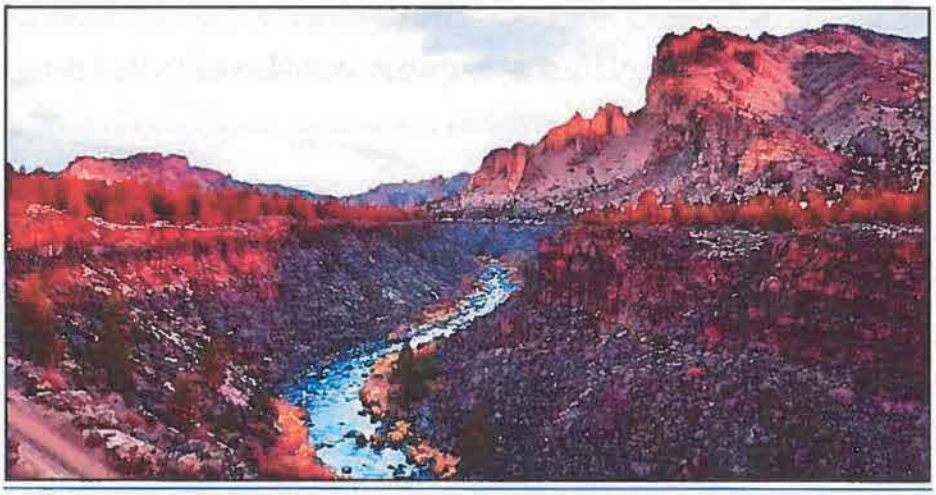
North Unit Irrigation District

Optimize Diversion Precision at Crooked River Pump Station



WaterSMART: Drought Resiliency Grant FY 2019 Proposal

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Date: March 27th, 2019
Applicant Name: North Unit Irrigation District
City/County/State: Madras, Jefferson County, Oregon

As part of North Unit Irrigation District's (the District) drought resilience strategy, the District owns 9 450-horsepower pumps that divert water from the Crooked River into the main canal. Combined the 9 pumps have the pumping capacity of 200 cfs; each with a rigid pumping speed. For this project, the District proposes to install a Variable Frequency Drive (VFD) on one of the nine pumps to improve the flexibility of the intake rate to match the variability of the Crooked River flow rates. This will allow for one of the nine pumps to vary its intake based on river flow from its current state of all on or all off. By accomplishing this, the District can maintain consistent flow on the Crooked River thus creating greater water quality and habitat in the Crooked River for the reintroduction of the endangered Middle Columbia Steelhead trout while also assisting in meeting minimum instream flow requirements. Because the pump can fluctuate with the river, it will give the district access to an estimated 3,500 acre feet per irrigation season of water; water to which the District holds a diversion right. The process not only improves the conveyance efficiency, but it improves the operational and energy efficiency of the pumping station as well. And by improving the diversion efficiency from the Crooked River, stress will be reduced on other sensitive water sources such as the Deschutes River which faces challenges to support the endangered Oregon Spotted Frog. This application is a request for funding the installation of a VFD system at the Crooked River pumping plant. This proposed project will contribute to accomplishing the following goals:

- Task A – Water Conservation: Enhance irrigation conveyance efficiencies within the District.
- Task B – Energy-Water Nexus: Conserve an estimated average 201,420 kilowatt hours of electricity annually in perpetuity.
- Task C – Benefits to Endangered Species: Improve conditions for ESA listed Mid-Columbia steelhead trout in the lower Crooked River, and ESA listed Oregon Spotted Frog in the Upper Deschutes River.

Construction of the project is planned to begin in October 2020 and ending in October 2022.

Background Data

Brief Project Introduction

North Unit Irrigation District provides irrigation water to nearly 59,000 agricultural acres in Jefferson County, Oregon. The system is part of the Deschutes Project which was funded and managed by the Bureau of Reclamation. The District primarily diverts water from the Deschutes River and supplements from the Crooked River (especially as a drought resilience strategy). Since the Deschutes River is over allocated and because the District is the Junior Water Right holder to the Upper Deschutes River, 70% of the water diverted into the District comes from storage in Wickiup Reservoir. In recent years, both water sources have been challenged by the Districts support of endangered species thereby drastically reducing water access and the requirement of more mindful water management strategies. Though other basin irrigation districts have experienced change as a result of the endangered species, no other irrigation district carries the burden more than the junior right, North Unit Irrigation District.

The District is based in Madras, but the project spans for miles upstream; first releasing water from Wickiup Reservoir into the Deschutes River, which travels 60 miles to its diversion into the District's main canal in Bend, Oregon. Once in the main canal, the water travels 30 miles through the partially lined and open canal before crossing over the Crooked River by box flume and entering the District's irrigated agricultural land. From Wickiup Reservoir to the tail end of the irrigation district, water travels over 120 miles and takes nearly three days to make the journey. The system is made up of 65 miles of main canal and 235 miles of laterals. The project is vast but also clever and inherently energy efficient; besides pumping water from the Crooked River Canyon, the entire system is gravity fed.

The region has a respectable agricultural legacy worth protecting. These 59,000 acres of irrigated land managed by North Unit Irrigation District make up nearly half of all the irrigated acres dependent on the Deschutes and Crooked River. Though vast in acreage, the District is the Junior Water Right holder, and are only able to supply, on average, 2.00 acre feet per acre of water from the Deschutes River and 1.00 acre feet per acre from the Crooked River to their patrons. Very little can be grown with only 2.00 acre feet per acre let alone 1.00, but patrons within the District have created remarkable value from what little they receive. The agricultural region served by the District has become the most economically-prosperous, agricultural region in Central Oregon. In a recent economic study comparing the Agriculture and Irrigation in Oregon's Deschutes and Jefferson Counties (May 2017), it was reported that within North Unit Irrigation District 13,000 acres of specialty crops were harvested, such as vegetable and grass seed, per year. Most notable of the vegetable seed is the hybrid carrot seed; within Jefferson County alone, our patrons grow over 55% of the nation's and 40% of the world's hybrid carrot seed. This equates to a gross income from agricultural sales totals of $74.4 million in Jefferson County and over $260 million to the Central Oregon economy in 2012. To put this value into context, the five irrigation districts senior to North Unit Irrigation District divert 60 % more water from the

Deschutes River and only harvest an average 239 acres of specialty crop per year. For Senior Water Rights holders in Deschutes County, this equates to an average $26.1 million and contributed $91.3 million in total economic impacts. The agricultural region served by the District contributes nearly three times the economic value to Central Oregon by only using roughly one third the water.

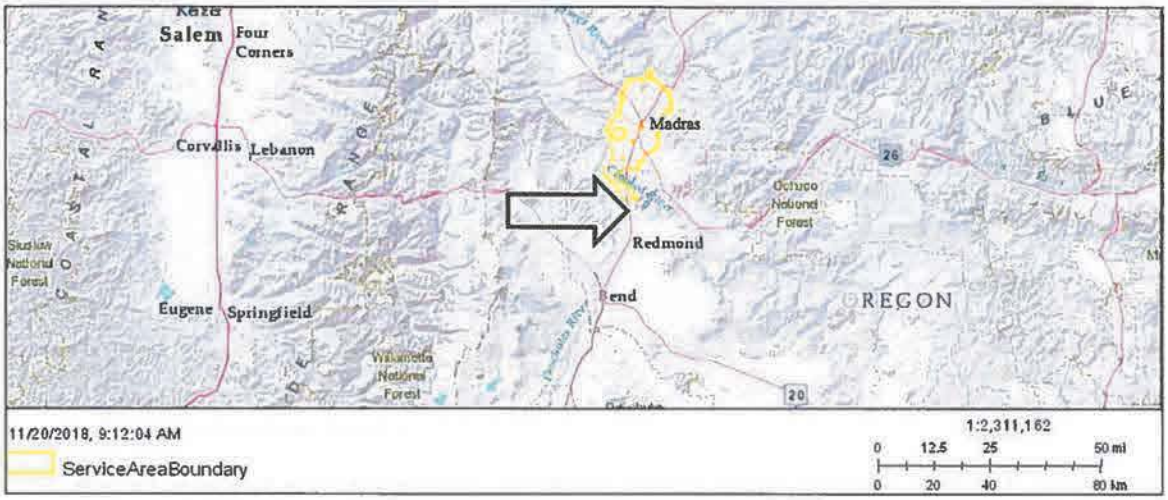

Figure 1. Crooked River Pumps located on the Crooked River which cuts just south of the District boundaries– Area Map

While the Senior Water Right deliver at 45-50% water efficiency, North Unit Irrigation District has worked hard to improve our system delivery efficiency to closer to 60% and our on-farm to nearly 93% efficient. The efficiency comes from not only the operational benefit of function as an "on-demand" system (where water is only delivered if ordered 24-hrs in advance), or by pushing for many piping and lining projects throughout the District, but out of necessity for survival. Remaining piping projects have been outlined in our System Improvement Plan (2017), which is estimated to return roughly 60,000 acre feet in water savings upon its completion, and await funding and time. But these piping projects will take decades to complete, and stress from dramatic changes in water management require more immediate and diverse solution to ensure the District's survival.

