Columbus Recharge Project

March 27, 2019

LOWERLOUP
NATURAL RESOURCES DISTRICT

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TECHNICAL PROPOSAL

1.0 EXECUTIVE SUMMARY

Project Name: Columbus Recharge Project
Date: March 27, 2019
Applicant Name: Lower Loup Natural Resources District
Columbus, Platte County, Nebraska

The Lower Loup Natural Resources District (LLNRD), in coordination with the City of Columbus, Nebraska (City), recently completed an evaluation of the water resources within Columbus and the surrounding areas. The evaluation showed that groundwater levels have declined in the southeast portion of the study area in the last 10 years, due to groundwater pumping from agricultural and industrial uses. The purpose of the Columbus Recharge Project (Project) is to mitigate the groundwater declines and increase water supply reliability with specific resiliency during drought through intentional recharge of the aquifer. Preliminary design of the project is nearly complete. The Project has been designed so that an amount of water, in a volume equal to or less than the process effluent from an industrial user (Archer Daniels Midland (ADM)), will be pumped to two recharge locations. Funds will be used to construct the necessary infrastructure to facilitate aquifer recharge at two locations through infiltration - the Lost Creek channel and Christopher's Cove - to create a sustainable, ecologically beneficial, and drought resistant water supply.

The length of time to construct the project is estimated to be 9 months. Construction will begin in November 2019 with an estimated completion date of July 2020. The proposed project is not located on a federal facility.

2.0 BACKGROUND DATA

LLNRD, in coordination with the City, recently completed the Columbus Area Water Resources Assessment (Study) to better understand the current water resources in the area, identify areas of concern, and evaluate mitigation alternatives, including the feasibility of recharge projects to provide a sustainable water supply (Attachment A – June 2016 *Columbus Area Water Resources Assessment*). The results of this Study are discussed in the following sections. The Study Area is shown in Figure 1.

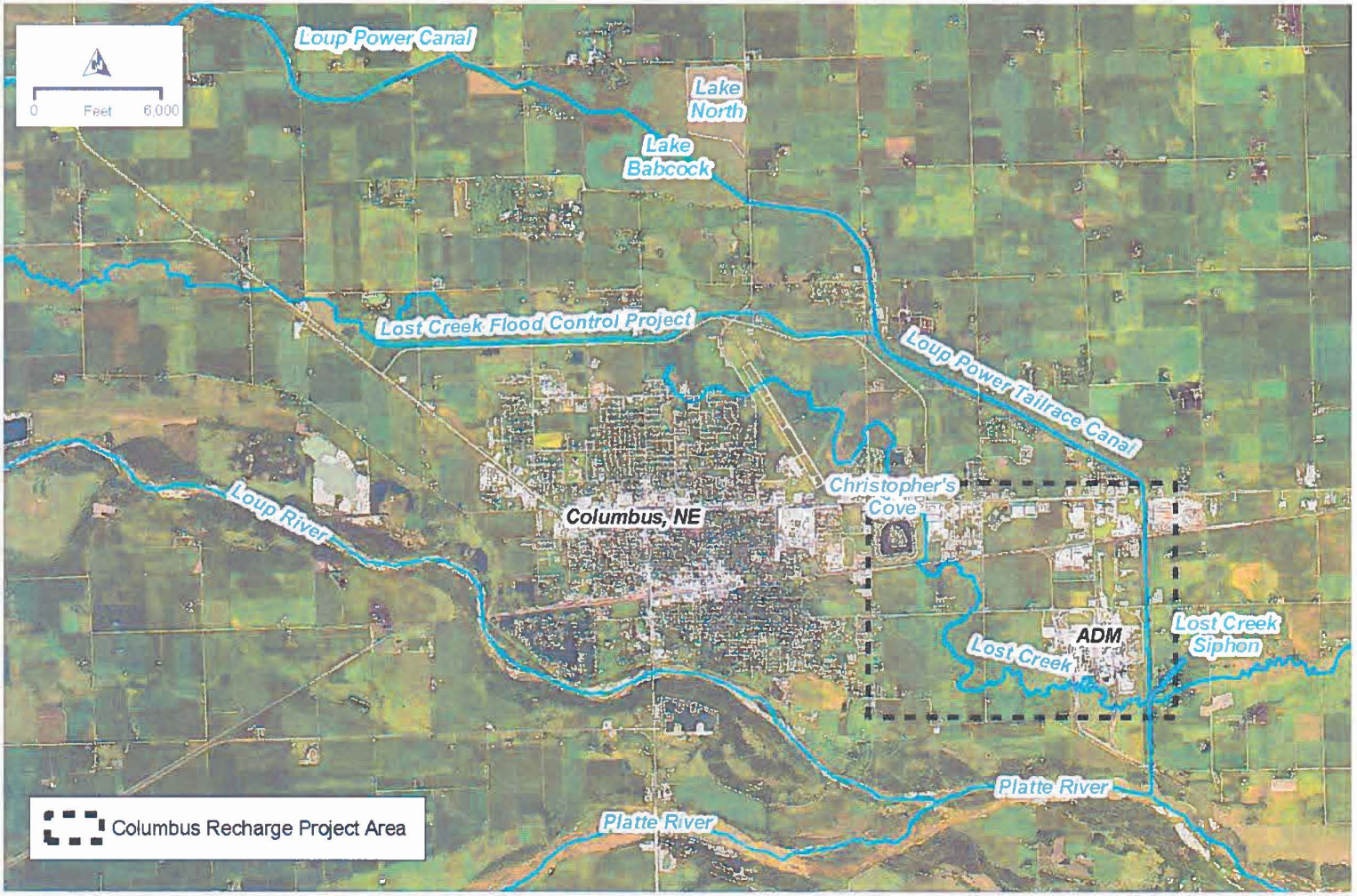

Figure 1. Columbus Recharge Project Study Area and Project Area

Water Supply
The community of Columbus has many demands placed on its water, including:

- Municipal (population approximately 24,000).
- Agricultural irrigation, including approximately 4,000 irrigated acres.
- Numerous commercial and industrial users. Large industrial water users that use groundwater for process water include the ADM ethanol plant and Becton, Dickinson and Company (BD).

As part of the Study, a water budget of the major sources was developed and the annual contributions of each quantified, revealing that the Study Area has significant surface water sources including the Loup River, Platte River, Loup Power District Tailrace canal, in addition to groundwater. The water supply source for the users listed above is primarily groundwater. The average groundwater use is approximately 23.4 million gallons per day (Attachment A – June 2016 *Columbus Area Water Resources Assessment*). Of that, 10.1 MGD is for agriculture, domestic, and livestock; 5.2 MGD is for municipal; and 8.1 MGD is for industrial. Groundwater permits are administered by the LLNRD based on the correlative rights system.

A hydrogeologic evaluation was conducted for the Study that indicated relatively steady state groundwater contours in the western and northern portion of the study area, with **declining groundwater in the southeast portion of the Study Area.** Figure 2 shows groundwater contours in 2010 and 2016 based on monitoring well data collected as part of the Study. This declining groundwater trend began in approximately 2010, indicating approximately 10 ft of decline (Figure 2). The decline adversely affects domestic, commercial, industrial, and agricultural users. A groundwater model was developed and calibrated to assist in identifying the extent of the groundwater decline, and to analyze recharge and water management project(s) to offset this decline. A goal was to evaluate resilient and sustainable water supply for the community.

