NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Lower Big Blue NRD Airborne Electromagnetic Hydrogeologic Mapping (LBBNRD-AEM1)

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

Sponsor Business Name: Lower Big Blue Natural Resources District

Sponsor Contact's Name: Tyler Weishahn

Sponsor Contact's Address: 805 Dorsey Street, Beatrice, NE 68310

Sponsor Contact's Phone: (402) 228.3402

Sponsor Contact's Email: weishahn@lbbnrd.net

1. **Funding** amount requested from the Water Sustainability Fund: $ 216,000.00

   Grant amount requested. $ 216,000.00

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

   If a loan is requested amount requested. $ Click here to enter text.

   - How many years repayment period? Click here to enter text.
   - Supply a complete year-by-year repayment schedule. Click here to enter text.

2. **Neb. Rev. Stat. § 2-1507 (2)**

   Are you applying for a **combined sewer overflow project**? YES☐ NO☒

   If yes:

- Do you have a Long Term Control Plan that is currently approved by the Nebraska Department of Environmental Quality? YES☐ NO☐
- Attach a copy to your application. Click here to enter text.
- What is the population served by your project? Click here to enter text.
- Provide a demonstration of need. Click here to enter text.
- **Do not complete the remainder of the application.**

3. **Permits Required/Obtained**

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

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

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

Click here to enter text.

4. **Partnerships**

List each Partner / Co-sponsor, attach documentation of agreement:
None

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

While the Lower Big Blue NRD (LBBNRD) is the lead agency for this specific project proposal and application to the Water Sustainability Fund (WSF), there are several other planned and approved AEM efforts across the State of Nebraska and in neighboring states in the coming years. As such, the use of a single geophysical consulting firm to perform and develop the planning and coordination of all flights, data collection, processing, interpretation and data products will improve efficiency and consistency. More specifically, the use of a single Consultant divides the costs of mobilization and de-mobilization of the data collection equipment among multiple project sponsors and partners in the region, thereby reducing the overall costs for each. This Project will be planned in accordance with other AEM projects planned in the region of Middle Republican (WSF #5315) to improve efficiency and gain economy of scale. This was done in 2020 with the NNRD project (WSF #5255) being coordinated with the Papio-Missouri River NRD (WSF #5238) and Middle Republican (WSF#5249) surveys which minimized mobilization/de-mobilization and logistical costs for the data collection and allowed for additional bonus flight lines for each NRD involved.

In regard to playing several roles and carrying out the various responsibilities to complete this project, the LBBNRD has been working with, and will continue to lean on the expertise and generosity of peers at neighboring and nearby NRDs who have conducted or are conducting similar projects, namely Chuck Wingert with Nemaha NRD (NNRD) and staff at the Lower Platte South (LPSNRD) and Papio-Missouri (PMNRD) NRDs, Katie Cameron with Eastern Nebraska Water Resources Assessment (ENWRA), Aaron Young, Jesse Korus and staff at the University of Nebraska Conservation and Survey Division (CSD), as well as the Nebraska GeoCloud, staff at the Nebraska Department of Natural Resources (NeDNR), and of course administrators and staff with the WSF. Initial correspondence with these individuals and agencies has been incredibly valuable as the LBBNRD seeks to better understand the aquifer characteristics and extent within its District boundaries.

5. Other Sources of Funding

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

The project sponsor, the LBBNRD, is the only other source of funding, and will be solely responsible for the remaining 40% ($144,000) local matching funds commensurate with the WSF grant request ($216,000). The LBBNRD, through its budget process, has confirmed budgeting for its portion of the proposed $360,000 project (see LBBNRD Match Assurance Letter). The NRD anticipates budgeting for this type of project in future fiscal years for AEM projects in other parts of the District where groundwater depletions and concerns about aquifer

limits persist. While there are no other sources of funding proposed for this project, a considerable amount of time, effort and money has been spent to develop this technology and implement it in many areas of the state. The project will not be implemented as planned if the grant application is not awarded, however; the LBBNRD will continue to pursue AEM flights through other funding opportunities that might arise.The LBBNRD, like other project sponsors and partners, is committed to utilizing AEM to continue to develop a hydrogeologic framework for better understanding of its aquifer, as well as for use in identifying hydrogeologic transition areas to better protect, conserve and manage groundwater resources in the District.

6. **Overview**

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

The Lower Big Blue NRD Airborne Electromagnetic Hydrogeologic Mapping (LBBNRD-AEM1) project is the District's latest and most comprehensive approach to understanding the character and vulnerability of its aquifer formations for use in establishing a hydrogeologic framework and assessing groundwater quantity and quality, particularly in areas of groundwater depletion and/or contamination, increased development and conflicts between groundwater users. More specifically, the aquifer formations of the LBBNRD are multiple and varied, including juxtaposition of Paleovalley and Maha (Dakota) aquifers in the east, northeast, south and southwest, as well as High Plains aquifer in the west and northwest (Young, et al. 2021), this creates challenges in managing groundwater resources.

Historical groundwater quantity and quality monitoring in the District seem to bear out the relationships between subsurface composition, recharge and contamination (i.e., coarse sediments/thin unsaturated zones = higher recharge/more contamination vulnerability, fine-grained sediments/thick unsaturated zones = lower recharge/less contamination vulnerability) in single locations, but the extent of these potential impacts is not well understood. While the NRD's objective is to ultimately conduct AEM studies throughout the District, thereby providing a completely robust framework, funding and feasibility dictate a progressive and phased approach. This specific WSF project aims to apply a more scientifically based approach to delineating those aquifer formations and the extent of any potential groundwater impacts in one of the District's most challenging areas.

Within the 235-square mile area proposed for this effort, the primary groundwater concerns revolve around quantity and recharge. The area contains 21 irrigation wells and 11 dedicated monitoring wells used in the NRD's monitoring network for measuring groundwater recharge. Of the 21 network monitoring irrigation wells in the project area, ten have been measured since 1981, one since 1994,

one since 1998 and nine since 2011. The 11 dedicated monitoring wells were constructed in 2016, and have groundwater level measurement data since then, and nitrate concentration data since 2017. As alluded to above, the aquifer formations in the project area lend themselves more to quantity and recharge concerns than to contaminant concerns.

Regarding drawdown, LBBNRD Groundwater Rules and Regulations dictate that any monitoring network well with a static water level decrease of five feet or more below the baseline level or five percent or more below the upper elevation of the saturated thickness for any well with saturated thickness less than 100 feet for a period of three consecutive years initiates the delineation of a Phase II Groundwater Quantity Management Area (GWQMA). As part of the Phase II delineation process, groundwater level monitoring is to be increased in the area, and ultimately the District may require any combination of control measures.

Since 2011, at least 2 wells in the project area have been at their Phase II designation level for that year, with a high of 16 wells in 2018 and 2022. That equates to 9.5% to 76.2% of the monitoring wells in the project area being at or below their Phase II designation level in a given year during the three year period. The process of identifying and evaluating water availability using both traditional and state of the art techniques is critical to the State's water planning activities and ensuring the sustainability and protection of the State's water supply. As an example, LBBNRD-AEM1 would aid the NRD in more clearly assessing groundwater declines and their impacts, as well as delineating any potential Phase II GWQMAs. While LBBNRD rules dictate increased monitoring of established individually drilled boreholes to assess subsurface materials, the remote sensing technique of AEM has the capability of collecting thousands of virtual boreholes at a fraction of the cost of traditional drilling and monitoring.

In addition to persistent groundwater level declines in the project area, there was a steep increase in irrigation well development between 2011 and 2013 – years which sandwich one of the driest years in recent history in the District. From 1997 to 2010, the District permitted 482 new irrigation wells (avg. 34.43/yr.). Then, from 2011 through 2013, 241 new irrigation wells were permitted (avg. 80.33/yr.) – an average annual increase of 133.32% over the 1997-2010 period. Throughout 2011 and 2012, NRD officials received multiple reports of landowner conflicts over water, prompting rules and regulations changes that began with a temporary moratorium on November 26, 2013. The NRD consulted with Olsson Associates to update its groundwater rules and regulations, as well as develop a districtwide Hydrogeological and Subarea Delineation Report. On March 27, 2014, the District's updated groundwater rules and regulations took effect, and with them, a new method for permitting incorporating a well scoring system. Between 2015 and 2022, since the incorporation of the scoring system, 92 new irrigation wells have been permitted districtwide (avg. 11.50/yr.) – an average annual decrease of 85.68% over the 2011-2013 period. Focusing on the project area, there were 46 new irrigation wells permitted during that 2011-2013 period

and 19 since, but only 7 during that 2015-2022 period – eight full years utilizing the scoring system.

While this data suggests the NRD's updated well permitting is having a positive impact on groundwater supplies in the project area, economics has also been a major contributor to slowing development. As far as the aquifer's response to those drought conditions, groundwater levels in the area show steep declines between the 2012 and 2013 spring readings, with many bottoming out between 2015 and 2019. For many of these wells, their lowest groundwater elevations ever recorded occurred during these years. By 2020 and 2021, levels began climbing back up, in at least two cases even returning to elevations at or above their 2012, pre-drought levels, respectively. Spring 2022 water levels, however, have again declined steeply, in at least one case even declining to the lowest level historically recorded for that well. AEM is quintessential to better understanding the aquifer connections and spatial extent, determining the extent of impacts, aiding in conflict resolution between groundwater users and ultimately managing groundwater resources. Combining AEM with existing studies and monitoring will result in a robust hydrogeologic framework from which to operate and will provide the best available information available to the NRD.

