WaterSMART Grants: Water & Efficiency Grants for Fiscal Years (FY) 2020 & 2021

Superior/Courtland Canal Automation Project

Enhancing Storage in Harlan Reservoir by Automating the Headgates of the Superior and Courtland Canals

Application for Funding Opportunity No. BOR-DO-20-F001, Fiscal Year 2020

By

Nebraska Bostwick Irrigation District

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Nebraska Bostwick Irrigation District

Superior/Courtland Headgate Automation Project

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Date: March 14, 2019
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Project Name: Superior & Courtland Canal Headgate Automation Project

This project will enhance water sustainability in the Republican River basin by recovering on average 1,000 acre-feet of surplus deliveries to the Superior and Courtland Canals each year, retaining this water in Harlan County Reservoir and allowing retimed release to contribute to multiple water supply goals including sustained crop production, stream augmentation, preservation of wildlife habitat and improved river health, flood control, and assisting with interstate compact compliance. It will also help guarantee compact compliance between Nebraska and Kansas by providing online, continuous control of the flow crossing the border, as well as preparing these canals for further automation where almost all of the spill can be recovered (records show this is an average of 4,00 acre-feet per year). This project will install canal automation technology to provide closed-loop flow control to the supply of the Superior and Courtland Canals. Precise actuation, level measurement, and flow controllers will be installed into the Superior and Courtland Canals headgate structures, utilizing their existing radial gates. The flows through these control gates will be recorded by an existing, centralized controller through a combination SCADA radio/cellular telemetry network. The continuous real-time control solution will match supply need to real-time supply flows, thereby increasing the availability of stored water for other users of the Harlan County Reservoir and the Republican River system.

Background Data

The Bostwick Division is a Federal facility constructed by the Bureau of Reclamation in south-central Nebraska and north-central Kansas. It extends from Orleans, Nebraska, above Harlan County Lake, to Concordia, Kansas, and includes land on both sides of the Republican River.

Features of the Bostwick Division include Harlan County Dam and Lake on the Republican River (constructed by the Corps of Engineers), Lovewell Dam and Reservoir on White Rock Creek, one existing and one proposed diversion dam, six pumping plants, and the canals, laterals, and drains necessary to serve 104,240 irrigable acres (86,240 with available service and 18,000 potential) in seven counties.

The reservoir, lake, and surrounding lands of the division provide benefits for flood control, irrigation, sediment control, fish and wildlife enhancement, and recreation.

The Bostwick Division is split into two districts by the state line; the Nebraska Bostwick Irrigation District, and the Kansas Bostwick Irrigation District. The Nebraska Bostwick Irrigation District (NBID) is located in the Republican River Basin in southern Nebraska and extends from Harlan County Dam and Lake down to the state line near Superior. The irrigated area follows the Republican River Valley, extending 105 miles downstream from Harlan County Reservoir. To the south, the Kansas Bostwick Irrigation District (KBID) serves agricultural lands in Jewell County and Republic County in North Central Kansas and is headquartered in the town of Courtland, KS.

NBID currently services 22,455 acres. The water delivery system is an open ditch and canal system constructed in the 1950s. The District includes approximately 90 miles of main canals and 90 miles of laterals. NBID has upgraded many of its canals, structures and gates over the past decade to improve operations and water deliveries, and to extend their water supply into the growing season. Laterals on the Franklin canal system have been buried into pipes to reduce system losses. Approximately 70 miles of these open laterals have been converted to buried pipe, mostly in the 18-24" range. NBID has also added actuated gates and a SCADA system to better monitor and control flows at specific locations.

KBID currently services 42,500 acres. The District is made up of 100 miles of main canals and an additional 150 miles of lateral canals and pipelines. KBID is also principally supplied by the Harlan County Dam; water flows down the Courtland Canal to the Lovewell Reservoir, which is used for both irrigation purposes as well as recreation. KBID is in the process of an eight-year system improvement of converting open laterals to piped laterals. Six open laterals totalling 19 miles have been designated for piping.

The water supply for the Bostwick Division is derived from the Republican River and from White Rock Creek. Releases from Harlan County Lake are made to the Franklin and Naponee Canals and to the Republican River. Releases from the Harlan County Dam are operated by the US Bureau of Reclamation. NBID informs the dam operators when a release is needed and that flow is captured by the District at the downstream diversion structure as it arrives. The flow to be delivered to KBID is included in the daily calculation for NBID's request to the USBR, in accordance with a compact agreement between Nebraska and Kansas.

The Superior-Courtland Diversion Dam is located on the Republican River 3 miles west of Guide Rock, Nebraska. It is a concrete ogee weir structure with a hydraulic height of 8 feet and a weir crest length of 420 feet. Embankment wings total more than 4,000 feet. The Superior Canal begins at the north side of the dam and extends 30 miles eastward to the State line. The canal has a capacity of 139 CFS, and supplies water to 5,863 acres north of the river in the Superior-Courtland Unit in Nebraska.

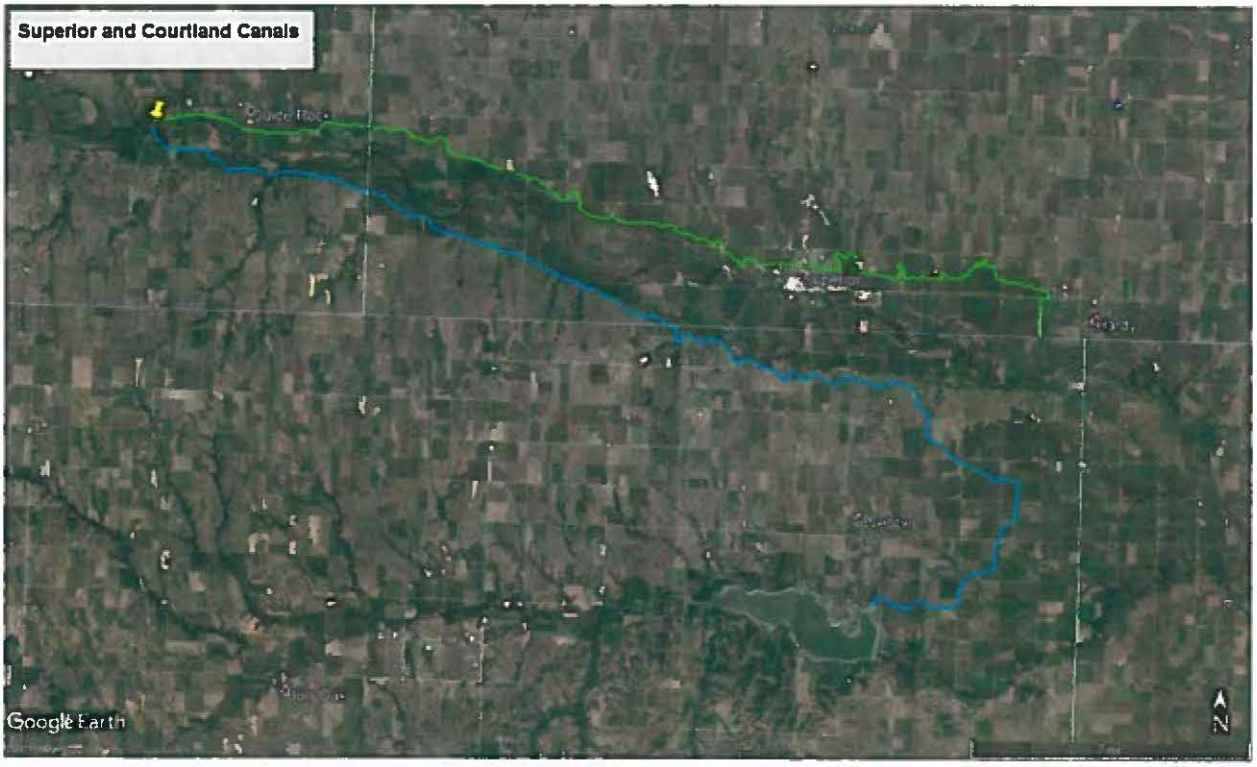

Figure 1 – Satellite View of Superior and Courtland Canals

The Courtland Canal originates at the Superior-Courtland Diversion Dam located on the Republican River 58.8 miles downstream of Harlan County Dam. The Courtland Canal runs along the south side of the river over a length of 33 miles and provides irrigation water for 1,960 acres in Nebraska and 12,771 acres in Kansas. The Courtland Canal connects the Republican River to the Lovewell Reservoir. The Courtland Canal is shared by both NBID and KBID. Although technically a joint effort, the day-to-day operations of the canal are done by KBID staff via contract with NBID. KBID operates the system as a whole via contract with NBID The Courtland Canal has an initial flow capacity of 750 CFS.

The structures contain one radial gate and six overpour bays whose overflow levels are dictated by checkboards. Flow adjustments are typically done once per day. All flow adjustments are currently made by manual movement of the radial gate via a powered drill at the radial's

gearbox (t is understood that the checkboards are adjusted infrequently). With regular fluctuation in the Republican River, the resultant flows diverted through each set of headgates is also fluctuating, thereby undersupplying the farmers or extracting too much from the river.

