WaterSMART Grants: Water and Energy Efficiency Grants
FOA# BOR-DO-18-F006

Heart Mountain Irrigation District

FY 2018

Rattlesnake Canal Liner Phase III Project

Applicant

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Applicant Info

Date: May 10, 2018

Applicant Name: Heart Mountain Irrigation District (HMID and District)

City, County, State: Powell City, Park County, Wyoming

Project Manager:

Brian Deeter
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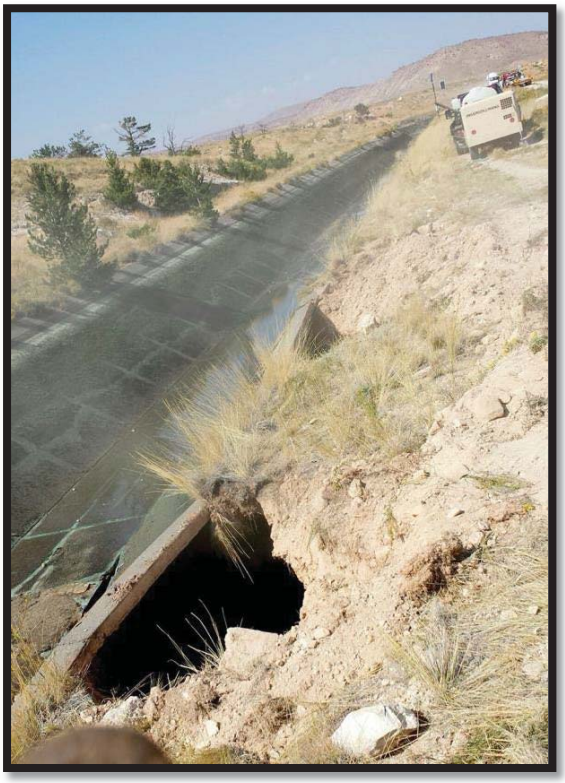
Project Funding Request: Funding Group I $300,000; Total Project Cost $900,005

Project Summary

Specify the work proposed, including how funds will be used to accomplish specific project activities and briefly identifies how the proposed project contributes to accomplishing the goals of this FOA.

This project is the third phase of the Heart Mountain Irrigation District Rattlesnake Canal Liner and Small Hydro Project. By now Phase III may seem like just the same canal liner project, but it is not. It is the final phase of a critical water conservation project. This phase of the Rattlesnake Canal Liner Project will start 1,274 feet below the Rattlesnake Mountain Tunnel and will be the bottom half of the canal. This phase will construct another 637 feet of liner which will complete the entire 1,911 feet of 70-year-old liner. This will allow the entire canal to have been fully relined and newly reconstructed. The project will also install an additional small crossfloat hydro turbine. When all three phases of the project are complete 1,911 feet of liner will be installed, and three crossfloat hydro turbines will be installed. The deteriorating concrete that is leaking and creating massive voids beneath the concrete liner is 70 plus-year-old. There are large cracks, exposed rebar, and voids that continuously require the District to shut down the flow of irrigation water for days during the hot summer months. In 2017 two large breaches in the liner caused the water to be shut off for days. Due to the age of the liner many attempts to fix and patch the liner have been made but they are only band-aids to much broader issues that can just be fixed by reconstructing the entire canal.

Photo 1 Sept 2017 Breach in the liner



With almost every eight out of ten sections having leaks, voids, and rebar showing. It is difficult to keep the water from seeping out and causing more voids as it seeps into the limestone fill. The limestone fill is easily dissolved or eroded as water flows into these voids. So the water is absorbed, and no water actually shows up outside of the canal. So you do not know you have a leak till it is too late.

This WaterSMART application is to request funding for construction of Phase III of the Rattlesnake Canal Liner Project, and the installation of a 2 kW crossfloat hydro turbine. The Project will start 1,274 feet below the Rattlesnake Mountain Tunnel and continue downstream 637 feet. The liner within this phase will be replaced with an entirely new liner. The old liner will be removed, and voids encountered will be filled with cement-treated backfill. A geotextile fabric will be used to bridge across the filled voids that stretches between the cement-treated backfill and the road base. Finally, a new concrete liner section will be poured in place.

A 2 kW crossfloat hydro turbine will be placed in the canal that will produce 8,784 kilowatt-hours of power per year. This power will be used to help supplement the energy needed to operate the screening and SCADA for the Rattlesnake Canal.

The proposed project will contribute to the goals of this FOA in the following ways:

- Conserve water: The District will seek to conserve and use water more efficiently by producing a quantifiable water savings of 211 acre-feet and by better managing 236,500 acre-feet of water. The project will also conserve water in the Buffalo Bill Reservoir and Shoshone River.
- Contribute to water reliability: Development of this project will give the District and its users the ability to reduce water losses by having a canal that is not frequently failing, nor one that is required to be shut down for maintenance during the critical water times of the irrigation season.
- Reduce future water conflicts: This project will reduce the continual conflicts between users and District staff as they work to keep the canal operational.
- Increase opportunities for hydro production: Installing a 2 kW crossfloat hydro turbine will increase the production of hydropower. It will be placed in the canal, and is estimated to produce 8,784 kilowatt-hours of power per year. These types of small turbines are easy to install and remove and can be added in multiples throughout the canal so that over time you can continue to increase your hydropower output.

Length of Time and Estimated Completion Date

State the length of time and estimated completion date for the proposed project.

This project is ready to move forward as soon as it is awarded. Matching funds have been approved and preliminary design completed. The contract process could take 30 to 60 days. However, the environmental document process will need to be started as soon as notice of award in order to meet the two year construction window. If the notice of award is September 2018, HMID will start the environmental review in October 2018 to move the project forward. It will take six to eight months to complete the environmental review and final design (September 2018 – April 2019).

The lining portion of the project will take six to eight months and will need to start outside of the irrigation season, which begins around April 15 and ends around October 15. Advertising and bidding the project will depend upon the bidding climate and could take place July – August 2019 so as to be ready to have the contractor mobilizing on the job a few weeks before the water is out of the canal. It is anticipated that the actual lining installation of the project will begin in the October 2019 – April 2020 timeframe. The installation of the hydro will get going through the spring months April – May 2020. The project will be accomplished within the two-year allowance.

Federal Facility

Whether or not the project is located on a Federal facility.

The facility was built by the Bureau of Reclamation as part of the Shoshone Project in 1905, later to be called the Buffalo Bill Dam. This Dam was the Reclamation's first high concrete arch dam. The existing Rattlesnake Liner was constructed by Reclamation in 1938 following the completion of the Shoshone Canyon Conduit. In the late 1940s and 1950s, Reclamation operated the facilities in the project until the Heart Mountain Irrigation District was established and irrigation operations and maintenance were transferred to them in 1958.

Background Data

Photo 2 Historical irrigated fields of Cody Wyoming

Part of the "Grand Vision" of Buffalo Bill Cody, the Heart Mountain Irrigation District is one of four entities delivering irrigation water that is collected behind the Buffalo Bill Dam, west of Cody, Wyoming. Cody, due to running out of cash, had to team up with the Federal Government. Cody, working with President Theodore Roosevelt, who also had a "grand vision" of an irrigating West, built the Dam that would be the key to open about 90,000 acres in northwestern Wyoming to irrigated farming on Reclamation's Shoshone Project. The construction took place between 1905 and 1910. The Heart Mountain Irrigation Canal was the last division of Reclamation's Shoshone Irrigation Project to be provided water and opened to settlement. Reclamation operated the facilities in the project until irrigation was established, and transferred operation and maintenance to the District in 1958. The HMID is comprised of 31,345 irrigable acres north of the Shoshone River, from Cody, Wyoming to about seven miles north of Ralston, Wyoming and 52 miles to the east entrance of Yellowstone National Park.