7. Project Tasks and Timeline

Identify what activities will be conducted to complete the project, and the anticipated completion date.
For multiyear projects please list (using the following example):

Tasks	Year 1$	Year 2$	Year 3$	Remaining	Total $ Amt.
Permits	$18,000				$18,000
Engineering		$96,000			$96,000
Construction		$87,000	$96,000		$183,000
Close-out				$8,000	$8,000
				TOTAL	$305,000

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

Tasks	Year 1$	Year 2$	Year 3$	Total $ Amt.
Contract Signing	$108,000			$108,000
Data Collection		$180,000		$180,000
Deliverables (Report, etc.)			$72,000	$72,000
			TOTAL	$360,000

Funding Sources	FY23 (30% by March 1, 2023)	FY24 (Next 50% after July 1, 2023)	FY24 or FY25 (Last 20% around one year after flights)	Total
LBBNRD (40%)	$43,200.00	$72,000.00	$28,800.00	$144,000.00
WSF reimbursements (60%)	$64,800.00	$108,000.00	$43,200.00	$216,000.00
Total Project Cost	**$108,000.00**	**$180,000.00**	**$72,000.00**	**$360,000.00**

This project will map a flight block across an approximately 235-square-mile area of concern for groundwater quantity between Jefferson and Gage Counties. The area encompasses the southern portion of the Lower Big Blue Natural Resources District (LBBNRD) that has been developed for groundwater irrigation and includes approximately 390 line-miles of Airborne Electromagnetic (AEM) survey (see Supplemental Information Attachment (SIA), Figures 1 and 2). The project will result in the development of a three-dimensional view of the aquifer in the vicinities of the City of Wymore-Blue Springs and Villages of Jansen, Harbine and Diller, and includes portions of the Cub Creek, Big Indian Creek, Mud Creek and Wolf-Wildcat Creek HUC-12 Watersheds. Bedrock geology underlying the flight lines ranges from Cretaceous Dakota (Kd) in the west to Permian Chase Group (Pc) through the middle to Permian Council Grove Group (Pcg) in the east (see SIA, Figure 3). Project activities will consist of flight line planning within the block area, collection of AEM data along the flight lines, processing and quality assurance/quality control of the raw AEM data, interpretation of the processed data and reporting of the overall results for the LBBNRD. The deliverables will include a digital PDF report with color appendices depicting individual flight lines in profile view, maps of the aquifer(s) and maps of potential recharge areas for the LBBNRD. The AEM survey results will also be incorporated into a Geographic Information Systems (GIS) spatial database for use by the LBBNRD. The resistivity data from the processed results will also be tied to local geologic interpretations from various registered bore holes (see SIA, Figure 4). Finally, the AEM data may also be incorporated into the Nebraska GeoCloud, a statewide, cloud-based AEM data library for public use.

Being an area of concern for groundwater quantity – specifically groundwater declines – the District has assigned high priority to better understanding the aquifer and targeted it for AEM for use in managing groundwater supplies, projecting recharge and aiding in potential use conflicts (see SIA, Figure 5). Reconnaissance flight lines conducted for this survey will be spaced approximately one mile apart in a grid pattern that completely canvases the extent of registered active irrigation wells utilizing the aquifer, as well as all NRD monitoring network wells critical to the area of concern (see SIA, Figure 6).

Upon notice of award of the Water Sustainability Fund (WSF) grant, the LBBNRD will contract with the Consultant to refine the proposed flight lines (see SIA,

Figure 7). Payment of 30% of the total contract amount of $360,000, or $108,000 will be due at the time of contract signing (anticipated between March 1, 2023 and June 30, 2023). The Consultant, working with the LBBNRD, will develop the reconnaissance flight lines, maximizing the coverage area while avoiding infrastructure that creates electromagnetic interference (powerlines, pipelines, roadways, etc.). Data collection and processing will occur in the LBBNRD fiscal year 2024 (between July 1 and December 31, 2023). Payment of 50% of the total contract amount, or $180,000 will be due on or around the last day of the flight campaign to collect data. The remaining 20% of the total contract amount, or $72,000 will be paid upon delivery of the final report (approximately one year from the end of data collection – LBBNRD FY2024 or FY2025). Review and use of the data will likely continue beyond the project timeline by Conservation Survey Division (CSD), United States Geological Survey (USGS), Nebraska Department of Environment and Energy (NDEE), Eastern Nebraska Water Resources Assessment (ENWRA), Nebraska Department of Natural Resources (NeDNR) and the LBBNRD.

8. **IMP**

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

Section B.

DNR DIRECTOR'S FINDINGS

Prove Engineering & Technical Feasibility
(Applicant must demonstrate compliance with Title 261, CH 2 - 004)

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

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

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

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

1.A.2 Describe the plan of development (004.01 A); Click here to enter text.

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

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

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

1.A.6 Discuss each component of the final plan (004.01 E); Click here to enter text.

1.A.7 When applicable include the geologic investigation required for the project (004.01 E 1); Click here to enter text.

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

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

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

1.B.1 Insert data necessary to establish technical feasibility (004.02); Airborne Electromagnetic Mapping (AEM) utilizes a helicopter to carry resistivity-sensing geophysical equipment along a predetermined flight path. Electrical resistivity,

as it is used for AEM survey, is a measure of how well or poorly the subsurface materials resist the flow of an electrical current. The electrical resistivity being measured from the subsurface geologic material is then used to interpret the type of materials that are in place such as clay, silt, sand and gravel. This is done through correlation of the resistivity to local borehole composition – resistive materials are typically sands and gravels, while less resistive materials tend to be silts and clays. This provides an almost continuous set of subsurface information along the flight lines, producing a virtual borehole approximately every 50-75 feet.

More specifically, due to the aquifer depths and variability of overlying material, Time-Domain Electromagnetics (TDEM) AEM has become the standard for large-scale remote sensing of aquifer characteristics in Nebraska. The Eastern Nebraska Water Resources Assessment (ENWRA) began an AEM effort in 2006 as a coalition and partnership of six Natural Resources Districts (NRDs), federal, state and local agencies and experts with the purpose of developing a three-dimensional geologic framework and water budget for eastern Nebraska. While the Lower Big Blue NRD was not part of that effort, it shares many hydrogeologic similarities with the partner NRDs. The recognition by ENWRA and its partners of the value in using AEM to study aquifer composition has resulted in over 18,000 miles of geophysical data collection throughout the area since then and 25,000 line-miles throughout Nebraska. Other NRDs and agencies outside of ENWRA have also begun conducting AEM surveys. The historical expertise, combined with future planned surveys in the state and region, all of them using the same Consultant, brings with it well-established methodologies and efficiencies in order to achieve a successful survey the first time.

The results of past AEM projects have been used by ENWRA NRDs, CSD and others to better plan and site new test hole and monitoring well locations in targeted aquifer units, saving costs associated with traditionally selected, but perhaps less useful locations. Groundwater quantity concerns (water level declines) in the project area, and the LBBNRD's management of groundwater supplies are the primary drivers behind this project (see Section A.6), as well as its budgeting to commence the project as soon as possible (see Section A.7). Specific uses of this data will include initiation and establishment of an improved hydrogeologic framework, Groundwater Management Area (GWMA) delineation refinement, GWMA rules and regulations updates to address well permitting and groundwater use, assessment of increased monitoring locations and groundwater user conflict resolution, to name a few. As further study ensues regarding the usefulness of AEM in groundwater quality assessment and management in the state, the LBBNRD anticipates future incorporation of the data into its groundwater quality monitoring program and high nitrate areas, as well.

1.B.2 Discuss the plan of development (004.02 A); In addition to the information below, please also refer to the Supplemental Information Attachment (SIA) and

Bibliography sections at the end of this application. The SIA includes the following figures:

- Figure 1 – LBBNRD-AEM1: Overview/HUC-12 Watersheds
- Figure 2 – Project Area Over Road Map
- Figure 3 – Project Area Over Bedrock Geology
- Figure 4 – Project Area Over Road Map Including Registered Boreholes
- Figure 5 – Example of Recharge Area Mapping (NNRD/ENWRA Project)
- Figure 6 – LBBNRD-AEM1: Reg. Active Irrigation & Monitoring Wells
- Figure 7 – Cost Letter from Aqua Geo Frameworks, LLC (AGF)
- Figure 8 – LBBNRD-AEM1: Wellhead Protection Areas (WHPAs)
- Figure 9 – LBBNRD-AEM1: ENWRA Recon/Profile Lines in LBBNRD
- Figure 10 – LBBNRD-AEM1: Track Map from NNRD 2020 AEM Project
- Figure 11 – LBBNRD-AEM1: 2021 Nitrate Results by Phase
- Figure 12 – LBBNRD-AEM1: 2021 Nitrate Results by Phase (MW9 Area)

Inspired by persistent groundwater quantity concerns in the project area, specifically groundwater level declines, as well as great variability in the location of aquifer-bearing material, the Lower Big Blue NRD has sought cost-effective ways to better understand the local subsurface material. Traditional methods for monitoring and managing groundwater supplies in the District are valuable but limited in their ability to be used for assessing and managing large areas. It has, therefore, been challenging in sustained dry periods, to accurately determine the extent of impacts – how to address groundwater user conflicts, future well development, increased monitoring locations and screen depths, etc. It is almost impossible to manage what is not measured, but perhaps equally as important is a comprehensive knowledge of where to measure. This project will improve the LBBNRD's effectiveness to do both.

The resulting project datasets will be used by the LBBNRD for insight into groundwater management concerns, such as potential re-evaluation of management area boundaries/rules, positioning network monitoring/observation well locations and/or screen intervals, evaluation of recharge areas, updates and/or refinements to areas of hydrologically connected groundwater and surface water, current and future groundwater and basin modeling projects. The project will also cover five Wellhead Protection Areas (WHPAs) and will be used to assess impacts to those and potentially a sixth (see SIA, Figure 8). The three-dimensional hydrogeologic framework and water budget developments for past ENWRA projects have actually been instrumental in the development of some LBBNRD groundwater management policies (well permitting process, for example), even in the near absence of AEM survey in the District. This project will aid the NRD in assessing the appropriateness of that well permitting process for the project area and provide a case study of sorts for determining locations and realizing benefits from potential future AEM projects.

Logistically, the plan has been developed through research into past AEM projects in the state, cooperation with those project sponsors and partner agencies, and correspondence with and refinement from the Consultant. If funded, the LBBNRD would hire a geophysical contractor (Consultant) for the following services:

1. Review of proposed flight lines and adjustments where necessary to minimize interference from power lines and other infrastructure. Preliminary flight line locations, spacing and distances have been estimated for the project area (see SIA, Figures 1 and 2)
2. Selection of the appropriate AEM method and equipment, as well as any necessary subcontractors (schedule and contract with the appropriate geophysical vendor)
3. Oversight and coordination of the survey activities
4. Collection and quality check of the AEM data
5. Processing, analyzing and interpreting the data
6. Gathering and georeferencing all existing geologic data near flight lines
7. Interpreting the data into a final report, including Google Earth and GIS files that can be readily shared with interested parties to assist landowners, well drillers and local agencies with decisions regarding groundwater resources.
8. Uploading all AEM data to the Nebraska GeoCloud

In addition, results may be provided to ENWRA, the Nebraska GeoCloud Project, CSD, USGS, NDEE, NeDNR and the general public for collaboration and shared use of the best available comprehensive hydrogeologic framework data for the area. Like NeDNR and CSD borehole records, AEM data is considered long-term "legacy" data that can be used well into the future due to its unique nature and validation of its metadata including the following datasets: raw data, inversion data and interpretation.