Natural river flow from both the Deschutes and Crooked River is no longer enough to support all the dependent irrigated acreage. The river had been over allocated since the planning of all the irrigation projects in the early 1900's; though in the 1930's, the construction of Wickiup Reservoir designed to sustain the North Unit project did functionally resolve this over allocation for many decades. Wickiup Reservoir holds 200,000 acre feet at full capacity and from this storage the District pulls 70% of our total diverted water. However, this allocation structure ensures that increased frequency and severity of drought to the region, along with the detrimental changes to water management to Wickiup Reservoir, the Deschutes and the Crooked River in protection of multiple ESA-protected species weigh solely on North Unit Irrigation District.

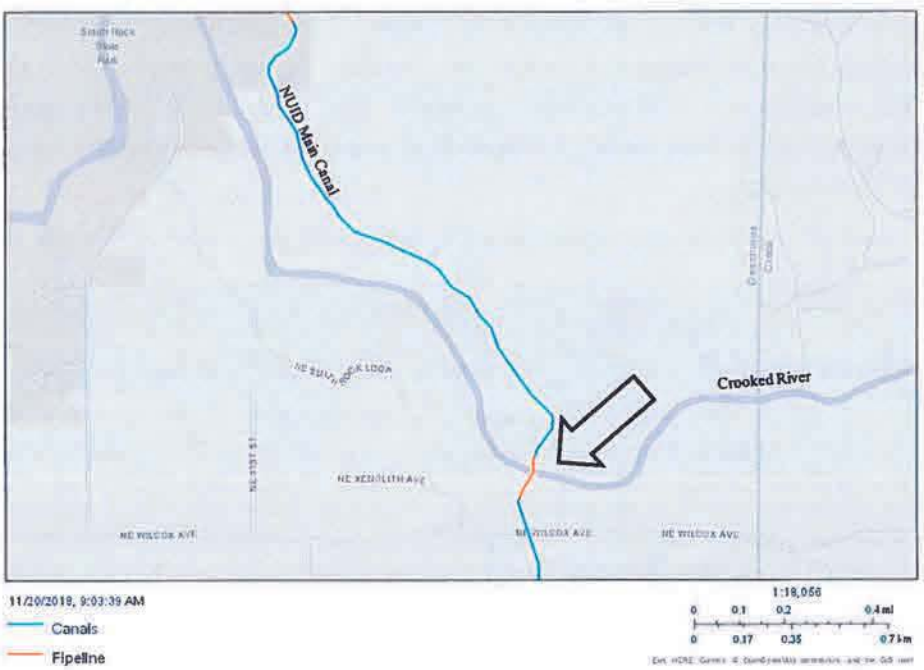

Figure 2. Crooked River Pump Station is located below where the North Unit Irrigation District main canal crosses over the Crooked River Canyon by box flume– Project Area

In times of drought, such a shortage in natural river flow from the Deschutes River or in the case Wickiup Reservoir does not fill, the District's drought resilience strategy is to pump from the Crooked River through their pump station. On a normal year, the District has needed to pump ~11,000 acre feet from the Crooked River, while during a drought year the diversion has double to an average of 22,000 acre feet. Though the technology available at the pump station seemed enough in the past, it limits the District's ability to efficiently and effectively manage its water to the best of its ability in order to meet watershed goals and survive through troubling droughts. The necessary technology must create a flexible pumping rate that matches the diurnal variations of the river flow rate while also ensure enough flow remains in the river to meet fish and wildlife needs including ESA-protected species.

In addition to drought resilience for shortages felt based on low precipitation, the District relies on Crooked River through shortages resultant of drastic management changes to Wickiup Reservoir for the endanger Oregon Spotted Frog. Recent changes in Wickiup reservoir management in protection of the endangered species, the Oregon Spotted Frog, have intensified water shortages in drought years to the District. For the endangered species, 30,000 acre feet of storage from Wickiup Reservoir is unusable by the District because it is released during the winter season. And in coming years the release rate could potentially increase to where 60,000 acre feet of storage per winter will be released from Wickiup Reservoir.

The first wake-up call came in 2018. The Deschutes Basin experienced a promising, wet spring followed by a detrimental summer drought. Wickiup Reservoir started the season full, but such

extreme, unpredictable conditions layered with multiple dependents on Wickiup Reservoir and increased storage release for the Oregon Spotted Frog led to its complete drainage. The reservoir had not reached such lows in over 50 years. The District strategized ways to endure the drought but was limited by our technology. It became obvious that any reduction in dependence on the Deschutes River reduced the detrimental competition for the stored water in Wickiup Reservoir. The Crooked River has always acted as a successful drought resilience strategy; however, the changing water management plan for endangered species has intensified the need to optimize water efficiency at the Crooked River Pump Station.

The Crooked River winds through a fractured basaltic canyon, ridged with thousands of invasive western juniper trees. The invasive tree can consume up to 20 gallons per day and transpire 30 to 40 gallons per day on a warm mid-summer day. Because this region is hydraulically connected through the fissure network of the canyon, and the roots of western junipers burrow deep, the water consumption by the western juniper can be seen in the diurnal fluctuation of the Crooked River flow rate. The flow rate in the river drops to its lowest during the day while the trees are transpiring and peaks each night. Regional efforts have been made by the U.S. Forest Service, Middle Deschutes Watershed Council, U.S. Bureau of Land Management, U.S. Department of Agriculture and more to reduce the spread of the invasive western juniper throughout the region; however, fewer and fewer restoration projects are being funded because of the futile effort. It has been encouraged to find more effective and longer lasting strategies to endure the effects of the invasive tree.

To the Crooked River, the effects are consistent and predictable regardless of the time in the summer. The fluctuation is a consistent sinusoidal swing congruent with diurnal fluctuation and operational schedules upstream and is unmanageable by the current pump station. The troughs in the flow rate trigger pumps to shutdown abruptly and turning on a pump during the evening to capture the peak flow can riskily overdraw from the river and be energetically inefficient. It is estimated that throughout the irrigation season anywhere from 3,000 to 5,000 acre feet of available water remain uncaptured by the current pump technology. This could mean that during a drought year the pump station could be functioning as low as 75-80% efficient. An accurate estimate of this inefficiency has been hard to capture; so instead these estimates, which are based on well-informed observation and operational procedure, provide a quantifiable, low resolution estimate.

Energy Uses and Sources

North Unit's largest source of energy usage is associated with the Crooked River Pumping Plant described above. The current average as of 2018 for kwh used for pumping water annually at the Crooked River pumping facility is 4,142,680 based on a 10-year average. Pumping water from the Crooked River canyon costs approximately $16.75 per acre foot in electricity charges due to the change in elevation between river and canal. Current pumping costs for a typical irrigation season are approximately $250,000 with power rates expected to significantly increase in the coming years.

Endangered Species

Because the District pulls from both the Deschutes and Crooked River, water savings and improved efficiency in the District's water management abilities will benefit aquatic life in both river systems. The Deschutes Watershed is home to the threatened Oregon Spotted Frog, Middle Columbia Steelhead, and Bull Trout protected by the Endangered Species Act (ESA). The Upper Deschutes River is home to the Oregon Spotted Frog while the Crooked River is home to Middle Columbia Steelhead in addition to proposed reintroduction of the endangered Bull trout, as well as Spring Chinook Salmon, Summer Steelhead, and Redband trout. Both of which require a minimal amount of stream flow and clarity for survival.

The Endangered Oregon Spotted Frog has found habitat in the headwaters of the Deschutes River in Crane Prairie Reservoir and along the Deschutes River below Wickiup Reservoir. To endure the winters and successfully spawn in the spring, the frog finds safe habitat in calm side pools along the reservoirs and rivers. These pools can only be maintained by increasing winter discharge from the reservoirs in to the rivers or halted discharge to ensure reservoir height fills the calm side pools along the reservoir edges.