Based on the availability of source water location, hydrogeology, and groundwater model results, two viable recharge locations were identified. These two viable project recharge locations are 1) the Lost Creek channel west of Loup Power Tailrace Canal and 2) Christopher's Cove, a nearby former sandpit with direct connection to the groundwater (Figure 1).

Source Water Evaluation
Groundwater data and analysis of the water budget information suggest that the decline in water levels would require a consistent source of water in both quantity and quality to mitigate groundwater deficits. The potential infiltration capacity of the recharge project locations, based on soil survey information and field percolation tests, ranges from approximately 4 acre-feet per day (AF/D) to 20 AF/D, or 1.3 to 6.5 million gallons per day (MGD). Several water sources were identified in the Study as having a potential to supply water to the selected recharge locations (Attachment A – June 2016 *Columbus Area Water Resources Assessment*, Section 5.4).

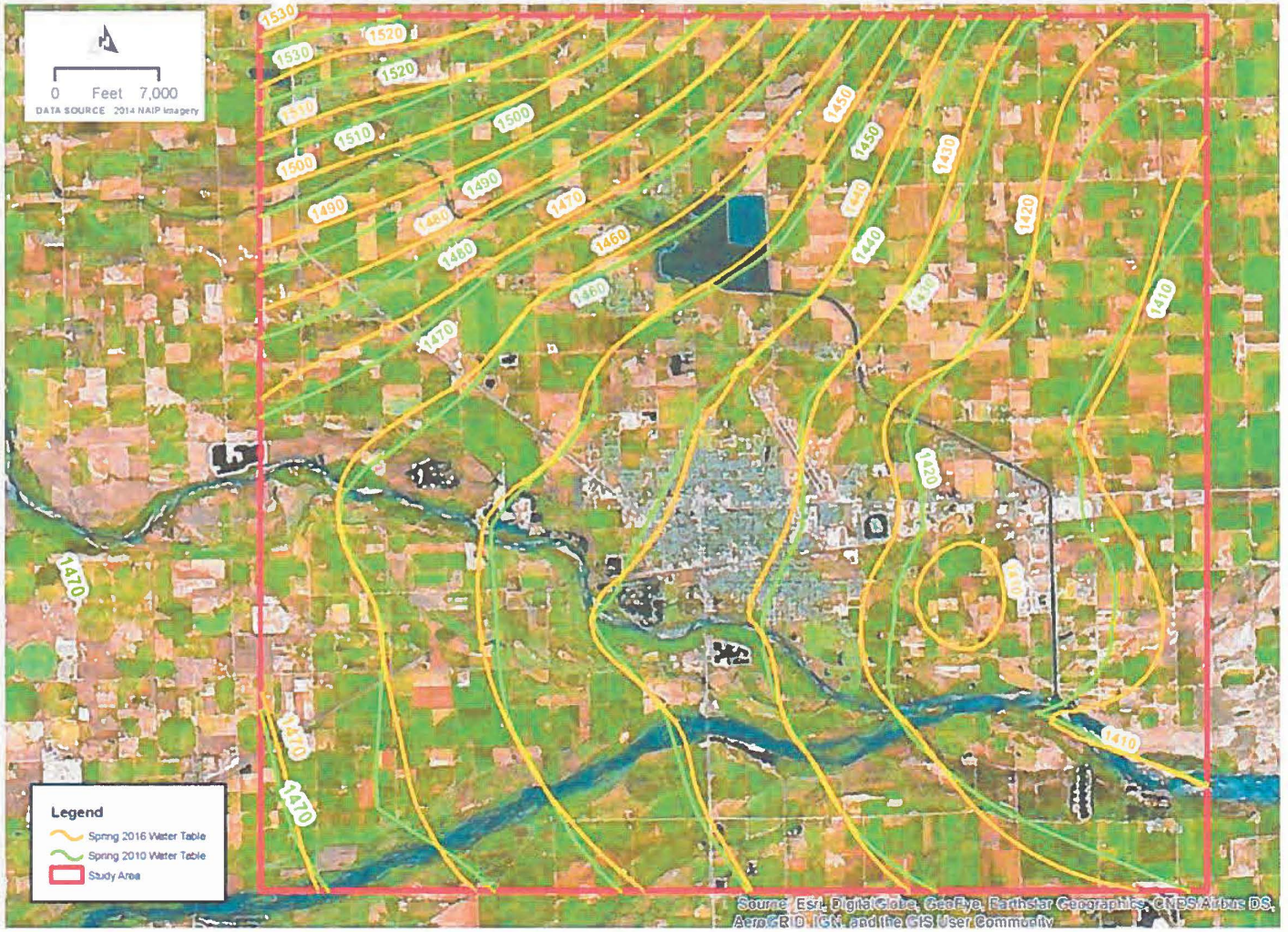

Figure 2. Groundwater Declines in the Southeast Portion of Study Area

The source water evaluation from the Study indicates that sufficient water exists for recharge through repurposing wastewater effluent from ADM. ADM uses groundwater for production, and once processed, discharges approximately 3.5 to 5 MGD to the Tailrace Canal. The Tailrace Canal discharges into the Platte River, and the return water is lost from the system. The available water from ADM is within the range of the potential recharge capacity (1.3 MGD to 6.5 MGD). Conceptually, using the ADM discharge would allow the groundwater that was withdrawn to return (recycle) to its source area in the form of recharge.

However, while the return water meets all discharge permits, it may require additional treatment if placed directly into Lost Creek or Christopher's Cove. To avoid this, an equal amount of water withdrawal from the Loup Power Canal, or water supply pumped from wells adjacent to the canal, is recommended as the sustainable water supply for the Project.

Proposed Solution

The recharge project will pond the water in the two selected recharge locations, and allow it to infiltrate into the areas most affected by declining groundwater trends, creating a sustainable approach to reduce groundwater declines and improving drought resiliency. Supply water approximately equal to the ADM return water (3.5 MGD) would be pumped from Tailrace Canal through a surface water intake structure, or from three wells adjacent to the Tailrace canal. To avoid potential introduction of undesirable species, an auxiliary pump adjacent to Lost Creek channel would pump recharge water to Christopher's Cove.

The model suggests that except for some evaporative and transpiration losses, more than 90 percent of the introduced water will recharge to the aquifer. The average groundwater pumping in Columbus is approximately 23.4 MGD. The Project would pump 3.5 MGD of which approximately 3.2 MGD would recharge the aquifer, or approximately 13.5% of the average daily groundwater used in Study Area. As expected, over a 15-year simulation period, the groundwater model showed that aquifer levels would begin to recover. The groundwater model period included a representation of wet, dry, and average conditions for the Columbus area. The analysis was a surrogate for expected climate change that research suggests will bring large swings in temperature and precipitation. Soil boring data was collected, and percolation tests were conducted to verify the recharge potential of the soils underlying Lost Creek; this information confirms that the soils have the capacity for the recharge rates and volumes used for the modeling analysis. The recommended project is discussed in more detail in Section 4.