The original structure of the Rattlesnake canal is made up of trapezoid-shaped, four-inch reinforced concrete liner. This section of the canal crosses large limestone and travertine formations. The west side of the canal was typically built in a cut section the mountain with the east side of the canal built almost entirely of fill (limestone) from the excavated area. From the

number of drill holes that are visible along the west side of the canal, it is evident that a large extent of the excavation was blasted.

There are so many caverns and voids under the canal that the liner is weak and eroding. The District has made many repairs to the canal over the past 20 years, but the repairs do not seem to resolve the issues that keep returning no matter what they do; largely because the issues have to do with the fundamental way in which the canal was originally built.

On February 18, 1997, the District did a process called "sounding" to identify potential voids and caverns under the concrete liner. Sounding involves striking the concrete surface and interpreting the sound produced. Solid concrete will produce a ringing sound, while concrete that is delaminated, spalled, or has separated from the base material will produce a flat or hollow sound. Subgrade voids will also produce a flat or hollow sound. Numerous locations were identified as having potential voids. District personnel then used a hammer drill to check these areas for voids. Three sections were chosen to be removed because of significant voids.

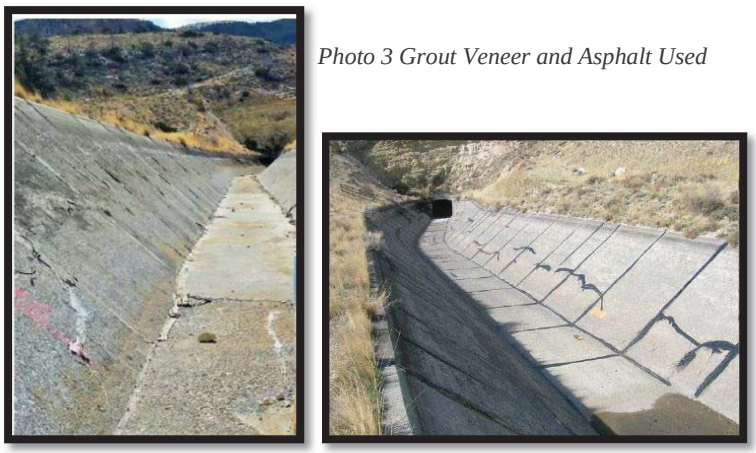


Photo 3 Grout Veneer and Asphalt Used

Since 1997, the District has tried many ways to fix the liner. Some of these include pouring new concrete liner sections, using asphalt crack repair, applying polyurethane coating to random crack and cold joints, using hot tar for cold joints, dumping cement grout into caverns as they surfaced, and placing grout veneer along the floor of the canal. Still, many breaks, leaks, and voids have continued. Many of these fixes have caused even more problems.

In 2015, another study was completed through funding from Wyoming Water Development Commission. This time, HMID used Ground Penetrating Radar (GPR) and a non-destructive investigation method to survey the condition of the canal liner. After using the ground penetrating radar method, a total of **nine possible massive void areas were identified**.

With the non-destructive exploration approach, a four-pound sledgehammer and a chain were used to conduct the sounding tests. Similar to 1997, the sounding involved striking the concrete surface and interpreting the sound produced. This time, a steel chain was drug over the floor of the canal for additional sounding on the floor area. Results from the hammer and chain tests located **twenty-nine suspected sections within the walls and floors** of the liner.

The study indicated that with the amount of cracking, poor subgrade, and the overall age of the existing liner, a major failure is definitely likely. It was the recommendation of this study that the existing liner should be removed entirely and replaced. Trying to "Band-Aid" the existing liner will only postpone the inevitable needed replacement.

In 2018, the canal liner is still continually cracking and shrinking, and being undermined by the cold joints that are set every ten feet within the liner. These issues, along with the exposed rebar, massive voids, and crumbling 70-plus-year-old concrete will continue to be the source for shutdowns during the irrigation season. A major failure of the concrete liner that would require a longer time for a shutdown would impact the District and their users in catastrophic ways. Since this canal is located at the top of the system, every user is impacted every time they shut down the canal to fix the leaks in the liner. The possibility of a week or more without water during July or August could mean a complete loss of irrigated crops. This would be economically and financially crippling to both the irrigators and Park County.

Photo 4 Exposed Rebar

This proposed WaterSMART application is for Phase III of the Rattlesnake Canal Liner. As stated previously there are three phases of this canal that must be reconstructed in order to actually fix the crisis within the entire length of the canal. Additional WaterSMART applications will address Phases I and II of the Rattlesnake Canal Liner. To view an overall Rattlesnake Canal Phasing Plan Map, see Attachment 1 Rattlesnake Canal Liner Phasing Map.

Water Supply

Describe the source of water supply, the water rights involved, current water uses

Source of water supply and water rights involved.

The source of Heart Mountain's water supply comes from the Buffalo Bill Reservoir, stored behind the original Buffalo Bill Dam via the two and a half mile long Shoshone Canyon Conduit. A penstock was placed through Cedar Mountain to carry reservoir water downstream to a hydropower station and to the 14-foot diameter steel siphon that carries irrigation water over the Shoshone River. The water then enters the Rattlesnake Mountain Tunnel before discharging into the beginning of the Rattlesnake Canal Lining and the start of the Heart Mountain Irrigation District.

Water users place water delivery orders with the District staff, and headgates are then adjusted daily to fulfill orders. Most headgates are equipped with Cipoletti weirs.

The Wyoming State Engineer allows base water right for HMID of 3.18 acre-feet of water per acre based on mapping provided by the Bureau of Reclamation. There are approximately 31,345 acres mapped within the HMID boundaries. Any water that is used by individual irrigators above their base water right is Reclamation project water and is accounted separately. During peak season (July-August) HMID limits irrigators to a 3 CFS per 100 acres.

Current water uses and number of water users served.

The District delivers water to 691 landowners representing 31,345 acres of irrigated land. The State Engineer's Office (SEO) maintains diversion records from Buffalo Bill Reservoir into the Heart Mountain main canal. Table 1 below is a summary table of total water deliveries from Buffalo Bill Reservoir to the Heart Mountain Irrigation District for the past 5 years.

Table 1 Five Year Deliveries

Year	AF Diverted
2012	257,000
2013	235,900
2014	215,000
2015	246,000
2016	249,000
2017	216,000
Average	236,500

Current and projected water demand/potential shortfalls in water supply.

Although growth is happening in Cody, Wyoming, the impact to HMID is not one that would be considered a shortfall. The shortfall that is threatening the District is the failure of the Rattlesnake liner. Every time the canal has to be shut down for repairs, users lose days of water for their crops. In 2017, all water users lost four days of water during critical times of the irrigation season because the Rattlesnake Canal liner is at the top of the canal system, and when it is shut down, **all the water is shut off to all users.** Water demands will remain the same as they have been in the past, but with the development of this project, users will be able to receive their full share of the water.

If water is primarily used for irrigation, describe major crops, and total acres served.