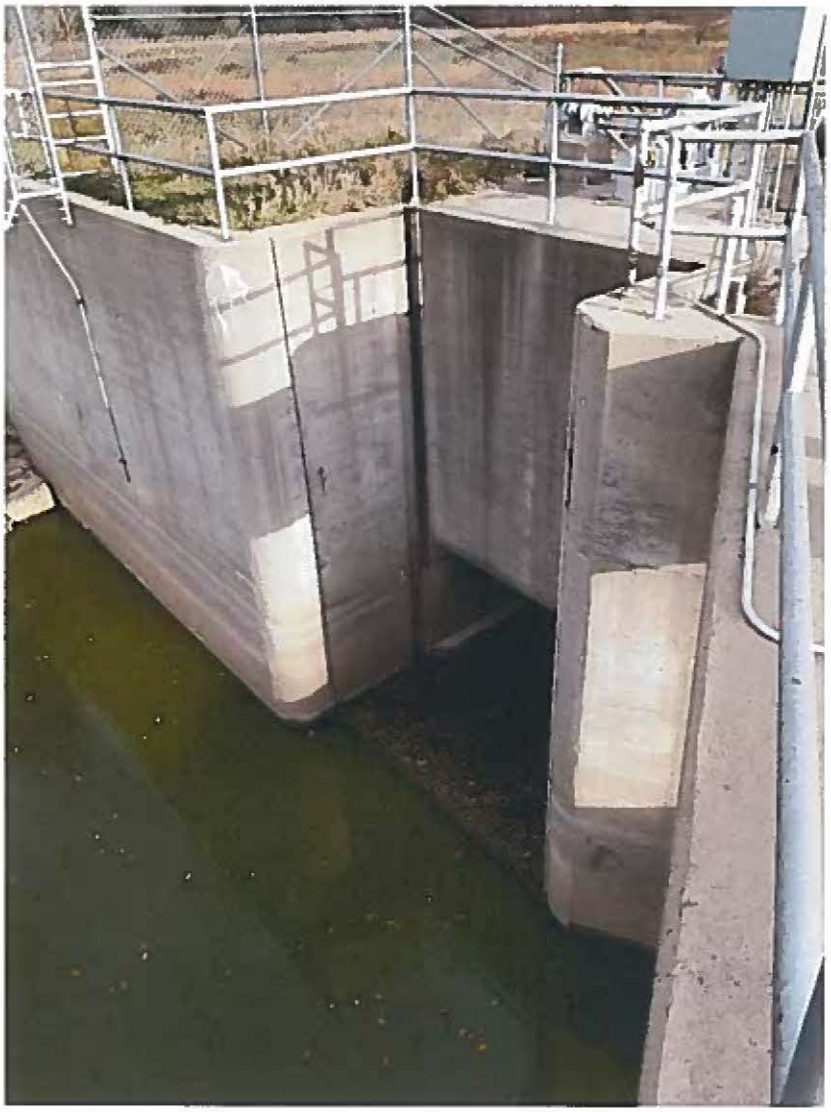

Figure 3 - Superior Canal Diversion

Figure 4 - Courtland Canal Diversion

Both NBID and KBID have one ditchrider each to oversee the operation of the diversions; adjustments are typically made once a day.

INEFFICIENT HISTORICAL OPERATIONS

Efficient on-demand operation of canals is a big challenge. Unpredictable water levels and potential shortages of water can occur. To ensure that the requested flow rates are delivered to farmers, canals are generally operated by supplying excess water from the head-works to ensure supply to farmers. This approach often results in operational spills which limit the availability of water for crop production or other beneficial use.

With an increasing focus on system operations efficiency, there is a growing awareness of the importance of eliminating canal and farm spill, whilst at the same time improving service levels to farmers.

The Harlan County Lake O&M, Environmental Impact Statement published in June 1985 contains historical water use efficiency estimates for the Canals in the Bostwick Division. These

are presented below. (The document can be found at https://play.google.com/books/reader?id=vSM0AQAAMAAJ&hl=en&pg=GBS.PP4).

Approximate diversion rates and on-farm rates for the Bostwick Irrigation Units were obtained from Bureau Records and are given in Table 1. This information indicates that the Courtland Canal has a delivery efficiency of approximately 55 percent.

Table 1. Bostwick Irrigation Division, Operating Characteristics of Individual Units, 1969 thru 1978

Irrigation Unit	Av. Acres Irrigated	(acre-feet) Net Water Supply	Main Canal Waste & Losses (acre-feet)	Lateral Waste & Losses (acre-feet)	Delivery Efficiency (%)	Delivered to Farm, Total (acre-feet)	Acre ft. per acre
Franklin Canal	9,80o	24,329	14,120	2,070	44.o	10,26	1.05
Naponee Canal	1,472	3,53o	1,1o0	88	o4.o	2,281	1.55
Franklin Pump	1,978	3,408	945	223	o5.7	2,241	1.13
Superior Canal	5,125	14,589	7,305	480	51.7	7,549	1.47
Courtland Canal (Neor)	1,575	10,o08*	7,952	111.3	16*	1,808	1.15
Courtland Canal (Kansas)	10,o49	o7,405 -8o,8ee** 2o,7o9	5,988	o,183	54.5	14,598	1.45
Courtland Canal below Lovewell Reservoir	19,439	45,8o3	7,943	12,51o	55	25,245	1.3o
	49,444	173,972				8o,771	
Weighted Average					38		1.34

* Losses in this reach are misleading because the canal is so large with respect to the acreage irrigated.

** Flow delivered to Lovewell Reservoir

Table 1 - Diversion Rates Documented in Harlan County Lake Environmental Impact Statement

This Environmental Impact Statement study reports on a consideration of benefits of automating the Courtland Canal.

4.18 Automation of Courtland Canal: *Another way to more efficiently use water within the lower Republican Basin would be to automate the first 33.5 miles of the Courtland Canal from the diversion dam to Lovewell Reservoir. This would permit a portion of excess flows of the Republican River to be diverted into the Courtland Canal for use by irrigators or for storage in Lovewell Reservoir. Studies by the Bureau indicate that about 6,200 acre-feet of water could be saved for irrigation use at a total cost of about $2.9 million. This would be a cost of about $10.25 per acre-foot of water supply. Automation of the canal would result in reduced demands for release from Harlan County (about 4,800 acre-feet). This conserved water could potentially be used to enhance the water supplies of other irrigation units in the Bostwick Division or to provide multipurpose benefits in Harlan County Lake, although appropriate cost-sharing agreements would have to be made to compensate the Kansas-Bostwick Irrigation District for the costs involved in such a plan.* (page 4-6).

Automation of the Courtland headgates would allow for a constant flow to enter the canal, but this automation could have an effect on the water level at the shared diversion. This would likely result in an increased fluctuation level of any other gate on the diversion; leaving that gate at a constant opening (or even a once-a-day adjustment) will result in increased variation in delivered flows. For this reason, it makes sense to automate both in order to deliver just what is needed through each headgate.

A HISTORY OF WATER SCARCITY

The ability to divert water from the Harlan County Dam varies year to year according to the availability of water from snow melt and rainfall. Over the past decade, the supply reservoirs have not filled to adequate levels to allow the District to deliver irrigation water in adequate quantities to its farmers. Farmers have had to adjust accordingly by changing crops, fallowing plots, growing crops under stress and using supplemental wells where available. While diminished snowmelt and rainfall is the main reason for water shortage, testing and modelling have confirmed that pumping from the aquifer underlying the Republican River and its tributaries has also impacted flows in the streams, creeks and rivers.

The lack of water in the Republican River Basin has also significantly impacted other downstream surface water and ground water users within the basin. As part of the three state compact between Colorado, Nebraska and Kansas, a formula-based quantity of water must be allowed to pass into Kansas via the Harlan County Reservoir. The water level in Harlan County Reservoir is closely monitored and its level at the start of year figures into the determination of how much water must be allocated to Kansas per the compliance agreement. As determined by the Nebraska Director of Natural Resources, if this quantity is not delivered then a Compact Call Year can be put into effect.

This call has been enacted in the years 2013 to 2015 and had the impact of severely reducing all irrigation in the Republican Basin above Harlan County Reservoir. Due to lack of water, the seasons have been rather short, with the last few seasons only lasting 6-10 weeks in duration.

Many farmers can augment their delivered surface water with well water thus avoiding fallowing their land during dry years. Some may be forced to shut down when allocations are too meagre to support farming.

A HISTORY OF INVESTMENT IN SYSTEM IMPROVEMENTS

The District has taken measures to better use what water it still does store by improving delivery operations and implementing solutions that leverage technology. The District has a long term structured and strategic plan to maximise its distribution efficiency by converting all open ditch lateral to buried pipe and implementing SCADA control systems and precise measurement and control devices to precisely match supply to demand in the distribution canals.

NBID has taken measures to better use what water it still does store by improving delivery operations and implementing solutions that leverage technology, and in 2017 an agreement was made to employ Rubicon Water's Network Control solution to save water and improve service. This project was implemented in 2018-2019, and 2020 will mark the first year that the Franklin Canal will be operated in Network Control. This work was funded by the Nebraska Water Sustainability Fund and by partnering NRDs to capture operational spill and retain this water in Harlan Lake to lengthen the irrigation season.

By automating the Franklin Canal's check structures and converting the canal operations from a supply-driven to a demand-driven managed system, this spill is recovered under normal operations, making on average an additional 2,700 acre-feet available for further beneficial use each year. Phase 1 of the Franklin Canal project (headworks through MP 17.2) was installed prior to the 2018 season. Phase 2 (MP 17.2 through the end, MP 45.3) will be installed by April of 2019 for preparation of the 2019 irrigation season.

The volume of water historically lost from operational spills will remain in storage for later use in the season. Water not released and used during the season will remain in Harlan Reservoir for the following year allowing the reservoir to fill more quickly in the off season and start spilling into the Republican sooner. This water can also be used by the District and the Kansas Bostwick Irrigation District #2 to meet its minimum requirements during drought years, and will increase the potential of water marketing activities being done in Nebraska and downstream at the Milford Reservoir in Kansas.