Previous Working Relationships with the United States Bureau of Reclamation

LLNRD has successfully worked with the United States Bureau of Reclamation (USBR) on previous efforts in Nebraska. Specifically, the Davis Creek Recreation Area operations from 1991 to current and with recent upgrades. The LLNRD has worked directly with the USBR through the Title 28 fund to modernize and upgrade the camping facilities and the boater/fisherman access to the Twin Loups Reclamation and Irrigation

District's Davis Creek Reservoir. The reservoir is part of the USBR and Twin Loups Reclamation and Irrigation District's project on the Calamus, and North Loup River System.

3.0 PROJECT LOCATION

The Columbus Recharge Project is located approximately 1.5 miles east of the City in the southeast corner of the Study Area (see Figure 1 presented earlier).The Study Area for the Columbus Area Water Resources Assessment is bounded on the north by Loup Power District's supply canal; on the east by the Tailrace Canal (return canal); on the south by the Loup and Platte Rivers; and on the west by 63rd Avenue. The Study Area is approximately 35 square miles.

4.0 TECHNICAL PROJECT DESCRIPTION AND MILESTONES

4.1 Project Components

The project includes three water supply wells or a surface water intake structure adjacent to the Tailrace Canal, a pipeline to convey the pumped water to Lost Creek channel and Christopher's Cove, outlet structures, and water control structures to impound water in the Lost Creek channel to promote infiltration.

LLNRD, the City, Platte County, Archer Daniels Midland (ADM), and the Christopher's Cove Home Owners Association have formed the Columbus Recharge Project Coalition (Coalition) to assist with developing recommendations for the design, as well as to provide a contractual vehicle for constructing and maintaining the Columbus Recharge Project. Funding for the project was secured based on the concept-level design through the Nebraska NRD Water Sustainability Fund and matching funds from the Coalition. However, the conceptual level design had to be modified to accommodate water quality concerns with respect to the water supply location. This modification requires additional pumps and piping, thus increasing construction cost. The funds requested will be used to offset the increased construction cost based on the redesign effort.

Source Water Supply

As previously stated, the water supply would be approximately equal to the ADM return water (3.5 MGD) and would be pumped from Tailrace Canal through a surface water intake structure, or from three wells adjacent to the Tailrace canal. This is water that would otherwise have been lost from the system. The project would return water to the aquifer creating a sustainable approach to help mitigate groundwater declines and make the area more drought resistant. In addition, year round recharge enhances aquifer storage in the area ensuring supplies during drought to users. The enhanced aquifer storage also maintains baseflow contributions and reduces depletive effects to the lower Platte River during drought conditions when these contributions are most vital.

Water Supply Wells, Delivery System, and Outlet Structures

If wells are used for water supply, three vertical wells, each with a 16-inch diameter casing and screen with 28-inch borehole will be constructed adjacent to the Tailrace Canal. The wells will be approximately 100 to 120 feet in depth. Submersible pumps, with 800 gallons per minute capacity will be used. Water will be collected and conveyed to Lost Creek channel through a 12-inch-diameter polyvinyl chloride (PVC) pipe. Alternatively, water can be extracted from the canal through a surface water intake structure that would consist of a wet well, submersible pump, and intake pipe. The wet well would be 8 ft in diameter, and the intake pipe would be 20" ductile iron pipe with a screen/trash rack on the canal side. The submersible pump would have 2,400 gallon per minute (gpm) capacity. A schematic of the proposed delivery system is provided in Figure 3.

An auxiliary well will be constructed adjacent to Lost Creek channel to provide water to Christopher's Cove for recharge. The well will be located within the Project's Lost Creek Channel recharge area, and thus will essentially pump infiltrated recharge water to Christopher's Cove. A single vertical well consisting of a 12-inch-diameter casing and screen with a 24-inch-diameter borehole will be constructed. A submersible pump, with 500 gallons per minute capacity will be used. A 6-inch-diameter PVC pipe will convey water to Christopher's Cove. The purpose of the auxiliary well is twofold: 1) it provides a dedicated system to Christopher's Cove that is not dependent on the Lost Creek channel system operation, and 2) provides a means to control the water table for an adjacent neighborhood that has concerns about recovering water levels affecting their property.

The outlet structure for the Lost Creek channel transmission line will consist of a riprap lined plunge pool based on Soil Conservation Service guidelines. The outlet structure at for the Christopher's Cove transmission line will consist of a riprap apron based on Federal Highway Administration guidelines. Culverts under the existing low water crossings will be modified to accommodate stop log type water level control structures. The structures will have the ability to pond water to a depth of approximately 2 to 3 feet. The pumps and water control structures will have sufficient instrumentation and controls to allow Coalition staff to manage and monitor the Project.

4.2 Affected Water Users

The recent decline has affected many water users in the Columbus area. The City distributes water for public potable supplies, as well as for three golf courses. In the vicinity of Columbus, many farms use groundwater to irrigate their crops. Large commercial and industrial water users that use groundwater for process water include the ADM ethanol plant and BD. The community has numerous human-made lakes that were created from gravel mining operations. Several of these lakes have become central water features for residential neighborhoods. As such, the Columbus area has both the largest municipal and commercial water users within the entire Loup River Basin.