The Crooked River was once a major spawning ground for anadromous fish such as spring Chinook salmon, Steelhead trout and Pacific lamprey. And home to non-migratory fish such as Redband trout and Bull trout. The installation of Cove Power Plant on the lower Crooked River blocked upriver migration for spring Chinook salmon. And the construction of Ochoco Dam blocked fish passages completely. Though attempts have been made to install fish passages, the populations have not yet recovered. Current plans to re-introduce endangered Bull trout have motivated water quality and habitat reviews of many sections of the Crooked River. The North Unit Irrigation District pumping station is in the middle of both dams; the natural morphology of river bend at the pump site does not contain pools or sandbars suitable for spawning. But the District is committed to facilitating river improvements for fish and wildlife by reducing the disturbance to river flow.

Past Working Relationship with Reclamation

North Unit Irrigation District has a long-standing relationship with the Bureau Reclamation as part of the Deschutes Project. The Deschutes Project includes Wickiup Dam and Reservoir, Haystack Dam and Reservoir, the North Unit Main Canal, and associated delivery facilities. The Deschutes project was authorized by a finding of feasibility by the Secretary of the Interior dated September 24, 1937, approved by the President on November 1, 1937, pursuant to section 4 of the Act of June 25, 1910 (36 Stat. 836) and subsection B of section 4 of the Act of December 5, 1924 (43 Stat. 702). Construction of Haystack Dam and equalizing reservoir was authorized by act of the Congress on August 10, 1954, (68 Stat. 679, and Public Law-573). In 2007, a congressional bill and contract modification, initiated and funded by the District, was passed that authorized the District to participate in conserved water projects. Previously the District could not participate in conserved water projects as a result of the conditions of their contract with the US Bureau Reclamation.

The District has participated in numerous water conservation projects with Reclamation's financial support. Projects are summarized below:

In Progress

2015-2019 – Phase II (R15AP00109) - North Unit Irrigation District piped the remaining 3 of 5 miles of sublaterals 58-11 and conserved 380 AF of canal seepage per season in three phases. The saved water was again returned to the Crooked River in an effort to increase water quality and quantity for Middle Columbia Steelhead reintroduction. Reclamation Funding: $704,478

Completed

2012-2016 - Phase I (R12AP13010) - North Unit Irrigation District piped the first 2 of 5 miles of sublateral 58-11 and conserved 380 AF of canal seepage per season in three phases. The saved water was again returned to the Crooked River in an effort to increase water quality and quantity for Middle Columbia Steelhead reintroduction. Reclamation Funding: $942,982

2015-2017 - Haystack Ramp Flume (R15AP00054) - Funding for BOR Water Conservation grant and Apple, Inc. to install a ramp flume below the discharge at Haystack Reservoir for water measurement. Reclamation Funding: $18,337

2011-2016 – Central Oregon Irrigation District (COID) I Lateral (R12AP13009) - Funding for BOR WaterSmart grant, OWEB and Pelton Fund to pipe a portion of COID's I Lateral. The conservation water from this project will be transferred to NUID lands with Crooked River water rights. Cooked River water rights will be transferred instream as described in the Main Canal Lining Project Below. Reclamation Funding: $600,000

2011-12 – North Unit Irrigation District Energy and Conservation Initiative (R11SF80303)- Line approximately five miles of its Main Canal and conserve up to 7,880 acre-feet (AF) of water from the Deschutes River. The saved water will be used to irrigate lands currently supported by water that is pumped from the Crooked River. The Crooked River water rights displaced by the new water resulting from the lining project will be retired to support water quality and fish habitat improvements in the Crooked River. Reclamation Funding: $1,000,000

2011 – 58-9 Surge Pond (R11AP1C008) – Construct a surge pond at the confluence of Lateral 58-9 and Lateral 58-11 to improve water management capacity. The surge pond is designed to hold 25 to 30 acre feet of water and will be utilized to catch irrigation water surges in the system and utilize the water for irrigation rather than allowing it to flow off the irrigation district and carry excess sediment into the creeks, degrading critical fish habitat. Reclamation Funding: $130,000

2010 – Haystack Flow Measurement (R10AP1C052) – Install a Horizontal Acoustic Doppler Current Profiler within the district's easement near the base of Haystack Dam just downstream where the bypass chute and Haystack discharge come together. Reclamation Funding: $10,899

2010 – Modernization of the Bend Diversion (R10AP1C006) NUID will replace and/or install at the headgate, river site, flow monitoring station and the canal site flow monitoring station SCADA Programmable Logic Controllers, river/gate position sensors, and cellular modem to communicate data. Reclamation Funding: $31,016

2009 – WCFSP Lateral 58-9 Piping Phase II (09FG1U1446) Install 22,000 feet of pipe to provide improved water management; eliminate soil erosion; pressurize a portion of the water delivery system and improve water quality. Reclamation Funding: $318,663

2009 – WCFSP Ramp Flume – Lateral 58 (09FG1U1421) Install a ramp flume on Lateral 58 to for more accurate measure of water at the head end of the lateral to conserve an estimated 900 AF of water per year. (Revised to installation of an acoustic Doppler). Reclamation Funding: $16,270

2008 – WCFSP Pipelines 41-6 Lateral and 43-7-1 Lateral (1425-08-FG-1L-1350) Convert sections of two earthen ditches to pipe to conserve water by reducing seepage and evaporation losses. Reclamation Funding: $38,906

2007 – Water 2025 Challenge Cost Share Program, Lateral 58-9 Pipeline Phase I – improve Lateral 58-9 by converting one half mile of open earth ditch to two parallel pipes to conserve water and thereby increase available water supplies associated with Reclamation's Deschutes River Project. Reclamation Funding: $237,002

2007 – Water 2025 Challenge Grant, Telemetry & Action Plan. Partner with 5 other irrigation districts in Central Oregon to install flow measurement telemetry stations at 18 strategic locations across the 5 districts to measure the benefits of water conservation. Two sites were installed on the district. Reclamation Funding: $8,818

2007 – Piping Laterals 53, 58-13 and 63-1. Upgrade 3 laterals from open ditch or leaking pipe to plastic pipe to conserve water, increase water use efficiency and enhance water management. Reclamation Funding: $55,410

2006 – Lateral 58-3, pipe 1,800 feet to conserve water and enhance on farm irrigation efficiency. Reclamation Funding: $20,017

2005 – Water 2025 GIS and Aerial Imagery Consortium: Using Technology, Best Practices and Information System Management to Support Conservation Program Development and Implementation. Reclamation Funding: $25,000

2005 – Automation and Telemetry Financial and Technical Assistance to install telemetry at Haystack Reservoir, 58 lateral turnout, 37–6 lateral and 58-11 lateral to conserve water and enhance water management through automation. Reclamation Funding: $24,100

2004 – Lateral 51-1, piping approximately 3,500 feet of the distribution system to prevent seepage losses and soil erosion. Reclamation Funding: $11,470

2004 – Lateral 58, this project included 6,600 feet of pipe and abandon a section of lateral that passes through an industrial park. This piping project saved water and prevented soil erosion by decreasing canal seepage. Abandoning the section through the industrial park will kept runoff from parking lots and roofs from entering the irrigation system. Reclamation Funding: $66,972

2003 – North Unit Small Pipelines 2003 – piping of various short sections of canals in the distribution system to prevent erosive destruction of the canal banks by livestock and to save water. The project included installation of three pipelines for a total of 6,291 feet. Reclamation Funding: $38,000

2002 – Lateral 58-1, pipe approximately 5 miles of open canal to save water and reduce soil erosion by decreasing canal seepage. Reclamation Funding: $107,188

1998 – Lateral 51-4, demonstration high head pressure pipeline system, installation of 25,000 feet of pipe to enclose an open canal. Reclamation Funding: $105,000

1995 – Lateral 52, installation of 12,500 feet of pipe to enclose an open canal. Reclamation Funding: $126,000

Project Description

The Crooked River Pump Station is located at the base of a 125-ft canyon, inaccessible by cellular, and, on-average, a 30-minute drive from the District base. Constructed in the 1960's as our first drought resilience strategy, the station contains 9 450-horsepower pumps which were originally cooling pumps for the 1940's Manhattan project. Though old, the pumps have proven to remain impressively efficient; multiple energy efficiency assessments have endorsed their usage today. The station has previously been retrofit with a control system that monitors Crooked River flow and will automatically turn off pumps based on the designated minimum flowrate within the river. All automation is designed to necessitate flow rates required to meet current minimum instream flow requires per established partnership agreements. After a pump has been shut off automatically, it can only be turned back on manually, on site. Procedurally limiting the operations to an "on-site, manual turn-on" has a mindful-water-management intent; it reduces the potential of error or harm to the river and our equipment, and it improves the overall safety. However, its distance from our operators has made the process of keeping pumps continuously on is a technical challenge in addition to being water and energy inefficient. The District proposes to upgrade one of nine 450-horsepower pumps at the Crooker River Pumping Plant with a variable frequency drive (VFD). The VFD will allow one pump to fluctuate from 5 to 15 cfs to match the highly variable flow rate within the Crooked River, ensuring both the demands of efficient agricultural water management and improved quality habitat for fish and wildlife.

