous Airborne Electromagnetic (AEM) geophysical survey of the district flown in 2014 by the Eastern Nebraska Water Resources Assessment (ENWRA). That AEM survey was flown as a reconnaissance survey, which proved the usefulness of AEM data for mapping the thickness and extent of the aquifers and geologic formations of the glaciated regions. The AEM data proved capable of identifying all of the aquifer systems of the district along the flown flight lines including the Dakota Formation where the surface of the formation can be as deep as 900 feet below the land surface. The initial survey results also proved the resulting data could be reliably verified using test hole data from new and existing sites (LCNRD observation well network and CSD database). The project will consist of flying approximately 240 line kilometers (149 miles) in a three mile grid of southern Cedar County (from Hartington south, see [Attachment 1](#)) in the Lewis and Clark NRD. Hartington is the largest community served by a groundwater system in the Lewis and Clark NRD and the Village of Coleridge is also served by groundwater. Magnet is located in the flight area, they are currently served by the Wausa water system, however they could benefit from the flight data in the future. Both Hartington and Coleridge are experiencing rising nitrate concentrations in at least one of their public water system (PWS) wells. The survey results can provide the NRD and these communities tangible, scientific-based information, such as areas where recharge reaches the aquifer, to support them in the development of rules and regulations to protect the resource for the long-term.

If funded, the Lewis and Clark NRD would use a geophysical contractor (in a manner as previously used by ENWRA [see www.enwra.org website for history of airborne applications and results]) for the following services: review the flight line locations and adjust them as needed to minimize interference (from power and pipe lines, etc), collect and quality check the airborne data, process the data, gather/georeference all existing data near the flight lines, and interpret the data in a final report taking into account the reconnaissance framework (2014 flights) specific to the Lewis and Clark NRD ([see letter with detail of services, Attachment 2](#)). The resulting dataset will be used by the Lewis and Clark NRD as described above and will be provided to ENWRA, the UNL-CSD, NDEQ and the DNR for collaboration and shared use of the best available comprehensive hydrogeologic framework data for the area.

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

AEM geophysics was first explored as a method to develop a three-dimensional geologic framework and water budget for the glaciated region of Nebraska with three pilot studies flown in 2007. Different AEM technologies and methods of flights were employed during studies conducted between 2007 and 2013 in an effort to determine the means to best define and accurately represent the geologic framework (please visit

www.enwra.org for full investigation history). Through the efforts of ENWRA, UNL-CSD and Aqua-Geo Frameworks (AGF, personnel involved with previous studies are currently with the selected AEM contractor) successful AEM survey procedures were identified and developed. In 2013 the Lower Elkhorn and Lower Platte South NRDs flew block studies with AEM on 300-meter spacings. In 2014, The Lower Elkhorn flew 3X3 mile grids for areas in their district in conjunction with ENWRA's mobilization for recon flights across the northern portion of eastern Nebraska. The closely spaced block flights and 3X3 mile grid flights were successful in providing a framework to build an inferred three dimensional representation of aquifers, which provides the information needed to develop a broad understanding of the subsurface (www.enwra.org for full investigation history). CSD is in the process of developing county atlases for each county in Nebraska, using in part, this data and borehole information to develop estimates of the geology and associated groundwater conditions. The surveys were also able to show areas of hydrogeologic connection and to depict potential recharge areas in the subsurface along the flight lines. The previous surveys have shown that AEM is a rapid and efficient way to remotely sense geology in eastern Nebraska without the need for extensive drilling and that well-calibrated AEM methods allow for small and large-scale characterization in areas of thick glacial till where aquifers are deeply buried.

Over the last three years LCNRD has been working with UNL-CSD on a project to establish a preliminary study of the aquifer systems of the district. To date thirty-five test holes have been drilled across the district with focus on areas of water quality concern and Wellhead Protection Areas (WHPAs), as well as in areas where little data exists. Twenty-nine dedicated observation wells have been or will be established in the target areas (see Attachment 3). The goal of this project has been to establish the base data required to define the geologic framework of the district. The next step of the process is to perform AEM survey data collection across the district at a large scale (3x3 mile grid), starting in the portion of the district where the most test hole data and existing work has been completed in order to best calibrate and get the most out of the resulting data. The location of the proposed project also coincides with planned AEM flights of the Lower Elkhorn NRD and the Bazile Groundwater Management Area which will simplify many aspects of conducting the work including mobilization of the flight crews, data processing by ENWRA and UNL-CSD. The survey will be conducted in a three mile grid pattern, which is based on previous flights (Lower Elkhorn 2014 grid flights depicted on Attachment 4) and provides the optimum spacing for interpretation profiles to get the best possible value for the cost of the flight lines (ie. large coverage area with enough detail to see local scale understandings and ability to view in a 3-D grid manner).

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

N/A - no water or land rights are required to complete this project. Landowners will be notified through mailings that the flights will be conducted over their property. No trespass on private property or human health issues result in data collection. All data is collected under Federal Aviation Administration rules and procedures.

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 project will greatly improve the understanding of groundwater resources in southern Cedar County of the LCNRD. This knowledge could influence the future well siting of any well type for any beneficial use. The data could also help the communities of Hartington and Coleridge to protect their existing wellheads through development of plan components to address specific concerns, such as contamination due to leaching of organic or inorganic fertilizer, in the areas where the public supply wells are most susceptible to contamination instead of applying blanket requirements in the protection area. In addition the data can help communities identify whether limiting construction of livestock facilities in the WHPA is appropriate or to identify locations better suited to livestock facility construction. The data will also be used to help landowners and the district to narrow down areas where irrigation development is appropriate. With additional information, private landowners could use the data to identify suitable areas to construct a domestic or stock well, especially in areas where water resources are highly variable.

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

The next best alternative to gain the same degree of information as conducting the proposed three mile grid flights is to drill test holes to draw cross sections of the geologic formations. If you assumed that it would require five hundred test holes drilled to typical depths (150 to 350 feet) spaced every 1,000 to 1,550 feet along the flight lines, which is conservative considering AEM provides virtual borehole soundings about every 20 feet with x,y,z data lumped every 250 feet to depths over 1,000 feet, it would cost on the order of \$750,000 to \$2,625,000 (test hole rates: \$10-\$15 per foot) and take decades to complete the work in this manner. Additionally, the costs would more than double if test holes were advanced to 700 feet which is still short of the AEM imaged depths. Further, there is no UNL-CSD staff/equipment available to dedicate to completing this scale of work compared to the two years anticipated for the grid flights and reporting.