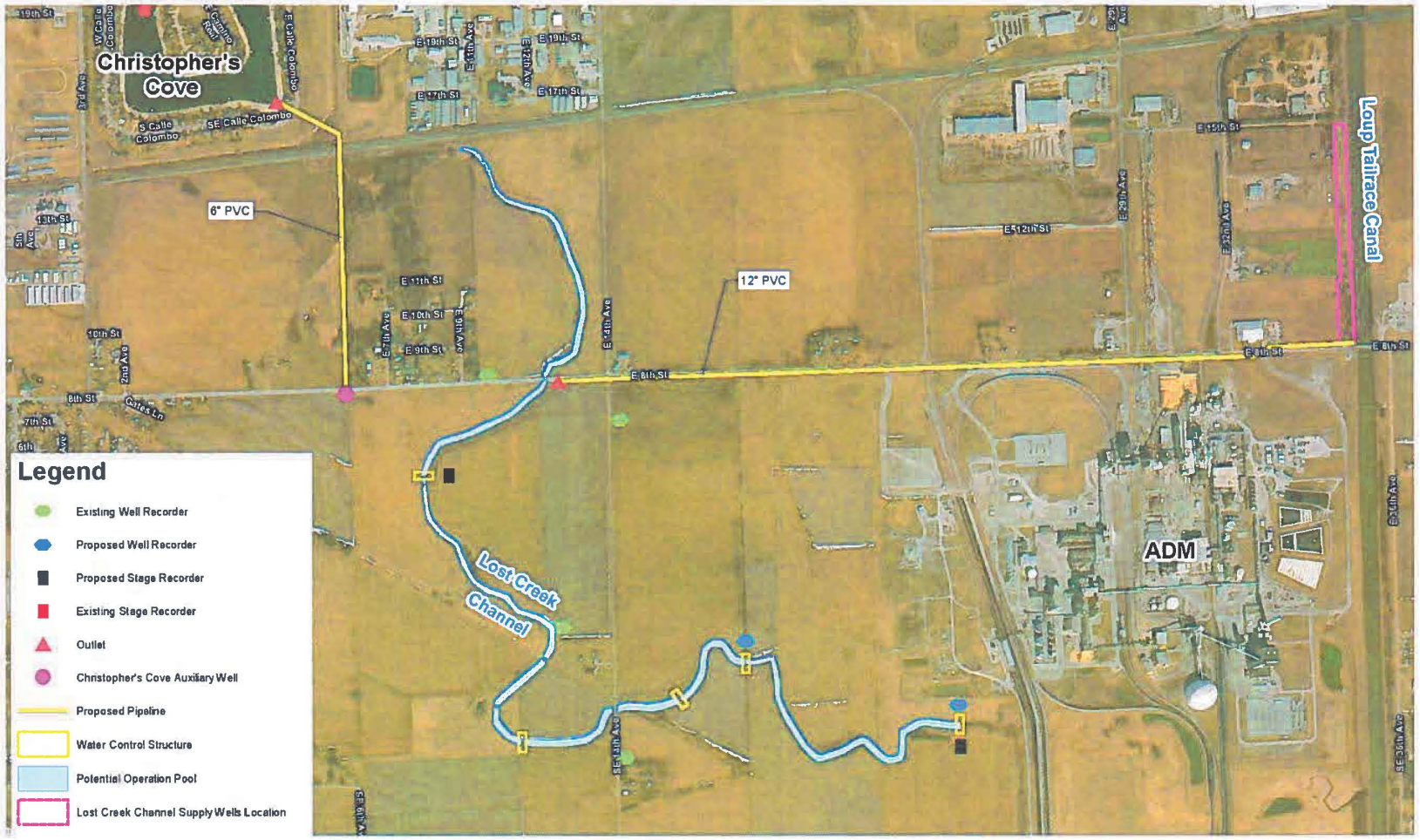

Figure 3. Schematic of Proposed Delivery System

4.3 Milestones

The construction of the Project is expected to take 9 months from the grant award date. It is anticipated that the financial assistance agreement will be executed by November 2019. Preliminary design is underway and final design is expected to be complete in July 2019. The project can be bid in August/September 2019, with award for construction in October. Construction will commence immediately upon receipt of grant and will be complete by July 2020. Grant reporting will be ongoing throughout the project duration. Milestones include:

- April 2019 – Complete 30% Design
- April 2019 – Submit U.S. Army Corps of Engineers (USACE) Section 404 Clean Water Act Permit Application, and other permit applications
- July 2019 – Complete Final Design
- August/September 2019 – Notice Project for Bid
- October 2019 – Award Contract for Construction
- November 2019 to May 2020 – Construct the Project
- July 2020 – Construction Complete

5.0 PERFORMANCE MEASURES

A robust qualitative and quantitative procedure will be used to measure the success of the project, which will allow the project sponsors to observe the response of the aquifer to the recharge project. Additionally, observation will confirm recharge by examining water levels along Lost Creek and groundwater monitoring wells within the Project area. The goal will be to operate the system such that no recharge water flows beyond the most downstream water level control structure on Lost Creek. If so, the system discharge rate will be reduced, or the system will be shut down until conditions favorable for infiltration return.

A quantitative analysis will be made to determine the effect of recharge on groundwater levels. Flow meters will be used to determine the amount of water that is discharged into Lost Creek and Christopher's Cove. These meters will be part of the City's Supervisory Control and Data Acquisition (SCADA) system that will record and save the data for analysis. Water level sensors in the form of transducers will provide information of the stage along Lost Creek. This data will serve two functions: first, monitor the system on a real-time basis so that recharge water is not spilled out of the system by flowing past the most downstream water level control structure on Lost Creek; second, provide a record of the amount of recharge water introduced into the system. For water introduced at Christopher's Cove, the water level will be monitored and the system will be shut down when lake levels reach an approximate elevation of 1,425 mean sea level. Figure 3 presented earlier shows the location of Lost Creek, Christopher's Cove, and the water level control structures along Lost Creek.

System operation will be optimized so that the maximum amount of recharge water will be delivered to Christopher's Cove and Lost Creek while maintaining surface water and groundwater elevations below those that would trigger a reduction in flow or

system shut down, causing adverse effects on third parties. The triggers will be developed by the Coalition based on input from constituents.

Groundwater level data will be used to determine the effectiveness (success) of the recharged water in recovering groundwater levels that have declined with increased pumping. Changes in groundwater surface elevations will be measured directly using observation wells that are already in place and additional wells that will be installed as part of the Project. Several of these existing wells have continuous recorders that can be used to monitor changes in groundwater elevations; newly installed wells will be configured with similar recording equipment. These existing locations coupled with new wells will offer a robust data set that will be effective in calculating aquifer volume changes over time. Effectiveness will be measured comparing aquifer volume changes to the amount of water infiltrated. Figure 3 shows the location of the existing observation wells and stage recorders for the Project and the locations of additional wells and stage recorders that will be installed for the Project.

6.0 EVALUATION CRITERIA

6.1 Evaluation Criterion A – Project Benefits

Long-Term Drought Resilience
The Project will return a volume of water directly back to the aquifer that is similar to that currently being withdrawn from the groundwater system, thus helping to create a more sustained groundwater resource and provide for drought resilience. The water volume that is currently discharged to the Tailrace Canal as wastewater, and eventually out to the Platte River and out of the system, will now be returned to the aquifer. The project will create improved groundwater levels, reducing Tailrace Canal losses to the aquifer and likely increase tailrace discharge to the Platte River.

In addition, year round recharge enhances aquifer storage in the area ensuring a stable aquifer. This stable aquifer also sustains baseflow contributions during drought periods.

Additional Water Supplies
The current groundwater use is approximately 23.4 MGD. The Project would recharge approximately 3.2 MGD (90% of the delivered 3.5 MGD), or approximately 13.5% of the total groundwater use. Tangible benefits of the project include reduced pumping costs from groundwater wells for the City's downtown water supply wells, the ADM water supply well field, and for irrigation supply wells located near the project. In addition, it helps with sustained baseflow contributions to the Lower Platte River. Other benefits include avoided emissions, specifically criteria air contaminants (CAC) and greenhouse gas (GHG) emissions associated with the production of electricity used to power groundwater well pumps.

Improved Water Management
LLNRD is responsible for the development, management, utilization, and conservation of groundwater and surface water and managing water supply for beneficial uses. LLNRD has the authority to regulate water uses in accordance with State statutes. This

provides LLNRD the authority to enforce rules and regulation for the protection of groundwater quality and quantity, as well as prevent or resolve conflicts between water users.