In order to save electricity and have finer resolution to the flow pulled from the Crooked River, the District proposes to install a variable frequency drive on a pump in need of rewinding. The pump will be rewound to be suitable for VFD application. The VFD would then be incorporated into the control scheme to allow it to be the swing unit. A new building would be constructed to house the VFD and the many controls associated with the upgrade. The engineers responsible for all previous automation and engineering upgrades would also provide the automation, furnishing, wiring, and programming for the VFD. The District would then install the VFD into the constructed building; leaving all final programming to the engineers.

The fluctuating pump can capture up to 14 cfs more per day because of the inherent fluctuation to Crooked River flow rates on an hourly basis. Throughout an irrigation season, it is estimated that it could increase access to 3,500 acre feet of water to which the District has the right but previously unable to capture. The increased accuracy to our diversion at the Crooked River Pumps Station will also release pressure on other sources of water throughout the watershed. Reductions in demand on Wickiup Reservoir not only helps provide for the ESA Oregon Spotted Frog, but it gets us all closer to the goals outlined in the Upper Deschutes Basin Study and those proposed in the Deschutes Basin Multi Species Habitat Conservation Plan.

Performance Measure

With the help of accounting technology, the energy use and the water diversion rate of the District has been closely monitored throughout the irrigation season and tightly accounted for in each yearly budget. However, there are limits to our current means of data collection. The installation of the VFD and the advanced operation software will not only improve our diversion precision but also our data collection capability. This project will then be quantified by the improved water diversion capacity and reduction in overall energy cost throughout the season. And in the case of increase drought resilience, it will also be included in drought resilience studies designed to improve and update our water management plan.

Evaluation Criteria

Evaluation Criteria A: Project Benefits

Installing the VFD to the Crooked River Pumping Station will make additional water supply available, improve water management and benefit the fish and wildlife with whom we share our water sources. Diverting from the Crooked River has acted as a valuable drought resilient strategy for the District; yet, in recent years, it has proven to be limited and outdated in our efforts to meet our evolving water management goals. Not only will the District need to reduce dependency on stored water in Wickiup Reservoir (from which 70% of the District's water originates) in support of the ESA-protected Oregon Spotted Frog, but we need to effectively manage the Crooked River to assist in creating healthy habitat for the successful reintroduction of the ESA-protected Middle Columbia River Steelhead trout. The VFD is designed to meet the nexus of each of these concerns by improving our access to the water we hold the right to divert- therefore improving our water management strategy and drought resilience while also maintaining a healthy, constant flow for the aquatic species in the Crooked River.

The Crooked River is highly variable; changes in operational flow upstream and even evapotranspiration rates from surrounding vegetation cause the river flow rate to fluctuate hourly. At our current, rigid diversion rate, the District is unable to effectively match the river's behavior and ineffectively manages our water supply. By installing the VFD, previous inaccessible water- to which the District has a right- can affectively be diverted into the District.

It is conservatively estimated that on average 10 cfs per day of natural Crooked River flow- of which the District holds the right to divert- passes by the station uncaptured as a result of the inflexible system. As seen in Figure 3, the current District Pumping Rate at our Crooked River diversion is rigid and ineffective at meeting the natural fluctuation to the river flow rate. Most of the flow loss occurs throughout the night when it is operationally unmanageable. In an instance where the flow of the river drops below a defined flow rate, a pump will shut off causing a spike to the river flow rate. This spike always brings the river flow well-above the required flowrate, though we successfully maintain flow in the river for fish and wildlife, the process with the current technology also leads to significant loss to the district. Throughout a season, that adds up to 3,500 acre feet; it would take over $10 million in piping to match that level of water savings.

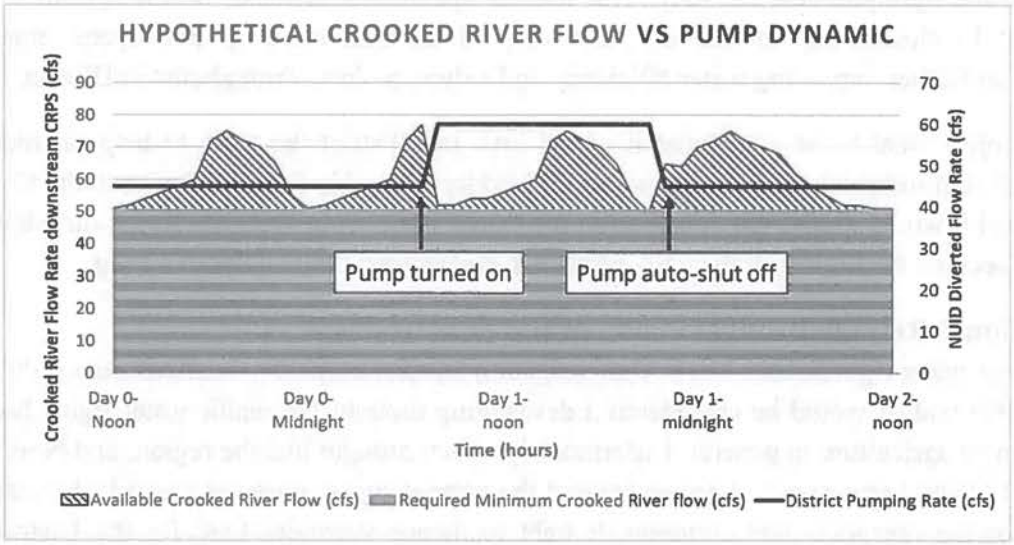

Figure 3. Hypothetical dynamic between fluctuating Crooked River flow and rigid pumping capacity of the current pumping station. The available Crooked River flow is the portion of water passing by the pumping station to which the District has the right to pump but not the technology. The Required Minimum Crooked River flow defines the minimum flow needed to meet partnership agreements and improved flows for fish and wildlife; this example shows the minimum of 51 cfs, which is the minimum during July under Dry-Year requirements (left axis). A pump is turned on when the difference between the Available Crooked River Flow and the Minimum Crooked River flow exceeds 15 cfs for a sustained period (right axis). A pump automatically turns off when the flow in the river drops below the minimum required flow.

The VFD provides operational flexibility and improved water management accuracy by allowing for the pumps to match the fluctuation of the river and reducing the frequency of stark turn-ons and offs. The river flow rate fluctuates as a result of multiple upstream operational changes as well as natural influences. The technology to vary the diversion rate to match the flow intake optimizes the conveyance efficiency and water supply access. Currently, when the river flow drops suddenly below the minimum, an entire pump will shut off. This causes a spike in the river; most often an entire pump did not need to turn off to meet the minimum flow demands but

that was all that could be done. After a shut off, a district employee makes the 30-minute drive to the station to turn off the fish screens for that pump and ensure its properly pulled offline. Without the VFD, hours or days pass after a pump is shut off as we wait for the river to stabilize at a rate that could confidently sustain the diversion rate of an entire pump. When that time is reached, a district employee drives down to the pump station and manually brings the pump back online. Operationally, over 120 hours per season is spent in management and transport to/from the pump station because of its current technology. It is estimated that this process costs the District over $12,000 a year for labor costs, liability risk, vehicle wear and tear, and operational efficiency loss. With the VFD, the pump's ability to match the dips and rises of the river drastically reduces pump shut-offs and eliminates water loss resultant of river flows not perfectly matching the rigid pumping capacity. This lessens operational demands on the system by over 60% just in eliminating unnecessary shut-offs; which then frees up employees' time and attention to further improving water efficiency and valued projects throughout the District.