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). [Click here to enter text.](#)

The project costs are for a hydrogeologic study (see Section D #4 and cost/benefit table of this section, Section B #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). [Click here to enter text.](#)

The project is designed to last two years with the contractor costs incurred in year one. Analyzation of the data and dissemination of the data will begin in year one and will continue through year two. The timeframe of usefulness for the data is unending similar to the CSD test hole data. The data can be built upon in future years, extending mapping through the district or to focus on areas where more detail would be beneficial. The mapping of the district will result in a grid of the district with the lines crossing every three miles which provides a large scale three-dimension representation of the surface and sub-surface geologic formations of the Lewis and Clark NRD. Existing flight data conducted by the LENRD has reinforced for both UNL-CSD and ENWRA that the frequency of the 3-mile distance between flight lines is suitable to achieve the goals of this project. Because the proposed flight area covers the region of the Lewis and Clark NRD where UNL-CSD staff has the most geological and hydrogeological data, it is best suited to start at the 3X3 mile spacing in this part of the district and future flights could be planned at other appropriate flight line spacings to build upon the insight gained from the data obtained in southern Cedar County and LENRD.

- 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).

Activity	Cost Year 1	In Kind *	Cost TOTAL	Benefits (potential cost of drilling 500 test holes and processing the data to produce an aquifer boundary map)
WSF Grant funding	\$61,200	0	\$61,200	Test hole drilling (150-350-foot depths): \$750,000-\$2,625,000
LCNRD	\$40,800	\$5,000	\$45,800	
UNL-CSD		\$15,000	\$15,000	
ENWRA		\$15,000	\$15,000	
TOTALS			\$137,000	

* Indicates in-kind match, funding is only sought for conducting the flights and contractor costs through the Water Sustainability Fund. In kind dollars will be carried over into year 2 to complete proposed activities.

- 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). [Click here to enter text.](#)

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

The Lewis and Clark NRD has the ability to levee funds to complete work which benefits the natural resources and public of the District. The NRD can levee up to 4.5 cents per 100 dollars of taxable valuation annually. At this time 2.1186 cents per 100 dollars of valuation are leveed. The board approved LCNRD FY2016 budget page is available for review in [Attachment 5](#), and the minutes from the December 17th LCNRD board meeting approving the application to the WSF is in [Attachment 6](#).

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

The NRD has sufficient annual revenue available to repay the reimbursable costs, see [Attachment 5](#), FY16 budget table. The extended cost to operate and maintain the work achieved is covered in the annual dues paid to ENWRA by the associated NRDs including LCNRD UNL-CSD also has long-term data management capabilities should there be a need to transition storage of the data (CSD submitted grant request in September 2015 to NET for data storage and handling funds which includes accommodating statewide AEM data). Because the project is primarily data collection there is no cost associated with equipment replacement.

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

No loan involved.

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

The plan minimizes impacts on the natural environment as only a small number of test holes are required to validate the data obtained through the survey. The AEM survey provides approximately 50 virtual boreholes per mile of empirically collected subsurface information. Because the data will help to identify aquifer boundaries along the flight lines and areas where contaminant threat to the groundwater resource is high; the survey will help to pin point locations to establish observation wells to obtain the most relevant information about the identified aquifer systems, providing knowledge to

develop water management criteria which sustain the ground water resource. This type of work will substantially limit the amount of drilling and disturbance to the above ground habitats and subsurface geology while providing quality data. Drilling test holes and/or observation wells requires the use of several vehicles to complete the process, digging slush pits for both test hole and observation well development. Because the number of holes and observation wells required to define aquifer systems is decreased significantly by this process it lowers the degree of impact on the natural environment. The areas of impact to the natural environment will be narrowed to only those necessary to complete the data and monitor groundwater quantity and quality where identified as the most beneficial for the public and the NRD.

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. The NRD staff members have local knowledge for the area and groundwater resources, while UNL-CSD and ENWRA staff have the expertise in hydrogeology.

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

Gathering groundwater data and sustainability understandings support many state plans and programs, including interagency coordination, integrated management and prioritization of data collection and analysis capabilities to support state and local planning efforts as stated in DNR's annual report from September of 2015.

ENWRA's 2014/2015 recon lines provided a grid-like data set to compare with DNR's numerical groundwater model work for the Lower Platte and Missouri River Tributaries (LPMRT) Assessment. The LPMRT Assessment is one of DNR's current Integrated Management projects and covers the surface area of Nebraska tributaries that drain into the Missouri and Lower Platte Rivers and the groundwater areas that impact surface water flows in the region. The data from this project could provide the DNR base of aquifer and aquifer thickness information for a large continuous area along the boundaries of the two basins on a tighter grid spacing than ENWRA's recon lines for additional model input comparison purposes thus assisting in the DNR's annual evaluation of basin water supplies.

The LCNRD and NDNR are in the process of drafting an Integrated Management Plan. It is estimated the plan will be adopted sometime in 2016. The proposed project meets goals and objectives identified in the plan (Attachment 7) draft Goal 1, to "develop and maintain a district-wide water inventory", and Objective 1.3 to "refine delineations of hydrologically connected areas so the best available data are captured in the inventory". One of the identified methods to achieve development of the water inventory is to employ AEM technology and 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. Improving water resource sustainability will be achieved through the understanding of groundwater systems and ground and surface water connections, which will allow for better management in areas where appropriate.

The LCNRD groundwater management plan 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 1986 district Groundwater Management Plan (GWMP) acknowledges the NRD has a complex groundwater reservoir that forces technical focus to be very general and that any specific description would require new studies and investigations (see Attachment 8, pg. 32&33 of 1986 GWMP). The plan also states the district has a variable groundwater resource limited by geologic factors. The 1995 amendment indicates a goal of the NRD is to infinitely maintain the natural quality of the groundwater sufficient for all beneficial uses and establishes the entire District as a Phase I groundwater quality management area (see Attachment 9, pg. 65 of 1995 amendment). The Phase I objectives include terminology indicating additional study may be necessary to evaluate the hydrogeologic systems of the district. These general goals and objectives will be met through the ability of AEM technology to begin building the aquifer framework and develop a map product representing a 3X3 mile grid of the southern portion of Cedar County and define the geology and hydrogeology of the area.

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 Lewis and Clark NRD has authority to undertake and participate in the project as the purpose relates to development, management, utilization, and conservation of groundwater and surface water as designated in Nebraska State Statute Chapter 2 Article 32. Further authority of the NRD is 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.