A robust monitoring plan will be implemented to effectively manage the 3.5 MGD, being delivered to the Project to inform the project team regarding water supply and response, as well as adjacent property owners as to increasing groundwater levels. The project monitoring will allow for efficient use of water. For example, if during a wet period water levels are at or near trigger groundwater elevation levels, the project would not be operated, thus conserving water and energy. Similarly, if a water control structure is not functioning properly and water is being discharged downstream of the project instead of being captured for infiltration, the project can be suspended until the problem is resolved allowing for conservation of water. The monitoring will also allow for water management to prioritize greatest water use and benefit, while managing against third party impacts

Fish, Wildlife, and Environmental Benefits

Due to project related actions within jurisdictional waters of the United States, compliance with Section 404 of the Clean Water Act is required. Based on coordination with USACE, the project could be authorized for Clean Water Act (CWA) Section 404 compliance via Nationwide Permit 27 – Aquatic Habitat Restoration, Enhancement, and Establishment Activities. This nationwide permit requires that the project result in an ecological gain as compared to the existing conditions. USACE Omaha District recommended that the Montana Wetland Assessment Method (MWAM) be used to assess project related ecological gains. The project will result in a net increase of 53 percent of ecological functional units located within the former Lost Creek channel. The increase in functional units is a result of the increase in function and value of the post-project wetlands. In addition, baseflow contributions to the Lower Platte River during drought periods will benefit threatened and endangered species habitat, reduce fish kills, etc.

In addition, due to an increase in drought tolerance relative to base flows in the Platte River, the project would also benefit fish and wildlife species within the lower Platte River. Improvements in base flows during drought conditions would reduce the risk of food source loss (minnows and macroinvertebrates) for the Federally endangered least tern and threatened piping plover. Improvements in base flows would also minimize the risk of fish kills, including the Federally endangered pallid sturgeon, due to stranding, high water temperatures, and/or loss of oxygenated water.

Wells

If wells are used for the water supply system, the proposed wells would be gravel packed wells constructed to a depth of approximately 100 to 120 feet using 12-inch screen over the bottom 30 feet and casing in a 24-inch borehole. Wire-wrapped stainless steel screen with a PVC well casing would be specified.

Wells adjacent to the canal would be 800 gpm spaced at 800-foot and at about 80 feet from the canal. The canal acts to recharge the aquifer. Because these wells are adjacent to the canal, they will induce recharge from the canal and minimize any local

drawdown impact. Drawdown in the aquifer was estimated using the Cooper-Jacob[1] equation as approximately 23 to 26 feet and will likely be less because of induced infiltration from the Canal.

The auxiliary well for Christopher's Cove would be 500 gpm and finished in the same aquifer. At its location the aquifer is coarser, with more gravel. Drawdown in the aquifer at the proposed 500 gpm well was estimated using the Cooper-Jacob equation as approximately 12 to 14 feet.

The aquifer at the Project site is the highly productive sand and gravel alluvial aquifer associated with the Platte River. It does not have significant clay layers that might be dewatered by pumping and is not susceptible to land subsidence from groundwater pumping. The LLNRD is charged with management of groundwater and they are the regional experts on aquifer conditions and capacities. The District's knowledge and well records from the Nebraska Department of Natural Resources[2] suggest that this area of the alluvial aquifer has a depth of 100 to 116 feet in unconfined conditions.

A robust monitoring plan is described in Section 5.0 - Performance Measures. It establishes procedures to document the project's success and establishes triggers and controls for operations.

Environmental/Wildlife Projects

Based on the functional assessment completed as part of the CWA Section 404 Permit, the proposed project would provide a functional lift on approximately 15 acres of wetlands. Based on guidance provided by USACE, the MWAM was used to determine the wetland functions pre- and post-project. The project would increase the functions of the existing wetlands by providing more potential of groundwater recharge and increasing sediment/nutrient/toxicant removal.

The project does not include benefits tailored for a specific species of interest.

- Project information was submitted to the Nebraska Game and Parks Commission (NGPC) and U.S. Fish and Wildlife Service (USFWS) Conservation and Environmental Review Tool (CERT). CERT identified the potential occurrence of the following state and/or federally listed species: lake sturgeon, piping plover, small white lady's slipper, river otter, interior least tern, northern long-eared bat, and Blanding's turtle. The post-project condition is not anticipated to affect these federally listed species or their habitat. Coordination with USACE and USFWS was conducted on October 4, 2018, as part of a CWA Section 404 pre-application meeting. The only species identified that could potentially be adversely affected by the project is the small white lady's-slipper (*Cypripedium candidum*). The potential for adverse effects resides in the sub-irrigated meadows adjacent to Lost Creek, but not within the channel and there is no work anticipated in the sub-irrigated meadows.

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[1] Cooper, H.H. and C.E. Jacob, 1946. A generalized graphical method for evaluating formation constants and summarizing well field history, Am. Geophys. Union Trans., vol. 27, pp. 526-534.

[2] Nebraska Department of Natural Resources, 2019. Registered Well Database. Accessed online via the Nebraska Groundwater Interactive Map at: http://prodmaps2.ne.gov/html5dnr/?viewer=groundwater

Adverse effects on northern long-eared bat are not anticipated because tree removal is not expected. Additionally, USFWS determined that there would be no long-term effects on groundwater depletions, thus negating potential effects on Platte River-listed species.

6.2 Evaluation Criterion B – Drought Planning and Preparedness Status of Existing Plans

The State of Nebraska's *Drought Mitigation and Response Plan* (Attachment B) was developed in response to severe droughts and highlighted the need to create continuity between various water administration agencies. The current state drought plan places greater emphasis on mitigating drought effects and was developed by multiple stakeholders including:

- Nebraska Department of Agriculture;
- Nebraska Department of Natural Resources;
- Nebraska Health and Human Services System;
- Nebraska Emergency Management Agency;
- University of Nebraska Cooperative Extension Service;
- University of Nebraska Conservation and Survey Division;
- Livestock producers, crop producers;
- Governor's Policy Research Office.

Nebraska's revised drought plan places more emphasis on mitigation. Mitigation is defined as short- and long-term actions, programs, or policies implemented during and in advance of drought that reduce the degree of risk to human life, property, and productive capacity. The types or forms of mitigation activities vary from one natural hazard to another. Drought-related mitigation actions are different from those used for other natural hazards because of the insidious nature of drought. Mitigation projects such as this are much more proactive and economical than response actions.

LLNRD has and is undertaking planning efforts that mitigate the effects of drought. LLNRD's planning includes many of the elements of a drought contingency plan. Table 1 contains a summary of the existing plans to address water management and drought mitigation planning, along with the periodic scheduled updates and/or reviews of those plans.

Table 1. Previous water planning and drought planning efforts

Name of Plan	Most Recent Update	Frequency of Reviews
State of Nebraska Drought Mitigation & Response Plan	2000	Annual
LLNRD Integrated Management Plan (IMP)	2016	Annual
Lower Platte River Basin-Wide Plan	2016	Annual

Several of LLNRD Integrated Management Plan (IMP) goals are addressed with this project:

Goal 2: Implement this water management plan to maintain an efficient and economical balance between current and future water supplies and demands. Objective 2.1: Collaborate with state and local governments to identify opportunities of augment water supplies within the district and, if necessary, identify opportunities to supplement with imported water from outside the District.

This project achieves this goal by collaboratively working with local government (City of Columbus and Platte County) to address water supplies shortages and maintain and efficient and economical balance between current users and future demands within the LLNRD.

Goal 3: Develop and implement water use policies and practices that prioritize and contribute to the protection of existing surface and groundwater uses while allowing for future water development. Objective 3.1: Identify available water storage opportunities throughout the District.