If this project were to be completed it would give the District the tools to help facilitate the successful reintroduction of the ESA-protected Middle Columbia Steelhead trout to the Crooked River. And it would reduce the competition for stored water from Wickiup Reservoir which has recently become the lifeline of the ESA-protected, endangered Oregon Spotted Frog.

Evaluation Criteria B: Drought Planning and Preparedness

As a junior water right holder, North Unit Irrigation District normally functions on a tight water budget; this budget would be considered a devastating drought for senior water rights holders- and for most agriculture in general. Unfortunately, when drought hits the region, and North Unit Irrigation District experience shortage beyond the normal stress, it causes unavoidable damage. The following operations are common drought resilience strategies that, for the District, are employed in everyday operations so that we can endure water shortages as a junior water right holder and carrying much of the burden to preserve multiple endangered aquatic species in the Deschutes and Crooked River:

- Remove dependence of natural flow by relying more heavily on a storage reservoir (Wickiup Reservoir), supplementing river flow as needed
- Installing a re-regulating reservoir, with highly tuned- BOR funded- automation, to improve operational efficiency up 90%
- Optimize diversion efficiency from the Deschutes River to eliminate any loss from poor management, and ensure in-stream flow for endangered species are perfectly met
- Optimizing on-farm efficiency to 93% efficient (Agriculture and Irrigation in Oregon's Deschutes and Jefferson County May 2017) and further provide patrons with tools to better improve their irrigation planning/scheduling
- Implement allotments to patrons to limit and regulate water usage, encourage on-farm efficiency and wise on-farm irrigation strategies

- Plan for complete piping of the district, as outlined in our System Improvement Plan (2017)
- Maintain a constant flow of feasibility, planning, funding and piping projects to reach the goals of complete piping
- The District just finalized the BOR funded 58-11 lateral piping project, is collaborating with Central Oregon Irrigation District to pipe a portion of their main canal, and soon initiating the funding search for the "Feather Drive" piping project (feasibility study and 30% engineering planning complete)
- Actively pursue additional storage options to remove dependence on current water supplies and create an additional re-regulating point of control to further optimize basin wide water management

This is not to say that the District does not have a drought resilience strategy, but rather to point out that remaining Districts options for drought resilience are fairly limited since most strategies are already employed during normal operations. So what remains? The District has three main strategies that are employed during drought years: (1) define a limited allotment that may be below the minimum right defined by our patrons' water right, (2) purchase stored water from Prineville Reservoir and increase pumping from the Crooked River, (3) as a region, the patrons fallow much of their land so that they can bunch their water rights onto fewer acreage. In order to define the allotment accurately, the District works with the best information available, with experts in the area and with historic records to provide the most conservative yet least detrimental allotment to the patrons. The VFD, which will be discussed in full next, will optimize the Crooked River diversion, give access to at least 3,500 acre feet of water meant to the District and is the missing piece to optimizing our diversion accuracy from our water sources. And lastly, a highly versatile customer portal to give patrons the ability to track and plan their water usage has been developed for a 2019/2020 launch so that our patrons have the best technology to optimize on-farm efficiency and irrigation management.

There are two diversions into the District: one off the Deschutes River, and the second off the Crooked River. As explained, the Deschutes River diversion is the primary diversion to the District and is supplemented by the Crooked River flow as a drought resilience strategy. The automation at the Deschutes River needs improvement but is impressively accurate based on the operational limitations of the system. It can be ensured that the most water possible can be diverted from the Deschutes without impeding on in-stream rights. The automations at the Crooked River Pump Station, however, limits the District ability to maximize access to our available water. The diversion from the Crooked River was originally constructed to improve resilience through shortage and has been one of the drought resilience strategies for the District. But the Crooked River Pumping Station was constructed in the 1960's and modern technology can further increase water access and conveyance efficiency.

Not only does the Crooked River Pump Station divert natural Crooked River flow, but it also captures stored water released from Prineville Reservoir. In times of drought, an additional

drought resilience strategy for the District is to purchase 10,000 acre feet of stored water in Prineville Reservoir. Though costly, it is a necessary sacrifice to support this valuable agricultural region. This can be seen in our diversion rates: a normal year the Crooked River Pumping Station diverts roughly 10,000 acre feet of water; but with additional flow purchased from Prineville Reservoir, the station diverts over 20,000 acre feet in dry years. Without the effective and efficient conveyance system, a significant portion of this water can be left uncaptured. Every drop counts for the District in dry years. An increase of 3,500 acre feet on a dry year, capable with the VFD, could mean the difference between planting in the fall for next year or not and protect the livelihood of our patrons.

Evaluation Criteria C: Severity of Drought Impacts to be Addressed by the Project

Defining Shortage: North Unit Irrigation District services 59,000 acres on an average 1.90 acre feet per acre allotment from the Deschutes River and 0.95 acre feet per acre from the Crooked River; this average is below our minimum water right (2.00 and 1.00 acre feet per acre respectively) because water shortage as a junior water rights holder is common. The District manages over half the irrigated acres dependent on the Deschutes River by using less than a third of the water compared to all the other senior irrigation districts: the water budget is tight and calculated. As the junior water right holder in the Deschutes Basin, the District is the most susceptible to drought because we are the first to lose access to natural river flow. In normal years, the District can expect to gain 30% of our water from natural Crooked and Deschutes River flow, but in water short years that portion drops down to 15-20% natural flow (Table 1). Water shortage is first seen in the loss of natural flow from the Deschutes River; at which time, releases from Wickiup Reservoir and diversion from the Crooked River carry the District. If the natural flows on the Crooked River fall too low or are at a flow rate the pumps cannot accommodate, more is released from Wickiup Reservoir. In the case that Wickiup Reservoir cannot accommodate the increased demand, special resolutions such as temporary shut-offs are employed to ensure at the least some portion of water is available to patrons at pivotal times.

*Table 1. Estimated Percent of Total Diversion by Source. Access to natural flow from the Deschutes River drops drastically during dry years. *10,000 acre feet is purchased from Prineville Reservoir as a drought resilience strategy, Prineville Reservoir is not a primary water source for the District*

Estimated Percent of Total Diversion by Source

Water Source	**Normal Year**	**Drought Year**
Natural Flow: Deschutes River	25%	10%
Storage: Wickiup Reservoir	70%	80%
Natural Flow: Crooked River	5%	5%
*Stored: Prineville Reservoir**	0%	5%

Frequency of Natural Drought: The Deschutes Basin includes both the head waters for the Deschutes and Crooked Rivers and has experienced more frequent and extreme droughts.

Climate scientists have predicted more rain in lieu of snowpack and more extreme weather events such as drought or severe storms in the Pacific Northwest; and the past three decades have proven to support these predictions. Five of the past ten years have set climate records for the century, each breaking the record of the last. The winters have been equally as variable, with either minimal snow or record-breaking precipitation events that have collapsed buildings and flooded the region. For agriculture, this has lowered the certainty that Wickiup Reservoir will fill as a result of melted snow pack, and an increased summer irrigation demands in order to endure the extreme heat and dry spells. Currently, the average difference between the available water diverted during a normal versus a dry year is 23,000 acre feet per season. It is expected that the droughts will become more extreme; therefore, increasing the gap between supply and demand and mandating more to endure the shortages.

Frequency of Management-Caused Shortage: In addition to the natural shortages, the recent operational changes to Wickiup Reservoir (as of 2016) in protection of the ESA Oregon Spotted Frog have introduced regulatory droughts more extreme than most natural droughts experienced by the District. On average, limited supply during a natural drought have necessitated the District to reduce the diversion total by ~ 23,000 acre feet a year. To provide for the Oregon Spotted Frog over-wintering habitat, the District must discharge- without means of recovery- 15,000 acre feet each winter. Each spring, in April alone, the District releases another 15,000 acre feet to provide breeding habitat for the frog, bringing the total to 30,000 acre feet each year lost to habitat creation for the frog as well as all other benefiting fish and wildlife. With time, the winter discharge rate is planned to double or triple, leading to 45,000- 60,000 acre feet of unrecoverable storage loss each winter. With the current discharge agreement alone, the loss of stored water already exceeds the average historic deficit for natural droughts. The strength behind preserving the Deschutes River and all dependent fish and wildlife comes from it being a well-established Wild and Scenic region, rich with wildlife and a valued salmon passage. Rather than obstructing these goals, the District has switched their focus toward the Crooked River. As a basin, fellow irrigation district, water resource managers, key environmental groups, etc. have identified the need for the District to shift dependence away from Wickiup Reservoir and instead gaining access to water through the Crooked River.