HMID supplies irrigation water for lands around Cody, Ralston, and on Heart Mountain, totaling 31,345 serviceable acres. Of those acres, 26,638 acres are currently irrigated. Major crops include sugar beets, dry beans, brewing barley, alfalfa, and urban landscapes.

Water Delivery System

Describe the applicant's water delivery system as appropriate. For agricultural systems, please include the miles of canals, miles of laterals, and existing irrigation improvements.

The canal begins at the inlet to the Shoshone River Siphon, which spans the river below the Shoshone Canyon conduit outlet. The canal has an initial capacity of 914 cubic feet per second and a length of about 28 miles. About 140 miles of distribution laterals and 145 miles of open and closed drains also serve the Heart Mountain division.

This application is for Phase III, which is the last 637 feet that starts 1,274 feet below the Rattlesnake Mountain Tunnel.

Energy Efficiency

If the application includes hydropower or energy efficiency elements, describe existing energy sources and current energy uses.

A 2 kW crossfloat hydro turbine will be placed in the canal that will produce 8,784-kilowatt hours per year. This power will be used to help supplement the power needed to operate the screening and SCADA for the Rattlesnake Canal.

Relationship with Reclamation

Identify any past working relationships with Reclamation. This should include the date(s), description of prior relationships with Reclamation, and a description of the project(s).

As previously stated, the facility was built by the Bureau of Reclamation in 1938 and then turned over to the District in 1958. The District was obligated to continue to build additional infrastructure for the canal and to maintain the system. The District has a long-term non-interest bearing loan payable to the United States to help complete those projects. The original amount was 8 million dollars, payments of $56,000 per year, with a final payment in 2065. They currently have a balance of 3.8 million dollars. HMID also has a 1.8 million dollar loan to Reclamation for a Rehabilitation and Betterment project which began in the early 1980s. The District has made considerable efforts to maintain their system over the years to ensure that water is delivered to its users.

Project Location

Geographic Location

The Heart Mountain Irrigation District is located in the vicinity of the City of Cody and the City of Powell in Park County, Wyoming. The east entrance to Yellowstone National Park lies 53 miles to the west and is located along the Shoshone River in the Bighorn Basin in northwest Wyoming. This basin is surrounded by mountain ranges on three sides: the Absarokas to the west, the Owl Creek Mountains to the south, and the Bighorn Mountains to the east. For a larger view of the project location map and to see a project detail map, see Attachment 2 Project Location Map and Attachment 3 Project Detail Map.

Photo 5 Project Location Map

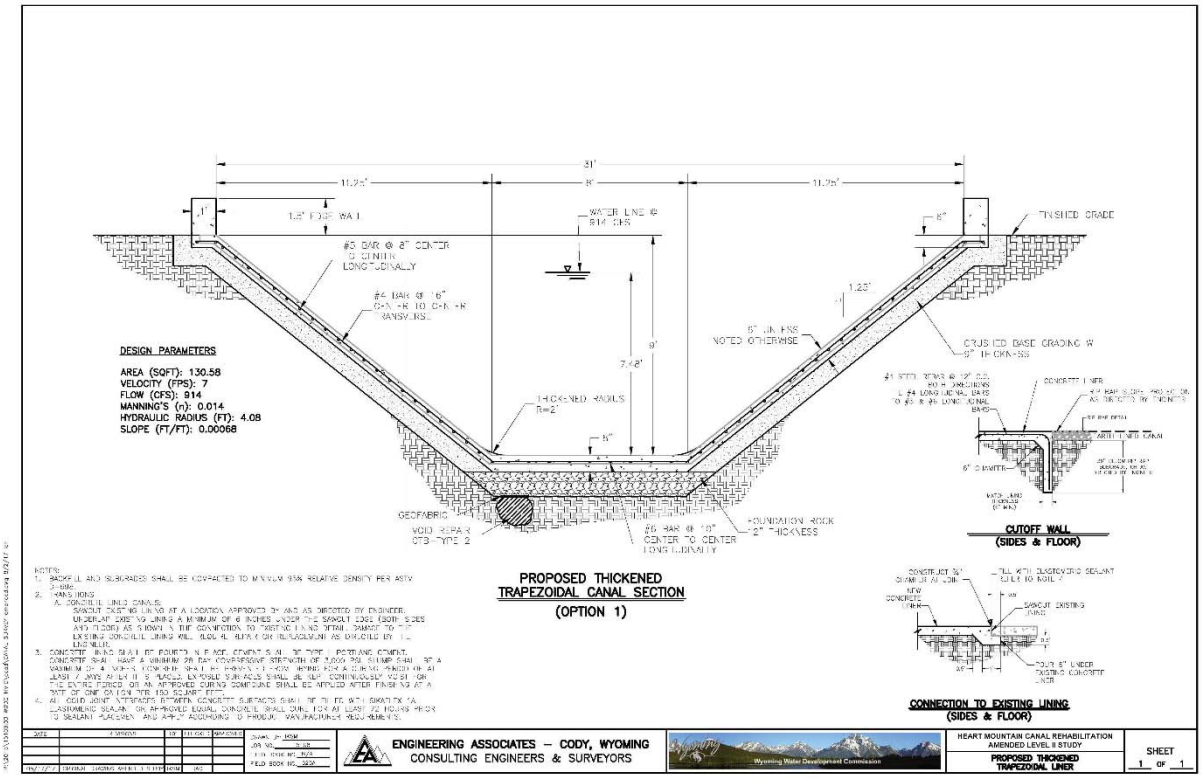
Technical Project Description

Describe the work in detail, including specific activities that will be accomplished. This description shall have sufficient detail to permit a comprehensive evaluation of the proposal.

The project consists of the complete reconstruction of 637 feet of the trapezoidal-shaped liner, located 1,274 feet below the Rattlesnake Mountain Tunnel. The existing liner will be removed and any voids encountered will be filled with a cement-treated backfill. A geotextile fabric will be used to bridge across the filled void between the

cement-treated backfill and the foundation rock. Finally, a new concrete trapezoidal-shaped liner section will be poured in place using the original 1938 BOR cross-section dimensions, but modified with newer design recommendations. The canal cross-section is shown below in Figure 1. This cross section will utilize radii at the wall/floor intersection to minimize the cracking that occurs in this location, as well as thicker concrete walls and floor. With the larger amount of steel and thicker concrete, longer sections can be poured at one time. With fewer construction joints and no need for control joints with this design, opportunities for water migration through the liner will be reduced.

Figure 1 Proposed Canal Cross Section from the Study



E.1. Technical Proposal: Evaluation Criteria

E.1.1. Evaluation Criterion A – Quantifiable Water Savings

Quantifiable Water Savings

Describe the amount of estimated water savings. For projects that conserve water, please state the estimated amount of water expected to be conserved (in acre-feet per year) as a direct result of this project.

It is estimated that this lining project will have an impact on water savings, especially as we complete all three phases. However, this phase will have an estimated savings of 211 acre-feet of water annually through this last section of canal that is associated with this project. This sections just like the others have a number of cracked panels (see Figure 2 below), leaks, breaches, and large voids. The canal has had many breaches in the canal liner. This one that is indicated in Photo 6 shows how the breach breaks the liner and void happens, and then the District can do nothing but fill it as fast as it can to get water back into the canal. The canal was shut down for 3 days during this breach. Water losses are based on the sections of the canal that are being fixed as part of the project. The water saved is estimated to be 211 acre-feet as a direct result of this project.