This recharge project has identified a mitigation opportunity that would recharge water and protect existing water uses while allowing for future development. It meets a primary focus of Nebraska's Drought Plan of mitigating existing and future effects on water supplies affected by climate change and drought (Attachment B, page 7). The project will restore ground water levels that have declined even in wet periods so that a water supply buffer will be developed to protect water supplies in times of drought. Correspondingly, the stored supplies will provide buffer against the expected effects of climate change.

LLNRD, in coordination with the City of Columbus, developed the Columbus Area Water Resources Assessment (Study) with the goal of understanding the current water resources in the area and determining the effect of drought and climate on these resources. A robust analysis, including a water budget and groundwater model, was used to evaluate the continued effect of lower water levels with particular focus on drought conditions. The analysis examined the effect of drought conditions in 2012 and forecast future water availability both without and with this recharge project. Without this recharge project, a sustainable water supply will not be achieved resulting in an adverse effect on project sponsors along with regulatory administration. While a regulatory option might achieve some relief, the cost and long-term effect on the community, businesses, and LLNRD stakeholders would be mitigated using this project's sustainable water recharge approach to offsetting groundwater declines in the area.

This project specifically focuses on mitigating the current effects of water shortages and the compounding effect of drought and climate changes on those water resources. Without this recharge project, a sustainable water supply may not be achieved without regulation from LLNRD. Should this project not go forward, and groundwater declines continue, the potential exists for the requirement of additional wellfield development. During drought conditions, private wells in the area may become inoperable, cost more to operate, or may need to be drilled deeper.

There could be increasing uncertainty as to the future of the municipal drinking water supply. Administration via regulation may need to be employed long-term if the project

is not implemented. Although a regulatory option might achieve some relief, the community, businesses, and LLNRD stakeholders will achieve a sustainable drinking water source to offset groundwater declines in the area by implementing this project, thus increasing drought resiliency.

6.3 Evaluation Criterion C – Severity of Actual or Potential Drought Effects to be Addressed by the Project

The severity of actual and future drought conditions was evaluated during the development of a robust assessment of water resources for the area (Attachment A). A 14-year hydrologic cycle was simulated for the "without project" condition, while maintaining current pumping. The current declining trend continued, taking the water table to unprecedented levels. The proposed recharge significantly reduces this decline. With the project area, groundwater modeling shows an improvement in the water table level of up to 10 feet (Figure 4). This type of improvement will create a buffer against the expected swings of wet and dry cycles that climate change will bring. In particular, the project would mitigate against drought conditions, a primary tenant of Nebraska's statewide drought planning. This project is a sustainable approach to water supply which will directly mitigate drought impacts.

If the project is not implemented, there will be adverse effects on the community and region, specifically the following:

- Agricultural will continue to be affected by higher input costs for irrigation supplies due to higher pumping depths. In the absence of the recharge project, drought conditions will exacerbate these costs. In addition, regulation may limit the amount of water available to agriculture for irrigation and domestic uses.
- Industrial water supply would be curtailed from regulation to limit current effects and the effect of drought conditions as demonstrated through groundwater modeling (Attachment A).
- Reduction in baseflow contributions to the Lower Platte River.
- City costs for pumping water have increased with lower groundwater levels. During drought, these costs will increase even more and there may be the need to put water restrictions in place. This would affect the quality of life in the area and the economic viability of the region.

The project would allow for several additional improvements for the area including:

- The severity of future drought will be mitigated through the conservation and preservation of the groundwater resource.
- Reduced pumping costs and avoided emissions because of higher power consumption.

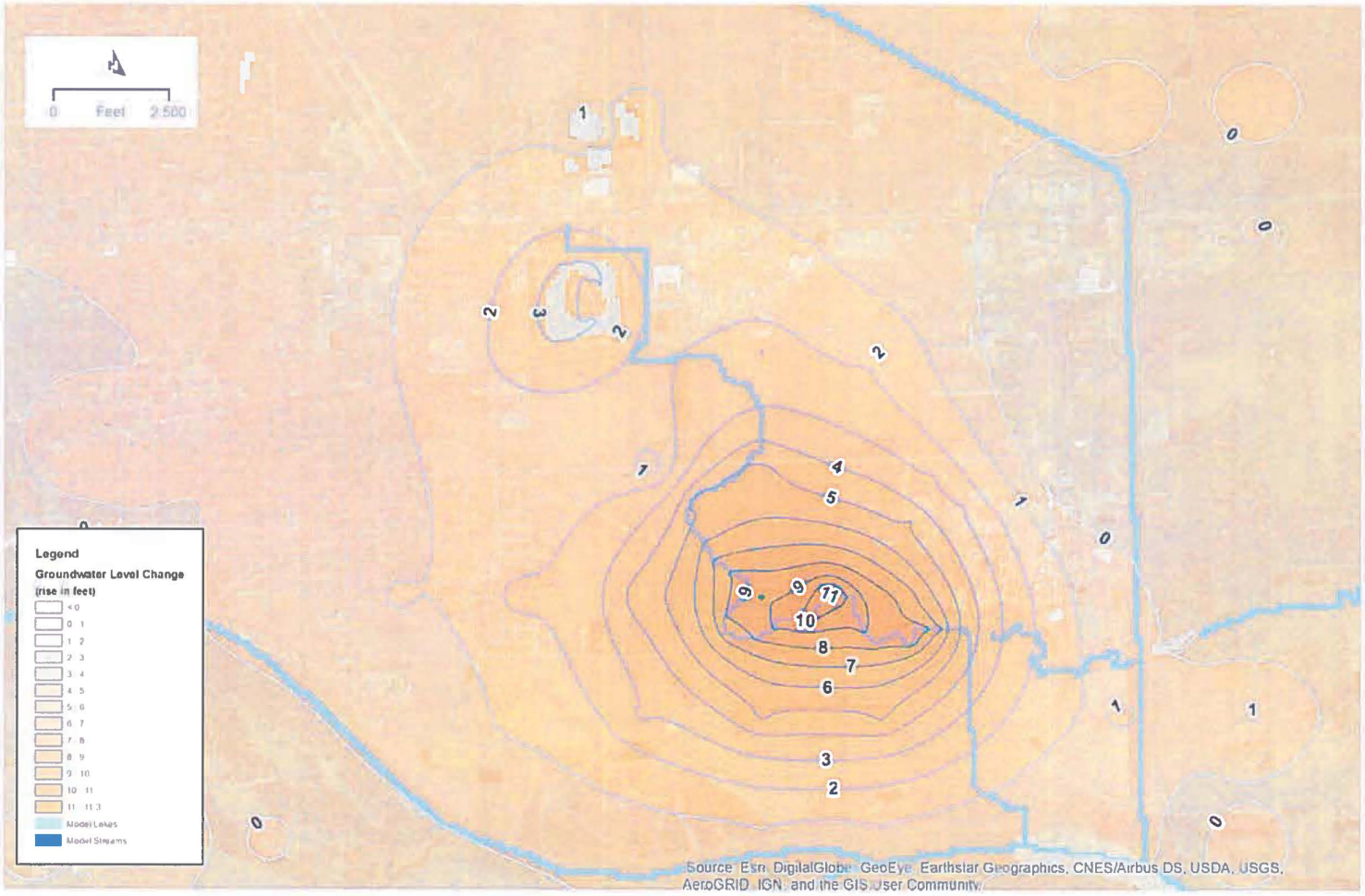

Figure 4. Proposed Project Will Improve Groundwater Levels up to 10 Feet

The project is born out of collaboration among Coalition members. There was a great initiative that included many discussions and several public meetings with the LLNRD, City, industry, agricultural producers, and the public. The goal among project partners is to develop a sustainable source of supply that resolves the local effect of declining water levels and the effect the drought will have on amplifying the existing problems

Without the implementation of the project, conflicts over water availability will become a reality for the community and region.