Economic Impact: As a result of an average, natural shortage, the difference between a sufficient supply and a struggling water shortage for the District is 23,000 acre feet. In a normal year, the District diverts close to 210,000 acre feet into our system to provide the 2.00 acre feet per acre defined by our junior water right. During a dry year, the average diversion drops down to 187,000 acre feet which can only support a 1.80 acre feet per acre allotment with the current delivery system. For farmers, decreasing the allotment by 0.20 from 2.00 to 1.80 acre feet per acre (10% loss of total available water) fundamentally changes their plan for that year and the economic loss follows them to the next. In comparison, a 0.20 acre foot per acre loss to senior water users would only reduce their water usage from ~6 to 5.8 acre feet per acre (3% loss) which is unmeasurable by their current delivery technology and has no impact on their economic

production. Shortages from changes in reservoir management (Oregon Spotted Frog) have decreased the allotment to 1.50 acre feet per acre from the Deschutes, which has not been seen in decades. Allotments at this level challenge the risk-to-reward balance of every individual dependent on that water for their livelihood.

Senior water rights holders sustain their high allotment through dry and wet years to support urban areas and minimal agriculture, grossing $26 million in agricultural sales and economic value. With the 2.00 acre foot per acre for Deschutes River and 1.00 acre foot per acre for Crooked River allotments, the District supports a respectable agricultural community with a $194 million economic impact, grossing over $75 million in sales alone. However, with this large gross return, the wealth is not spread in a way that returns to the farmers because this region also pays the most per drop of water than any other irrigation district in the region. The region gives excessively to the economy, but the cost of water cuts deeply into operational costs, limiting each private farmers' and ranchers' financial stability.

In response to the decreased allotment, farmers within the District struggle to switch between types of crops because a switch might require different equipment or more labor than available. Therefore, even if the opportunity arrives to grow a different crop on less water, if the farmer cannot afford the equipment or labor, the field will instead be left fallow. Most of the irrigated acres in the District are set up to grow wheat, hay or grass seed; an important minority grow high-value, "cash crops" such as hybrid carrot seed, garlic, and peppermint oil. Many farmers who contribute to the over 65 % of the nations' and 40% of the world hybrid carrot seed (grossing over $15 million in carrot seed alone); but not all will be able to carry that production demand and risk under such a small allotment. Normal or wet years provide for more water-thirsty wheat harvests, while dry years must limit to grass seed production of the least risk. Unlike popular belief, cash crops such as garlic, or carrot seed, do not increase significantly during dry years because of the risk involved in their production. The process requires high investment in drip tape and labor which are often covered by the high return. But the risk to reward does not make it a better drought resilience strategy over fallowing land. It is unknown how much is economically lost due to the choice in planted crop type and reduction in planted acres chosen to sustain operations through such a low allotment.

Water Quality Impact: Water shortages within the District lead to an economic loss on a regional to global scale, while also introducing water quality concerns within the basin from fallowed land. Because the water allotment is normally low, there is little room to buffer the impacts of droughts and water shortages. Decreased allotments in response to water shortages are applied equally across all District acres, and as a result the allotment is often below the minimum irrigation demand for most crops. In order to ensure that the crop they do plant can survive and meet necessary quality requirements, the farmer will leave much of their fields fallow and bunch their water rights on fewer acres. Land fallowing has been an effective drought resilience strategy, but the fallowed land erodes, causing water and air quality issues as the top soil is washed or blown away. Great efforts to increase cover crop usage and sediment catch ponds

have been employed throughout the District, but there is still much more to be done. The severe erosion has caused most sediment ponds to fill, and maintenance on these private ponds have been hard to fund or sustain. Because the allotment is normally low, roughly 3,000 acres (5% of all irrigatable acreage) is left fallow within the District. Based on the past 10 years, that total acreage fallowed doubles during a water shortage- endangering surrounding water ways to water quality issues under unfortunate circumstances. The response of the agricultural community on a 1.50 acre foot per acre for the Deschutes River and 0.75 acre foot per acre for Crooked River allotment (as set in 2019) has not been fully understood due to its rarity, but it can be predicted that the amount of fallowed land will increase significantly and beyond any historic level.

Evaluation Criteria D: Project Implementation

This project has been on the District radar for three years, as the District built up internal cost share capability and hired qualified employees to implement the application and execution of the project. The project will be implemented in three phases: (1) the staging, (2) the installation, and (3) the furnishing. Staging will include clearing out space and constructing a structure that will house and protect the variable frequency drive. The installation not only requires lowering in the variable frequency drive, but also the rewound pump designed to function with the new drive. And the furnishing will include the operational wiring and troubleshooting to finalize the project.

Phase 1: Staging

Following the end of the irrigation season in October, when the pump house if off line, the staging phase will begin. In order to bare the weight of the variable frequency drive, a 16 by 10 foot foundation is required to safely spread the load. The District will excavate, gravel and concrete this foundation pad at the Crooked River Pump Station by means of a 320 Excavator, D6 and D8 Caterpillar. Upon this pad, the District will construct a building structure designed to endure high internal and external heat, solar radiation, and snow as well as be operationally accessible through a removable roof and double barn doors. The roof will be a 2 by 6 foot frame with a 2 by 16 foot center to bare heavy snow loads and heat release vents install along the walls. To and from this building conduit for power and controls will be staged. Off site, one pump will be rewound for compatibility with the variable frequency drive. The structure has already been designed, the pump is ready to be rewound and the rewind-outfitter prepared for the project.

Phase 2: Installation

Once the structure is complete and all supplies have arrived, the variable frequency drive will be transported to the site, safely lowered into the canyon, and into the constructed building by way of the opened roof. The removable roof to the adjacent pump house will also clear the way for the rewound, compatible pump to be crane-lowered in. Installation of these pieces are delicate and require highly trained crane-operators capable of less than centimeters of error. Strong relationships with local crane providers has guaranteed us a reliable and highly trained crane-operator qualified to ensure the success of this project.

Phase 3: Furnishing

The final phase will be managed by the engineers responsible for the automation of the VFD. OS Engineering will furnish, wire (power and controls) and program the VFD to function within our needed parameters. The District will provide the installation of all necessary conduits and connections. All controls will relay back to a Human Machine Interface already installed at the station, simplifying a portion of the automation needs. Once installed, the engineers will then troubleshoot and finalize all installation for the project. Furnishing, automation, and wiring have been designed and are ready to implement on arrival of the variable frequency drive.

Evaluation Criteria E: Nexus to Reclamation

This project will provide more accessible water to North Unit Irrigation District from the Crooked River while also maintaining consistent flow in the river for fish and wildlife; North Unit Irrigation District is a BOR irrigation project. By pulling more efficiently from the Crooked River, the District can reduce water demands on Wickiup Reservoir – a BOR managed dam/reservoir- in order to meet goals imposed by the ESA Oregon Spotted Frog. This endangered species has altered water management for the entire Deschutes Basin watershed, within which the BOR has history in constructing many reservoirs, dams and irrigation projects.

Evaluation Criteria F: Department of Interior Priorities

This project is designed to *create a conservation stewardship legacy second only to Teddy Roosevelt*. The District is challenged to release more stored water in order to create habitat along the banks of the Deschutes River. This timing of habitat creation has created conflict because it challenges the Districts ability to efficiently manage all their available water. However, by optimizing our diversion technology from the Crooked River we are achieving three higher goals: (1) reduce the demand on Wickiup Reservoir and therefore the conflicting competition with endangered species for stored water, (2) improve drought reliance and environmental changes to the watershed, and (3) ensure water quality and precise quantity is maintained in the Crooked River in anticipation for Middle Columbia Steelhead reintroduction. The District has been very supportive of *restoring trust with local communities* by seeking cooperative solutions to balance operational demands or limited logistical barriers with greater watershed goals. Not only has this project ensured the protection of habitat for fish and wildlife, but it has also strengthened relationships with local natural resource offices, fish and wildlife officers, water authorities and energy providers. Its value in *striking a regulator balance* comes from this projects ability to sustain quality habitat for the ESA Middle Columbia Steelhead within the Crooked River by maintaining a constant flow on the river, while also reducing competition for stored water with the ESA Oregon Spotted Frog because our water will be more efficiently diverted from the Crooked River. Lastly, the process of *modernizing our infrastructure* will improve our energy efficiency, lower our operations cost, and improve our ability to effectively manage our water supply with respect to our patrons and the fish and wildlife of our watershed.