Photo 6 Canal Liner Collapse had to just fill it and go.

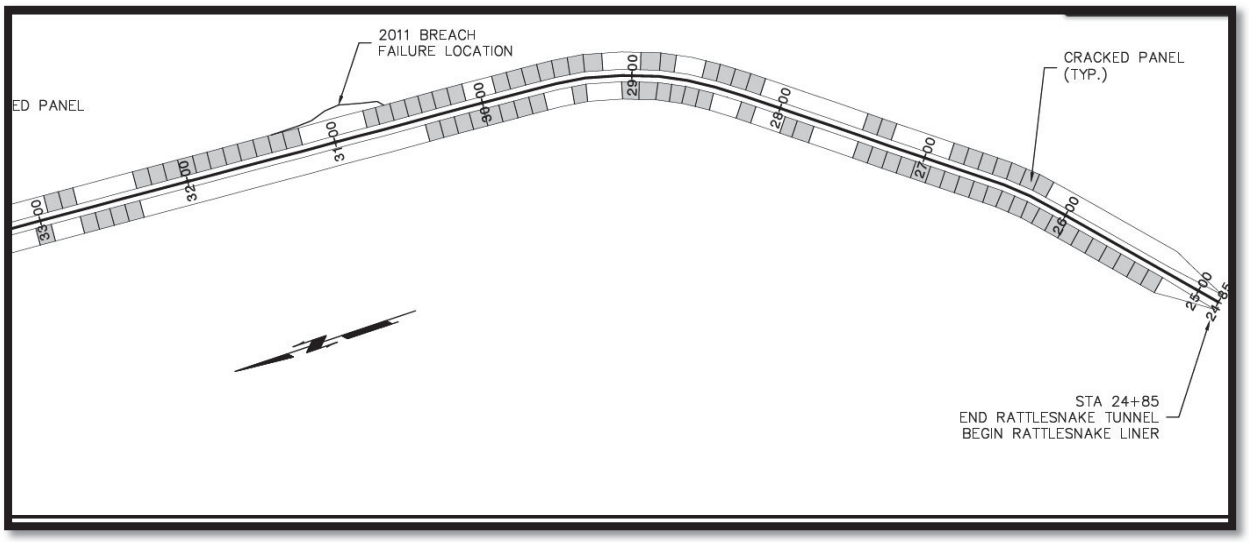
Describe current losses. Explain where the water that will be conserved is currently going (e.g., back to the stream, spilled at the end of the ditch, seeping into the ground)?

As previously stated, the existing 70-plus-year-old liner is in extremely poor condition. Water is currently lost to seepage into underlying soils and limestone formations along the mountain in which the canal liner is built on.

In addition to the on-going constant seepage, as the cracks and leaks form in the canal liner, large voids are created under the liner and water begins to leak into the voids. The limestone fill is easily dissolved or eroded as water flows into these voids. No water actually shows up outside of the canal. No wet spots, no rise in the local water table, no water in residents basements! Ditch riders do not know there is a severe leak until they start to see a funnel of water form in the canal. Then, and only then, do they know they have a void with water leaking, compromising the liner and putting the canal in danger of failure. HMIC knows the conserved water is going somewhere but is not actually sure where. Most likely, the water is eventually making its way back to the Shoshone River. One other thing they do not know is for how long the water has been leaking.

In November of 2015, the entire concrete-lined section of the HMID canal was visually inspected in dry condition. During the dry inspection, large cracks, exposed rebar, and deteriorating concrete were located. Figure 2 indicates a sampling of the locations of cracked panels. The cracked panels are indicated in gray. This is just one area of the canal shown, and it indicates that the canal invert and sidewalls are cracked for almost the entire length along both

Figure 2 Top of the Rattlesnake Liner location of cracked panels (shown in gray)



sides.

Describe the support/documentation of estimated water savings. *Provide sufficient detail supporting how the estimate was determined, including all supporting calculations.*

This project includes the last 637 feet of the District's canal, which is 1,274 feet below the Rattlesnake Mountain Tunnel below the Buffalo Bill Reservoir. There is a series of daily flow records that were used to develop the calculation of the water losses. Daily flow records at the beginning of the canal and approximately 13.5 miles downstream on the canal were used, as well as daily outflow records to irrigators. There are flumes located at the Rattlesnake Mountain Tunnel and 13.5 miles downstream at the gatehouse near turnout 79. These flumes have the ability to record daily flows. Each head gate between these main canal flumes also has flow measurement devices. Flows are recorded daily by the ditch riders assigned to this canal reach. The flow losses were determined using a mass balance equation for the reach. Flow losses for the section of the canal that represents the project were calculated based on the ratio of the project section length to the overall reach length multiplied by the total annual reach water loss measured. Water losses were then calculated using these records of flows into and out of this 13.5-mile reach of the canal. Water losses for the project section were calculated as a percentage of the project length to the overall reach length.

Looking back over the past 5 years of flow records, only 2014 and 2015 have a complete flow record for the entire year. Reasons for missing records include equipment failure, human error, and failure of the liner causing the canal to be shut down for a period of time. The average for these 2 years was used to estimate water losses. See below for the actual calculations.

Canal Lining/Piping

a. *How has the estimated average annual water savings that will result from the project been determined? Please provide all relevant calculations, assumptions, and supporting data.*

As previously stated, water losses were calculated using records of flows into and out of the 13.5-mile reach of the canal. Water losses for the project section were calculated as a percentage project length to the overall reach length. Table 2 below is a summary of monthly losses in acre-feet for the 13.5-mile reach. These losses were calculated by the following formula:

$$Beginning\ Reach\ Flow - Turnout\ Flows - Ending\ Reach\ Flow = Reach\ Water\ Loss$$

Table 2 Summary of Monthly Water Losses

	2013	2015
April	383	1833
May	5542	2771
June	5453	3592
July	5409	5702
August	4659	3622
September	4510	2489
October	381	405
Total	**26337**	**20414**

The exact length of the reach is 72,200 feet. The length of the project is 637 feet. This represents 0.9 percent of the total reach length. This percentage was used to calculate the average annual water loss over the length of the project, as shown in Table 3 below.

Table 3 Average Annual Water Loss over Length of Project

	Length		2013 Loss	2015 Loss	Average Loss
	(ft)	(%)	(AF)	(AF)	(AF)
Reach	72200	100%	26337	20414	23376
Project	637	0.9%	237	184	**211**

The estimated annual water loss to seepage is 211 acre-feet for the 637-foot canal length representing this project.

b. *How have average annual canal seepage losses been determined? Have ponding and/or inflow/outflow tests been conducted to determine seepage rates under varying conditions? If so, please provide detailed descriptions of testing methods and all results. If not, please provide an explanation of the method(s) used to calculate seepage losses. All estimates should be supported with multiple sets of data/measurements from representative sections of canals.*

As stated earlier, there are flumes located at the Rattlesnake Mountain Tunnel and 13.5 miles downstream at the gatehouse near turnout 79. These flumes have the ability to record daily flows. Each head gate between these main canal flumes also has flow measurement devices. Flows are recorded daily by the ditch riders assigned to this canal reach. The flow losses were determined using a mass balance equation for the reach. Flow losses for the section of

the canal that represents the project were calculated based on the ratio of the project section length to the overall reach length multiplied by the total annual reach water loss measured.

c. What are the expected post-project seepage/leakage losses and how were these estimates determined (e.g., can data specific to the type of material being used in the project be provided)?