When looking at the project and how it will impact the environment and ecology it is important to say it will have a much smaller negative impact than alternative methods of determining aquifer characteristics and extent. Typical subsurface investigations are much more invasive from several standpoints, including the drilling of hundreds of test holes, disturbing geological and hydrogeological formations, operating drill rigs and other equipment. Collecting a similar amount of data is not possible in the time frame of which it can be accomplished by AEM survey. Delay in understanding the subsurface has a negative impact by not providing important management information in a timely manner. All of which impact the environment and ecology of the state. Conducting the flights will also impact the environment through by the burning of fuel to fly the helicopter as well as the small engines and support vehicles required to carry out the initial work. However, the flights will be completed in a matter of days and support drilling of test holes in a couple of weeks, where conventional methods (approximately 5 vehicles needed to drill a test hole with crews mobilizing from Lincoln) would pollute the environment over a period of decades if conducting program with 500 test holes in LCNRD. Drilling alone would not provide the near continuous line of information collected by the AEM surveys.

There are several positive ecological impacts provided by an improved understanding of the groundwater resources of the district. The knowledge will lead to improved management of the resource for water quality and quantity. Identifying areas of ground and surface water connection will also alter the current management method and better define Management with support of data pertaining to specific aquifers will prevent unsustainable water use and prevent development in areas where the aquifer systems cannot support it.

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.

Groundwater Quality: The Aero Electromagnetic (AEM) survey project will address threats to drinking water of northeastern Nebraska communities and rural residents by obtaining subsurface geologic and hydrogeologic information that will enable the Lewis and Clark Natural Resources District (referred to as Lewis and Clark NRD or LCNRD) and associated communities to identify public water supplies which may be susceptible to contamination by agricultural chemicals due to the characteristics of the geologic formations and their proximity along with hydrologic connection of aquifers to the land surface. The information obtained from the flights and data conversion will provide NRD directors and communities background information to help them pin point areas of potential contamination and develop management strategies and specific practices to reduce the risk of agricultural contaminants entering the aquifer systems serving communities or private domestic wells. The data will increase the knowledge of groundwater/surface water connections in areas where groundwater is in close proximity to ground surface and there is a risk of nitrate leaching to the water table. This information will also provide planning for more detailed investigative work by optimizing selection of areas for additional site assessments.

Groundwater Quantity: The data will provide 2-dimensional cross sections along the flight lines, providing information on aquifer locations, orientation, groundwater level (using 1995 CSD water table map), and connectivity between deposits and local streams which enables University of Nebraska Lincoln – Conservation and Survey Division (UNL-CSD) and Eastern Nebraska Water Resources Assessment (ENWRA) to identify the boundaries of aquifers and predict areas susceptible to groundwater decline. As these areas are identified, it is better understood where observation wells should be constructed and where monitoring efforts should be focused and where additional subsurface information should be collected (if needed). If any area of risk is identified, it can be managed by existing groundwater rules and regulations of the District as opposed to waiting for serious declines to be observed by irrigation and/or domestic groundwater users.

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 groundwater in the geologic terrain of the LCNRD, its' importance to the community, and the need to protect that resource from contamination threats are difficult to express to the general public. The map products produced by this project will facilitate understanding of the concepts and provide a platform for discussion with the communities at risk. The population of the project area, southern Cedar County, is approximately 2841, based on 2010 census data, and the area relies primarily on groundwater as the main drinking water source.

2. Meets the goals and objectives of an approved integrated management plan or ground water management plan;
 - Identify the specific plan that is being referenced including date, who issued it and whether it is an IMP or GW management plan.

- Provide the history of work completed to achieve the goals of this plan.
- List which goals and objectives of the management plan the project provides benefits for and how the project provides those benefits.

The LCNRD groundwater management plan 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 1986 district Groundwater Management Plan (GWMP) acknowledges the NRD has a complex groundwater reservoir that forces technical focus to be very general and that any specific description would require new studies and investigations (see Attachment 8, pg. 32&33 of 1986 GWMP). The plan also states the district has a variable groundwater resource limited by geologic factors. The 1995 amendment indicates a goal of the NRD is to infinitely maintain the natural quality of the groundwater sufficient for all beneficial uses and establishes the entire District as a Phase I groundwater quality management area (see Attachment 9, pg. 65 of 1995 amendment). The Phase I objectives include terminology indicating additional study may be necessary to evaluate the hydrogeologic systems of the district. These general goals and objectives will be met through the ability of AEM technology to begin building the aquifer framework and develop a map product representing a 3X3 mile grid of the southern portion of Cedar County and define the geology and hydrogeology of the area. The proposed grid size allows the district to identify the location, orientation, groundwater level (from CSD water table map), connectivity between the deposits and streams of the project are, and determine recharge characteristics of the subsurface materials along the flight lines. In addition, the framework will help identify the boundaries of aquifer systems and pinpoint areas for further investigation and/or monitoring. All of this information will be used to inform the public, identify areas where sustainability of the resource is at risk, identify if areas exist where beneficial development is appropriate, and provide guidance in district management policies.

The LCNRD and NDNR are in the process of drafting an Integrated Management Plan. It is estimated the plan will be adopted sometime in 2016. The proposed project meets goals and objectives identified in the plan (Attachment 7) draft Goal 1, to “develop and maintain a district-wide water inventory”, and Objective 1.3 to “refine delineations of hydrologically connected areas so the best available data are captured in the inventory”. One of the identified methods to achieve development of the water inventory is to employ AEM technology and 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. Improving water resource sustainability will be achieved through the understanding of groundwater systems and ground and surface water connections, which will allow for better management in areas where appropriate.

The Lewis and Clark NRD experienced a large degree of irrigation well development from 2011 to 2013 with 412 wells completed, which is 27 percent of the total number of irrigation wells in the district at that time. In response to the high degree of development and the drought conditions of 2012, the NRD 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 guidelines for required irrigation management and methods to conserve groundwater in times of sustained decline of the groundwater resource as determined by NRD measurement of identified irrigation wells in the district. AEM Survey data will help to identify areas where increased monitoring is needed to assess the overall health of aquifer systems and to detect at risk aquifers in times of decline. They will also help determine if there are areas where future development may be possible.