In addition, these projects provide ongoing increases in the efficiency of management and will provide operational continuity as experienced personnel retire from the district to be replaced by potentially less experienced operators.

Kansas Bostwick Irrigation District has invested heavily in conversion of open laterals to pipeline. KBID is in the process of an eight-year system improvement of converting open laterals to piped laterals. Six open laterals totalling 19 miles have been designated for piping. This automation project represents a logical next step in continued system improvements to maximize distribution efficiencies.

PROPOSED AUTOMATION OF THE SUPERIOR AND COURTLAND HEADGATES

This present project will implement closed-loop flow control at the headgates in order to provide continual, as-needed flows to the Superior and Courtland Canals – avoiding overdelivery from lack of adjustability – and allowing operators to better manage their individual canals.

The eventual goal is to implement the same Total Channel Control (TCC) technology that is successfully recovering unmanaged spill from other automated canas to further improve the distribution efficiency of the Superior Canal to recover additional water for further beneficial use. By precisely matching supply with demand, delivery overages will be eliminated leaving more water in Harlan Reservoir for later availability to farmers.

The volume of water historically lost from surplus delivery will remain in storage for later use in the season. Water not released and used during the season will remain in Harlan Reservoir for the following year allowing the reservoir to fill more quickly in the off season and start spilling into the Republican sooner. The earlier spilled water will help to meet the requirements of the compact with Kansas.

Project Location

The Nebraska Bostwick Irrigation District is located in the Republican River Basin in southern Nebraska and is headquartered in the town of Red Cloud, NE.

To the south, the Kansas Bostwick Irrigation District (KBID) serves agricultural lands in Jewell County and Republic County in North Central Kansas and is headquartered in the town of Courtland, KS.

The project location is roughly 8 miles east of the town of Red Cloud, Webster County, Nebraska, through to Lovewell Reservoir in Kansas. The locations (including GPS coordinates) are shown below:

Figure 2 - Location of Courtland Canal in Nebraska and Kansas

Technical Project Description

This project will modernize the headgates by installing precision actuation and level measurement that will be used to quantify and control flows, and will eventually work in sync with other system management hardware and software further down the canals in order to eliminate spill and overdelivery losses. The automation of the headgates will be completed within one year of the award; if awarded in January 2020, the solution should be in place for testing and proving during the 2020 irrigation season.

This project involved the renovation of the existing radial gates with digitally-controlled actuators, precise ultrasonic level measurement on both the upstream and downstream sides of the gates, a controlling Remote Terminal Unit (RTU) that will calculate flows through the radial based on the USBR's WINGATE radial flow calculations and control gate position with a PID loop with respect to flow, and a data connection back to NBID's existing SCADA server in Red Cloud to give operators real-time access to levels, flows, control changes, and any alarm conditions.

Below is further description of each particular component in the system:

- Digital Actuator. The actuator to be used, supplied by Rotork, is a precision actuator that has positional accuracy to 0.1%, thereby giving previously unparalleled accuracy of gate position and subsequent gate opening to the controller for accurate flow calculation. The actuator shall communicate with the RTU via Modbus digital communications, thereby alleviating any resolution error typically found in analog devices, and also gives any warnings or alarms over the same communication network.
- Ultrasonic Level Measurement. By use of Rubicon's OpenAir measurement sensors, water levels can be measured to a fraction of an inch due to their use of 75KHz measurement frequencies. The OpenAir sensor also utilizes Modbus communications, which eliminates signal resolution error as well when reporting back to the RTU.
- Remote Terminal Unit (RTU). The RTU, a Motorola ACE, acts as both a PLC and a SCADA/communication portal to efficiently take in all input from sensors, actuators, etc and use that data to determine real-time water levels and calculate flows passing through the gates. The ACE also communicates back to the Motorola gateway currently under use in NBID's SCADA system to properly route feedback and control data to keep the office and operators in step with all aspects of the gate. Data is shared with the server, but data can also be retained locally on an SD card in the event of communication outages.
- Data Connection. NBID currently has two data options for communication with the server at the office in Red Cloud: 1) a cellular connection that can tie into the server via their office internet connection, or 2) a licensed radio that can be incorporated into NBID's existing SCADA network. Option 2) would be the default as it incorporates into the existing system, but at the time of the grant submission we don't have sufficient data to know if the path from the site to the nearest repeater tower will support a reliable data connection. If this is not feasible, option 1) can be employed.

Not only does this configuration of equipment support the efficiency gains as proposed in this application, but this configuration will also automatically fit into and support a Total Channel Control expansion in the near future.

Evaluation Criteria

E.1.1. Evaluation Criterion A—Quantifiable Water Savings (30points)

This project will conserve water and improve water use efficiency by modernizing existing infrastructure. This improvement and the eventual roll-out of Rubicon's Total Channel Control

(TCC) will further address unintended surplus diversions from Harlan County Reservoir, retaining this recovered water in storage. The Quantifiable Water Savings resulting from this project will be the reduced surplus diversion that is recovered by precisely matching supply to demand along the length of the Courtland Canal and into Lovewell Reservoir.

This is a component of a system-wide modernization program that has been already seen to create significant water savings. The experience of a nerighboring district, the Frenchman-Cambridge Irrigation District (FCID), is that with the implementation of Total Channel Control, operational spill has been reduced, and effectively eliminated. Both FCID and NBID have similar topography and deliveries, canal and soil types, USBR structure and spill designs, and utilize similar methodologies of management.

SUPERIOR CANAL

The historical operating efficiency of the Superior Canal can be estimated by reference to HydroMet data and by previous studies conducted by the US Army Corps and the Bureau of Reclamation. The Bureau's Monthly Water Distribution Records document the following historical spills from the Canal:

Year	Net Supply (ac-ft)	Main Canal Waste (ac-ft)	Delivered to Farms (ac-ft)	% Waste
2008	5666	566	1060	10%
2009	6336	507	2523	8%
2010	6489	1211	2769	19%
2011	7070	1265	2169	18%
2012	9744	930	4194	10%
2013	6161	438	2566	7%
2014	0	0	0	-
2015	6571	449	1864	7%
2016	6308	687	1834	11%
2017	7493	316	2340	4%
	AVERAGE WASTE	708		10%

Table 2 - Historical Operational Spill from the Superior Canal

This data shows an average recorded canal spill of 708 ac-ft per year, which represents 10% of the typical yearly diversions into the Superior Canal.

In addition to the recorded spills some spillback structures are un-measured and not recorded, these structures tend to spill water intermittently into a dry tributary to the Republican River and in most cases the spilled water does not reach the River.

Rubicon's Total Channel Control typically recovers 80-90% of the operational spill in a canal system, with the beginning of the automation starting at the headgate. This project would be the "first step" in recovering almost all of the 700 acre-feet; as a stand-alone project, this should be able to recover 20-30% of that lost water.

COURTLAND CANAL

The Harlan County Lake O&M, Environmental Impact Statement published in June 1985 contains historical water use efficiency estimates for the Canals in the Bostwick Division. (The document can be found at https://play.google.com/books/reader?id=vSM0AQAAMAAJ&hl=en&pg=GBS.PP4).

This Environmental Impact Statement study reports on a consideration of benefits of automating the Courtland Canal.

4.18 Automation of Courtland Canal: *Another way to more efficiently use water within the lower Republican Basin would be to automate the first 33.5 miles of the Courtland Canal from the diversion dam to Lovewell Reservoir. This would permit a portion of excess flows of the Republican River to be diverted into the Courtland Canal for use by irrigators or for storage in Lovewell Reservoir. Studies by the Bureau indicate that about 6,200 acre-feet of water could be saved for irrigation use at a total cost of about $2.9 million. This would be a cost of about $10.25 per acre-foot of water supply. Automation of the canal would result in reduced demands for release from Harlan County (about 4,800 acre-feet). This conserved water could potentially be used to enhance the water supplies of other irrigation units in the Bostwick Division or to provide multipurpose benefits in Harlan County Lake, although appropriate cost-sharing agreements would have to be made to compensate the Kansas-Bostwick Irrigation District for the costs involved in such a plan.* (page 4-6).

These water savings estimates were based on diversion data recorded from 1969-1978 when net diversions averaged 36,777 ac-ft per year. These diversions have reduced since then, and so the quantifiable water savings have been established by considering the reduced demands that have been diverted from 2007-2018.

Year	Nebraska Bostwick Net Supply (ac-ft)	Kansas Bostwick Net Supply (ac-ft)	Total Net Supply (ac-ft)	Recoverable Savings (ac-ft)
1969-1978			36777	6200
2007	0	14748	14748	2486.271311
2008	311	17433	17744	2991.347853
2009	718	18833	19551	3295.978465
2010	202	20190	20392	3437.757294
2011	428	17889	18317	3087.946271
2012	884	26777	27661	4663.191669
2013	558	20093	20651	3481.420453
2014	0	15525	15525	2617.260788
2015	483	20436	20919	3526.600865
2016	557	19762	20319	3425.450689
2017	471	24094	24565	4141.256764
2018	532	17007	17539	2956.78821
			AVERAGE	3342.605886

Table 3 - Annual Savings Opportunity 2007-2018

The Recoverable Savings for each year have been calculated by determining the ratio (Total Net Supply to the Courtland Canal for the year / Total Net Supply averaged from 1969-1978) and multiplying the 6,200ac-ft yearly saving assessed over the period 1969-1978 by this ratio.