The new canal liner for this section of the canal is assumed to be 100 percent watertight, so seepage losses will be 0.

d. What are the anticipated annual transit loss reductions in terms of acre-feet per mile for the overall project and for each section of canal included in the project?

The anticipated annual seepage loss reductions for this project are 1,749 acre-feet per mile.

1. How will actual canal loss seepage reductions be verified?

The same methodology that was used to calculate the losses can be employed post project. All of the measurement devices and recording procedures will still be in place. In addition, HMID will use a portable Acoustic Doupler Profiler. This will allow them to isolate the flow measurements used in canal loss verifications specifically to the 637 feet of new liner that is the project.

2. Include a detailed description of the materials being used.

- **Geotextile Fabric**–Geotextiles will serve to separate the imported liner backfill from native soils, and cement treated backfill to prevent migration of soil particles from the subgrade, through the lining material. Geotextile will be specified in accordance with NRCS Design Note 24, "Guide for the Use of Geotextiles."
- **Epoxy Coated Reinforcing Steel** – Epoxy coated rebar is required to strengthen the concrete against tensile stress. The epoxy coating is to protect the steel from corrosion. Bar sizes are anticipated to range from #4 to #6 bars. The rebar will be specified in accordance with the following American Concrete Institute (ACI) standards: ACI 301 - Specifications for Structural Concrete, ACI 318 - Building Code Requirements for Structural Concrete and ACI SP-66 - ACI Detailing Manual.
- **3000 psi Concrete** – Concrete will compose the main component of the liner. The concrete cement will be Type II Portland Cement Concrete with 3000 psi compressive strength. The minimum thickness will be 8 inches on the floor and 6 inches on the side slopes. Concrete specifications will follow customary ACI and ASTM standards.
- **Cement Treated Backfill** – Cement-treated backfill is a mixture of aggregate material and/or granular soils combined with measured amounts of portland cement and water that hardens after compaction and curing to form a more durable backfill that is less susceptible to the migration of soils that have created the voids that are found under sections of the existing liner. Cement-treated backfill will be specified after consultation with a qualified local geotechnical engineer. Locally available materials will be analyzed, and cement treated backfill design prepared using ACI and other applicable standards.
- **Imported Backfill** – At least 9 inches of the crushed base will be used under the side slopes, and at least 12 inches of foundation rock will be used under the base of the canal. The foundation rock will provide bridging and stability as well as allow or

drainage. The imported liner backfill, in general, provides for a better-graded surface for concrete placement.

E.1.2. Evaluation Criterion B – Water Supply Reliability

Address how the project will increase water supply reliability. Provide sufficient explanation of the project benefits and their significance. These benefits may include, but are not limited to, the following:

- *Does the project promote and encourage collaboration among parties in a way that helps increase the reliability of the water supply?*
    - *Is there widespread support for the project?*

      There are 691 users who all take their irrigation water below the Rattlesnake Liner section. They are all concerned, as they have experienced failures of this section of the canal, resulting in shutting down the entire canal for a number of days, and leaving them without water. The State of Wyoming is in Support of the project and has committed to fund a portion of the project.

    - *What is the significance of the collaboration/support?*

      The District has support from many who know that this project is essential to the conservation of water in this area. They received funding to study this section of the canal in 2015-16 from Wyoming Water Development Commission (WWDC). This in-depth study was developed because of the anticipated critical impacts on the District and their users if a failure of this concrete liner were to happen. Failure of the concrete liner would have catastrophic implications since it is located at the beginning of the system. Every user would be impacted by a failure, and the possibility of a complete loss of irrigated crops will be economically and financially crippling to both the irrigators and Park County.

      Wyoming Water Development Commission thought that this was so significant that they retained an engineering consultant through a $130,000 grant to conduct a Level II Study of the canal liner for Heart Mountain Irrigation District. Included in the study are the following items:

      – Map the existing canal lined section using GPS survey equipment.
      – Using ground penetrating radar (GPR), inventory the current physical condition causing the seepage issues and structural instabilities.
      – Using hydraulic analyses to look at cross-section design, slope, velocities, and water depths to design the capacity of the canal and look at options to use a closed-conduit system.
      – Create conceptual designs and construction cost estimates for improvements to the canal liner.

      Throughout this study, the consultant met with the District, users, WWDC, and others to better understand the system and to gain support for the project. Later, as they approached the State of Wyoming for funding, other groups were in support of the project and helped move funding forward so that a percentage of the grant was made available to advance this project.

- *Is the possibility of future water conservation improvements by other water users enhanced by completion of this project?*

  Yes, this project will make water more reliable to the users and will advance future phases.

- *Will the project make water available to address a specific water reliability concern? Please address:*
  - *Explain and provide detail of the specific issue(s) in the area that is impacting water reliability, such as shortages due to drought, increased demand, or reduced deliveries.*

Liner Failure: In 2011, a major failure of the canal liner occurred, causing a breach. The water flowed over the top of the liner and eroded the material behind it to the point that a portion of the liner collapsed. The District shut down the canal for days to repair the collapse, leaving over 30,000 acres without irrigation water. A more recent canal failure occurred multiple times during the 2017 irrigation season, prompting days without water during this critical time. This has been happening over the past twenty years, but over the past five to ten years, the number of shutdowns has been increasing with each irrigation season. When a leak occurs, it causes massive voids under the liner that initiate the failure of the liner.

Photo 7 Cracked and broken liner

Delivery Failure: As the liner fails, HMID fails to deliver water to its users. The obligated water shares are reduced because the District has to shut the entire canal down at the top of the canal to fix the liner. With the exception of a few "pick-up" water diversions in existing creeks and drainages, this is the only source of irrigation water for the Heart Mountain Irrigation District.

Seepage Losses: The analysis done to determine seepage losses shows that in 2013, nearly 11 percent of the total volume diverted into the canal was lost just in the first 13.5-mile section of canal. The seepage losses just in the 637 feet of canal being addressed with this project were 211 acre-feet annually. This project is just one of the phases in addressing the large volume of water lost annually to seepage losses. This water is lost to the system and unavailable to farms who desperately need this water for irrigation. This is particularly true at the end of the irrigation season. Water not lost to seepage could be left in the reservoir to be drawn upon later in the irrigation season to extend the season and increase crop production.

- *Describe where the conserved water will go/how it will be used. Will the project directly address a heightened competition for finite water supplies and over-allocation (e.g., population growth)? Will it be left in the river system?*

  The conserved water will be delivered to the farmers who have not been able to use this water in the past. They will now be able to take advantage of all of their water shares.

- *Describe how the project will address the water reliability concern?*

  In the past, when the canal had to be shut down for multiple days, users were worried about the time it took to get the system up and running. This project will address the harsh climate of the high Wyoming desert and bring the canal up to current construction standards. This Phase III project will begin to lessen anxiety and give the District and its users the ability to conserve 211 acre-feet of water and reduce the need to shut down the canal. This will reduce water reliability concerns and the risk of potential conflicts that come from the fear of crop and economic losses.

- *Will the project help to prevent a water-related crisis or conflict? Is there frequently tension or litigation over water in the basin?*

  There is tension in the area because of the number of days the canal is shut down during the irrigation season and the impact it has on farmer's crops, and eventually on their bottom line. No litigation has occurred, but if the canal has a catastrophic failure, users are going to face economic issues. This project will help prevent a water-related crisis associated with the Rattlesnake canal liner. Although this project is only one phase, it is a step in the right direction and will move the project forward.