It is worth noting that project work related to 80% of the $216,000 total grant request from WSF for this project will be completed by the end of the flight campaign (potentially $172,800 in state dollars spent by Winter 2023). Upon completion of this project, the District will have established a one-mile hydrogeologic framework grid over approximately 390 line-miles to improve the understanding and management of its most confounding aquifers.

1.B.3 Describe field or research investigations utilized to substantiate the project conception (004.02 B); The AEM work done by ENWRA NRDs and partners since 2006 through almost twenty WSF grant awards has gone from first-of-its-kind pilot-projects to trusted science upon which groundwater management districts (NRDs) make important decisions. AEM has an established, proven history of accurately assessing the subsurface composition underlying over 25,000 line-miles flown in approximately 15 of Nebraska's 23 NRDs.

Consequently, Nebraska has become one of the international leaders in the coordinated use of AEM for groundwater management.

The resistivity-sensing technology of AEM is perfectly suited for the subsurface variability encountered in the Lower Big Blue NRD. What is known from historical analysis through various methods about the groundwater supplies in the District suggests a certain degree of unpredictability and rapid change exist across the aquifer(s). AEM has been used successfully in similar landscapes and geology to this project elsewhere in the region and directly adjacent to the District. Likewise, the realized values of AEM mapping and analysis translate to the deficiencies and/or needs of the Lower Big Blue NRD in developing a robust hydrogeologic framework and appropriately managing groundwater supplies in the District.

The monitoring data outlined in Section A.6 and the needs assessed in Section A.7 above provide greater detail on LBBNRD-specific metrics used to substantiate this project conception (as well as the need for future AEM projects). As further substantiation for assessing the subsurface composition of the area delineated for this project, there has been measurable interest in irrigation development. Post-implementation of the 2014 rules and regulations updates, the District has conducted pre-scores with landowners using neighboring registered well logs to give them as much and as good information as possible to assess the feasibility of developing an irrigation system in a given location. Through this effort to help landowners and the public navigate the groundwater rules and regulations of the NRD, for those pre-scores which the District has record, 14.47% to 19.03% depending on characterization (approximately 23 of 159 farms or approximately 55 of 289 scenarios, respectively) have been requested within the project area. Additionally, there are 95 irrigation wells included in the District's traditional groundwater level monitoring network. Of those, 20 meet the criteria for Phase II designation and 21 currently have declines significantly below their baseline elevations (drops of more than 4 feet). Twelve of the 20 wells that meet Phase II criteria and 14 of the 21 with significant declines (most of these are the same wells) are located within the project area. In other words, almost 20% of the interest in constructing new irrigation wells and projects in the entire District exists in the project area, which accounts for approximately 14% of the District land area and includes 60% of the Districtwide traditional monitoring network wells which meet Phase II criteria for groundwater quantity and 66% of the 21 monitoring network wells with the greatest declines from their respective baselines.

When the LBBNRD enhanced its traditional monitoring network with 45 dedicated monitoring wells beginning in 2016, it did so in cooperation with District communities and their Wellhead Protection Areas (WHPAs). The majority of those dedicated monitoring wells were drilled within the 10- and 20-year time of travel delineations. While doing so has obvious water quality benefits to those communities, drilling in those locations also produces water quantity benefits.

For the five or six communities whose WHPAs are included in or adjacent to the project area, the benefits of this AEM project will be compounded. Those communities will have the benefit of the best information available in regard to their water supply and the extent of potential impacts to it. AEM has already been and is being used for the benefit of communities in understanding their wellfields in the neighboring Nemaha NRD, as well as the Lower Platte North NRD's 2017 AEM project and the Basile Groundwater Management Area 2017 AEM project to name a few.

1.B.4 Describe any necessary water and/or land rights (004.02 C); No water or land rights are required to complete this project, nor are they anticipated. Similarly, no trespassing on private property or impacts to human health will result from data collection and all data is collected under Federal Aviation Administration rules and procedures. To ground truth the remote sensing data obtained through AEM, traditionally drilled CSD- and NeDNR-registered well logs will be utilized, and flight lines for this project will be refined to better facilitate that utilization (see SIA, Figure 4). Where well logs are not available but the need for ground truth locations is critical, additional test holes and associated monitoring wells may be advanced for detailed geologic/downhole geophysics, as well as to identify groundwater quantity and quality. In these instances, planning, securing access and implementation of those activities will be conducted separately, subsequent to this project. The collected AEM data will be used for optimization of the locations of any critical test hole needs, which will improve efficiencies regarding test hole drilling expenditures. Should additional test holes be required, access agreements with landowners will be needed. Test hole drilling requires the use of a drilling rig on location for approximately one to three days to drill and describe the geologic materials. Access agreements from landowners for this type of work typically are readily obtainable as there are limited impacts to the land surface and the landowners typically benefit from the findings.

1.B.5 Discuss the anticipated effects, if any, of the project upon the development and/or operation of existing or envisioned structural measures including a brief description of any such measure (004.02 D). The anticipated immediate effects of this project directly correspond to the data and deliverable of Google Earth/GIS layers including information every 50 to 75 feet along each flight line. The information includes interpreted profile image files broken into approximate five- to ten-mile sections with legal description track maps shown at the top (see SIA, Figure 10). There are a few, less comprehensive profiles that were developed under the umbrella of a previous ENWRA project (2015) that have intrigued LBBNRD staff and board members, but the current inversion interpretations being developed will be even more intriguing and beneficial (see SIA, Figure 9). Ultimately, this publicly available dataset could [and likely will] influence future well siting for wells of any type for any beneficial use. The LBBNRD receives regular inquiries regarding the location of aquifer-bearing material for use in potential well siting. Through this project, NRD staff will be able to provide landowners with site-specific printouts of the available information

about potential groundwater resources under their property for identifying suitable areas to construct a domestic, livestock or irrigation well. Owners of existing wells will also find value in the data, especially during times of potential well interference. In each instance, the value of the AEM data and deliverables is enhanced where water resources are highly variable and/or limited as in this project area, namely by saving time and money in test hole drilling and other development costs. Surveys will also be incredibly beneficial to communities and the Nebraska Department of Health and Human Services (NDHHS) during instances of supply and contaminant concerns to public water systems or siting for new public water supply wells.

The anticipated long-term effects of this project include benefits and impacts to all current and future well owners, communities, the public and any other groundwater users. The LBBNRD and local landowners will be able to better evaluate groundwater level declines, forecast water supply concerns and more appropriately define areas where further development is sustainable and interference issues can be avoided. Determining the extent and degree to which neighboring well owners, including communities, might impact or be impacted by water quality concerns is also conceivable. Beyond that, the AEM surveys could be used to assist in evaluating and even adjusting WHPA boundaries for those communities included in this project. Proactively, the NRD can use the data to select locations within the project area for managed aquifer recharge projects to increase groundwater supplies and meet associated surface water objectives.

Prove Economic Feasibility

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

2. Provide evidence that there are no known means of accomplishing the same purpose or purposes more economically, by describing the next best alternative. To achieve an even remotely comparable product to that of AEM survey in this project area using traditional methods would cost approximately $115,830,000 as opposed to the $360,000 cost estimate included (see SIA, Figure 7). Traditional methods of collecting hydrogeologic information through drilling test holes every 160 feet to depths of approximately 300 feet for this area and logging the geologic material would take decades and is still more limited than AEM mapping. Individual test holes provide a single point of information about the hydrogeology of an area, and the materials between test holes (which may be several miles) must be inferred. In the project area, based on well logs drilled over time, it is evident that geologic material can change drastically in a few tens to one hundred feet. The virtual borehole production of AEM every 20 feet, lumping x-, y- and z-axis data every 70 feet to depths of around 500 feet, produces a nearly continuous cross-section of aquifer materials, more readily accounting for those drastic changes in geology.

In addition to the improved frequency and depth of data collection as compared to traditional methods, AEM does not involve any ground disturbance or trespassing or land rights acquisition. According to 2022 quote requests for a yet to be drilled monitoring well in the LBBNRD, the lowest cost per foot to drill is $30. Casing and ultimately developing the monitoring well brings the cost per foot to $48 and $74, respectively. The eleven monitoring wells currently constructed in the project area in 2016 totaled a depth of 1,685 feet and span 31.52 linear miles – an average of 2.87 miles between wells. Simply drilling those eleven boreholes (not developing them as they currently are) today would cost approximately $50,550, and then the NRD would need to contract with a hydrogeologist to interpret the results and develop usable products. AEM products for that same 31.52-mile stretch would cost $29,095.48 and would equate to approximately 8,321 virtual boreholes including hydrogeologic interpretation and deliverables. Stated inversely, to achieve the traditional, yet more limited, output utilizing drilled boreholes every 160 feet over 31.52 miles would require 1,040 test holes and cost up to $9,360,000. Bearing in mind no consideration of costs other than merely drilling the boreholes to evaluate the area through traditional methods, no consideration of inflation of material and labor costs over a decades-long timeframe (versus roughly two years for AEM flights and reporting) and no consideration of land rights costs, it would cost $115,830,000 to drill 12,870 test holes roughly 300 feet deep. That alone is almost 322 times more expensive than the proposed AEM project, and as established above, yields more limited products.

3. Document all sources and report all **costs** and **benefit data** using current data, (commodity prices, recreation benefit prices, and wildlife prices as prescribed by the Director) using both dollar values and other units of measurement when appropriate (environmental, social, cultural, data improvement, etc.). The period of analysis for economic feasibility studies is the project life, up to fifty (50) years; *or*, with prior approval of the Director up to one hundred (100) years, (Title 261, CH 2 - 005). Cost and benefit data relevant to the timeframe for implementation of this project include mobilization of the geophysical equipment and helicopter, flight line planning, data collection and interpretation and the Consultant fee to produce the final report versus costs for traditional alternative approaches. The cost to collect the remotely sensed geophysical data from a helicopter is approximately $923 per mile and the estimated life of the project is two years. Data collection using traditional methods through test hole drilling and logging would amount to approximately $297,000 per mile and take several decades to complete 390 equivalent miles of data as described above.