Project Budget

Cost-Share Requirements

This project will leverage $131,885.54 of federal investments along with $131,885.54 of non-federal investments to provide the maximum benefits to all funding partners. The District will provide the $104,885.54 of in-kind and cost share and combine $27,000 third party funding from Central Electric Coop to match the 50:50 cost share. Of the $104,885.54, in-kind contribution makes up $17,811.37 and the remaining $87,074.17 as cash from the District.

Pre-Project Costs

North Unit Irrigation District anticipates that this project, as funded by Reclamation, will start October 2019 and no pre-project costs will be encored.

Funding Partners

The District has partnered with Central Electric Coop in funding this project as it will lower energy costs for the District and reduce tax on the electric system.

Other Federal Funds

No federal funds have been requested or received from other sources.

Pending Funding Requests

The District is awaiting final funding from the Central Electric Coop.

Funding Summary

Table 2. Summary of non-federal and federal funding sources.

Funding Sources	Funding Amount
Non-Federal Entities	
1. North Unit Irrigation District*	$17,811.37
2. North Unit Irrigation District	$77,674.17
3. Central Electric Coop	$27,000
*indicates in-kind contributions	
Non-Federal Subtotal	**$122,159.70**
Requested Reclamation Funding	$122,159.70
Total Project Funding	**$244,971.07**

Budget Narrative

Salaries and Wages: The salaries and wages listed in the budget are the in-kind/indirect contributions from the North Unit Irrigation District. District employees will provide the labor in the installation of the construction of the enclosing structure, guidance of the installation, and

monitoring of the project logistically and financially. The price per hour set for District employees was based on their current wage as of March 20th, 2019. Employee's wages will increase on January 1 of each year of the project and based on the Collective Bargaining Agreement will increase a minimum of 2.5% to 4% based on the CPI that year.

The Operation Manager Gary Calhoun will coordinate the rewinding of one of our pumps, the ordering of the variable frequency drive, and oversee all operations. The Watermaster/ Construction Manager will manage the construction of the structure, the installation of the VFD and final furnishing details necessary for automation. The Water Operations and Special Projects Coordinator, Lisa Windom, will manage and coordinate the integration of the automation into the current automation system and design a data measurement system to record and analyze the success of the project. All three will be involved in updating operational protocol in order to ensure the new equipment is operated to meet all regulations and water management goals. The Office Manager Marlene Lloyd and Water Records Clerk Sue Levitt will complete the necessary grant paperwork and accounting. Maintenance Foreman Mark Taylor will oversee three maintenance staff who will construct the enclosure, monitor the installation, and aid the final furnishing. In order to aid these processes, maintenance will also be transporting and operating equipment. An estimate of hourly time is listed in the budget breakdown with an hourly rate based on current wages effective Mach 20, 2019. The administrative and office wages usually increase January 1 of each year based on the CPI.

Fringe benefits: Hourly fringe benefit rates were calculated based on individual employee benefits. These rates will change over the life of the grant based on current rates. Fringe benefits and rates include the following

1) FICA/Medicare tax - 7.65%
2) Unemployment tax - 0.10%
3) Workers' Compensation – 4.28% project employees & 0.14% administrative and office employees
4) 401k retirement – 5.75%
5) Health insurance - 7.80 per hour
6) Life Insurance - $0.09 per hour
7) Short Term Disability Insurance - $.16 per hour
8) Health Reimbursement Arrangement - $0.38
9) Employee Housing Benefits- $0.93 per sq. ft.

Travel: This project requires the transport of six vehicles, 60 miles round trip, over eight days of work. Each car is experiencing $0.58 in gas and wear per mile for a total of 2880 miles.

Equipment: This District will use equipment owned by North Unit Irrigation District and operated by internal staff to construct the enclosure building. All equipment besides the dump

truck will be transported from the District's central base to the Crooked River Pump Station by the Districts truck and lowboy. The 320 Excavator will be used to clear out space for the foundation. The District's dump truck will transport gravel to stabilize the foundation. The D6 and D4 Caterpillars will flatten and set the foundation. All remaining work will require contracted equipment or no equipment.

Materials and Supplies: This project requires materials for the VFD and its enclosure. For the VFD, the supplies and materials include the VFD itself and spare parts to ensure its resilience and operational success. The enclosure requires supplies to construct a weight-bearing foundation sufficient for the VFD. It will protect the VFD from overheating with an active vent to maintain internal temperature. It will protect the drive from natural wear from solar damage and heat, and heavy snowpack. And it will be accessible by roof and a double barn door so it can be maintained without hinderance.

Contractual: The District will enter into four contractual agreements throughout this project. First the District will enter a direct contractual agreement with the VFD fabricators who will also provide the District with a warranty, and freight of the VFD to the location. Next, a contract with OS Engineering, with whom the District has worked heavily for all automation at the Crooked River Pump Station, will expand their work into furnishing and programming the drive. The District will also be signing into a contract with the refurbishing company specialized in rewinding the pump so it may be compatible and ready to function with the VFD system. And lastly, the installation of both the VFD and the rewound pump will require a large crane operated by an advanced operator. The District will be entering a contract with our local crane operator who is already familiar with the Crooked River Pump Station and has provided exemplary precision for previous pump maintenance.

Environmental and Regulatory Compliance Costs: There are no costs in the budget for environmental and regulatory compliance costs.

Reporting: District staff will be responsible for the reports on the status of the project as per the grant guidelines. The hours spent on reporting are included in the in-kind hours reported in the budget. The office manager will prepare the financial reports and the manager and assistant manager will provide the progress reports.

Other Expenses: None

Indirect Costs: None

Total Costs: $244,971.07

Detailed Project Budget

Please refer to Table 2, which provides the detailed breakdown of all costs encountered during the project. Note the contracts are broken down into the tasks being performed by the contracted agency. (See Exhibit A)

Environmental Compliance

The project does not require any environmental compliance.

Funding Plan and Letters of Commitment

The District is still awaiting the letter of commitment from Central Electric Coop, in reference to their Energy Efficiency, Variable Frequency Drive Program. The program provides $60.00 per motor horsepower controlled by the VFD, which equates to $27,000 in financial support for the 450 horsepower motor.

Environmental and Cultural Resources Compliance

The District must ensure minimum in-stream flow is met for fish and wildlife. And therefore, the programming for the VFD will be specifically designed to maintain the minimum flow.

Required Permits or Approvals

There are no required permits for this project.

Letters of Support

Attached are Letters for support.

Official Resolution

Written but scheduled to be signed April 9th, 2019 at the first available Board Meeting. Will be sent separately within 30 days of application deadline.

Exhibit A

	RATE	NUMBER	UNITS	TOTAL COST
PERSONNEL COST				
Gary Calhoun, Operations Manager	$33.65	16	hours	$538.40
Watermaster/Construction Manager	$28.85	32	hours	$923.20
Lisa Windom, Special Projects and Water Operations Coordinator	$21.61	16	hours	$345.76
Marlene Lloyd, Office Manager (AP/Grant Financial Reporting)	$30.31	20	hours	$606.20
Sue Light, Water Records Clark (Payroll)	$22.46	15	hours	$336.90
Mark Taylor, Maintenance Foreman	$19.46	64	hours	$1,245.44
Rex Heckathorn, Maintenance	$23.01	64	hours	$1,472.64
Lane Spring, Maintenance	$23.01	64	hours	$1,472.64
Marcus Schonneker, Maintenance	$23.01	64	hours	$1,472.64
			SUBTOTAL	**$8,413.82**
FRINGE BENEFITS				
Gary Calhoun, Operations Manager	$22.92	16	hours	$298.00
Watermaster/Construction Manager	$23.38	32	hours	$308.72
Lisa Windom, Special Projects and Water Operations Coordinator	$16.64	16	hours	$696.96
Marlene Lloyd, Office Maager (AP/Grant Financial Reporting)	$12.67	20	hours	$272.24
Sue Light, Water Records Clark (Payroll)	$11.55	15	hours	$336.42
Mark Taylor, Maintenance Foreman	$11.86	64	hours	$298.00
Rex Heckathorn, Maintenance	$12.48	64	hours	$308.72
Lane Spring, Maintenance	$17.96	64	hours	$696.96
Marcus Schonneker, Maintenance	$20.31	64	hours	$272.24
SUBTOTAL				**$5,814.81**
TRAVEL				
employee transport	$0.58	2880	mile	$1,670.40
SUBTOTAL				**$1,670.40**
EQUIPMENT				
320 Excavator	$37.25	8	hours	$298.00
D6	$38.59	8	hours	$308.72
D8	$87.12	8	hours	$696.96
Dumptruck-10yd	$34.03	8	hours	$272.24
Equipment transport-Lowboy	$56.07	6	hour	$336.42
SUBTOTAL				**$1,912.34**
SUPPLIES AND MATERIALS				
Variable Frequency Drive				
VFD	$136,140	1	each	$136,140
VFD Spare Parts	$14,490	1	each	$14,490