- *Provide a description of the mechanism that will be used, if necessary, to put the conserved water to the intended use.*

  The replacement of the failing and leaking liner will keep the water in the canal and allow it to be delivered to the users as it was intended to be. Irrigators will have a dependable source of water that they can now count on, especially during the critical hot summer months when they rely on having the water for their crops. Users at the end of the canal will now be able to get their full share of water, which they have been unable to receive in the past.

- *Describe the roles of any partners in the process. Please attach any relevant supporting documents.*

  The state of Wyoming funded what they term a "Level II Study," specifically to study the problems associated with the Rattlesnake Liner. The Executive Summary of that report can be found in Attachment 4 HMID Level II 2016 Study Executive Summary.

  The state of Wyoming is providing 67 percent of the funding for this project through a loan and grant funds. That funding was already approved by the Wyoming legislature in February 2018, and is now available.

- *Indicate the quantity of conserved water that will be used for the intended purpose.*

  The total volume of 211 acre-feet of conserved water will be used for irrigation within the District.

- *Will the project benefit Indian tribes?*
  The Crow Indian reservation receives tailwater at the end of HMID that flows into the Big Horn River that enhances their water reliability. With the reconstruction of the full Rattlesnake Canal Liner, the Crow Reservation should be able to receive tailwater at the end of the canal in ways that they have been accustomed to.

- *Will the project benefit rural or economically disadvantaged communities?*
  This area is not considered an economically disadvantaged community. However, it is a rural community that relies on tourism, recreation, and agriculture for economic viability, all of which depend on water reliability.

- *Will the project benefit species (e.g., federally threatened or endangered, a federally recognized candidate species, a state listed species, or a species of particular recreational, or economic importance). Please describe the relationship of the species to the water supply, and whether the species is adversely affected by a Reclamation project.*
  There are no known threatened or endangered species that this project will have a direct impact on. However, the Buffalo Bill Reservoir and its environments provide habitat for a variety of fish and wildlife species. The reservoir offers a minimum flow to maintain the fishery in the Shoshone River below the dam. By HMID conserving water, this can have a benefit to the reservoir, which in turn can have a benefit to the flows to the Shoshone River.

- *Will the project address water supply reliability in other ways not described above?*
  No, all water supply reliability concerns have been addressed above.

E.1.3. Evaluation Criterion C – Implementing Hydropower

If the proposed project includes construction or installation of a hydropower system, please address the following:

Describe the amount of energy capacity. *For projects that implement hydropower systems, state the estimated amount of capacity (in kilowatts) of the system. Please provide sufficient detail supporting the stated estimate, including all calculations in support of the estimate.*

This project will include the installation of a crossfloat hydro turbine in the main canal. These small hydropower generation site will provide an excellent source of renewable energy. That energy will be connected to the main electrical grid through a net metering arrangement at the location of an existing mechanical screening station. The small hydro site part of this project is estimated at 2kW.

Describe the amount of energy generated. *For projects that implement hydropower systems, state the estimated amount of energy that the system will generate (in kilowatt hours per year). Please provide sufficient detail supporting the stated estimate, including all calculations in support of the estimate.*

The small hydropower generation will operate the entire time that the canal is in use, from April 15th to October 15th. The turbine will operate for 4,392 hours during this time. The small hydro generator produces 2kW. This site will generate 8,784kilowatt-hours per year.

Describe any other benefits of the hydropower project. *Please describe and provide sufficient detail on any additional benefits expected to result from the hydropower project, including:*

- *Any expected reduction in the use of energy currently supplied through a Reclamation project*
  Phase III will have a slight reduction of the required energy now used to power the screening and SCADA system. However, as HMID continues to construct the additional

phases of the Rattlesnake Canal and installs additional hydro units, more energy will be produced. This will benefit HMID as they reduce their reliance on Reclamation Project power grids. These Reclamation projects include the Heart Mountain Power Plant, the Buffalo Bill Power Plant, the Shoshone Power Plant and the Spirit Mountain Power Plant.

- *Anticipated benefits to other sectors/entities.*
  Over a twenty-year span, this project could save enough energy to help reduce the carbon footprint of others who may be using a coal power plan. It would offset approximately 288,241 lbs. of CO2 over this twenty-year span, which is a reduction in a carbon footprint equivalent to:

The carbon footprint equivalent information above was provided by the United States Environmental Protection Agency Greenhouse Gas Equivalencies Calculator by entering the kilowatt-hours reduced and then multiplying the equivalent results of the reduced carbon dioxide emission by twenty years.

- *Expected water needs, if any, of the system*
  No water will be needed.

E.1.4. Evaluation Criterion D – Complementing On-Farm Irrigation Improvements

If the proposed project will complement an on-farm improvement eligible for NRCS assistance, please address the following:

- *Describe any planned or ongoing projects by farmers/ranchers that receive water from the applicant to improve on-farm efficiencies.*
  - *Provide a detailed description of the on-farm efficiency improvements.*
    This project will help provide a safer, more reliable, and more efficient water delivery system for the District. Many farmers already have installed pipes, sprinklers, and pivots to make their irrigation systems more efficient and have found that it has allowed for higher crop yields. Others who have not taken this opportunity have shown interest and are looking forward to evaluating the best option for their agricultural lands.

    HMID provides water to many different ditches and turnouts. This project will be a positive move toward ensuring that shareholders will receive their shares of water through a canal that is lined and functioning so that losses are reduced, and water can be delivered.

The District is aware of a few local farm projects that are being considered, most of which are ditch expansions, piping of ditches, and conversion of water deliveries from flood irrigation to sprinklers. There is a list of nine farmers that have substantial acreage who have interest in on-farm efficiency projects. See Attachment 5 On-Farm Signature Page.

- *Have the farmers requested technical or financial assistance from NRCS for the on-farm efficiency projects, or do they plan to in the future?*

  The nine listed farmers have expressed interest in participating in NRCS funding programs and have in the past participated in other opportunities with NRCS. This project will give them more security in knowing that the canal will function properly and not be shut down constantly, allow for better safety, and conservation of water. They have not requested assistance from NRCS however they plan to in the future. If available, provide documentation that the on-farm projects are eligible for NRCS assistance, that such assistance has or will be requested, and the number or percentage of farms that plan to participate in available NRCS programs.

  The on-farm assistance has not been requested from NRCS. They have a strong interest to meet with NRCS to develop high-efficiency irrigation systems. As stated previously, many farmers already have on-farm sprinkler improvements on their farms. These interested farmers have over 4,128 acres that could be sprinkled in addition to thousands of others that are already sprinkling their farms. Some of these farmers listed have sprinklers on another acreage they farm and want to expand, and others are interested in acquiring the sprinkler systems for the first time. Those who have signed up would represent 15.5 percent of the irrigable acreage.

- *Applicants should provide letters of intent from farmers/ ranchers in the affected project areas.*

  The farmers have signed a signature page that can be found in Attachment 5 On-Farm Signature Page. This form indicates the name, signature, and acreage of those irrigators benefiting from the project who are interested in applying for NRCS assistance.