3.A Describe any relevant cost information including, but not limited to the engineering and inspection costs, capital construction costs, annual operation and maintenance costs, and replacement costs. Cost information shall also include the estimated construction period as well as the estimated project life (005.01). Costs relevant to the timeframe for implementation of this project include mobilization of the geophysical equipment and helicopter, flight line

planning, data collection and interpretation and the Consultant fee to produce the final report and total $360,000. Two years is the estimated life of the project.

3.B Only primary tangible benefits may be counted in providing the monetary benefit information and shall be displayed by year for the project life. In a multi-purpose project, estimate benefits for each purpose, by year, for the life of the project. Describe intangible or secondary benefits (if any) separately. In a case where there is no generally accepted method for calculation of primary tangible benefits describe how the project will increase water sustainability, in a way that justifies economic feasibility of the project such that the finding can be approved by the Director and the Commission (005.02). Primary tangible benefits of this AEM project are the same as those for test holes in that the data obtained are records of subsurface geologic material at different depths. The outcomes and products for this project are enhanced by the existing CSD test hole logs and NeDNR registered well datasets. Advancements in visualization software programs and interpretation methods combine individual point location data together to produce highly detailed cross-sections and three-dimensional geologic frameworks. The resulting framework can be used in addressing any future hydrogeologic problem or supporting any future hydrogeologic project and will allow all partners and the public to be more efficient and effective in directing future groundwater-related activities and decisions. Secondary benefits might include incorporation into modeling efforts, forecasting groundwater supplies and/or impacts and responses to drought, overuse, recharge, contamination, introduction of a large water user, etc..

3.C Present all cost and benefit data in a table to indicate the annual cash flow for the life of the project (005.03).

Cost Activity	**30% Down (03.01.23-06.30.23)**	**Cost After 07.01.23**	**Report Costs (03.01.24-06.30.24)**	**Cost Total**	**Benefits –** approximate cost of drilling 12,870 test holes 300 feet deep at $30/ft and processing the data to produce aquifer boundary maps (160 ft hole spacing along 390 mi of planned flight lines)
WSF Grant	$64,800	$97,200	$54,000	$216,000	Test hole drilling $115,830,000 plus incalculable analysis, processing and LBBNRD time
Local Match	$43,200	$64,800	$36,000	$144,000	
Totals	**$108,000**	**$162,000**	**$90,000**	**$360,000**	**>$115,830,000***

*This cost does not include any subsequent consulting/engineering staff time for decades of hydrogeologic analysis and creation of usable products, nor does it include costs of land rights or easements to physically drill test holes.

3.D In the case of projects for which there is no generally accepted method for calculation of primary tangible benefits and if the project will increase water sustainability, demonstrate the economic feasibility of such proposal by such method as the Director and the Commission deem appropriate (005.04). (For example, show costs of and describe the next best alternative.) Among other obligations, Natural Resources Districts have the statutory responsibility for the development, management, use and conservation of groundwater and surface water, as well as water supply management for any beneficial uses. Of primary consideration for the LBBNRD Board and staff, in cooperation with communities, District landowners and the general public, is the question of whether the measured data justify the management of a given resource. Often, secondary considerations center on the questions of data type and quality. In regard to groundwater management in the LBBNRD, a consistent approach and methodology have been applied to groundwater users regardless of location. Specifically pertaining to permitting of new irrigation and other high-capacity wells (excluding Public Water Supply wells), the NRD relies on data from on-site test hole data and the proximity of existing wells to the proposed new well to assist in assessing sustainability and managing new development. The system is an improvement over previous practice, but uncertainty remains around whether it provides areas of the District with adequate protections or, alternatively, whether it is too restrictive in other areas. As for certification of irrigated acres, expansion of irrigated acres and groundwater use allocation, the NRD has tools at its disposal when groundwater level triggers are reached, but the extent of those tools is not necessarily scientifically informed and, therefore, may or may not provide adequate protection to existing groundwater users. In an age of increasingly tight margins with high input costs and volatile commodity markets, it is more critical than ever that management of and access to groundwater resources be well informed and appropriate. Furthermore, aquifer protection and the sustainability of groundwater resources – both quantitatively and qualitatively – for priority uses through public water supply, domestic and livestock wells must be maintained while still managing for those beneficial uses like irrigation that drive the local economy.

The purpose of the mapping through AEM is to identify and define the relationship of the aquifer systems to one another, as well as to the land surface and any surface water systems. The project area – a priority area of concern in the District – requires improved understanding of the aquifer(s) contained within, the relationships between overall use, recharge and discharge and ultimately its sustainability. This project will provide just that through improved overall identification of confining layers between aquifers and understanding of the interrelationships of use, recharge, discharge and potential contamination threats. This will drive management decisions in the area with regard to quantity and groundwater demands. Quantifying the benefits of that improved understanding depends on how the information is used to make those management decisions over a given timeframe. Tailoring approaches to improve

sustainability and extend the life of groundwater resources in this area of persistent declines will ensure long-term conservation and protection of the resource and can even assist groundwater users with understanding their capacity for continued development.

With better quality data informing decisions, the costs and benefits of any alternatives ranging from doing nothing to over-regulation will be contingent on inferior or inadequate data. These costs and benefits, while not completely uninformed, will likely be less than optimized.

Prove Financial Feasibility

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

4. Provide evidence that sufficient funds are available to complete the proposal. The Lower Big Blue NRD has planned to budget matching funds for this project in their annual fiscal year (FY) FY2023 and FY2024 budgets as the project timeframe dictates. The NRD budget is finalized after July 1 each year, and the table below lists LBBNRD funding levies, property tax revenues and NRD budgets for the past three fiscal years.

Fiscal Year	Cents per $100 Assessed Valuation	Property Tax Revenue	Total Budget
FY2022	2.1334	$1,288,760	$3,514,726.40
FY2021	2.1921	$1,289,000	$3,480,092.26
FY2020	2.3873	$1,414,420	$3,463,292.73

5. Provide evidence that sufficient annual revenue is available to repay the reimbursable costs and to cover OM&R (operate, maintain, and replace). Any costs to cover operations and maintenance are included in the LBBNRD annual budget. Because data collection is the primary objective of the project, there are no costs associated with equipment replacement. Should the LBBNRD financially partner with ENWRA and/or the Nebraska GeoCloud or enter into an agreement, those dues would be budgeted, and any operations and maintenance built into their long-range plan budgets for data management would apply as well.

6. If a loan is involved, provide sufficient documentation to prove that the loan can be repaid during the repayment life of the proposal. Not applicable

7. Describe how the plan of development minimizes impacts on the natural environment (i.e. timing vs nesting/migration, etc.). Data collected during AEM survey flights is remotely sensed and has no potential impacts to the natural environment and includes no ground disturbance. Flights will be conducted outside of major bird migration times. Local airports will be utilized during the AEM survey, as well, so data collection will be accomplished without trespassing on private land and conducted according to current FAA rules, which minimize disturbance to property owners. AEM mapping significantly decreases the number of physical boreholes and observation wells required to define the

aquifer system, which in turn lowers the extent of impacts on the natural environment from drilling and support vehicles.

8. Explain how you are qualified, responsible and legally capable of carrying out the project for which you are seeking funds. Passed in 1975, the Nebraska Groundwater Management and Protection Act established the Natural Resource Districts (NRDs) as the preferred local entities for groundwater regulation and protection. NRDs work cooperatively with cities, counties, state and federal agencies to accomplish groundwater resource protection through programs, projects and regulations. Each NRD is required to have in place a Groundwater Management Plan (LBBNRD first completed a GWMP in 1985), based upon the best available information and approved by the Director of the NeDNR. The District voluntarily entered into an Integrated Management Plan (IMP) development process with NeDNR to take a proactive approach to the protection of hydrologically connected surface water and groundwater. The staff, management and Board of Directors (Board) of the LBBNRD devote significant time and resources toward their duties to understand and manage the groundwater resources. Combining the District's previously collected groundwater data with the information collected during this project will enable the NRD staff and Board to make more informed assessments and decisions about the management and protection of groundwater resources going forward.

9. Explain how your project considers plans and programs of the state and resources development plans of the political subdivisions of the state. Periodically, through completion of Sections A and B above, references have been made to ENWRA, the Nebraska GeoCloud and similar efforts undertaken by other NRDs. Other similar WSF funded AEM projects have included references to NeDNR's Annual Evaluation of Availability of Hydrologically Connected Water Supplies (aka FAB report), USGS Nebraska Water Science Center goals and UNL-CSD service area goals and efforts, among other regional and statewide plans and programs. Certainly, the same cooperative and collaborative spirit that has existed, and does exist, among partners and stakeholders in those projects has been evident and communicated to the LBBNRD in the pursuit of this project effort. Future support in understanding and utilizing the data and products derived from this project has been extended to the LBBNRD by those same partners, and the data may also be incorporated into the Nebraska GeoCloud for consideration and incorporation by those agencies, organizations and the public.

   Without question, the primary purpose of this AEM project – LBBNRD-AEM1 – is to establish a hydrogeologic framework for and develop a more comprehensive understanding of the aquifer in the District's primary area of concern for groundwater depletions. As referenced in Sections A.6 and 1.B.3 above, there are other areas of the LBBNRD that warrant AEM mapping for assessing groundwater quantity, groundwater quality or both, specifically those areas of suspected transition between aquifer throughout the District. The jointly

developed IMP between the LBBNRD and NeDNR outlines three goals, all of which this project helps to achieve:

1. Develop a better understanding of District's water supplies and uses
2. Prevent or mitigate water related conflicts within the District
3. Inform the public of the District's water resources and management efforts (Integrated Management Plan, 12-14).

Objectives and action items specifically focus on collection and maintenance of a database of water supplies in the District utilizing the best available information, data and science, development of a groundwater model, monitoring and assessment of changes in water supplies and uses, implementation of management approaches and solutions to address conflicts and expanding public education on the District's water supplies and management efforts. Obtaining a better understanding of aquifer connectivity through projects like this is a critical component to achieving these goals and objectives. Several of the ways this project will meet, or contribute to meeting, these and other IMP objectives have been described in detail throughout this application (see Sections A.6, 1.B.3, 1.B.5, B.3.D, B.7 and B.8). More broadly, having a contiguous view of the aquifer formations, which AEM data provides, will allow for management and flexibility in dealing with localized issues for both water quantity and quality. The IMP is meant to be adaptive in nature, and the collection of new information is critical to keeping it up to date and effective now and well into the future.