LCNRD has been working with UNL-CSD on a project to establish a preliminary framework of the aquifer systems of the district. To date thirty-five test holes have been drilled across the district (Attachment 3) with focus on areas of water quality concern, Wellhead Protection Areas, and areas where little data exists. Twenty-nine dedicated observation wells have been or will be established in the target areas. The goal of this project has been to establish base data required to define the geologic framework of the district. The next step of the process is to perform AEM data collection across the district, starting in the portion of the district where the most test hole data and UNL-CSD work has been completed in order to best calibrate the resulting information. Collecting AEM data is also considered the next step for the ENWRA goal to conduct recon flights (northern part flown in 2014 and southern part in flown in 2015, see Attachment 4) and to provide regional geologic reconnaissance information for the NRDs to work off of (see ENWRA Long Range Plan Table in Attachment 10). Which depicts how the LCRND and other ENWRA NRDs planned projects fit with ENWRA's long term hydrogeologic assessment goals).

Southern Cedar County of the Lewis and Clark NRD is the focus area for the proposed project, in part because the location coincides with planned AEM survey flights of the Lower Elkhorn NRD and the Bazile Groundwater Management Area which will simplify many aspects of conducting the work including mobilization of the flight crews and data processing by ENWRA and UNL-CSD.

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

List the following information that is applicable:

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

The proposed AEM survey will contribute to water sustainability goals through identifying areas where aquifer recharge is likely in the southern portion of Cedar County of the LCNRD and using that information to focus management and education efforts to sustain water quantity. If we know the areas where the resource is limited the

district can manage to reduce depletion and identify the areas where management may be appropriate. Approximately 8 townships are impacted by this project.

The streams that will be crossed with the survey include parts of the Bow, East Bow, Norwegian Bow, Pearl, Kerloo, and North Logan. At this time none of the streams in the project area are officially designated as hydrologically connected with ground water. However there is potential for connection between the Bow Creek Alluvial aquifer and surface water, which could be supported by the survey. Water level and water chemistry would need to be measured in order to confirm the connection. It is also likely a hydrologic connection exists between the Niobrara Formation and alluvial sands and gravels.

Cross basin benefits include improving the ability of UNL-CSD to delineate aquifer boundaries that may cross both the Lower Platte and Missouri-River Tributaries basin and NRD 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 DNR's numerical groundwater model work for the Lower Platte and Missouri River Tributaries (LPMRT) Assessment. The LPMRT Assessment is one of DNR's current Integrated Management projects and covers the surface area of Nebraska tributaries that drain into the Missouri and Lower Platte Rivers and the groundwater areas that impact surface water flows in the region. The project data, along with the LENRD's existing and planned data collection (LENRD is planning additional grid flights in 2016), could provide the DNR base of aquifer and aquifer thickness information for a large continuous area along the boundaries of the two basins on a tighter grid spacing than ENWRA's recon lines for additional model input comparison purposes thus assisting in the DNR's annual evaluation of basin water supplies.

Cross basin benefits include expansion of subsurface hydrologic data which impacts the Lower Elkhorn NRD along the southern border of the project area. Aquifers do not align with district boundaries and the determination of aquifer boundaries, hydrologic connection, and recharge areas is shared across boundaries.

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.](#)

The project contributes to groundwater and surface water supply goals by using AEM technology combined with historic data in the following ways:

1. Defining a hydrogeologic framework of southern Cedar County in the Lewis and Clark NRD see Attachment 1.
2. The survey data will enable the district to assess recharge of the aquifer systems and potential impacts from non-point source pollution.
3. The survey will better define aquifer characteristics and storage potential of the aquifer systems present.
4. Provide improved understanding of the bedrock formations, which will better define groundwater flow and improve understanding of how that flow impacts water storage and water quality in respect to both surface water and groundwater systems.
5. The information collected and analyzed from the survey will provide a better understanding of the water resources and enable improved management for both water quality and quantity.
6. Provide information to locate areas where additional test hole drilling will better define aquifer boundaries and provide additional information to improve aquifer understanding.
7. Provide information about where to site observation wells to gather representative water quality and quantity information.

The AEM survey will provide a framework of the hydrogeologic formations in the district allowing for the evaluation and achievement of the goals described above. The framework development will facilitate management from the knowledge of the subsurface geology, aquifer characteristics, and bedrock geology. Because the eastern third of Nebraska was impacted by multiple stages of glaciation, therefore, the aquifer systems of the district are highly variable and their existence is unpredictable. As a result the source of groundwater used for domestic, stock, irrigation, municipal and industrial applications varies across the district and wells could be developed in the Missouri River Alluvium, un-differentiated sands and gravel, Niobrara Bedrock Formation, the Dakota Bedrock Formation, as well as several other minor sources. Mapping the poorly understood, diverse groundwater aquifer setting of the district will substantially improve the ability to answer critical questions associated with groundwater sustainability in a time of increased demand.

If the district is to continue to on the current path and build upon existing data with additional test hole drilling and evaluation, it would be decades before the district would have even preliminary information to logically and effectively guide management of the groundwater resource for long term sustainability. The additional benefit if the AEM data will guide optimal location of future CSD test holes. There is no CSD or NRD staff dedicated to doing this type of work and therefore the NRD would continue to operate with essentially the same knowledge obtained from the current project undertaken with CSD and LCNRD to establish the very basic hydrogeologic framework of the district. With the current understanding of the aquifer systems, any management strategies would be applied to a management area estimated to address problems. Everyone in a problem area or region would be under the same management scenario regardless of potential differences in the aquifer make-up. This type of management can lead to the inclusion of landowners who have no direct impact on the problem being unnecessarily

managed and the exclusion of landowners who would have direct impact to resolve the problem not being managed.

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 project will maximize the increased beneficial use of Nebraska's water resources by developing a hydrogeologic framework for southern Cedar County of the Lewis and Clark NRD. Without conducting this project it could potentially be decades before similar work could be completed and offer the district the same knowledge and tools to protect and increase sustainability the resource. The district will be able to build on this work and complete surveys in the future focusing on areas of the district most at risk for decline and/or contamination, or where increased information about groundwater and surface water connection is desired. The survey provides data to better infer the groundwater storage capability (note: 750 foot spacings are ideal for representative volume calculations) and aligns with existing work in an area of the district where irrigation development is the highest. As landowners look for ways to maximize profits from their crop acres this information could help to determine areas where increased groundwater development could be supported. It will also provide knowledge about those areas where the district should monitor the resource to protect existing beneficial uses. The beneficial uses of the resource in the northeast portion of the state is maximized using Aero Electromagnetic technology to maximize the information we can collect and use to protect the resource in a very short amount of time.