- *Describe how the proposed WaterSMART project would complement any ongoing or planned on-farm improvement.*
  - *Will the proposed WaterSMART project directly facilitate the on-farm improvement? If so, how? For example, installation of a pressurized pipe through WaterSMART can help support efficient on-farm irrigation practices, such as drip-irrigation.*

  OR

  - *Will the proposed WaterSMART project complement the on-farm project by maximizing efficiency in the area? If so, how?*

    Yes, the proposed project will complement the on-farm project in the following ways:

- Irrigators will have a dependable source of water that they can now count on, especially during the critical hot summer months when they rely on having the water for their crops.
- Users at the end of the canal will now be able to get their full share of water, which they have been unable to receive in the past.
- More confidence in the main canal system which would allow the farmer to make an investment in sprinkling and drip irrigation methods.

- *Describe the on-farm water conservation or water use efficiency benefits that would result from the on-farm component of this project.*
  - *Estimate the potential on-farm water savings that could result in acre-feet per year. Include support or backup documentation for any calculations or assumptions.*

    Based on calculation and information available from NRCS flood irrigation is only 40 to 50 percent efficient compared to the 75 percent, the efficiency of sprinklers. Estimates have not been made for the potential saving for on-farm implementation projects. However, water savings already submitted as part of this application are substantial and would work towards having an impact on saving essential water resources in the area. The most meaningful benefit that comes from sprinkling an additional 4,128 acres would be in the reduce salts and nutrients that flow off of the land into the rivers. This alone is will have an impact on all the water users and should be considered a significant water quality savings.

E.1.5. Evaluation Criterion E – Department of the Interior Priorities

Address those priorities that are applicable to your project. Points will be allocated based on the degree to which the project supports one or more of the priorities listed, and whether the connection to the Priority(ies) is well supported in the proposal.

Creating a conservation stewardship legacy second only to Teddy Roosevelt: President Theodore Roosevelt envisioned an irrigated West. The proposed project will allow his vision to remain unbroken. Wyoming knows water is a vital limited resource. Time, age, drought, and growth are quickly teaching this state that you have to work towards conservation continually.
Teddy Roosevelt's conservation stewardship legacy is manifest in this area of Wyoming and is one of the first projects he developed as part of the Reclamation Act of 1902. The Shoshone Project or Buffalo Bill Dam, as many know it, feeds the Rattlesnake Canal and was the real vision of irrigating the west.

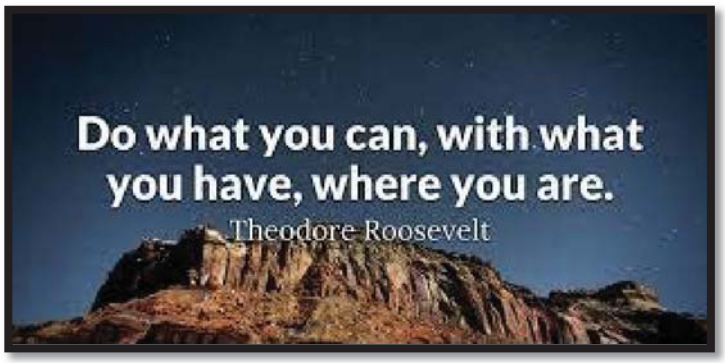
The Rattlesnake Canal Liner Project will rebuild those "legacy canals" that have served the land of Wyoming for over 70 plus years. As President Roosevelt said, "One hundred and sixty acres of fairly rich and well-watered soil, or a much smaller amount of irrigated land, may keep a family in plenty, whereas no one could get a living out of one hundred and sixty acres of dry pasture land capable of supporting at the outside only one head of cattle to every ten acres."

Irrigation in Wyoming is the only thing that makes cultivating the land possible.

This project will help expand water reliability for the Heart Mountain Irrigation District, Buffalo Bill Dam, Shoshone River, and other recreation sites in the area. As the District reduces the losses in the Rattlesnake Canal Liner, more water can be held in the Dam and released into the River. Water can be conserved to be used on crops and no longer lost into the voids under the 70-

plus-year-old canal that has seen better days. This project will once again capture the vision of "good old Teddy," which was to irrigate the west; not to get lost in transit!

Utilizing our natural resources: The hydro turbine station that will be constructed will use natural stream flows in the canal to produce power for the screen and SCADA system. By utilizing the natural resources within the canal, HMID can follow the initiative of Teddy Roosevelt to harness the water and do what you can, with what you have, where you are.



Restoring trust with local communities:
Crop production and eventually the economic viability of the area will be the cost of this canal. When voids happen, and the canal is breached, it has to be shut down for days. Large amounts of water are lost, and the impact on the farmers are compounded. In the past, farmers have faced:

- Reduced watering days
- Low yields and crops dying in the heat of the summer
- Need to purchase additional feed for cattle
- Delivering a lesser-quality product to the Sugar Beet Factory, which requires more processing and less or late pay to farmers
- Economic losses and impact to farmers and community

Farmers begin to lose trust that water will be there and that the system will be reliable. Fear of spending money to invest in seed, livestock or equipment is at the forefront of every conversation and has a rippling effect on other businesses in the area.

This project will begin to regain confidence and reduce conflict by alleviating burdens placed upon others due to water losses within the canal system. The development of the Heart Mountain Canal Rehabilitation Level II Studies in 2016 generated long-needed dialogue between the irrigators, the State, local community, WWCD, and others that would not have happened under other situations. The groups have come together to work toward understanding the issues, fixing the canal, finding money to help rebuild the canal, and restoring trust between all the stakeholders to help them move forward towards one goal; to reconstruct the Rattlesnake Canal liner so that District, farmers, and the community have a sustainable future.

Modernizing our infrastructure: The proposed project develops a partnership between the District, Wyoming, and Reclamation. This partnership will allow Heart Mountain to modernize their system and bring them into the twenty-first century. The development of this project will:

- Build a new, modern canal that will reduce maintenance times and costs
- Allow for reduced water losses and conflicts
- Provide opportunities to sprinkle farmland and increase crop yields
- Facilitate hydropower generation that will supplement the needed power to run the screen and SCADA system.

E.1.6. Evaluation Criterion F – Implementation and Results

E.1.6.1. Subcriterion No. F.1 – Project Planning

Does the applicant have a Water Conservation Plan and/or System Optimization Review (SOR) in place? Please self-certify, or provide copies of these plans where appropriate to verify that such a plan is in place.

Provide the following information regarding project planning:

1) *Identify any district-wide, or system-wide, planning that provides support for the proposed project. This could include a Water Conservation Plan, SOR, or other planning efforts done to determine the priority of this project in relation to other potential projects.*

In the 2013 Session, the Wyoming legislature approved an irrigation system master plan for the District. The study was completed in May 2015 and recommended further investigation of the Heart Mountain Main Canal and its occurring failures. In the 2015 session, legislation was approved for completion of a Level II Study, which examined the canal and provided recommendations for rehabilitation. In June 2015, the Wyoming Water Development Commission (WWDC) commissioned the Level II investigation of the canal. See Attachment 4 HMID Level II 2016 Study Executive Summary.

The scope of that study primarily included the following:

1. Evaluation of the canal by visual inspection, ground penetrating radar, and other non-destructive techniques;
2. Hydraulic analyses to examine canal geometry, capacities, and closed-conduit conveyance options;
3. Preparation of rehabilitation and/or improvement options, conceptual designs, and cost estimates.

The report was completed in July 2016 and identified options for repair or replacement of the canal. Those are the options that are being proposed for implementation.