Adherence to the District's Groundwater Management Plan was a focus of the 2014 updates to its Groundwater Rules and Regulations. Many of the policies and procedures historically in place for groundwater management needed to be reevaluated in light of the irrigation development, climatological and economic impacts to groundwater recharge. At the time, LBBNRD staff and Board built in more appropriate tools for managing groundwater resources based on the best information available. As described in Section A.6, the District saw a 133% (241 well permits) increase in average annual new irrigation well permits during the years of FY2011 through FY2013 as compared to FY1997-FY2010 (482 well permits). In the project area, there were 46 new irrigation well permits during FY2011 through FY2013. While those numbers were reduced to 92 new irrigation wells Districtwide from FY2015 through FY2022 and a mere seven in the project area, current groundwater level data suggest more information, and perhaps more management, is needed. As a measure of developmental interest, Section 1.B.3 included a detailed summary of pre-score data, the gist of which is 20% of the interest in constructing new irrigation wells has been within the project area, which constitutes 14% of the District area and includes 60% of the NRD's monitoring network wells with latest readings at or below Phase II designation levels and 66% of the monitoring network wells with the greatest declines from their baseline levels (see that section for further explanation). The LBBNRD-AEM1 project would take that monitoring data, the newly developed well logs and

the regulatory measures present to-date into consideration for the development of a comprehensive hydrogeologic framework for the project area. From there, informed assessments could be made regarding the delineation of a more intensively monitored or controlled management area, the locations of recharge areas, potential short- and long-term impacts to WHPAs, potential groundwater use interference and conflicts, solutions to conflicts and even optimal locations to construct new wells or new irrigation or groundwater use projects to improve economic development.

While this project is quantity focused, it should also be noted that the benefits of AEM mapping to groundwater quality management may also be realized immediately in a small, centrally located sub-area within the project area (see SIA, Figure 11). One of the District's dedicated monitoring wells – Monitoring Well MW9 – located 4.5 miles south of Ellis, Nebraska (see SIA, Figure 12). Since 2017, annual nitrate readings for this monitoring well have been 5.5, 5.8, 7.5, 10.1 and 11.2 parts per million (ppm), respectively. Additionally, there were readings in six neighboring irrigation wells over 9 ppm (90% Maximum Contaminant Level and Phase III Groundwater Quality designation), none of which was above 14.1, as well as four neighboring wells over 6 ppm (60% Maximum Contaminant Level and Phase II Groundwater Quality designation). An auxiliary benefit to AEM mapping in this project area will be determining whether there are any similarities or connections between these wells. It will also help the LBBNRD realize the benefits of AEM for groundwater quality and inform whether the next AEM project it pursues should be its priority concern area for groundwater quality.

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

If yes:

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

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

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

11. Identify how you possess all necessary authority to undertake or participate in the project. As a political subdivision of the State of Nebraska, the LBBNRD has the authority to undertake the project because the purpose of the project directly relates to the development, management, utilization and conservation of groundwater and surface water as designated in Neb. Rev. Stat. Chapter 2, Article 32. Further authority of the NRDs is defined under the Nebraska Groundwater Management and Protection Act, Neb. Rev. Stat. Chapter 46,

Article 7, to enter into contracts or agreements, to budget and expend levied property taxes, to own and operate property and equipment and to conduct investigations relative to the protection and management of groundwater. The contract for professional services with the Consultant to collect AEM data will require approval from the LBBNRD Board of Directors and be signed on behalf of the LBBNRD by the General Manager.

12. Identify the probable consequences (environmental and ecological) that may result if the project is or is not completed. This project will assist the LBBNRD in comprehensively assessing and finding solutions to issues with groundwater level declines and interference and conflicts between groundwater users. It will help the NRD identify which areas have a higher degree of recharge and which areas are the most vulnerable to even greater declines. It will help delineate transition areas between aquifer-bearing material and assess the potential for sustainable use of groundwater supplies in the project area; areas that are perhaps overdeveloped, as well as areas where further development could be sustained.

Past AEM studies in eastern Nebraska have revealed that aquifers are complicated and regional geology can have profound impacts on groundwater quantity as well as quality. There exists an opportunity to assess the extent and potential impacts of high nitrate levels within the project area as well. A consequence of managing groundwater supplies not only in the project area but Districtwide without AEM data has been trying to do so with limited information. This has resulted in an incomplete understanding of the extent to which groundwater rules and regulations, Phase II designations for groundwater quantity, quality or both and even increased monitoring should be delineated and enacted. Identifying areas of groundwater and surface water connection and better defining the presence, extent and volume of specific aquifer formations will likely alter the current management methods in those areas, thus promoting more sustainable, wiser use of the resources.

Remote sensing projects, like AEM data collection and mapping, do not have physical impacts on ecosystems such as wetlands, nesting habitats, forest areas, etc. There are no known negative environmental or ecological consequences from AEM data collection, however 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 also reduce the number of test holes required with exploratory drilling, including refining and reducing the impacts from landowners pursuing well permits under current NRD rules and regulations, ultimately making the project more beneficial than detrimental environmentally/ecologically.

Section C.

NRC SCORING

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

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

Notes:

- The responses to one criterion ***will not*** be considered in the scoring of other criteria. Repeat references as needed to support documentation in each criterion as appropriate. The 15 categories are specified by statute and will be used to create scoring matrixes which will ultimately determine which projects receive funding.

- There is a total of 69 possible points, plus two bonus points. The potential number of points awarded for each criteria are noted above. Once points are assigned, they will be added to determine a final score. The scores will determine ranking.

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

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

1. Remediates or mitigates threats to drinking water;

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

   The proposed LBBNRD-AEM1 project area includes parts of southern Jefferson and Gage Counties, including the communities and/or WHPAs of Blue Springs, Diller, Ellis (adjacent), Harbine, Jansen, Liberty (adjacent), Odell and Wymore.

The NeDNR water well registration database indicates there are 349 irrigation wells, 110 domestic wells, 25 public water supply wells, 20 livestock wells and 1 commercial well within the project area. Of the public water supply wells, most serve communities with a combined total population of about 2,500 people and about 600 businesses and one serves a rural water system with 486 service connections ("Chamber of Commerce").

Regarding specific threats to drinking water, the primary contaminants of concern throughout the Lower Big Blue NRD are nitrates. As such, the District annually samples dedicated monitoring wells and registered irrigation wells for nitrate analysis. In 2021, sample results in the project area indicated one monitoring well (MW9 south of Ellis) and 20 registered irrigation wells with nitrate concentration levels at or above the Environmental Protection Agency's (EPA's) maximum contaminant level (MCL) of 10 parts per million (ppm), with the bulk of these wells located in an approximate township-sized area (6 miles by 6 miles) in the center. Unfortunately, there are also 21 registered irrigation wells, primarily located in the northwest portion of the project area, with nitrate concentrations at or above 6.0 ppm, which, if sustained, would qualify for NRD Phase II delineation for groundwater quality (60% of MCL). Not to discount the other ten dedicated monitoring wells and the almost 70 registered irrigation wells with nitrate concentrations below 6.0 ppm, as the overall monitoring of the project area historically indicates more water quantity than water quality concerns, but the potential mitigating actions available and revealed by the AEM survey would be incredibly valuable.

The combination of traditional hydrogeologic information and the detailed information collected through AEM into a more comprehensive framework provides a better understanding of the physical extents and potential interactions of the local and regional aquifers and surface waters. A hydrogeologic framework includes the depth to the top of the aquifer, the extent of the aquifer material and the depth to the bottom of the aquifer. An aquifer's susceptibility to surface contaminants, like nitrogen, is partially determined by the type of overlying materials and how well those materials contribute to aquifer recharge. Sands and gravels with limited clay content contribute to more rapid recharge, while thick sections of clay reduce the rate of percolation and recharge. Greater understanding of the extents of materials that limit or transmit percolating water can provide the LBBNRD with the ability to tailor management activities intended to protect drinking water quality. As an example, historically, domestic well construction occurred in the uppermost portion of the aquifer and stopped whenever the driller encountered adequate water bearing sands and gravels in order to save the well owner the 'unnecessary expense' of drilling deeper. AEM mapping would help domestic well owners, as well as community public water systems, determine if and at what depth drilling and screening a well would reduce impacts from surface contaminants. Additionally, a deeper drinking water well also reduces the potential interference from nearby wells during peak use periods and/or times of drought when aquifer drawdown is the highest.

Regarding historical issues and tried solutions along with unresolved long-range impacts, the LBBNRD has had delineated Groundwater [Quality] Management Areas (GWMAs) for nitrate concentrations since 1995. In the District's current Phase II GWMA in and around the WHPAs of the City of Beatrice and the Village of DeWitt, information and education programs along with voluntary best management practices (BMPs) have been utilized. Unfortunately, these measures have not yet resulted in the reduction of nitrates in that GWMA. This specific area will likely be the focus of a future AEM survey, but as it pertains to the current project area, AEM will assist the NRD in understanding why nitrate concentrations are climbing in monitoring well MW9, any connections between wells with concentrations above the MCL and ultimately provide for better solutions in the optimum locations should another Phase II GWMA ever need to be established.

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.

Officially adopted in April 2022, the jointly developed Integrated Management Plan (IMP) between the LBBNRD and the NeDNR has an ultimate goal of protecting existing investments and interests while facilitating economic growth and well-being across the District. The following is directly excerpted from Part 7 of the IMP:

> "For the first phase/increment of the integrated management planning process for the District's VIMP, the goals and objectives focus on understanding the water supplies and uses within the District, resolving potential conflicts between users, planning for future uses and effectively communicating water resource information and management actions to the general public. These fundamental elements of integrated management planning allow for tailoring Department and District actions in the following phases of the VIMP process and provide the framework for water management decisions going forward" (Integrated Management Plan, 12).