This project directly benefits the residents of northeast Nebraska by providing aquifer and hydrogeologic data which enables the landowners, communities, and NRD to effectively manage the resource and enable increased sustainability. The project area includes some of the highest degree of irrigation development in the district, 37 percent of the district irrigation wells and is 17 percent of the total acres are located within the project boundary. The project area is also home to approximately 20 percent of the district population. The combination of highly variable, unpredictable aquifer characteristics, irrigation density, and population density increases the potential of well interference and potentially ground and/or surface water contamination that could impact the residents of the region. There are two community wellhead protection areas located in the project boundaries, Hartington and Coleridge, both of which are experiencing increasing nitrate concentrations in at least one of their Public Water Supply wells. The project will enable investigation of the hydrogeologic formations where the subsurface permeability can impact contamination from surface applied chemicals, enable determination of aquifer boundaries where more rapid depletion is likely, and enable identification of hydrologic connection with surface water, facilitating the investigation of the need for further management.

6. Is cost-effective;

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

The proposed project is a study which does not include construction, O/M costs or land acquisition costs. The estimated cost of the project is \$102,000 with additional in-kind contributions estimated at \$35,000. The benefits gained from the project outweigh the cost of the reconnaissance project flown in 2014. The reconnaissance flights showed the method is effective in defining the geology up to a depth of 1,300 feet. The proposed project will result in 2-dimensional profiles which provide location, orientation, groundwater level (from 1995 CSD water table maps), and connectivity between the deposits comprising principal aquifers and local streams. The 3X3 mile grid will provide a framework to build an inferred three dimensional representation of aquifers. Future work can be identified in an optimal manner from this large scale work to characterize aquifer volumes, groundwater in storage and detailed recharge area information.

The next best alternative to gain the same degree of information as conducting the proposed three mile grid flights is to drill test holes to draw cross sections of the geologic formations. If you assumed that it would require five hundred test holes drilled to typical depths (150 to 350 feet) spaced every 1,000 to 1,550 feet along the flight lines, which is conservative considering AEM provides virtual borehole soundings about every 20 feet with x,y,z data lumped every 250 feet to depths over 1,000 feet, it would cost on the order of \$750,000 to \$2,625,000 (test hole rates: \$10-\$15 per foot) and take decades to complete the work in this manner. Additionally, the costs would more than double if test holes were advanced to 700 feet which is still short of the AEM imaged depths. Further, there is no UNL-CSD staff/equipment available to dedicate to completing this scale of work compared to the two years anticipated for the grid flights and reporting.

The project is designed to last two years with the contractor costs incurred in year one. Analyzation of the data and dissemination of the data will begin in year one and will continue through year two. The timeframe of usefulness for the data is unending similar to the CSD test hole data. The data can be built upon in future years, extending mapping through the district or to focus on areas where more detail would be beneficial. The mapping of the district will result in a grid of the district with the lines crossing every three miles which provides a large scale three-dimension representation of the surface and sub-surface geologic formations of the Lewis and Clark NRD. Existing flight data conducted by the LENRD has reinforced for both UNL-CSD and ENWRA that the frequency of the 3-mile distance between flight lines is suitable to achieve the goals of this project. Because the proposed flight area covers the region of the Lewis and Clark NRD where UNL-CSD staff has the most geological and hydrogeological data, it is best

suited to start at the 3X3 mile spacing in this part of the district and future flights could be planned at other appropriate flight line spacings to build upon the insight gained from the data obtained in southern Cedar County and LENRD.

Activity	Cost Year 1	In Kind *	Cost TOTAL	Benefits (potential cost of drilling 500 test holes and processing the data to produce an aquifer boundary map)
WSF Grant funding	\$61,200	0	\$61,200	Test hole drilling (150-350-foot depths): \$750,000-\$2,625,000
LCNRD	\$40,800	\$5,000	\$45,800	
UNL-CSD		\$15,000	\$15,000	
ENWRA		\$15,000	\$15,000	
TOTALS			\$137,000	

* Indicates in-kind match, funding is only sought for conducting the flights and contractor costs through the Water Sustainability Fund. In kind dollars will be carried over into year 2 to complete proposed activities.

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

The Safe Drinking Water Act of 1947 (Pub.L.93-523 88 Stat. 1660 42 U.S.C. §300) discusses the protection of groundwater sources of drinking water in Part C of the law. Part B discusses Public Water Systems, the definition of a public system, contaminants identified as threats to public health and the acceptable levels of these contaminants in public systems. Part C discusses the designation of a sole source aquifer (section 1427) and the establishment of wellhead protection areas (section 1428). The Nebraska Safe Drinking Water Act mimics this federal regulation. Nebraska’s drinking water program has 1,375 public water systems, serving most of its 1.7 million residents (Nebraska Health and Human Services [HHS] website accessed Dec 2015). Ground water is the source for most of Nebraska’s drinking water. Only five public water systems in the state get their drinking water from surface water sources [HHS website accessed Dec 2015].

Municipal supplies (namely Hartington and Coleridge, the largest municipalities near the planned flight lines) utilize the groundwater resources, and therefore the Safe Drinking Water Act would apply to these systems. Before the municipalities decide to utilize or

expand their utilization of the resource, they need to know if the water quality is suitable for human consumption and if the resource is sustainable for long term use. This AEM study will help provide answers to those questions for municipalities along the flight lines by providing interpreted subsurface profiles depicting potential contaminant movement pathways that could pose a risk to the aquifers and depicting the extents and interconnections of the aquifers indicating if the nature of the aquifer is more limited or likely sustainable.

8. Reduces threats to property damage or protects critical infrastructure that consists of the physical assets, systems, and networks vital to the state or the United States such that their incapacitation would have a debilitating effect on public security or public health and safety;
 - Identify the property that the project is intended to reduce threats to.
 - Describe and quantify reductions in threats to critical infrastructure provided by the project and how the infrastructure is vital to Nebraska or the United States.
 - Identify the potential value of cost savings resulting from completion of the project.
 - Describe the benefits for public security, public health and safety.

The project will reduce the threats to the groundwater and surface water resources of southern Cedar County in the Lewis and Clark Natural Resources District (LCNRD). There is specific emphasis on the wellhead protection areas of Hartington and Coleridge as well as the drinking water sources for the rural residents of the project area. Drinking water is vital to all people of the district, state, and country. We are focusing our project on southern Cedar County due to the population density, irrigation well and crop field density, existing knowledge, and time limitations of the staff who will be evaluating the data and presenting the information to the residents of the district.