The average recoverable savings over the period 2007-2018 have been 3,342 ac-ft per year. This represents 16.8% of diversions to the Courtland Canal.

The opportunity is to save an average of 3,300 acre-feet of water per year and retain this in Harlan Reservoir.

The modernized gate measurement and flow infrastructure will allow NBID to accurately deliver the volume of water as specified by the Republican River Interstate Compact. This system will allow water to be stored 'upstream' in the Republican River Basin for multiple beneficial uses.

As mentioned earlier, Rubicon's Total Channel Control typically recovers 80-90% of the operational spill in a canal system, with the beginning of the automation starting at the headgate. This project would be the "first step" in recovering almost all of the 3,300 acre-feet; as a stand-alone project, this should be able to recover 20-30% of that lost water, which equates to 800-1,000 acre-feet annually.

Other benefits such as less mileage by operators on dusty roads (which saves time and influences air quality) and less damage to canal banks.

A PROVEN SOLUTION FOR RECOVERING OPERATIONAL SPILLS

Rubicon Water has a track record of proven water savings, increased operational control, increased safety and response, and better adaptation to irrigation district staffing needs of the future. Specific to the automation and control of existing radial gates, Rubicon has delivered a successful implementation of radial gate control, flow quantification, and induction into SCADA at the Pima-Maricopa Irrigation Project (P-MIP). At approximately 20 locations along multiple canals on the reservation of the Gila River tribe in Sacaton, AZ, Rubicon has provided, installed, commissioned, and operated a check control system that utilizes a pair of Rubicon FlumeGates that flank a Fresno radial gate. The radial gate has been driven and instrumented just as proposed for the NBID gates, whereas a Motorola RTU controls the radial gate and coordinates all remote control with the SCADA system through a licensed radio network.

Figure 5 – Typical Radial & FlumeGate Configuration at P-MIP

This project is a component of an eventual system-wide modernization program that has been already seen to create significant water savings. FCID's experience in the implementation of Total Channel Control is the effective elimination of operational spills.

Many case studies and customer references have been provided in the Rubicon Scoping Study for our projects to establish the fact that the proposed Total Channel Control solution eliminates spill and precisely matches supply to demand to reduce the draw-down of stored water and make it available for further beneficial use later in the season. Many of these systems also involve integration of existing sites using third-party technologies to envelope existing hardware to include it in the overall SCADA scheme.

Examples of references with contact details have been provided in Australia, California (Oakdale, Turlock and Solano Irrigation Districts), Washington (Naches Selah Irrigation District), Arizona (PIMA Maricopa Irrigation District) and Nebraska. The proposed solution has been proven in often more than fifteen years of operation in the irrigation districts referenced and has been put through extensive due-diligence assessments conducted by State governments in Australia and irrigation district engineering and operations staff. The experience of these broad implementations over fifteen years is that the Total Channel Control solution eliminates spill

and allows that water to be retained in the reservoir to reduce draw down and be made available for managed streamflow retiming.

Coleambally

Coleambally Irrigation Cooperative is a farmer-owned co-operative, providing irrigation water deliveries to 473 farms across 296 miles of gravity-fed canals. Faced with a significant reduction in water availability, Coleambally sought solutions to increase their water availability.

Coleambally chose Rubicon Water's Network Control Solution to modernize their canal system. The solution has largely eliminated spills, with water distribution efficiency increasing from around 75% in the 2002/03 season to 95% in 2012/13.

Each year Coleambally recovers between 49,000 to 57,000 acre-feet of water annually, which is now available to their farmers. Customers benefit from consistent flows through their outlets, and water is delivered within two hours of ordering online. Farmers can now use their water much more effectively.

Oakdale

Oakdale Irrigation District is located in the Central Valley of California. In 2010, Oakdale undertook a comprehensive evaluation of their system performance and embarked on a program to modernize their gravity distribution system. In particular, they aimed to reduce operational spills and improve service by reducing fluctuations in canal water levels.

Rubicon and Oakdale identified two key laterals where improved control would realize significant benefits – the 6.5-mile 17 pool Claribel Lateral and the 8.5-mile 10 pool Cometa Lateral. Rubicon automated both laterals, replacing 42 gates in 30 structures with networked FlumeGates. The solution precisely matches supply with demand, eliminating operational spills. And with near on-demand supply, farmers along the laterals now apply water to precisely meet crop requirements.

The resulting spill reduction has enabled Oakdale to recover 1,700 acre-feet per year from just one 8.5-mile lateral for further beneficial use.

NVIRP

In response to Australia's Millennium Drought, the irrigation infrastructure of Northern Victoria was modernized to make more water available for agricultural, environmental and urban uses. A once in a lifetime investment was made to modernize the canal networks of the Goulburn-Murray Irrigation Area. This area covers 840,000 acres of irrigated land which is supplied by 3,900 miles of open canals.

Rubicon Water delivered a modernized surface water delivery system to generate shared benefits for win-win outcomes. The Network Control solution made more water available for farmers, the environment and urban consumers.

Works to date include the supply and installation of nearly 12,000 automated gates and nearly 6,300 meters in turnouts. Rubicon installed the largest agricultural SCADA system in the world (7,445 PLCs over thousands of miles) operating on a private radio communications network.

To date the modernization works have completely automated 1,875 miles of primary canals operated by sophisticated management software to manage both demand and supply. The flow measurement capability of the FlumeGates was used to isolate leaking sections of canal, resulting in the lining of 75 miles of canal with HDPE. The ability to find the lossy pools in the network meant that only 4% of the network needed to be lined.

This project is creating savings of 182,250 ac-ft of water every year for further beneficial use.

Approach for verifying water savings upon completion of the project

The project will provide real-time flow measurement at all regulating structures and spillways in the system, and so the actual system diversions, spills and flows into Loveland Reservoir will be continually measured and recorded. The experience of the District's previous implementations of the Total Channel Control solution is that the spill will be zero under normal operations. Following implementation of this project we will have data to verify the water savings resulting from this project.

E.1.2. Evaluation Criterion B—Water Supply Reliability (18points)

The water stored in Harlan Reservoir is required to improve water supply reliability for users in the Republican River Basin. This water supply reliability is improved by maximizing the volume of water stored in Harlan Reservoir by minimising surplus diversions that result in over-deliveries and operational spills. The precise management of the volume and timing of supply releases improves water supply reliability by ensuring that water is available at the time of need of downstream users and that water does not pass through the system without benefit.

A History of Water Scarcity

Over the past decade, the supply reservoirs have not filled to adequate levels to allow the District to deliver irrigation water in adequate quantities to its farmers. Farmers have had to adjust accordingly by changing crops, fallowing plots, growing crops under stress and using supplemental wells where available. While diminished snowmelt and rainfall is the main reason for water shortage, testing and modelling have confirmed that pumping from the aquifer underlying the Republican River and its tributaries has also impacted flows in the streams, creeks and rivers. The District has taken measures to better use what water it still does store by improving delivery operations and implementing solutions that leverage technology.

The lack of water in the Republican River Basin has also significantly impacted other downstream surface water and ground water users within the Republican River Basin. As part of the three state compact between Colorado, Nebraska and Kansas, a formula-based quantity of water must be allowed to pass into Kansas via the Harlan County Reservoir located near the Nebraska-Kansas border. The water level in Harlan County Reservoir is closely monitored and its level at the start of year figures into the determination of how much water must be allocated to Kansas per the compliance agreement. As determined by the Nebraska Director of Natural Resources, if this quantity is not delivered then a Compact Call Year can be put into effect. This call has been enacted in the years 2013 to 2015 and had the impact of severely reducing all irrigation in the Republican Basin above Harlan County Reservoir. For two consecutive years (2013 -2014) irrigation water was significantly curtailed by State regulators so Nebraska could meet their Republican River Compact obligations. These severe drought years prevented the planting of crops. This project will provide increased water supply reliability for the benefit of our farmers and rural communities.

Making Water Available for Multiple Beneficial Uses

The project addresses the impact of water scarcity by increasing the available stored water which can help many parties prosper through dry conditions, including the agricultural economy, the tourism economy, and the municipal and urban water users who rely on aquifers and stream flows for their water supplies. Maximizing the availability of this stored surface

water provides additional opportunities and management options to enhance aquifer storage and increase streamflow. This project will enhance water supply reliability in the Republican River basin by providing the following benefits:

1. Reduced excess extractions from river, groundwater and surface reservoir storage in dry years - increased surface water availability reduces the need for river diversions and groundwater pumping - thereby reducing aquifer depletion.

2. Enhanced groundwater recharge in wet years - water-tight gates can be used to run specific sections of canals deeper for longer and therefore provide targeted incidental recharge, adding water availability to the system.

3. Improvements in water quality for downstream users and accompanying improvements in river health - water quality and river health improvements are achieved by minimizing the spill of irrigation water back into the river. In addition, river flows are increased along the reaches parallel to irrigation districts, with associated environmental benefits.

These benefits provide positive impacts to all users in the river basin. Experience in the west parts of the Basin has shown what can happen when canal flows cease to exist or have intermittent operations.

The project's method to increase water supply reliability.

By precisely managing the release of storage water, more water can be retained in storage to provide greater certainty of supply during extended dry periods, or make more available in the Republican River for environmental or other uses.

The proposed project will enhance the operation of Harlan dam by providing real-time demand information which can be used to precisely set dam release flows to the exact value required to meet downstream demand. This information allows dam operators to operate with a high degree of precision to reduce draw down and release of water which is presently passing through the system at unmanaged times and so is not providing maximal managed benefits.