The long-term benefits of the project include a sustainable source of water for agricultural irrigation. Wildlife habitat will benefit by increasing the amount of permanent aquatic habitat available within the region. Pumped water will be conserved by recycling. Less water will be withdrawn from the canal due to increased available water volume (Attachment A: June 2016 *Columbus Area Water Resources Assessment Report*, Section 6.7.1.2).

If the project is not built, groundwater levels can be expected to remain degraded and continue a downward trend, as determined in the Study (Attachment A: June 2016 *Columbus Area Water Resources Assessment Report*, Section 6.4.1). Regulatory action and reduced future water supply options for the community and industry would result.

6.4 Evaluation Criterion D – Project Implementation

Table 2 provides the implementation plan for the proposed project, and includes stages and duration of the proposed work.

Table 2. Project Implementation Plan

Construction Stage	Construction Duration
Lost Creek Wells	November 2019 to February 2020
Lost Creek Pumps and Discharge Valves	November 2019 to February 2020
Lost Creek Transmission Line (12" PVC)	November 2019 to February 2020
Lost Creek Well Field Collector Piping	March 2020 to April 2020
Christopher's Cove Auxiliary Well and Pump	November 2019 to February 2020
Christopher's Cove Transmission Line (6" PVC)	November 2019 to February 2020
Water Control Structures and Rock Outlet Structures	April 2020 to May 2020
Instrumentation and Control	March 2020 to May 2020
Electrical	April 2020 to May 2020
Site Restoration	May 2020 to July 2020

The following permits have been identified as being required for Project construction. Correspondence has been initiated with the regulatory agencies and permit applications will be submitted once preliminary design is complete. Based on this correspondence, there are no permitting roadblocks anticipated for project implementation.

- Clean Water Act Section 404 Nationwide Permit (USACE)
- CWA Section 401 Water Quality Certification (NDEQ)
- Threatened and Endangered Species Consultation (USFWS)
- Cultural Resources Consultation (Nebraska SHPO)
- NPDES Construction Stormwater Permit (NDEQ)
- NPDES Permit Authorizing Dewatering Discharges (NDEQ)
- Hydrostatic Testing Discharges Permit (NDEQ)
- Water Well Permit (NeDNR)
- Floodplain Development Permit (NeDNR and Platte County)
- Loup Power District easement and interference agreement
- NeDNR Water Right Permit

The following will be designed in support of the project.

- Four water supply wells located and sized for capacity based on boring information obtained during preliminary design. Three wells within Loup Public Power District right of way at 800 gpm and one well on private property at 500 gpm. Alternatively, the water could be withdrawn directly out of the adjacent canal through a wet well, intake pipe, and submersible pump sized for capacity within the Loup Public Power District right of way.
- Submersible well pumps with pitless adapters.
- Two transmission lines sized and located to deliver water to Lost Creek and Christopher's Cove. A 12-inch line delivering up to 2,400 gpm to Lost Creek will be PVC material, located on public right of way, and have a length of about 8,000 feet.
- A 6-inch line delivering up to 500 gpm to Christopher's Cove will be PVC material, located on private property, and have a length of about 5,000 feet.
- Two stone discharge structures are planned: one at Christopher's Cove and one at Lost Creek.
- Five water control structures designed for Lost Creek to allow water to pond and infiltrate into the groundwater.
- Instrumentation/Control system is planned to allow water depths to be monitored in Lost Creek and Christopher's Cove, monitor groundwater depth at Lost Creek, operated the well pumps, and measure the quantity of water delivered to Lost Creek and Christopher's Cove.

There are no new policies or administrative actions required to implement the project.

6.5 Evaluation Criterion E - Nexus to Bureau of Reclamation

The planning area associated with the Columbus Recharge Project contains USBR facilities and project initiatives of the Department of Interior. The Columbus Area Recharge Project is located within the Loup River Basin which is a tributary of the Lower Platte Basin. The Twin Loups Reclamation and Irrigation Districts Project is also within the Loup Basin. The operation of the Columbus Area Recharge Project will help to keep the Lower Platte Basin in balance by providing drought resiliency by reducing groundwater declines. The Nebraska Department of Natural Resources assesses the Lower Platte Basin annually to determine if the water supplies are in balance with the water uses. If the water budget is shown to be out of balance, restrictions may be applied to all future uses within the Basin. This project is designed to provide water sustainability which is a benefit to all projects in the Basin.

This project increases baseflow in the Lower Platte River, particularly during drought conditions. The project will operate during drought and non-drought conditions; therefore the impact from drought will not be as detrimental. Increases in baseflow will benefit upstream appropriators, including the BOR's North Loup Division. In addition, increases in baseflow will decrease the potential for an appropriator with priority to make a call on the river.

6.6 Evaluation Criterion F – Department of Interior Priorities

The Columbus Recharge Project is the result of the Columbus Area Water Assessment Study that was done to determine the water budget in an area south of the City of Columbus Nebraska. The LLNRD had identified a groundwater decline area that was causing conflicts between water users. The LLNRD Board of Directors then funded the Columbus Area Water Assessment study to complete the Hydrogeology work and 3D modeling that supported the Columbus Area Recharge projects design and development.

Conjunctive management is a best practice to sustain and increase the reliability of both surface and groundwater supplies now. In addition, it will provide the resiliency to the system to handle future climatic conditions, as illustrated in the analyses undertaken during design.

Restoring Trust with Local Communities

LLNRD is responsible for managing water supplies and resolving conflicts between water users. Through a collaborative effort with the state, county, city, homeowners association, and private industry, a project was identified that would benefit all. This recharge project will provide several intangible benefits starting with a local group working together to find a way to develop water sustainability and resolve a local concern and potentially eliminate the need for regulation. There is a broader benefit to the state as this type of project could act as an example for other NRDs and communities with similar water supply concerns. While not easily calculated in monetary terms, the project will help to promote a healthy and sustainable groundwater

resource, develop a greenway space along the recharge zone, and avoid conflict among water users.

7.0 APPENDIX

A. Project Budget

Funding plan and letters of commitment

The total proposal budget is $2,789,800. The Coalition (LLNRD, City of Columbus, Platte County, ADM, and Christopher's Cove Association) will be providing the $815,800 of cash cost-share to support this proposal (see Attachment C for letters of commitment). These funds are currently available and have been set aside to support the project if the proposal is successful. While additional in-kind services are likely to be performed, they have not been quantified and will not be relied upon for supporting the local match for the proposal. Cash commitments will be used to pay for consulting services in performance of this grant proposal. The Coalition has secured matching funds from the State of Nebraska Water Sustainability Fund for $1,224,000, for a total of $2,039,800. The Coalition is requesting the maximum fund under this grant for $750,000. With this amount, the total secured funding would be $2,789,800, which will provide the resources necessary to construct the project.