The goals of the IMP are also listed in Section B.9 of this application. This project will address the objectives and action items associated with the goals by contributing to the following:

1. collecting and maintaining a database of water supplies and uses, utilizing the best available information, data and science
    i. developing monitoring protocols for key new and existing water uses not currently monitored
2. continue development of a numerical groundwater mode of the Big Blue basin and interconnected water sources for use as a management tool
    i. define hydrologically connected areas within the District
    ii. simulate drought and new use effects on water supplies
    iii. maintain numerical groundwater model of the Big Blue Basin
    iv. use numerical groundwater model for calculations of water supply and use
3. monitor changes in water supplies and uses within the District (farming practices, land use, industrial growth, population, etc.)
    i. continue monitoring well data collection and trend analysis
4. assess the potential impact of new and existing surface water and groundwater uses on existing surface water and groundwater users within the District and maintain rules and regulations to enhance equitable water use management
    i. utilize tools such as groundwater models and hydrologic tools for the assessment
    ii. maintain the District's protocols for evaluating new groundwater uses
    iii. periodically review/update evaluation and approval process used for all new uses
5. maintain compliance with the Big Blue River Compact
    i. consider compact compliance in evaluating new uses
6. develop and expand educational material on the water resources of the District
    i. develop outreach material on water use/conservation
    ii. engage specialists as needed for educational programs
    iii. develop supporting educational material, workshops, etc. based on determined needs
7. maintain and expand public outreach activities
    i. develop outreach program to target specific groups with educational workshops
    ii. partner with NeDNR on opportunities for outreach

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 collection and assembly of hydrogeologic data into an overall aquifer framework provides the necessary information to help determine recharge characteristics, aquifer extents, volume of available groundwater, interconnection with other aquifers and stream-aquifer interactions. The LBBNRD has historically measured and collected groundwater level data in the LBBNRD-AEM1 project area, which as described in detail in Sections A.6 and 1.B.3 of this application, indicate poor recharge throughout. Interpretation of the AEM data, along with that of the historically collected data and any other pertinent borehole data (UNL-CSD, registered well logs, test hole data, etc.) 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 in SIA, Figure 10. Aquifer recharge is then determined by the water available from precipitation for deep percolation after considering runoff, evapotranspiration, soil characteristics, subsurface materials that directly overlay the aquifer and other factors. In general, more rapid recharge occurs where sandier materials overlay the aquifer while slower recharge occurs where clay-rich materials overlay the aquifer.

Conversely, the combined AEM, historical monitoring and any necessary supplemental data will also be effective in determining and delineating the location, area and amount that aquifer depletion could be reduced. Water levels in the area in 2022 matched the highest amount of historically measured wells (16 of 21 wells or 76.2%) with declines to Phase II groundwater quantity management status (were they to be sustained for three consecutive years) ever for the area (2018 was the other year). From those 16 wells, using traditional methods, the District could attempt to interpolate and delineate a management area if the regulatory criteria are met and that becomes necessary. However, using AEM technology, the NRD would be better informed and able to delineate a more appropriate management area. With that many wells declining to those trigger levels twice in five years, establishing a Groundwater Quantity Management Area (GWQMA) in the short-term is a real possibility, making this project even more critical at this time.

AEM mapping can be utilized to improve the LBBNRD's understanding of recharge potential by delineating the layers of material types overlaying an aquifer. Recharge potential can then be used by the District to better assess projects designed to increase recharge or reduce depletion, as well as inform NRD management of preferred development zones in areas where recharge is higher. Preferred development zones could 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 and/or where well impacts to streams are minimized. Management decisions for GWQMAs or even quality areas (GWMAs) would seek to balance the needs for groundwater development with the existing uses of

groundwater in an area. A more complete hydrogeologic framework will improve the LBBNRD's ability to make informed management decisions and improve the sustainability of the overall water resources. Decisions to utilize allocations, water use, rotation, limits on development, well spacing requirements or any other controls as part of a Groundwater Management Plan (GWMP) or Integrated Management Plan (IMP) could be better tailored to protect existing users and promote sustainable use of water resources.

In regard to the reach, amount and timing of increased streamflow and any cross-basin benefits, a significant portion of the surface and groundwater resources in the Lower Big Blue NRD, and certainly in the project area, drains directly into the Big Blue River. Once in the Big Blue River, that water is available to any downstream Nebraska surface water appropriators prior to the Barneston stream gauge in years where there is not a Blue River Compact call, and then it is essentially lost to Nebraska for beneficial use. Insomuch as it contributes to Nebraska remaining in compliance with the Blue River Compact, there is value in this, but in most areas of the state, water leaving a basin can still be used in the next basin, but this is not true for the Lower Big Blue NRD. Cross-basin benefits would be realized for the LBBNRD and its neighbors (Little Blue NRD and Nemaha NRD, specifically for this project) in improving the ability for groundwater professionals/agencies to delineate aquifer boundaries that may cross NRD boundaries. There would also be benefits to nearby communities and their Wellhead Protection Areas (WHAPs) in those neighboring Districts, most notably Fairbury, Endicott and Steele City in the Little Blue NRD to the west. Finally, depending on the timeliness and status of the Blue Basin Model currently being developed between the Little Blue, Lower Big Blue, Tri-Basin and Upper Big Blue NRDs, there would be cross-basin value in AEM data collection. Certainly, a much broader area of AEM mapping would directly translate to a more perfect understanding of the basin's aquifer and groundwater supplies. However, this project, being on the lower end of the basin, including flight lines approximately four miles north of the Barneston stream gauge and just below all of the major contributing watersheds but one (Wolf-Wildcat) gauged at that station, has the additional benefit of helping to detect interaction between groundwater and surface water or even the potential for streamflow augmentation projects. This could be directly applied to the model, as well as utilized for understanding similar watershed characteristics and geology elsewhere in the basin.

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 conservation and preservation of water resources for the beneficial use of the residents of the State of Nebraska requires detailed information about the aquifer characteristics and interactions of the groundwater and surface water resources. A detailed understanding of the quality and distribution of available groundwater is critical for developing sound strategies for conservation and preservation through management actions, programs and/or projects. AEM data collection through this project will not only benefit residents in this area of sustained groundwater declines through current studies but will also provide an invaluable amount of data for future management and conservation of water resources.

For over 15 years, the value of AEM data has been demonstrated numerous times within the state to address a variety of water resources issues including identifying areas of high groundwater recharge, mapping buried paleovalley aquifers in glacial terrain and assessing secondary bedrock aquifers for drinking water supply. AEM surveys have revolutionized aquifer mapping and greatly advanced groundwater management efforts in Nebraska by providing cost-effective, high-resolution subsurface information. More specifically, the LBBNRD-AEM1 project establishes a robust hydrogeologic framework for the District from which to accurately assess the impetuses and extent of the groundwater declines and user conflicts historically experienced in the project area. From there, the NRD staff and Board can make long-range forecasts and informed management decisions based on water supplies to ensure the continued beneficial use of water resources by existing users, as well as the sustainable addition of new uses.

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.

Pursuant to Neb. Rev. Stat. 46-613, preference in use of groundwater shall be given to those using the water for domestic purposes over those claiming it for any other purpose. Similarly, those using the water for agricultural purposes shall have the preference over those using it for manufacturing or industrial purposes. Furthermore, per Neb. Rev. Stat. 46-201, water for the purposes of irrigation in the State of Nebraska has been declared to be a natural want. Finally, pursuant to Neb. Rev. Stat. 46-702, groundwater in the State of Nebraska is considered a correlative resource, and while every landowner is entitled to a reasonable and beneficial use of the groundwater underlying his or

her land (subject to Neb. Rev. Stat. Chapter 46, Article 6), the conservation of groundwater and the beneficial use thereof are deemed essential to the economic prosperity and future wellbeing of the State and public interest demands the conservation and protection of groundwater supplies, as well as the prevention of contamination to it or inefficient or improper use thereof.

The LBBNRD-AEM1 project will maximize the beneficial use of water resources in this part of the state by improving the understanding of the aquifer systems in the area, and thereby improving its conservation and protection. The aquifer framework developed through this AEM collection project will provide the best information available to stakeholders for managing water use. Existing groundwater uses can be better protected, recharge projects can be explored and developed where they make the most sense, assessing, forecasting and permitting future development potential can be conducted and interference between water users can be mitigated because of this project. Explained in greater detail in Sections 1.B.3 and B.3.D of this application, sustained groundwater level declines are the impetus for many reductions in the beneficial use of water resources in the area. This project works to counter those impacts by providing local water resources managers with the information to maximize water supplies, protect drinking water supplies, understand susceptibility to groundwater quantity and groundwater quality detriments and ultimately provide a beneficial impact to area residents. For the Lower Big Blue NRD staff and Board, the information provided through this AEM project can be utilized to more effectively tailor approaches, programs and projects, where best management practices to improve water use efficiency will have the greatest impact and ultimately determine if and where management areas should be delineated or controls implemented.

6. Is cost-effective;

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

There are no costs for construction, O/M costs, land and water acquisition costs, etc. As described in Section B.2., to achieve an even remotely comparable product to that of AEM survey in this project area using traditional methods would cost approximately $115,830,000 as opposed to the $360,000 cost estimate included (see SIA, Figure 7). Traditional methods of collecting hydrogeologic information through drilling test holes every 160 feet to depths of approximately 300 feet for this area and logging the geologic material would take decades and is still more limited than AEM mapping. Individual test holes provide a single point of information about the hydrogeology of an area, and the materials between test holes (which may be several miles) must be inferred. In the project

area, based on well logs drilled over time, it is evident that geologic material can change drastically in a few tens to one hundred feet. The virtual borehole production of AEM every 20 feet, lumping x-, y- and z-axis data every 70 feet to depths of around 500 feet, produces a nearly continuous cross-section of aquifer materials, more readily accounting for those drastic changes in geology.

In addition to the improved frequency and depth of data collection as compared to traditional methods, AEM does not involve any ground disturbance or trespassing or land rights acquisition. According to 2022 quote requests for a yet to be drilled monitoring well in the LBBNRD, the lowest cost per foot to drill is $30. Casing and ultimately developing the monitoring well brings the cost per foot to $48 and $74, respectively. The eleven monitoring wells currently constructed in the project area in 2016 totaled a depth of 1,685 feet and span 31.52 linear miles – an average of 2.87 miles between wells. Simply drilling those eleven boreholes (not developing them as they currently are) today would cost approximately $50,550, and then the NRD would need to contract with a hydrogeologist to interpret the results and develop usable products. AEM products for that same 31.52-mile stretch would cost $29,095.48 and would equate to approximately 8,321 virtual boreholes including hydrogeologic interpretation and deliverables. Stated inversely, to achieve the traditional, yet more limited, output utilizing drilled boreholes every 160 feet over 31.52 miles would require 1,040 test holes and cost up to $9,360,000. Bearing in mind no consideration of costs other than merely drilling the boreholes to evaluate the area through traditional methods, no consideration of inflation of material and labor costs over a decades-long timeframe (versus roughly two years for AEM flights and reporting) and no consideration of land rights costs, it would cost $115,830,000 to drill 12,870 test holes roughly 300 feet deep. That alone is almost 322 times more expensive than the proposed AEM project, and as established above, yields more limited products.