By retaining more surface water in Harlan Reservoir, managers have more ability to maximize the beneficial use of this water in times of water scarcity. The ability to manage the time of release of stored water allows more stored water to be banked for future dry years, thereby preserving the water resource. These benefits of enhanced groundwater recharge, increased instream flows and improved water quality provide positive impacts to all users in the river basin.

A more reliable water supply for agricultural users

This project will provide a more reliable water supply for both surface water users and groundwater users.

The proposed solution will make more surface water available longer through the growing season and thereby extend water availability and resultant crop yields. For those farmers who rely solely on surface water, the additional water availability will increase crop yields. For farmers who use a mix of surface water and ground water, additional surface water will reduce pumping of groundwater and resultant aquifer overdraft and greenhouse gas emissions. In dry years, the additional water made available with this solution can mean the difference between a successful crop and a failed crop.

This project increases the water supply reliability of the Republican River Basin's aquifers and streams by increasing the opportunity for the surface water stored in supply dams to add to recharge and stream flow.

More reliable environmental flows

This project will provide better control of water stored in surface storages and provide increased in-stream flows in the later season for stream augmentation.

At present, surplus deliveries pass downstream at times where there may not be sufficient stream flow to ensure that the surplus water arrives at a point where it can be beneficially used.

Most of the waste ways are located on dry tributaries to the Republican River and water spilled never reaches the River or if it does the river is so low the flows don't reach Milford Lake to support flows along the length of the river. In most years the spills enter a tributary that is normally dry and the flows never reach the river and in some years if the water does reach the river the river is found to be dry.

More reliable recreational facilities

Retaining more water in storage will sustain storage levels with resultant recreational benefits for reservoir users. This will benefit all recreational users of the reservoir. Nebraska Games and Parks has many examples demonstrating that higher reservoirs levels increase the number of visitations per day at the three Reservoirs associated with this project. Additional recreational benefits are provided by the ability to retime storage releases so that more water is available when the river flows are improved, providing benefit to recreational river users.

Better environmental outcomes

The solution provides improved water quality for downstream users and accompanying improvements in river health. Water quality and river health improvements are achieved by minimizing the spill of irrigation water back into the river, improving water quality for downstream users.

During normal canal operations chemicals are used to control algae and a variety of plant vegetation with the most common infestations being pond weed. The chemicals used have been deemed safe for this treatment. However, not allowing the chemicals to leave the canal system would be most desirable management approach, and this project would accomplish this outcome.

This project will also reduce the impact of invasive vegetation species and help prevent the Harlan Country Reservoir from becoming impaired with pollutants such as Chlorophyll A, nitrogen and phosphorous. Higher pool elevations would mitigate some if not all of these listed pollutants.

River flows are increased along the reaches parallel to irrigation districts, with associated environmental benefits. Maintaining higher flow rates through the Republican River can improve drinking water quality for downstream users.

Wildlife habitat will benefit from an ability to retime release flows to buffer low flow situations that can occur late in the year. The Republican River area within the District, especially including Reclamation project waters in Harlan Reservoir, is host to many additional migratory bird species that use the Central Flyway on their annual journeys. The Courtland Canal is in the middle of the Sandhills Crane migration and Whooping Crane migration paths, which attract tourism revenue of $80 Million to $100 Million each year. Other migratory species, including shorebirds and songbirds, travel through by the millions and land on and near our lake and waterways, and although no longer listed as an endangered species, a significant population of protected Bald Eagles as well as Golden Eagles also remain resident in our district during portions of each year; several nesting pair of Bald Eagles now make a year-round home at Harlan County Reservoir. In addition, a very significant number of American White Pelicans utilize the Harlan County Reservoir within the boundaries of the District on their annual spring and fall migrations.

Low Reservoir pools at any of Reclamation Reservoirs in our area would pose a serious threat to these species.

<u>More reliable supply for municipal and industrial users</u>

Increased surface water security reduces farmers' needs for groundwater pumping – thereby increasing instream flows and reducing aquifer depletion and making more water available for Municipal and Industrial Users and better guaranteeing the quantity of supply and quality of drinking water supply.

Municipalities and small villages along the River corridor would benefit from the canal recharge.

The retiming of release of storage water changes the time of availability of this water for downstream municipal and industrial users to times of scarcity later in the year around August. It is much more efficient to move large amounts of water through the system during the winter months when vegetation is dormant and the river flows and alluvial aquifer have recovered from the mining of the aquifer during the irrigation season.

Resolving Water Related Conflicts in the Region

This project supports the goal of ensuring compliance with the Republican River Compact by increasing the availability of stored water in our reservoirs and providing the opportunity to make this water available for release at times that would best suit the needs of end users and of the Republican River Compact.

Administration of the Compact without sufficient water management tools has resulted in significant arbitration and financial penalties and caused significant conflict among the States of Colorado, Nebraska and Kansas. This project will provide precise management tools and real time scientific data to provide evidence-based documentation of compliance with the Compact and to allow each state to better manage its water to comply with its Compact obligations.

The saved water could be utilized to retime Compact augmentation water before it is actually pumped from the ground. This offset could be in lieu of the financial and energy expense of pumping expensive groundwater from the ground via N-CORPE.

Flood Control

An additional benefit provided by this project is improved flood water warning and management. The regulation of canal flows and water levels remotely via remote telemetry provides early warning via SCADA utilizing text messaging and email warnings of high flows or high water levels.

The ability to remotely control the flow control gates meaning that operational capability can be maintained when flood waters restrict vehicular access. This allows more capability to respond to flood events by maintaining the capability to operate structures when local access is not possible. The solution's water-tight gates can provide the capability to back water up and increase the rate of groundwater recharge to reduce the rate at which flood waters pass downstream.

The ability to operate the gates during a flood event also provides more routing opportunities and volume buffering opportunities to reduce localized flood damage.

E.1.3. Evaluation Criterion C—Implementing Hydropower (18points)

This project will provide the opportunity to reduce power consumption associated with pumping groundwater from the N-CORPE facility to ensure Nebraska's compliance with the Republican River Compact.

Most years Nebraska's consumption of its allocation exceeds their 49% share as defined in the Compact. Nebraska relies on the retime of flows with conjunctive management and stream flow augmentation with N-CORPE to offset the overages in consumption of its Compact allocation. Under present administration of the compact Nebraska relies on significant groundwater pumping to fulfil its obligations.

The water saved by this project could be utilized to retime Compact augmentation water before it is pumped from the ground. This offset could be in lieu of energy intensive pumping of groundwater from the ground via N-CORPE. This project will provide more water availability late season or early fall that can be efficiency moved to Harlan County Reservoir along with augmentation flows from N-CORPE before the June 1st deadline.

E.1.4. Evaluation Criterion D—Complementing On-Farm Irrigation Improvements (10 points)

This project will complement on-farm irrigation improvements in the following ways:

1. The additional water available in storage will provide the ability to better plan for the next year's irrigation requirements when establishing seasonal allocations.

2. The ability to increase seasonal allocations as a result of increased water availability will make the difference between being able to irrigate and not being able to irrigate in dry years. Any investment in on-farm efficiency improvements relies on sufficient allocation to irrigate, and this project will increase the likelihood of this outcome in years of marginal allocation.

3. The eventual upgrade of the balance of the canal to Total Channel Control will provide farmers with near on-demand delivery of precise water schedules at constant ordered flow rates will precisely enable farmers to schedule their irrigations to match crop requirements, facilitating the full opportunity of on-farm water savings that can be realized through investment in pivots and precision drip and sprinkler systems, including improvements that may be eligible for NRCS funding. This project will create delivery system improvements that complement on-farm improvements supported by NRCS through the EQIP program.

This project will complement ongoing and future on-farm improvements by providing an on-demand delivery system to provide a stable and reliable water supply for on-farm solutions and

equipment. Farmers in the region are making significant investments in pivots and micro irrigation. The majority of farm diversions are distributed to field by method of low-pressure pivot for mostly forage and cereal crops. On-farm turnouts are generally through-bank pipes feeding into pump pits, with pumps supplying pivots. These devices typically require constant flow rates, and the eventual Total Channel Control solution will enable these constant flow rates to be provided without requiring surplus deliveries or diversions to guarantee this.

The proposed project will maximize the overall distribution efficiency in the area, considered from the reservoir headworks to the root zone of the crops. Maximizing the delivery system efficiency will maximize the water available to be utilized by the on-farm efficiency investments.

The project will also allow the farmers to access an Internet of Things backbone in the future, provided by the SCADA network that will be installed in this project. This IoT capability will facilitate the adoption of remote field data sources such as weather stations and soil moisture probes which will allow farmers to make irrigation scheduling decisions to precisely match the crop water requirement and prevent over-watering. It can be common in this area that cellular communications are difficult to establish and so the provision of a communications gateway to Internet of Things devices at the proximity of the farmers' fields will create a significant opportunity for science-based data driven irrigation scheduling to generate additional water savings.

E.1.5. Evaluation Criterion E—Department of the Interior Priorities (10 points)

1. Creating a conservation stewardship legacy second only to Teddy Roosevelt

The solution utilizes science and technology to manage water resources to adapt to changes in precipitation patterns. This project will help to better understand the total water balance of our canal systems.

This project will provide wildlife benefits to sustain the environment by increasing instream flows, in alignment with the objectives of conservation organizations. Increased water in the Harlan Reservoir will provide wildlife benefits for migratory bird species and a reduction in invasive vegetation with improved water quality outcomes. In addition, there will be enhanced recreational outcomes resulting from an increase in the volume of water retained in the reservoirs.