The project will help narrow down where contamination could be occurring and guide detailed work to solve the problem. It will also help to inform the NRD staff and directors, community boards and residents, and general public about the threats to their drinking water sources. If areas susceptible to contamination and/or decline are not identified the communities of the district could eventually be faced with the expensive alternatives of treating groundwater prior to delivering it to customers or they could be faced with the need to identify a drinking water source where contamination is less of a threat and develop a new well field. The overall cost of using this technology to identify areas at risk for contamination or decline is much lower than either of these alternatives and there is potential each community could be faced with investigating these alternatives in the future if protective needs are not identified.

The City of Creighton constructed a reverse osmosis water treatment plant to remove nitrate from drinking water. The projected O&M cost of treatment, including depreciation over 20 years is estimated to cost the community \$3,492,820 according to

the 2015 Bazile Groundwater Management Area Plan, Attachment 11, pg. 33. Some communities may choose the alternative of relocating the well field to find a safe drinking water source below the 10ppm maximum contaminant level. However, relocating the well field does not guarantee a sustainable drinking water source into the future. If the well field is not investigated properly or not properly protected from contamination, there is still risk nitrate or other contaminants could impact the source. The proposed survey can be used to help communities identify potential well field sites if necessary.

Private well owners can also face the need to treat their drinking water for nitrate contamination, if there is an area where increased risk exists the district can focus education efforts for the private landowner and for the crop producers in the area where crop nutrients and chemicals may impact the resource. It is much more difficult to assign a value to the private well owners and the method they choose to manage nitrate. Some may choose to purchase drinking water while others may choose to install a treatment system.

Defining the aquifer boundaries of wellhead protection areas provides the basis for improved public security through ensuring communities have the knowledge necessary to water quality and quantity, which protects public health, and safety. In the remaining area the knowledge gained by the work achieved through this project will enable the district to focus management efforts in specific areas where the threat to groundwater quality or groundwater supplies are at risk to contamination or decline from agricultural practices or other activities. Therefore impacting only the specific acres and landowners where control mechanisms will yield the most impactful benefits to aquifer health.

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 primary groundwater quality issue for the Lewis and Clark NRD and many groundwater sources of the state and country is nitrate from surface applied agricultural fertilizers. This project will reduce threats to the groundwater and surface water quality of southern Cedar County in the LCNRD. There is specific emphasis on the wellhead protection areas of Hartington and Coleridge as well as the drinking water sources for the rural residents of the project area. The project is focused on southern Cedar County due to the population density, irrigation well and crop field density, existing geologic data, and time limitations of the staff who will be evaluating the data and presenting the information to the residents of the district.

The primary use of groundwater resources in the project area is for agricultural and drinking water purposes. There are approximately 163,000 acres within the project area and the population of southern Cedar County is approximately 2841 based on 2010 census data. Water quality can be specifically addressed through implementation of unspecified management mechanisms and controls as needs are identified by the district and/or communities in the project area. The project will help narrow down where source contamination could be occurring and where management efforts will provide the best potential to reduce contamination and improve quality. It minimizes the need of management efforts to be implemented over a large area due to the increased ability to focus management on the specific locations where modifying agricultural practices would have the most impact on water quality. It will also help to inform the NRD staff and directors, community boards and residents, and general public about the threats to their drinking water sources.

If areas susceptible to contamination and/or decline are not identified, the communities of the district could eventually be faced with the expensive alternatives of treating groundwater prior to delivering it to customers or they could be faced with the need to identify a drinking water source where contamination is less of a threat and develop a new well field (costs could range from \$200,000 to \$500,000 just for one well depending on the end application, not including the potential cost of additional piping if that well is far removed from the town center). If new public water supplies are needed the siting and development of them can be aided by the AEM survey or additional AEM surveys. This lowers the overall costs and risk associated with traditional well siting and development.

There are currently a minimum of two identified areas in addition to the wellhead protection areas identified above impacted by water quality concerns. An area east of Hartington has experienced increased nitrate concentrations for several years. Irrigation water sampling was intensified in 2015 and an observation well will be constructed in the area in 2016. There is another small area southwest of Hartington where high nitrate concentrations have also been recorded. There is little known about these areas and the LCNRD has monitored nitrate concentration from irrigation samples since the 1990s.

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

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

The local jurisdiction that supports the project is the Lewis and Clark Natural Resources District. The current valuation of the district is \$3,938,690,023 and the current tax levy is 2.1186 cents per 100 dollars of valuation. The Lewis and Clark NRD is looking to the Water Sustainability Fund to provide 60 percent of the cost to secure a contractor to

conduct the AEM survey, analyze the resulting data and produce reports for the project. The Eastern Nebraska Water Resources Assessment (ENWRA), the University of Nebraska Lincoln Conservation and Survey Division, and the Lewis and Clark NRD are providing services to complete the project through employee activities to facilitate, manage, process, evaluate, and disseminate the data obtained through the project.

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 groundwater management plan 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 1986 district Groundwater Management Plan acknowledges the NRD has a complex groundwater reservoir that forces technical focus to be very general and that any specific description would require new studies and investigations. The plan also states the district has a variable groundwater resource limited by geologic factors. The 1995 amendment indicates a goal of the NRD is to infinitely maintain the natural quality of the groundwater sufficient for all beneficial uses and establishes the entire District as a Phase I groundwater quality management area. The Phase I objectives include terminology indicating additional study may be necessary to evaluate the hydrogeologic systems of the district. These general goals and objectives will be met for selected areas of LCNRD through the ability of AEM technology to build the aquifer framework and develop a map product representing a 3X3 mile grid of the southern portion of Cedar County and define the geology and hydrogeology of the area. The proposed grid size allows the district to identify the location, orientation, groundwater level (from CSD water table map), connectivity between the deposits and streams of the project are, and determine recharge characteristics of the subsurface materials along the flight lines. In addition, the

framework will help identify the boundaries of aquifer systems and pinpoint areas for further investigation and/or monitoring. All of this information will be used to inform the public, identify areas where sustainability of the resource is at risk, identify if areas exist where beneficial development is appropriate, and provide guidance in district management policies.