Exhibit A

Enclosure Material				
gravel	$110.00	1	units	$110.00
concrete	$220.00	5	yards	$1,100.00
1/2x20x30 rebar sticks	$12.94	17	sticks	$220.00
4x8 3/4 CDX 23/32 net	$24.47	10	units	$244.70
2x6 12 DF #2 & BTR S-Dry	$6.77	75	units	$507.75
2x8 10 DF #2 & BTR S-Dry	$7.10	2	units	$14.20
2x8 16 DF #2 & BTR S-Dry	$13.03	2	units	$26.06
4x8x3/8" 8"oc L/P Smart Panel	$28.99	20	units	$579.80
Tuff Rib 36" 29 GA Colored 6/12	$2.79	72	units	$200.88
#14 x 1" OSB Colored Screw	$0.12	250	units	$30.00
Galv Box Nails by the #	$3.50	5	units	$17.50
15# 4 SQ ASTM Felt	$29.77	1	units	$29.77
Gable Trim 2	$19.39	2	units	$38.78
STD Eave Trim	$16.63	2	units	$33.26
Peak Flash	$22.00	2	units	$44.00
Misc	$500.00	1	Units	$500.00
SUBTOTAL				**$154,326.70**
CONTRACTS				
VFD Fabricators				
VFD Warranty				$1,647
VFD Freight				$5,090
OS Engineering				
Engineering and Programming				$10,760
Field Installation and Testing				$21,732
Engineering Travel Costs				$404
Rewind/Refurbish Specialists				
Rewind Pump for VFD Compatability				$32,000
Crane rental				
Crane rental	$1,200	1	day	$1,200
SUBTOTAL				**$72,833.00**
OTHER				
TOTAL DIRECT CHARGES				$227,159.70
INDIRECT/INKIND CHARGES				$17,811.37
TOTALS				$244,971.07

LETTER OF SUPPORT

63035 Plateau Dr. ■ Bend, OR 97702 ■ Phone (541) 393-3345 ■ Fax (541) 505-8917

March 20, 2019

Attn: Lisa Windom
North Unit Irrigation District
2024 NW Beech St
Madras, OR 97741

SUBJECT: CROOKED RIVER PUMP STATION VARIABLE SPEED DRIVE INSTALLATION

1.0 Purpose

The purpose of this memorandum is to voice our support of the water saving initiative that would involve upgrading one of the existing pumps from an across the line starter (i.e. all on or all off) to a variable speed drive (i.e. flexible amount of pump output) at the North Unit Irrigation District's (District) Crooked River Pump Station.

2.0 Water Conservation & Irrigation Efficiency

Due to the inherit functionality of the across the line starter, the pump is either fully on or fully off. Thus, the District is only able to pump water out of the Crooked River in ~15 cfs increments. With minimum in-stream flow requirements of the Crooked River, the District could be missing out on thousands of acre-feet per year of water they have the right to pump out of the Crooked River but are unable to do so due to the existing technology. The demand for the water is still present so these missing acre-feet must be drawn from Wickiup Reservoir.

For example, let's say the irrigation demand requires the full output of the Crooked River Pump Station, or 135 cfs (9 x 15 cfs/pump x 9 pumps). However, due to the in-stream flows of the Crooked River, the District can only take 133 cfs. With the current technology, the District would only be able to run 8 pumps equating to 120 cfs. The remaining 13 cfs would have to come from Wickiup.

With the new technology, a variable speed drive installed on a swing pump, the District would have one pump able to pump between 1 or 2 cfs to the full 15 cfs output. Therefore, they would be able to pump the full 133 cfs out of the Crooked River in the example above and save approximately ~4705 acre-feet of Wickiup's water.

Implementing this solution to lessen the District's dependence on Wickiup Reservoir is better for the Oregon Spotted Frog. The less water they have to draw from Wickiup is more that can be conserved in the reservoir or released and kept in stream as needed for the life cycle of the frog.

3.0 Operational Efficiency

The District has made improvements at their pump station already that allow for the automatic dropout of pumps if the Crooked River reaches certain flow setpoints. Automatically starting pumps is currently not implemented. However, this system has the capability to work with the variable speed drive to automatically adjust the output of the swing pump based on the flow of the Crooked River without direct operator intervention.

The current technology requires an operator to start each pump. If the flow in the Crooked River drops beneath the threshold in the middle of the night, then a pump will drop offline and an alarm is sent. If the flow then goes back up by early morning, it could still be hours before an operator is present to turn on a pump and capture this available water. With a variable speed drive solution, this water could be captured without operator intervention.

For example, let's say that 8 static pumps and the swing pump are running at full output at 135cfs and the flow in the river drops to a set threshold requiring an output of 117 cfs from the pump station. One static pump would automatically drop offline, reducing the output to 120 cfs and then the swing pump would ramp down to an output of 12 cfs for a total plant output of 117 cfs (7 x 15cfs + 12cfs) without operator intervention.

With the current technology, two pumps would drop offline resulting in a total pump station output of 105 cfs and operator intervention would be required to start the pumps again once the Crooked River flow increased enough.

4.0 Conclusion

We support this project due to the environmental benefits and efficiencies described above. It would be a good project for all the stakeholders, including the Oregon Spotted Frog.

Sincerely,

Digitally signed by Waylon Bowers
Date: 2019.03.20 09:42:02 -07'00'

Waylon Bowers, P.E.
OS Engineering

March 15th, 2019

North Unit Irrigation District
Lisa Windom
2024 NW Beech Street
Madras, OR 97741

Lisa Windom,

On behalf of WyEast RCD, we would like to express our support of North Unit Irrigation District's efficiency upgrade proposal to the BOR WaterSMART Program. We recommend this project be considered strongly for funding.

I have personally visited the Crooked River Pumping Site and assisted with the energy savings calculations to determine the electrical kWh savings. In addition to saving an estimated 200,000+ kWhs per year, this project will provide several other operational efficiency benefits for North Unit Irrigation District. The installation of a VFD will also allow the irrigation district to better control the volume of water pumped from the Crooked River, this is a very important factor to improve the Deschutes River Basin's water management practices.

We look forward to working with North Unit Irrigation District to optimize the setup and operation of the Variable Frequency Drive, this until will control (1) of the 450 Horse Power Turbine Pumps.

Please feel free to contact me directly with any questions about this project.

Sincerely,

Robert Wallace

Robert Wallace, C.E.M
Executive Director
Wy'East Resource Conservation and Development

By mail or USPS overnight services:	Bureau of Reclamation Financial Assistance Support Section Attn: Ms. Julie J. Hendricks P.O. Box 25007, MS 84-27814 Denver, CO 80225
All other express delivery:	Bureau of Reclamation mail services Attn: Ms. Julie J. Hendricks Denver Federal Center Bldg. 67, Rm. 152 6th Avenue and Kipling Street Denver, CO 80225
By courier services:	Bureau of Reclamation Attn: Ms. Julie J. Hendricks Denver Federal Center Bldg. 56, Rm. 1000 6th Avenue and Kipling Street Denver, CO 80225

D.4.2. Instructions for Submission of Project Application

Each applicant should submit an application in accordance with the instructions contained in this section.

D.4.2.1. Applications Submitted by Mail, Express Delivery or Courier Services

Please follow these instructions to submit your application by mail, express delivery, or courier services.

- Applicants should submit one copy of all application documents for hardcopy submissions. Only use a binder clip for documents submitted. Do not staple or otherwise bind application documents.
- Hard copy applications may be submitted by mail, express delivery, or courier services to the addresses identified in this FOA.
- Materials arriving separately will not be included in the application package and may result in the application being rejected or not funded. This does not apply to letters of support, funding commitment letters, or official resolutions.
- Faxed and emailed copies of application documents will not be accepted.
- Do not include a cover letter or company literature/brochure with the application. All pertinent information must be included in the application package.