This project's ability to provide an IoT telemetry backbone for irrigators will provide additional real-time data resources such as on-site weather stations and evapotranspiration data for irrigators to allow them to utilize science to adopt best practices in managing their land and water.

2. Utilizing our natural resources

The project's ability to reduce the electricity consumption required by the NCORPE groundwater pumping infrastructure will ensure American Energy is available to meet our security and economic needs.

The regulation of canal flows and water levels remotely via remote telemetry reduces vehicular usage and associated exhaust emissions and road wear and tear.

The project will also enhance the canal system's groundwater recharge to many wells (irrigation and domestic) that may not have a water supply without adequate recharge in dry periods that may occur in the future.

3. Restoring trust with local communities

This project will help build trust among surface water and ground water users and downstream users of Republican River water and will build trust in the correct distribution of water through Bureau conveyance networks.

This project will help ensure that surface water users assume their share to keep Nebraska in compliance by allowing them to continue to grow a crop with less water diverted. It improves the opportunity to grow a crop each year there and thereby reduces adverse economic, social, and environmental consequences.

4. Striking a regulatory balance

This project will conserve and use water more efficiently, mitigate conflict risk associated with disputes regarding the Republican River Compact, and will make more water available for the beneficial use of recreational, wildlife and agricultural interests in Colorado, Nebraska and Kansas. By providing automated high time resolution data and summary reports this system will reduce the administrative and regulatory burden associated with the Republican River Compact.

This project will allow better management of DOI water storage, transportation and distribution systems to resolve conflicts associated with the Republican River Compact and competing needs of surface water and groundwater users.

5. Modernizing our infrastructure

This project renovates existing infrastructure to create efficient water delivery systems that provide our farmers with the best available tools to maximise their agricultural output.

E.1.6. Evaluation Criterion F—Implementation and Results (6points)

E.1.6.1. Subcriterion F.1— Project Planning

The District has a Water Conservation Plan and System Optimization Review in place and this project forms a part of these plans. NBID has adopted a "District Operating Plan" that is approved by Reclamation and the Plan is an appendix to the repayment contract. Within this plan NBID has adopted Water Conservation Measures.

E.1.6.2. Subcriterion F.2— Performance Measures

Historical canal flow records provide knowledge of the surplus deliveries presently being passed to Lovewell Reservoir. These flow volumes are provided by Reclamation's Hydromet System flow summaries

The provision of real-time data through implementation of the project will demonstrate the resultant performance outcomes in eliminating overdelivery. This reduction in over delivery will represent the additional volume retained in Harlan Reservoir.

E.1.6.3. Subcriterion F.3— Readiness to Proceed

The engineering and inspection functions have already been performed, and all implementation costs have been priced at $152,434. This price includes any remaining engineering and inspection costs and capital construction costs. The estimated construction period is 4-5 months commencing January 2020.

The District plans to be ready to proceed immediately once funding approval is granted.

The gates and supporting SCADA and control system will be installed in a two-year program, and resultant water savings will be realized on an ongoing basis beginning one year after program commencement.

The project will involve the following key activities:

1. The securing of funding for construction.

2. A kick-off meeting at NBID to a) verify schedule and b) provide any site confirmations needed.
3. Perform a radio survey to confirm desktop analysis of radio requirements.
4. Place order with Rubicon for all hardware.
5. Order radial actuation from the appropriate vendors.
6. Run hydraulic simulations to build system controllers.
7. Install actuation and instrumentation.
8. Test/commission system.
9. Updating of NBID's server to include the new sites and algorithms.

There are no permits required for this project. Reclamation owns all the lands associated with the project and holds the Storage permits for the Reservoirs and the Storage Use permits on all the project acres. NBID holds the natural flow permits.

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

The environmental compliance estimate is based on the previous implementations of equipment installation over the previous two irrigation seasons. We understand the compliance requirements after having previously implemented these equivalent works. The plan of development will minimize the impact on the natural environment by ensuring the following: 1. Civil construction works will be limited to minimal modification to existing concrete structures and will not require excavation or moving of earth. 2. No chemicals will be released into soils or waterways as a part of these works.

The project will be fitting new flow measurement and flow control actuation to existing diversion structures. These structure upgrades will not modify the structural loading of the upgraded check structures, and so there is no requirement to undertake a structural or foundation assessment on these existing check structures..

E.1.7. Evaluation Criterion G— Nexus to Reclamation Project Activities (4 Points)

Nebraska Bostwick Irrigation District (NBID) utilizes the storage supply from Harlan Reservoir via Reclamation repayment contract no. 009D6B0121. Reclamation constructed the Canals, Drains and Laterals for this Irrigation Project, and NBID has a repayment obligation for the Project. Reclamation owns all the lands associated with this project and holds the Storage permits for the Reservoirs and the Storage Use permits on all the project acres (22,455 acres). NBID holds the natural flow permits for these 22,455 project acres. Within its repayment contract NBID maintains the Irrigation project and funds a percent of the O&M associated with the Harlan Reservoir. NBID has adopted a "District Operating Plan" that is approved by Reclamation and the Plan is an appendix to the repayment contract. Within this plan NBID has adopted Water Conservation Measures.

Reclamation has many water users under these federal projects that rely on the irrigation water for their livelihood.

E.1.8. Evaluation Criterion H— Additional Non-Federal Funding (4 points)

Matching funding for this project has already been pledged from the governor's office of Nebraska. In a compact violation between Colorado and Kansas, a decision was reached in the favor of Nebraska and a judgement of $4M was awarded to Nebraska. As the judgement was a result of insufficient flows delivered to the Republican basin, the governor's office has dedicated the $4M to efficiency improvements in the Republican basin. This project's matching funds have been pledged by the Department of Natural Resources in concert with the governor's office; see attached letter from the Nebraska DNR. These represent 31.50% of the costs. Also, the Kansas Bostwick Irrigation District has committed funds to this project; see attached letter from them. This represents 16.4% of the costs. Nebraska Bostwick will fund the remaining non-federal costs associated with this project.

Section H – Other Information

H.1. Environmental and Cultural Resource Considerations

- Will the proposed project impact the surrounding environment?

  This project will not impact the soil, air, water or animal habitat of the Superior or Courtland Canal. The plan of development will minimize the impact on the natural environment by ensuring the following: 1. No chemicals will be released into soils or waterways as a part of these works. 2. The solution provides wildlife benefits to sustain the environment by increasing instream flows. 3. The regulation of canal flows and water levels remotely via remote telemetry reduces vehicular usage and associated exhaust emissions and road wear and tear.

- Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designates critical habitat in the project area?

  No endangered species will be affected by any activities associated with the proposed project.

- Are there any wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as "Waters of the United States?"

  No.

- When was the delivery system constructed?

  The delivery system was constructed in 1950s.

- Will the proposed project result in any modification of or effects to individual features of an irrigation system?

  Yes, the project will involve installing flow measurement and control hardware into existing concrete diversion structures. These check structures were constructed in the late 1950s.

- Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places?

  No.

- Are there any known archaeological sites in the proposed project area?

  No.

- Will the proposed project have a disproportionately high and adverse effect on low income or minority populations?

  No.

- Will the proposed project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands?

  No.

- Will the proposed project contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area?

  No.

Project Budget

Funding Plan and letters of commitment

Describe how the non-Federal share of project costs will be obtained.

Project funding provided by a source other than the applicant shall be supported with letters of commitment from these additional sources. Letters of commitment shall identify the following elements:

- The amount of funding commitment
- The date the funds will be available to the applicant
- Any time constraints on the availability of funds
- Any other contingencies associated with the funding commitment

If commitment letters are not available at the time of the application submission, please provide a timeline for submission of all commitment letters.

Commitment letters from the State of Nebraska and Kansas Bostwick Irrigation District are attached.

Please identify the sources of the non-Federal cost share contribution for the project, including:

- Any monetary contributions by the applicant towards the cost-share requirement and source of funds (e.g., reserve account, tax revenue, and/or assessments)
- Any costs that will be contributed by the applicant
- Any third-party in-kind costs (i.e., goods and services provided by a third party)
- Any cash requested or received from other non-Federal entities.
- Any pending funding requests (i.e. grants or loans) that have not yet been approved and explain how the project will be affected if such funding is denied.

Budget Proposal

Experience shows that the adopted Total Channel Control automation solution typically costs as little as 1/10 the price of converting larger canals to pipeline, and generally is significantly cheaper than constructing balancing storages. The solution is economically attractive because it is adding to existing infrastructure investments and leveraging these previous investments. The costs of the project are a combination of control gate and telemetry hardware, civil works to modify existing structures, and labor associated with configuring the control system.

Table 1. —Total Project Cost Table

SOURCE	AMOUNT
Costs to be reimbursed with the requested Federal funding	$ 75000.00
Costs to be paid by the applicant	$ 4434.00
Value of third-party contributions	$ 73,000.00
TOTAL PROJECT COST	**$ 152,434.00**

Unit costs must be provided for all budget items including the cost of services or other work to be provided by consultants and contractors.

BUDGET ITEM DESCRIPTION	COMPUTATION		Quantity Type	TOTAL COST
	$/Unit	Quantity		
Salaries and Wages				
Employee 1				$ 0
Employee 2				$ 0
Employee 3				$ 0
Fringe Benefits				
Full-Time Employees				$ 0
Part-Time Employees				$ 0
Travel				
Trip 1				$ 0
Trip 2				$ 0
Trip 3				$ 0
Equipment				
Item A				$ 0
Item B				$ 0
Item C				$ 0
Supplies and Materials				
Item A				$ 0
Item B				$ 0
Contractual / Construction				
Contractor A				$147,434
Contractor B				$ 0
Third-Party Contributions				
Contributor A				$ 0
Contributor B				$ 0
Other				
Other				$5000
TOTAL DIRECT COSTS				**$152,434**
Indirect Costs				
Type of rate	percentage	$base		$0
TOTAL ESTIMATED PROJECT COSTS				**$152,434**

Budget Narrative

The budget narrative provides a discussion of, or explanation for, items included in the budget proposal.