This project specifically addresses the sustainable water use concern of the LCNRD as identified in the draft goals and objectives identified through the Integrated Management Planning (IMP) process undertaken with the Nebraska Department of Natural Resources ([see Attachment 7](#)). The IMP plan will be adopted sometime in 2016. The proposed project meets goals and objectives identified in the IMP, draft Goal 1, to “develop and maintain a district-wide water inventory”, and Objective 1.3 to “refine delineations of hydrologically connected areas so the best available data are captured in the inventory”. One of the identified methods to achieve development of the water inventory is to employ electromagnetic technology and 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. Improving water resource sustainability will be achieved through the understanding of groundwater systems and ground and surface water connections, which will allow for better management in areas where appropriate.

The Lewis and Clark NRD experienced a large degree of irrigation well development from 2011 to 2013 with 412 wells completed, 27 percent of the total number of irrigation wells completed in the district at that time. In response to the high degree of development and the drought conditions of 2012, the NRD 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 guidelines for required irrigation management and methods to conserve groundwater in times of sustained decline of the groundwater resource as determined by NRD measurement of identified irrigation wells in the district. AEM Survey data will help to identify areas where increased monitoring is needed to assess the overall health of aquifer systems and to detect at risk aquifers in times of decline. They will also help determine if there are areas where future development may be possible.

LCNRD has been working with UNL-CSD on a project to establish a preliminary framework of the aquifer systems of the district. To date thirty-five test holes have been drilled across the district with focus on areas of water quality concern, Wellhead Protection Areas, and areas where little data exists. Twenty-nine dedicated observation wells have been or will be established in the target areas. The goal of this project has been to establish base data required to define the geologic framework of the district. The next step of the process is to perform AEM data collection across the district, starting in the portion of the district where the most test hole data and UNL-CSD work has been completed in order to best calibrate the resulting information. Collecting AEM data is also considered the next step for the ENWRA goal to conduct recon flights (northern part flown in 2014 and southern part in flown in 2015) and to provide regional

geologic reconnaissance information for the NRDs to work off of (see ENWRA Long Range Plan Table, in Attachment 10, which depicts how the LCRND and other ENWRA NRDs planned projects fit with ENWRA's long term hydrogeologic assessment goals).

Southern Cedar County of the Lewis and Clark NRD is the focus area for the proposed project in part because the location coincides with planned AEM survey flights of the Lower Elkhorn NRD and the Bazile Groundwater Management Area which will simplify many aspects of conducting the work including mobilization of the flight crews and data processing by ENWRA and UNL-CSD.

The stakeholders are the individual owners of domestic and agricultural water supply wells, municipal and local NRD water managers, ENWRA and UNL CSD. This project benefits all current stakeholders and future generations.

12. Addresses a statewide problem or issue;

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

The primary objectives addressed by the project through mapping and development of a hydrogeologic framework are to better manage the water resources of Southern Cedar County with respect to groundwater quantity, quality and surface water connectivity. These local issues are in common with the ENWRA region (1.25 million constituents in 8.1 million acres) and the other NRDs statewide (1.88 million constituents across 49.2 million acres). Identifying areas at increased risk for contamination and/or decline can benefit the entire state by protecting the resource and limiting the potential need for future remediation or new public water system supply wells. It also maximizes the value to the tax payer over employing conventional methods to construct the hydrogeologic framework.

AEM technology can provide map profiles statewide and provide beneficial aquifer and connectivity data for management of water resources. CSD has submitted a grant request to NET for a geologic data storage platform and handling including accommodation for statewide AEM data. If funded, the data handling platform would gather statewide geologic and AEM data in one place, store it in a consistent structure, and make accessing/using the data easier for UNL-CSD and the stakeholders. The information gathered from this project will benefit the statewide database enhancement efforts by adding data and additional coverage areas in the data storage improvement effort.

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.

Activity	Cost Year 1	In Kind Year 1*	Cost TOTAL
WSF Grant funding (state)	\$61,200	0	\$61,200
LCNRD (local)	\$40,800	\$5,000	\$45,800
ENWRA (local/regional)	0	\$15,000	\$15,000
UNL-CSD (local/regional)	0	\$15,000	\$15,000
TOTALS			\$137,000

*Funding is only sought for the AEM contractor payments through the Water Sustainability Fund. ENWRA and UNL-CSD will be providing in kind match to build on the results of the AEM project and assist the NRD with using the results for informed management practices.

LCNRD has approved \$40,800 to complete this project and will also be dedicating staff time to provide assistance and support information as needed to the contractor, ENWRA, and/or UNL-CSD staff. ENWRA and UNL-CSD are partners in the project and have committed staff time to its completion, a letter of their support is included as Attachment 12. If funded, the project will have state and local funding sources contributing to (and partnering on) the effort.

14. Contributes to watershed health and function;

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

The sustainability of groundwater is significant to the health and function of a watershed. The work undertaken by this project will contribute to the health and function of the Missouri Tributaries watershed through increased understanding of the highly variable, diverse aquifers of the southern portion of the Cedar County in the Lewis and Clark NRD. Through increased understanding of the district hydrogeology, appropriate management, specific to the areas of greatest risk to groundwater declines or contamination can be implemented as needed. In turn, these concepts/new understandings support the overall health of the watershed by providing protection against surface water declines and contamination due to hydrologic connection with groundwater (examples: contamination from surface run-off events potentially affecting groundwater or subsurface geological controls impacting the flow of groundwater feeding the surface water resources).

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 proposed project supports the following objectives described in the NDNR Annual Report and Plan of Work for the Nebraska State Water Planning and Review Process from 2015:

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 coordination of federal agencies, state agencies, local natural resources districts (NRDs), and other water interests for the development of water resources programs and projects.

This project meets objective 1 by collecting and analyzing hydrogeologic data that can be used for water planning. The data also helps to identify areas where additional monitoring of water supplies in the project area would be beneficial. Objective 2 will be met through the dedication of WSF funds towards implementation of the proposed project to establish the hydrogeologic framework of southern Cedar County. Development of the hydrogeologic framework furthers objective 3 through the understanding of, and potentially management of hydrologically connected waters and contributes to the Draft Integrated Management Plan of the LCNRD and NDNR. This project furthers Objective 4, to provide coordination of federal, state, local and other agencies or entities in the development of water resources programs and projects. The data is beneficial to many entities and will be made publicly available.

The DNR supported the ENWRA group in mapping and assessing the groundwater resources in Eastern Nebraska using airborne geophysical methods as stated in the DNR's 2014 annual report. This project will use the data obtained from that DNR/ENWRA effort as additional flight lines to complete the mapping process. The project area will be adjusted to account for the lines and to achieve the most new flight coverage as possible.