Table 3. Summary of Non-Federal and Federal Funding Sources

Funding Sources	Funding Amount
Non-Federal Entities	
State of Nebraska Water Sustainability Fund	$1,224,000
Archer Daniels Midland	$571,200
Lower Loup Natural Resources District	$163,200
City of Columbus, Nebraska	$36,700
Platte County, Nebraska	$36,700
Christopher's Cove Home Owners Association	$8,000
Non-Federal Sub-Total	**$2,039,800**
Other Federal Entities	
1.N/A	
Other Federal Subtotal	**$0**

Table 3. Summary of Non-Federal and Federal Funding Sources	
Funding Sources	**Funding Amount**
Requested Reclamation Funding	$750,000
Total Funding	$2,789,800

Table 4. Summary of Non-Federal and Federal Funding Sources		
Funding Sources	**Percent of Costs Share**	**Total Costs by Source**
Recipient Funding	73%	$2,039,800
Bureau of Reclamation Funding	27%	$750,000
Other Federal Funding		

Budget Narrative
Preliminary estimated project costs are based on engineering design and construction of a water supply system, pipe conveyance system, and water control and rock outlet structures. Construction costs include, but are not limited to:

- General – Mobilization/demobilization;
- Wells – three vertical for Lost Creek channel supply system (16-inch diameter casing and screens) and one vertical for Christopher's Cove supply system (12-inch diameter casing and screen); Alternatively the recharge water would be pumped directly from the canal via a surface water intake wet well and pipe, and submersible pump;
- Pumps – three 800 gpm submersible pumps (alternatively, one 2,400 gpm submersible pump for a wet well) for Lost Creek supply system and one 500 gpm submersible pump for Christopher's Cove supply system for the vertical wells;
- Transmission line – 8,000 linear feet of 12-inch PVC pipe to Lost Creek and 3,200 linear feet of 6-inch PVC to Christopher's Cove;
- Water control structures –manual stop log structures;
- Rock riprap type outlet structures for each transmission line;
- Instrumentation and controls for pumps, stage recorders, and monitoring wells;
- Electrical hookups for the pumps and monitoring system;
- Permanent easements for the water control structures and the limit of inundation during operation;

The project cost summary, including engineering design, permitting, and preliminary opinion of probable construction cost is shown in Table 5.

Table 5. Budget Summary

Item	Cost	Notes
General Costs	$104,000	Includes mobilization, demobilization and profit on subs
Lost Creek Wells	$165,000[3]	Three vertical wells; 16-inch diameter casings and screens
Lost Creek Pumps and Discharge Valves	$145,000[3]	Three 800 gpm submersible pumps
Lost Creek Transmission Line (12-inch PVC)	$585,000	8,000 linear feet of 12-inch PVC - Includes jack and bore under RR
Lost Creek Well Field Collector Piping	$109,500[3]	8-inch-10-inch-14-inch PVC
Christopher's Cove Auxiliary Well and Pump	$90,000	One vertical well; 12-inch diameter casing and screen; One 500 gpm
Christopher's Cove Transmission Line (6-inch PVC)	$226,750	3,200 linear feet of 6-inch PVC - Includes jack and bore under railroad
Water Control Structure and Rock Outlet Structures	$107,000	Includes outlet structures of supply pipes
Instrumentation and Control	$71,000	For pumps, stage recorders, and monitoring wells
Electrical	$75,000	For Lost Creek and Christopher's Cove pumps
Easements and Site Restoration	$150,000	Includes easement for water control and outlet structures

[3] The estimated construction cost for the vertical well water supply option is $419,500. If a surface intake structure is used, the approximate construction cost is $435,000. The price difference is covered within the contingency. For purposes of this grant application, the well option is shown.

Table 5. Budget Summary		
Item	**Cost**	**Notes**
Subtotal	**$1,828,250**	
Contingency	$457,050	
Total Construction Cost	**$2,285,300**	
Engineering, Permitting, and Construction Administration	$504,500	
Total Project Cost	**$2,789,800**	

B. Environmental and Cultural Resources Compliance

It is anticipated the project would impact waters of the U.S., and based on coordination with the U.S. Army Corps of Engineers (USACE) the project would require Clean Water Act (CWA) Section 404 authorization via Nationwide Permit 27 – Aquatic Habitat Restoration, Enhancement, and Establishment Activities. As part of the CWA Section 404 authorization, the USACE will be the lead federal agency under the National Environmental Policy Act (NEPA) and will coordinate with the U.S. Fish and Wildlife Service (USFWS) for compliance with the Endangered Species Act (ESA) and the Nebraska State Historic Preservation Office (SHPO) for compliance with the National Historic Preservation Act (NHPA). Coordination with USACE and USFWS was conducted on October 4, 2018 as part of a CWA Section 404 pre-application meeting. The only listed threatened or endangered species identified that could potentially be impacted by the project is the small white lady's-slipper (*Cypripedium candidum*). The potential for impact resides in the sub-irrigated meadows adjacent to Lost Creek, but not within the channel itself and there is no work anticipated in the sub-irrigated meadows. Coordination with the SHPO was completed in December 2018. The SHPO determined that an archeological survey would not be required since the Project components occur primarily in areas that have been previously disturbed.

Coordination with the Nebraska State Historic Preservation Office (SHPO) was completed in December 2018. SHPO determined that an archeological survey would not be required because the Project components occur primarily in areas that have been previously disturbed.

C. Required Permits or Approvals

The following permits have been identified as being required for Project construction.

- Clean Water Act Section 404 Nationwide Permit (USACE)
- CWA Section 401 Water Quality Certification (NDEQ)
- Threatened and Endangered Species Consultation (USFWS)
- Cultural Resources Consultation (Nebraska SHPO)

- NPDES Construction Stormwater Permit (NDEQ)
- NPDES Permit Authorizing Dewatering Discharges (NDEQ)
- Hydrostatic Testing Discharges Permit (NDEQ)
- Water Well Permit (NeDNR)
- Floodplain Development Permit (NeDNR and Platte County)
- Loup Power District easement and interference agreement
- NeDNR Water Right Permit

D. Existing Drought Contingency Plan

The state of Nebraska has an existing drought mitigation plan (see Attachment B). Additionally, LLNRD has developed an individual management plan aimed at working on drought mitigation strategies or using their individual resources to respond to drought conditions.

E. Letters of Project Support

Letters of support from the City of Columbus, ADM, LLNRD, and Christopher's Cove Association are included in Attachment C.

F. Official resolution

LLNRD will be the agency responsible for administering the grant award. LLNRD has committed existing budget resources to ensure the financial and legal obligations associated with receiving Federal financial assistance through the Drought Resiliency Projects for FY19 will be met. The General Manager of LLNRD has provided a signed letter to indicate this commitment (see Attachment D).