Cost and benefit data relevant to the timeframe for implementation of this project include mobilization of the geophysical equipment and helicopter, flight line planning, data collection and interpretation and the Consultant fee to produce the final report versus costs for traditional alternative approaches. The cost to collect the remotely sensed geophysical data from a helicopter is approximately $923 per mile and the estimated life of the project is two years. Data collection using traditional methods through test hole drilling and logging would amount to approximately $297,000 per mile and take several decades to complete 390 equivalent miles of data as described above.

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.

Entered into on by the States of Kansas and Nebraska on January 25, 1971, the Blue River Basin Compact, aka the Kansas-Nebraska Big Blue River Compact, set forth articles agreed upon to accomplish the following purposes:

1. To promote interstate comity between the States of Nebraska and Kansas;
2. To achieve an equitable apportionment of the waters of the Big Blue River Basin between the two States and to promote orderly development thereof; and
3. To encourage continuation of the active pollution-abatement programs in each of the two States and to seek further reduction in both natural and man-made pollution of the waters of the Big Blue River Basin (Neb. Rev. Stat. A1-115).

The organization, responsibilities, apportionments and even water quality controls along with general provisions built into this interstate compact will potentially be impacted by the LBBNRD-AEM1 project. Any impacts will serve to better understand significant portions of the three southernmost HUC-12 watersheds above the Compact-referenced stream gauge at Barneston, Nebraska where minimum mean daily flows for Compact compliance must be maintained during the period of May 1 to September 30. The project area includes the confluences of Big Indian Creek and Mud Creek watersheds with the Big Blue River, as well as a significant portion of the Wolf-Wildcat Creeks watershed, the confluence of which is located directly upstream of the Barneston stream gauge. Beyond detecting interaction between groundwater and surface water and providing a robust understanding of creek- and river-adjacent aquifers, AEM data collection will better inform any Compact-related impacts to irrigators and other water users, provide the best science available for assessing impacts from wells on stream flows (and/or stream levels on well levels) and assist in the development of any potential flow augmentation projects.

In addition to the Blue River Basin Compact, the information provided by this project would assist water managers with science-based information to comply with Nebraska Title 118 – Groundwater 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.” As explained in Section C.3, the NeDNR water well registration database indicates there are 349 irrigation wells, 110 domestic wells, 25 public water supply wells, 20 livestock wells and 1 commercial well within the project area. Of the public water supply wells, most serve communities with a combined total population of about 2,500

people and about 600 businesses and one serves a rural water system with 486 service connections. This project could also assist in evaluating WHPA delineations and/or alterations.

Lastly, federally threatened or endangered species like the Western Massasauga (*Sistrurus tergeminus*), Northern Long-Eared Bat (*Myotis septentrionalis*) and Timber Rattlesnake (*Crotalus horridus*) exist within the project area and are susceptible to its health and function. Other listed species exist elsewhere in the District, but these three have ranges in the project area. By better understanding the aquifer resources, the Lower Big Blue NRD can make responsible decisions that will reduce potential negative impacts to its local threatened and endangered species.

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.

As described in Sections 1.B.4, B.2, B.7 and B.12 of this applications, the tasks necessary to complete the AEM data collection drastically reduce (if not eliminate) physical impacts to the landscape compared to any alternatives which could produce comparable products and results. With regard to reductions to threats to property and critical infrastructure achieved by completing this project, protections will be afforded to public water supply systems and domestic drinking water wells serving an approximate total population of 2,950 in the project area (2020 US Census Data). Additionally, the remaining 20 livestock wells, 349 irrigation wells and 1 commercial well registered in the project area will also be protected because of the LBBNRD-AEM1 project. Declining groundwater levels and/or increasing concentrations of contaminants like nitrates that impact wells often require well owners to lower their pumps, drill new or deeper wells (if possible) or install expensive filtration or treatment equipment. The costs associated with such projects range from a few thousand dollars to $500,000 or more depending on the size and scope of the project and would likely incur significant financial burdens on small communities with limited tax bases. Understanding the entire aquifer framework through AEM data collection and interpretation is essential to protecting these drinking water supplies and other beneficial uses from future overuse, as well as reducing the threat of groundwater contamination.

9. Improves water quality;

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

Groundwater quality is increasingly a concern in part of the project area (described in detail in Sections 1.B.3, B.9 and C.1 of this application). With climbing nitrate concentration levels in one of the dedicated monitoring wells to over 10 ppm (EPA MCL for nitrates), 20 registered irrigation wells with 2021 sample results at or above the MCL and 21 more registered irrigation wells at or above 60% MCL (trigger level for GWMA Phase II designation) in the project area, respectively, the LBBNRD would also use AEM data collection to improve groundwater quality. Certainly, while the primary concern for this portion of the District is declining groundwater levels, the data reveal it is not absolved of impacts to groundwater quality.

With an approximate total population of 2,950 (urban and rural), including six WHPAs in or directly adjacent to the 150,408-acre project area, those benefitting from the AEM data collection will include community, residential, commercial, agricultural and recreational water users. LBBNRD-AEM1 will assist NRD personnel, as well as well owners, in determining the extent of current aquifer characteristics similar to those portions of the project area with higher nitrate concentrations and the potential for elevated groundwater quality concerns elsewhere. In other parts of the District, where drinking water supplies are impacted by high nitrate concentrations, well owners are well aware of the costs to filter or treat water to remove or at least reduce the contamination. The creation of a hydrogeologic framework that delineates the extents, thickness and interaction of the area aquifer systems along the flight lines allows the LBBNRD Board to make science-based decisions regarding the protection of water resources. The NRD would be able to create programs and projects that directly impact water quality from further degradation and protect the health of the residents that are dependent on groundwater for their drinking water supply.

Also of note, the Nebraska Wellhead Protection Program (WHPP) is a voluntary program which assists public water supply systems in preventing contamination to their water supplies through active planning and on-the-ground practices in conjunction with the Nebraska Department of Environment and Energy (NDEE) and the local NRD. Similarly, Drinking Water Protection Management Plans (DWPMPs) are a tool for communities to implement long-term strategies for ensuring a safe and reliable drinking water source for years to come. The

objectives of these programs include identifying water quality concerns, establishing and/or updating Wellhead Protection Areas (WHPAs), proposing water quality restorative management measures, creating a monitoring schedule for preventative measures, educating the community on water quality issues and best management practices (BMPs) and developing a community-based planning process. Depending on the plan and funding sources, groundwater models are used to estimate time of travel or the distance away from a supply well that contamination of the aquifer would take to reach a supply well over a twenty-year or fifty-year period. The local hydrogeology entered into a groundwater model is typically only informed by the geologic logs of the supply well(s) and a few other surrounding registered wells or CSD test holes. The data collected through LBBNRD-AEM1 could be incorporated to greatly improve the input data used to model groundwater for WHPPs in the project area (public water systems are expected to review their WHPP every five years and incorporate new data into the model).

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 LBBNRD devotes substantial time and resources to the assessment of the overall quality and quantity of the groundwater resources in the District. This proposed project was discussed and voted on by the LBBNRD Board of Directors during the June 16, 2022 regular monthly board meeting. The motion to pursue resources to proceed with this project passed unanimously. Past financial input from the LBBNRD to support these types of projects includes annual water quality and quantity monitoring, the installation of dedicated monitoring wells, past flow meter and water and nitrogen use efficiency projects, as well as partnerships with communities, CSD, NeDNR, NDEE, other NRDs, USGS and other stakeholders to collect data of this sort.

The FY2023 budget and tax levy are yet to be finalized, but the LBBNRD FY2022 budget (July 1, 2021 through June 30, 2022) was $3,514,726.40 with a property tax levy of 0.021334 resulting in approximately $1,288,760.00 of local property taxes. The total project costs for this proposed AEM data collection, interpretation and reporting are $360,000.00. Of that, the LBBNRD will use general funds to cover the required local match of 40%, or $144,000.00. The remaining $216,000.00 required to complete the project are this grant request.

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.

The local jurisdiction is the Lower Big Blue Natural Resources District (LBBNRD). NRDs have the authority under the Nebraska Groundwater Management and Protection Act – Neb. Rev. Stat. 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. Neb. Rev. Stat. 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.

Developed jointly with the Nebraska Department of Natural Resources (NeDNR), the LBBNRD Integrated Management Plan (IMP) was officially adopted in April 2022. This was a voluntary IMP (VIMP) with the ultimate goal of protecting existing investments and interests while facilitating economic growth and well-being across the District. The following is excerpted from Part 7 of the IMP (the goals are also contained in Section B.9 and a list of relevant objectives and action items can be found in Section C.2 of this application, respectively):

> "For the first phase/increment of the integrated management planning process for the District's VIMP, the goals and objectives focus on understanding the water supplies and uses within the District, resolving potential conflicts between users, planning for future uses and effectively communicating water resource information and management actions to the general public. These fundamental elements of integrated management planning allow for tailoring Department and District actions in the following phases of the VIMP process and provide the framework for water management decisions going forward" (Integrated Management Plan, 12).

In general, the results of this project will support sustainable water use in the project area by creating an aquifer framework to better manage domestic, municipal, agricultural and industrial water supplies and water quality. Benefits of the project will address the persistent groundwater declines and increasing threat of nitrate contamination for an estimated population of almost 3,000 over more than 150,000 acres including approximately 2,500 people living and working in

seven or eight communities. Stakeholders involved in the LBBNRD-AEM1 project will include the Board and staff of the LBBNRD, local communities, landowners and any other local water users with the potential for CSD, ENWRA, NeDNR, NDEE, other agencies and the public through the Nebraska GeoCloud to be included.