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

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

The Safe Drinking Water Act of 1947 (Pub.L.93-523 88 Stat. 1660 42 U.S.C. §300) discusses the protection of groundwater sources of drinking water in Part C of the law. Part B discusses Public Water Systems, the definition of a public system, contaminants identified as threats to public health and the acceptable levels of these contaminants in public systems. Part C discusses the designation of a sole source aquifer (section 1427) and the establishment of wellhead protection areas (section 1428). No widespread data has been collected within the Lewis and Clark NRD which focuses on contaminants that pose a risk to public health. The purpose of this study is to define the hydrogeologic framework of the southern portion of Cedar County. This information will be used to improve the definition of aquifer locations, orientation, groundwater level (from 1995 CSD water table map, and connectivity between the deposits comprising the principal aquifer and the local streams in the project area. The information will help predict areas of risk to agricultural chemical contamination as infiltration of precipitation comes in contact with the subsurface geology or if it could be impacted by other hydrogeologic conditions. The Wellhead Protection Areas of Hartington and Coleridge are included in the project and increased knowledge of hydrogeologic conditions in those areas further the objectives of the Safe Drinking Water Act of 1947. When the municipalities develop wellhead protection plans or approve rules for their drinking water wells they need to be informed of the potential impacts those decisions could have on the drinking water they rely on for their population and whether steps to ensure sustainability are warranted and/or appropriate to implement. The LCNRD will be able to help these communities answer these questions with completion of this work.

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 Lewis and Clark Natural Resources District (LCNRD), located in northeastern Nebraska and in the glaciated portion (eastern third) of the state, working with University of Nebraska Conservation and Survey Division (UNL-CSD) and the Eastern Nebraska Water Resources Assessment (ENWRA) proposes the use of aero electromagnetic (AEM) technology to map a “three mile grid” of the aquifers in southern Cedar County. Unlike areas of Nebraska served by the High Plains Aquifer, the complex geology of the glaciated region poses a unique challenge to water managers who need to know: how much useable water is available, where it is located, and will it be sustainable considering increasing demand. Mapping the poorly understood groundwater settings of this area will substantially improve our ability to answer these critical questions, and provide management to sustain the groundwater resource. The AEM survey will build upon previous flight work conducted by ENWRA, DNR, and LENRD and decades of data collected by UNL-CSD. Improved understanding will be used to efficiently and economically prioritize NRD ground water management concerns for quality and quantity issues.

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.

LCNRD is requesting WSF funding to secure a contractor, Aqua Geo Frameworks LLC, to conduct an Aero Electromagnetic flight survey to log the subsurface resistivity of the geological formations in southern Cedar County and to interpret the resulting data and provide a report of the findings and map product of the region. Data collection and data processing will occur in year one of the project. The final map products (and all associated digital datasets) will also be delivered in year one (see letter with description of services and cost breakdown Attachment 2). More extensive review of the data and direct implications to the district will be conducted by UNL-CSD and ENWRA in year one and continue in future years beyond the project timeline.

Funding Source	Activity	Cost Year 1	In-kind Costs*	Cost TOTAL
WSF	AEM survey flights, data processing and report development.	\$61,200	0	\$61,200
LCNRD	AEM survey flights, data processing and report development.	\$40,800	\$5,000	\$45,800
UNL-CSD	Incorporation of AEM results into geologic framework/working knowledge of area/targeting ground truth test hole locations, County Atlas reports/local service objectives		\$15,000	\$15,000
ENWRA	Coordination of data storage, public presentation of data, assistance with NRD utility of the data, grant fund administration		\$15,000	\$15,000
	TOTALS			\$137,000

Funding is only sought for one year through the Water Sustainability Fund (associated 40% local match is also planned in year 1).

*In kind dollars could be in year one or future years.

3. Partnerships

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

The Lewis and Clark NRD is responsible for securing the geophysical contractor and making contact with local landowners and communities to inform them of the flights and to provide them the resulting data. LCNRD will also provide funding for 40% of the project cost for contractor fees.

In year one, ENWRA with input from UNL-CSD is responsible for evaluating the proposed flight lines, coordinating the flights with the contractor, and grant fund administration on behalf of LCNRD. In future years, starting in year one, ENWRA will add the project information to the ENWRA website, assist in the housing and the utility of the data (with assistance of UNL-CSD), and present/assist in public inquiry on the data.

UNL-CSD will provide involvement with ENWRA's part (outlined above) and will incorporate AEM results into geologic framework/working knowledge of area, target ground truth test hole locations with the LCNRD, incorporate the AEM in County Atlas report work and local service objectives/inquiries starting in year one and continuing throughout future years.

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 proposed AEM project is \$102,000. The LCNRD will be responsible for 40% of the cost and we are requesting \$61,200 from the Water Sustainability Fund. The total project cost will be applied to secure the contractor, Aqua Geo Frameworks for the following services: go over the general flight line locations and adjust as necessary to minimize interferences (avoid power and pipe lines, etc.), collect and quality check the airborne data, process the data, gather/georeferenced all existing data near the flight lines, and interpret the data in a final report taking into account the reconnaissance framework (2014 flights) and understandings specific to the Lewis and Clark NRD. There is considerable “soft match” dollars committed from ENWRA and UNL-CSD. ENWRA staff will coordinate with the contractor on the flight path placements after receipt of the initial flight route from UNL-CSD. UNL-CSD will plan the flight routes (see Figure 2 of Appendix A for a draft map) and compile existing data to ensure a reliable representation of the geology is provided to the district. UNL-CSD will evaluate the data interpretations “ground-truth” the resulting data based on existing test hole data. LCNRD has allocated the match funds to this effort contingent on WSF funding. The soft match is also expected as it fits with the missions of both UNL-CSD (investigation of Nebraska's geology and water resources) and ENWRA (assessing the hydrogeologic framework for sound planning and management of eastern Nebraska's ground water resources).

5. Support/Opposition

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

A support letter from the project sponsors, ENWRA and UNL-CSD is included in Attachment 12. A letter detailing the cost of project from the proposed contractor, Aqua Geo Frameworks is included as Attachment 2. The goals and objectives from the draft Integrated Management Plan developed with NDNR indicating the need to define the geologic framework of the district is included in Attachment 7. The ENWRA long range plan also supports the plan to develop the geologic framework of the area, Attachment 10) and supports understanding the resources within the area. There is no known/anticipated opposition to the project.