The engineering and inspection functions have already been performed, and all implementation costs have been priced at $152,434.00 This price includes any remaining engineering and inspection costs and capital construction costs. The equipment installed in the project is designed with a 30-year economic life and the ongoing maintenance costs are estimated to be less than 2.5% of the up-front capital costs per year. These ongoing maintenance costs are largely offset by reduced vehicular and operations costs. The estimated construction period is 4 months commencing January 2019, and the estimated economic life of the installed equipment is 30 years.

The O&M costs over the 30-year asset life of this solution are estimated at less than 2.5% of the capex. These O&M costs are expected to be largely offset by a reduction in existing costs such as vehicular usage and other operational costs. There are no land or water acquisition costs involved in this project. When the capital costs of the project are amortized over the 30 year asset life, this water is made available at a cost of only $42.00 per acre-foot per year – the value of this water is significantly greater than the cost of making it available.

The solution is economically attractive because it is adding to existing infrastructure investments and leveraging these previous investments.

Salaries and Wages

Indicate the Project Manager and other key personnel by name and title. The Project Manager must be an employee or board member of the applicant. Other personnel should be indicated by title alone. For all positions, indicate salaries and wages, estimated hours or percent of time, and rate of compensation. The labor rates must identify the direct labor rate separate from the fringe rate or fringe cost for each category. All labor estimates must be allocated to specific tasks as outlined in the applicant's technical project description. Labor rates and proposed hours shall be displayed for each task.

Project Manager – Tracy Smith, General Manager

No other district personnel will be involved with this project.

The budget proposal and narrative should include estimated hours for compliance with reporting requirements, including final project and evaluation.

Fringe Benefits

Identify the rates/amounts, what costs are included in this category, and the basis of the rate computations. Federally approved rate agreements are acceptable for compliance with this item.

Travel

Identify the purpose of each anticipated trip, destination, number of persons traveling, length of stay, and all travel costs including airfare (basis for rate used), per diem, lodging, and miscellaneous travel expenses. For local travel, include mileage and rate of compensation.

Equipment

If equipment will be purchased, itemize all equipment valued at or greater than $5,000. For each item, identify why it is needed for the completion of the Project and how the equipment was priced. *Note: if the value is less than $5,000, the item should be included under materials and supplies.*

If equipment is being rented, specify the number of hours and the hourly rate. Local rental rates are only accepted for equipment actually being rented or leased.

If the applicant intends to use their own equipment for the purposes of the project, the proposed usage rates should fall within the equipment usage rates outlined by the United States Army Corps of Engineers (USACE) within their Construction Equipment Ownership and Operating Expense Schedule (EP 1110-1-8)

Note: No equipment will be needed for this project.

Materials and Supplies

Itemize supplies by major category, unit price, quantity, and purpose, such as whether the items are needed for office use, research, or construction. Identify how these costs were estimated (i.e., quotes, engineering estimates, or other methodology). *Note: If the materials/supplies will be furnished and installed under a contract, the equipment should be included in the construction contract cost estimate.*

No other materials or supplies are known to be needed at this time. However $5000 has been added as contingency costs as a protection against unknown needs.

Contractual

Identify all work that will be accomplished by consultants or contractors, including a breakdown of all tasks to be completed, and a detailed budget estimate of time, rates, supplies, and materials that will be required for each task. For each proposed contract, identify the procurement method that will be used to select the consultant or contractor and the basis for selection. Please note that all procurements with an anticipated aggregate value that exceeds the Micro-purchase Threshold (currently $10,000) must use a competitive procurement method (see 2 CFR §200.320 – *Methods of procurement to be followed*). Only contracts for architectural/engineering services can be awarded using a qualifications-based procurement method. If a qualifications-based procurement method is used, profit must be negotiated as a separate element of the contract price. See 2 CFR §200.317 through §200.326 for additional information regarding procurements, including required contract content.

This project is 100% contractual with the Rubicon Systems as this is their product which will be installed and set up to function by their labor crew. Bostwick employees will not be involved in this project.

Third-Party In-Kind Contributions

Identify all work that will be accomplished by third-party contributors, including a breakdown of all tasks to be completed, and a detailed budget estimate of time, rates, supplies, and materials that will be required for each task. Third-party in-kind contributions, including contracts, must comply with all applicable administrative and cost principles criteria, established in 2 CFR Part 200, available at www.ecfr.gov, and all other requirements of this FOA.

Environmental and Regulatory Compliance Costs

Prior to awarding financial assistance, Reclamation must first ensure compliance with Federal environmental and cultural resources laws and other regulations ("environmental compliance").

Every project funded under this program will have environmental compliance costs associated with activities undertaken by Reclamation and the recipient.

To estimate environmental compliance costs, please contact compliance staff at your local Reclamation Office for additional details regarding the type and costs of compliance that may be required for your project. *Note, support for your compliance costs estimate will be considered during review of your application.* Contact the Program Coordinator *(see Section G. Agency Contacts)* for Reclamation contact information regarding compliance costs and requirements.

Environmental compliance costs are considered project costs and must be included as a line item in the project budget and will be cost shared accordingly.

The amount of the line item should be based on the actual expected environmental compliance costs for the project, including Reclamation's cost to review environmental compliance documentation. Environmental compliance costs will vary based on project type, location, and potential impacts to the environment and cultural resources.

How environmental compliance activities will be performed (e.g., by Reclamation, the applicant, or a consultant) and how the environmental compliance funds will be spent, will be determined pursuant to subsequent agreement between Reclamation and the applicant. The amount of funding required for Reclamation to conduct any environmental compliance activities, including Reclamation's cost to review environmental compliance documentation, will be withheld from the Federal award amount and placed in an environmental compliance account to cover such costs. If any portion of the funds budgeted for environmental compliance is not required for compliance activities, such funds may be reallocated to the project, if appropriate.

Costs associated with environmental and regulatory compliance must be included in the budget. Compliance costs include costs associated with any required documentation of environmental compliance, analyses, permits, or approvals. Applicable Federal environmental laws could include NEPA, ESA, NHPA, CWA, and other regulations depending on the project. Such costs may include, but are not limited to:

- The cost incurred by Reclamation to determine the level of environmental compliance required for the project
- The cost incurred by Reclamation, the recipient, or a consultant to prepare any necessary environmental compliance documents or reports
- The cost incurred by Reclamation to review any environmental compliance documents prepared by a consultant
- The cost incurred by the recipient in acquiring any required approvals or permits, or in implementing any required mitigation measures
- ***We do not believe there will be any Environmental and Regulatory Compliance Costs as this project will simply update existing equipment on the system.***

Environmental and Cultural Resources Compliance

Environmental compliance costs are considered project costs and must be included as a line item in the project budget and will be cost shared accordingly.

Required Permits or Approvals

Applicants must state in the application whether any permits or approvals are required and explain the plan for obtaining such permits or approvals.

None needed.

Letters of project Support

Please find letter of support from the State of Nebraska and Kansas Bostwick Irrigation at the end of ths proposal.

Official Resolutions

- The identity of the official with legal authority to enter into an agreement
- The board of directors, governing body, or appropriate official who has reviewed and supports the application submitted
- The capability of the applicant to provide the amount of funding and/or in-kind contributions specified in the funding plan
- That the applicant will work with Reclamation to meet established deadlines for entering into a grant or cooperative agreement
-

Please find the Board Resolution at the end of this proposal.

Unique Entity Identifier and System for Award Management

(i)Be registered in the System for Award Management (SAM) before submitting its application;

(ii)Provide a valid unique entity identifier in its application; and
(iii)Continue to maintain an active SAM registration with current information at all times.

Entity Identifier: 43KT4

QUOTATION

Rubicon Water
Rubicon Systems America, Inc.

Fort Collins
1501 S. Lemay Avenue
Suite 101
Fort Collins, CO 80524
toll free 1-877-440-6080
phone 970-482-3200
fax 970-482-3222
email inquiry@rubiconwater.com

Modesto
2318 Tenaya Drive
Modesto, CA 95354

Imperial
415 W Aten Road
Imperial, CA 92251

www.rubiconwater.com

Date:	April 10, 2019
To:	Tracy Smith
Company:	Nebraska Bostwick Irrigation District
Address:	1147 US-136 Red Cloud, NE 68970
Email:	bostwick@gpcom.net
Project:	Superior Canal Headgate
Quote #:	Q500975
Valid For:	60 days
Shipping terms:	FOB Fort Collins, CO
Billing terms:	Net 30 days (see Payment Terms for details)
Prepared by:	Darren McGregor

It is with pleasure that Rubicon Water submits this quotation for automation of the headgate of the Superior Canal, as a first step of automating the canal under Rubicon's Total Channel Control to match supply and demand, thereby minimizing operational spill and holding canal levels to constant setpoints to normalize flows on to farms.

This quotation outlines the process and parts that will be provided to automate the existing gate. The gate is a large radial on a manual gearbox actuation, normally ran with a drill as there is no local power source. Adjustment is made typically once a day as needed by system operators to best supply farmers on the Superior. By instrumenting and automating the gate, flow calculation can be done continuously and adjustments can be made several times an hour to better match the flows needed, thereby minimizing the draw from the river.