Finally, the LBBNRD has an adopted Groundwater Management Plan (GWMP) (adopted in 1985 and amended in 1995). Adherence to the District's GWMP was a focus of the 2014 updates to its Groundwater Rules and Regulations. Many of the policies and procedures historically in place for groundwater management needed to be reevaluated in light of the irrigation development, climatological and economic impacts to groundwater recharge. At the time, LBBNRD staff and Board built in more appropriate tools for managing groundwater resources based on the best information available (flow meter requirements on new and replacement wells, a well permit scoring system, groundwater transfer policy, etc.). As described in Section A.6, the District saw a 133% (241 well permits) increase in average annual new irrigation well permits during the years of FY2011 through FY2013 as compared to FY1997-FY2010 (482 well permits). In the project area, there were 46 new irrigation well permits during FY2011 through FY2013. While those numbers were reduced to 92 new irrigation wells Districtwide from FY2015 through FY2022 and a mere seven in the project area, current groundwater level data suggest more information, and perhaps more management, is needed. As a measure of developmental interest, Section 1.B.3 included a detailed summary of pre-score data, the gist of which is 20% of the interest in constructing new irrigation wells has been within the project area, which constitutes 14% of the District area and includes 60% of the NRD's monitoring network wells with latest readings at or below Phase II designation levels and 66% of the monitoring network wells with the greatest declines from their baseline levels (see that section for further explanation). The LBBNRD-AEM1 project would take that monitoring data, the newly developed well logs and the regulatory measures present to-date into consideration for the development of a comprehensive hydrogeologic framework for the project area. From there, informed assessments could be made regarding the delineation of a more intensively monitored or controlled management area, the locations of recharge areas, potential short- and long-term impacts to WHPAs, potential groundwater use interference and conflicts, solutions to conflicts and even optimal locations to construct new wells or new irrigation or groundwater use projects to improve economic development.

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 source of water in the State of Nebraska is groundwater. Groundwater supplies in the Lower Big Blue NRD face two primary issues in general – water level declines, especially in drought conditions (quantity) and nitrate-nitrogen contamination (quality). These problems are not unique to the LBBNRD and occur across the state, but they are particularly magnified in the LBBNRD-AEM1 project area. Of greater concern in this project area are groundwater level declines with increasing concerns around nitrate concentrations (in a planned future AEM project area, those concerns are flipped with decades of persistent high nitrates and more rapid water level recovery). The variable and limited nature of the aquifers occurring in the LBBNRD-AEM1 project area even further magnify these concerns in the face of increased interest in groundwater resource development.

The LBBNRD represents approximately 1.87% of the state's 1.93 million residents and has a diverse group of drinking water users including municipalities, small- and mid-size communities and towns, rural water systems and high densities of rural domestic users. This project will assist entities and individuals in maximizing current groundwater conservation and management efforts, as well as helping them identify potential new well locations should the need occur. As mentioned above, prioritization of future AEM projects has begun among District personnel. This project will guide and solidify those priorities and plans due to the diverse nature of its uses and benefits to evaluate and address the diverse nature of water supply impacts in the project area.

Ultimately, having accurate hydrogeologic data (geologic framework from AEM and boreholes, groundwater quality data, water level contours) and using it to map where in the District the high, moderate and low recharge areas exist is critical to assessing the complicated glaciated materials that make up these underlying aquifers. This project provides better understanding of impacts to major components of the water budget in the District for use in modeling efforts and for promoting science-based water management of groundwater quality and quantity in a coordinated manner for more sustainable future usage. Similarly, the AEM-derived maps of groundwater recharge potential that will be created as part of this project can also be viewed as maps of groundwater vulnerability to contamination. Protecting groundwater resources and related infrastructure is critical to Nebraska because the cost of replacing and/or updating public water supply components is enormous and would likely incur significant financial burdens on small communities with limited tax bases. It's also critical to the primary economic drivers in the state, namely crop production and animal agriculture. There are many benefits to these and any other water users derived from this project, but perhaps none is more important than those which will allow the NRD to manage limited and/or vulnerable groundwater supplies for long-term sustainability for current users while making informed decisions about resource availability for future users.

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.

As listed, the funding sources for this project in its entirety are this grant application (60%, or $216,000) and the Lower Big Blue NRD (40%, or $144,000). The primary leverage for this project will be to benefit local public water suppliers and domestic well owners. 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 (e.g., the State Revolving Fund and USDA Rural Development) when upgrading or installing new water or wastewater systems. The information on groundwater occurrence, as well as near-surface geology, will prove highly valuable when evaluating new facility sites. The refined aquifer volume estimates will help facilitate required aquifer analysis for the establishment of new groundwater-based drinking water systems.

As the initial AEM project in the LBBNRD, there are anticipated locations where increased groundwater monitoring will be optimized for the project area. Past partnerships for monitoring well installations and domestic water sampling in the District have included federal agencies. Data and deliverables from this project will also result in leveraging state dollars with local, federal or other partners to implement further water monitoring and water use efficiency BMPs to conserve and protect water resources.

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 one major NeDNR managed basin (Big Blue River) and will be vital for making informed decisions regarding management within the watersheds. There are essentially portions of four HUC-12 watersheds within which the AEM data collection will occur – Big Indian Creek (HUC #102702020505), Cub Creek (HUC #102702020303), Mud Creek (HUC #102702020602) and Wolf-Wildcat Creeks

(HUC #102702020605). In addition to those, a critical portion of the Big Blue River flows through the project area. This portion of the river includes two of the southernmost three confluences of HUC-12 watershed creeks with the Big Blue River above the Kansas-Nebraska Big Blue River Compact-dependent stream gauge at Barneston, Nebraska, as well as a significant downstream portion of the southernmost HUC-12 watershed confluence above the stream gauge.

The project area, in general, is dominated by sub-100-ft. mean aquifer thickness and sub 35,000 gallons per day per foot mean transmissivity based on UNL-CSD spatial data. There are small areas with mean aquifer thicknesses of 200 to 300 feet and veins with higher mean transmissivity rates (75,000 to 125,000 gallons per day per foot; even on small area of 175,000 gallons per day per foot underlying the Village of Diller's WHPA and NRD's monitoring well MW18). AEM mapping will provide a more accurate and refined delineation of these areas of greater aquifer thicknesses and higher transmissivity underlying the various land uses within each watershed.

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 connectivity between groundwater and surface water (stream/aquifer interactions). A more detailed understanding of this connection will help the basin 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 benefits could have direct implications regarding several components of the Kansas-Nebraska Big Blue River Compact along with supporting sustainable groundwater and surface water resources and the various plant and animal species (some of them threatened or endangered) which depend on these ecosystems.

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

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

The Annual Report and Plan of Work for the State Water Planning and Review Process (NeDNR, 2020) lists the following objectives:

1. Maintain data, information and analysis capabilities for water planning, including specific programs for collecting, maintaining and distributing information on stream flows, 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 conjunctively managing hydrologically connected groundwater and surface water supplies;
4. Provide resources to map and identify areas vulnerable to flood damage;
5. Participate in interagency collaboration with federal agencies, state agencies, local natural resources districts (NRDs) and other water interest entities on various water resources programs and projects; and
6. Consolidate and present information in a form that is understandable and useful to the public and interagency collaborators.

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 extents, thickness and interconnection of aquifer systems. That greater understanding directly informs analysis of streamflow 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 project directly supplements the staff and resources of the state for planning and management of the water resources of the state. Any project partners will utilize the data collected and the interpretation of the data to further their expertise in the local hydrogeologic framework. That expertise is utilized by the management and the Board of the LBBNRD to develop the appropriate plans, programs and projects for the protection and conservation of the water resources. The LBBNRD partners with many agencies of the state including NeDNR, the Nebraska Department of Environment and Energy (NDEE), the Nebraska Department of Health and Human Services (NDHHS), the Nebraska Game and Parks Commission (NGPC) and others with an interest in the protection and conservation of the state's water resources.

The project partners represent local, regional and state level interests, cooperatively studying the water resources of the state. Additionally, the data collected may be shared with other non-partner agencies and the general public to provide an overall greater understanding of the hydrogeologic framework. That understanding is fundamental to any program or project undertaken to protect and conserve the water resources.

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

- Describe the federal mandate.

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

As described, a primary function of this project (LBBNRD-AEM1) will be to gain a greater understanding of the aquifer and to establish and enhance a hydrogeologic framework for the LBBNRD, specifically within a priority area of concern for groundwater quantity within the District. Within the project area are located several Wellhead Protection Areas (WHPAs), which are required by the Safe Drinking Water Act to provide drinking water that meets various federal standards or Maximum Contaminant Levels (MCLs), the most applicable being that of 10 parts per million (ppm) for nitrate-nitrogen. Understanding the limitations of the aquifers in this area, in addition to the potential to identify aquifer volume and recharge areas within those WHPAs, will help those systems evaluate and manage possible threats to their groundwater supplies. Furthermore, it will provide the LBBNRD 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.

The project also assists the State of Nebraska in better understanding those characteristics of the basin which directly pertain to the Blue River Basin Compact (aka the Kansas-Nebraska Big Blue River Compact). Approved June 3, 1960, Public Law 489, an Act of the 2nd Session of the 86th Congress of the United States, granted consent to the States of Kansas and Nebraska to negotiate the Compact, which would ultimately be ratified by the states on January 25, 1971. As mentioned in Sections C.2, C.3, C.7 and C.14 above, and described in greater detail in Sections C.3 and C.7, this project has the potential to better understand the southernmost HUC-12 watersheds contributing to stream flows directly above the stream gauge at Barneston, Nebraska and what specific hydrogeologic factors exist for water users, as well as assist in determining the feasibility of any potential stream augmentation projects. This project will not only provide more robust data for determining those locations where groundwater and surface water are interconnected, but will also help State, NRD and basin stakeholders assess the degree to which formation, depth, design and proximity of constructed wells might impact stream flows. The Blue River Basin Compact is also a big unique in that it contains a water quality component. The data collected through LBBNRD-AEM1 will also assist stakeholders and water managers in better understanding the presence of any current and future surface water contaminants and how to better conserve and protect water resources from contamination. Finally, Compact compliance is an objective of the jointly-developed Integrated Management Plan (IMP) between NeDNR and the LBBNRD, and projects like this one support further cooperative efforts between NeDNR, the NRDs, landowners and other stakeholders to sustainably manage the State's water resources.