The hardware required will be:

- DC-powered actuator
- Control cabinet with solar power supply and local RTU
- Solar panels with mounting masts
- Upstream and downstream level sensors
- Licensed radio or cellular modem to connect with remote SCADA

Implementation cost is as follows:

Qty	Product Number	Description	Each ($)	Total ($)
1	N/A	Rubicon to supply actuator, control cabinet, solar power supply, level sensors, and (optional) gearbox or gearshaft replacement if needed for single-gate application. Rubicon to install and integrate.	$45,000	$45,000
1	*OPTION 1*	Supply of 450 MHz radio to tie the site to the existing SCADA system at NBID's offices in red Could. Price includes SCADA integration and commissioning.	$2,450	$2,450
1	*OPTION 2*	SCADAConnect Live Starter Kit (includes a cellular modem, antenna, cabling, as well as account and site configuration, and software licensing on Rubicon's cloud-based SCADA system). Price also includes first year service fees ($750/year).	$1,750	$1,750
1	N/A	Installation Supervision and commissioning	$1,500	$1,500
*Prices exclude all taxes			**Total Cost, Option 1:**	**$48,950**
			Total Cost, Option 2:	**$48,250**

NOTE: Separate options were given on remote access as a) the lack of a new repeater tower in this area might make communicating directly with the Red Cloud server difficult and b) we are unsure if KBID will also need access, and if so a cloud-based solution could be an easier one to manage.

SCADAConnect Live Description:
Rubicon's SCADAConnect Live is a cloud-based SCADA system that gives users full remote control of their sites. Data is transmitted through AT&T's cellular network to both send commands to the sites as well as gather all data, including flows, levels, alarms etc. Included in SCADAConnect Live:

- Full remote monitoring and control of sites. Note access can be varied depending on password for different officers of the irrigation district (full control versus monitoring only).
- Alarming functions can be sent through email or text.
- All data pertinent to each site can be viewed on the site's historian, or downloaded in .CSV format for storage or reporting.

Exclusions:

- Provision of concrete footing to mount control cabinet.
- Prices exclude all taxes.

QUOTATION

Rubicon Water
Rubicon Systems America, Inc.

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Suite 101
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toll free 1-877-440-6080
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Modesto, CA 95354

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415 W Aten Road
Imperial, CA 92251

www.rubiconwater.com

Date: April 10, 2019

To: Tracy Smith
Company: Nebraska Bostwick Irrigation District
Address: 1147 US-136
Red Cloud, NE 68970
Email: bostwick@gpcom.net

Project: Courtland Canal Headgates
Quote #: Q500976
Valid For: 60 days

Shipping terms: FOB Fort Collins, CO
Billing terms: Net 30 days (see Payment Terms for details)
Prepared by: Darren McGregor

It is with pleasure that Rubicon Water submits this quotation for automation of the headgates of the Superior Canal, as a first step of automating the canal under Rubicon's Total Channel Control to match supply and demand, thereby minimizing operational spill and holding canal levels to constant setpoints to normalize flows on to farms.

This quotation outlines the process and parts that will be provided to automate the existing gates. The gates are large radials on a manual gearbox actuation, normally ran with a drill as there is no local power source. Adjustment is made typically once a day as needed by system operators to best supply farmers on the Courtland. By instrumenting and automating the gate, flow calculation can be done continuously and adjustments can be made several times an hour to better match the flows needed, thereby minimizing the draw from the river.

The hardware required will be:

- DC-powered actuators
- Control cabinets with solar power supply and local RTU
- Solar panels with mounting masts
- Upstream and downstream level sensors
- Licensed radio or cellular modem to connect with remote SCADA

Implementation cost is as follows:

Qty	Product Number	Description	Each ($)	Total ($)
1	N/A	Rubicon to supply actuators, control cabinets, solar power supply, level sensors, and (optional) gearbox or gearshaft replacement if needed for all five gates. Rubicon to install and integrate.	$88,534	$88,534
1	*OPTION 1*	Supply of 450 MHz radio to tie the site to the existing SCADA system at NBID's offices in red Could. Price includes SCADA integration and commissioning.	$2,450	$2,450
1	*OPTION 2*	SCADAConnect Live Starter Kit (includes a cellular modem, antenna, cabling, as well as account and site configuration, and software licensing on Rubicon's cloud-based SCADA system). Price also includes first year service fees ($750/year).	$1,750	$1,750
5	N/A	Installation Supervision and commissioning	$1,500	$7,500
*Prices exclude all taxes			**Total Cost, Option 1:**	**$98,484**
			Total Cost, Option 2:	**$97,784**

NOTE: Separate options were given on remote access as a) the lack of a new repeater tower in this area might make communicating directly with the Red Cloud server difficult and b) we are unsure if KBID will also need access, and if so a cloud-based solution could be an easier one to manage.

SCADAConnect Live Description:
Rubicon's SCADAConnect Live is a cloud-based SCADA system that gives users full remote control of their sites. Data is transmitted through AT&T's cellular network to both send commands to the sites as well as gather all data, including flows, levels, alarms etc. Included in SCADAConnect Live:

- Full remote monitoring and control of sites. Note access can be varied depending on password for different officers of the irrigation district (full control versus monitoring only).
- Alarming functions can be sent through email or text.
- All data pertinent to each site can be viewed on the site's historian, or downloaded in .CSV format for storage or reporting.

Exclusions:

- Provision of concrete footing to mount control cabinet.
- Prices exclude all taxes.

Bostwick Irrigation District in Nebraska

P.O. Box 446, Red Cloud, Nebraska 68970
Phone/Fax (402) 746-3424

RESOLUTION FOR WATERSMART GRANT PROGRAM:

Application No. BOR-DO-20-F001 Fiscal Year 2020
September 30, 2019

WHEREAS, the Bostwick Irrigation District in Nebraska is a legally organized irrigation district in the State of Nebraska, and

WHEREAS, the District promotes, supports and encourages water conservation, and

WHEREAS, the District has suffered through a drought that allowed no/limited irrigation in 2004, 2005, 2006, 2007, 2014, 2015 and

WHEREAS, the District urgently needs system improvements to maximize the utilization of a limited water supply and help sustain the viability of the project.

THEREFORE, BE IT RESOLVED that the Board of Directors of the Bostwick Irrigation District in Nebraska agrees and authorizes that:

1. The Board has reviewed and supports the application proposal to the WaterSMART Grant Program;
2. The Board authorizes the District Manager, Tracy Smith, the legal authority to enter into the WaterSMART Program Grants agreement;
3. The Bostwick Irrigation District in Nebraska is capable of providing the in-kind services and matching obligations, along with the State of Nebraska and Kansas Bostwick Irrigation District, and
4. If selected for a WaterSMART Grant, the applicant will work with Reclamation to meet established deadlines for entering into a cooperative agreement.

DATED: Sptember 30, 2019

Walter Knehans, President

ATTEST:

Lee Fintel, Secretary

"Water is Life"

NEBRASKA

Good Life. Great Water.

DEPT. OF NATURAL RESOURCES

September 27, 2019
Tracy Smith, District Manager
Bostwick Irrigation District in Nebraska
1147 W. Highway 136
PO Box 446
Red Cloud, NE 68970

Dear Tracy:

Please consider this letter a formal expression of support and commitment from the Nebraska Department of Natural Resources to provide up to $48,950 of matching state funding for your Bureau of Reclamation WaterSMART grant application for the automation project associated with the headgates of the Superior Canal and Courtland Canal systems. These types of projects are key investments toward sustaining irrigation operations over the long term, and enhancing water supplies during periods of drought. The Department's current plans pertaining to the project area, an integrated management plan and the recently adopted Republican River Basin-Wide Plan, both recognize the benefits of these types of activities in supporting goals aimed at the long-term sustainability of irrigation uses in the basin.

Should your grant application be approved, Department staff will work with you to develop a contract that implements this financial commitment. Once again, the Department fully supports your district's efforts to implement these canal efficiency improvements and appreciates your district's efforts in working to support the state's integrated management plan and basin-wide plan goals.

Sincerely,

JEFF

Gordon W. "Jeff" Fassett, P.E.

Director

Gordon W. "Jeff" Fassett, P.E., Director
Department of Natural Resources
301 Centennial Mall South
P.O. Box 94676
Lincoln, Nebraska 68509
OFFICE 402-471-2363
FAX 402-471-2900
dnr.nebraska.gov

KANSAS
BOSTWICK IRRIGATION
DISTRICT NO. 2
COURTLAND, KANSAS

September 27th, 2019

Jared Gile • Superintendent
Scandia, Kansas
PHONE: 785-452-0592

Douglas G. Simms • Attorney
Belleville, Kansas
PHONE: 785-527-5316

To whom it may concern,

In regards to Bostwick Irrigation District in Nebraska's efforts to secure funding to apply towards the automation of the Courtland Canal head-gates located at the Superior-Courtland Diversion Dam on the Republican River west of Guide Rock, Nebraska, supplying water to both irrigation districts within the Bostwick Division, Kansas Bostwick Irrigation District (KBID) hereby agrees to commit up to $25,000 towards the said project.

This is done with the understanding that any amount of funding needed for the completion of the automation of the Courtland Canal head-gates, above and beyond the $25,000 commitment from KBID, will be provided by other entities and funding sources.

Sincerely,

Jared "Pete" Gile

Jared "Pete" Gile
Superintendent

528 Main Street • P.O. Box 165 • Courtland, Kansas 66939-0165
PHONE: 785-374-4514 • FAX: 785-374-4305 • E-MAIL: ksbostwick@gmail.com