2) *Describe how the project conforms to and meets the goals of any applicable planning efforts, and identify any aspect of the project that implements a feature of an existing water plan(s).*

In March 2017, the WWDC approved a request by the District to amend the July 2016 report to provide supplemental information. The revised report consisted of additions to previous analyses and focused explicitly on two cross-sectional options for canal replacement; one involving a rectangular cross-section, and one concerning updates and clarifications to the previously defined trapezoidal cross-section. Additionally, information was provided pertaining to construction access to the project site. The amended report was delivered in August 2017. It is the findings of this revised report that formulates the basis of this project application and recommendation.

E.1.6.2. Subcriterion No. F.2 – Performance Measures

Provide a brief summary describing the performance measure that will be used to quantify actual benefits upon completion of the project (e.g., water saved or better managed, energy generated or saved). For more information calculating performance measure, see Appendix A: Benefit Quantification and Performance Measure Guidance.

Upon completion of the project, the same methodology that was used to calculate the losses will be employed post project. All of the measurement devices and recording procedures will still be in place. The results will be compared with pre-project data.

In addition, HMID will use a portable Acoustic Doupler Profiler to measure flows at either end of the new project. This will provide project-specific verification of post-project seepage losses that exist. Those post-project losses are expected to be at 0.

The hydro performance measures will also include documenting the amount of power produced each month during the irrigation season to quantify the actual benefits of the hydro energy produced. This information will be tracked over a series of years to understand the power production of these small hydro units better. This will allow HMID to determine the viability of adding additional hydro units to other areas of the canal to help produce supplemental power to run meters and screens within the system.

E.1.7. Evaluation Criterion G – Nexus to Reclamation Project Activities

Is the proposed project connected to Reclamation project activities? If so, how? Please consider the following:

- *Does the applicant receive Reclamation project water?*
  The Buffalo Bill Reservoir is a Reclamation project, as well as the Shoshone Project. The Reservoir is the source of water for the Heart Mountain Irrigation District.

- *Is the project on Reclamation project lands or involving Reclamation facilities?*
  Yes, Heart Mountain is part of the Shoshone Project, which was later known as the Buffalo Bill Dam, a Reclamation project. The existing Rattlesnake Liner was constructed by Reclamation in 1938 following the completion of the Shoshone Canyon Conduit. In the late 1940s and 1950s, Reclamation operated the facilities in the project until the Heart Mountain Irrigation District was established and irrigation operations and maintenance were transferred to them in 1958.

- *Is the project in the same basin as a Reclamation project or activity?*
  Yes, as stated above.

- *Will the proposed work contribute water to a basin where a Reclamation project is located?*
  Yes, as stated above, conserved water can be held in the Buffalo Bill Reservoir for longer during the irrigation season.

Will the project benefit any tribe(s)?

No direct benefits will be realized, but the Crow Indian Reservation receives tailwater from the District's canal. If the canal does not have substantial water losses, then water will flow through the canal, and the Tribe will have access to the tailwater.

E.1.8. Evaluation Criterion H – Additional Non-Federal Funding

State the percentage of non-federal funding provided using the following calculation: Non-Federal Funding divided by Total Project Cost.

$$\frac{\$600{,}005.00 \text{ HMID Funding}}{\$900{,}005.00 \text{ Total Project Cost}} = 67\%$$

67 percent of the funding will come from a loan and grant the state of Wyoming. That funding was approved by the Wyoming legislature in February 2018.

Project Budget

Funding Plan and Letters of Commitment

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

How you will make your contribution to the cost-share requirement, such as monetary and/or in-kind contributions and source funds contributed by the applicant (e.g., reserve account, tax revenue, and/or assessments).

HMID received approval for a loan and grant from WWDC for 67 percent of this project.

Describe any donations or in-kind costs incurred before the anticipated Project start date that you seek to include as project costs. For each cost, identify:

No in-kind costs have incurred.

Describe any funding requested or received from other Federal partners. Note: other sources of Federal funding may not be counted towards the required cost share unless otherwise allowed by statute.

HMID received approval for a loan and grant from WWDC for funding 67 percent of this project.

Describe any pending funding requests that have not yet been approved, and explain how the project will be affected if such funding is denied.

There are no pending funds.

Summary of Non-Federal and Federal Funding Sources

FUNDING SOURCES	***AMOUNT***
Non-Federal Entities	
Recipient Funding/WWDC Loan/Grant	$600,005.00
Non-Federal Subtotal	$600,005.00
Other Federal Entities	
Other Federal Subtotal	$0.00
Requested Reclamation Funding	**$300,000.00**
Total Project Funding	**$900,005.00**

Budget Proposal

Budget Proposal

Budget Item Description	Computation		Quantity	Total
	$/Unit	**Quantity**	Type	Cost
Salaries & Wages	$0.00	-	-	$0.00
Fringe Benefits	$0.00	-	-	$0.00
Travel	$0.00	-	-	$0.00
Equipment	$0.00	-	-	$0.00
Supplies and materials	$0.00	-	-	$0.00
Contractual /Construction				**$898,005.00**
Design	$60,000	1	EA	$60,000
Construction Management	$60,000	1	EA	$60,000
Environmental Review (NEPA)	$20,700	1	EA	$20,700
Mobilization	$30,000	1	EA	$30,000
Remove Existing Concrete Liner	$83.00	637	LF	$52,871
Liner Excavation	$84.00	637	LF	$53,508
Liner Backfill	$85.00	637	LF	$54,145
Canal Liner	$837.00	637	LF	$533,169
Access Road Grading	$28.00	629	LF	$17,612
5kW Micro Hydro	$16,000	1	EA	$16,000
Other				**$2,000.00**
Reclamation Review Environmental Report	$2,000	1	EA	$2,000
Total Direct Costs				**$900,005.00**
Indirect Costs				
Type of rate	Percentage	$base		$0.00
Total Estimated Project Costs				**$900,005.00**

Budget Narrative

Salaries and Wages

No separate salaries or wages outside of contractual costs will be included.

Fringe Benefits

No separate fringe benefits will be included.

Travel

No separate travel costs will be included.

Equipment

No separate equipment costs will be included. All of these costs are included in the contractual contracts.

Materials and Supplies

No separate materials and supplies costs will be included. All of these costs are included in the contractual contracts.

Contractual

In order to determine unit costs, which were included in the cost estimate for this project, HMID relied upon contract unit prices from a study completed by Engineering Associates. The District will bid the construction portion of the project to several prequalified construction companies. The contractual costs shown are estimates for each of the components to furnish and install all the elements of the project. Generally, the low bidder will be selected based on a determination of acceptable qualifications.

Environmental and Regulatory Compliance Costs

It anticipated that the environmental document would be a categorical exclusion, in that HMID will be working within the existing canal alignment that has been disturbed and has continued to be disturbed over the past 20 or so years. It is expected that it will take $20,700 to evaluate the required information, prepare the report, and update any changes required from reclamation after their review for Phase III. The total cost is 3 percent of the project, which includes the $2,000 for review by Reclamation.

Other Expenses

The other expense that is expected for HMID is the setting aside of $2,000 in funds for Reclamation to review the environmental document.

Indirect Costs

No indirect costs will be part of the proposed project.

Total Costs

HMID Portion: $600,005 Fed Portion: $300,000 Total: $900,005

Environmental and Cultural Resources Compliance

Will the proposed project impact the surrounding environment (e.g., soil [dust], air, water [quality and quantity], animal habitat)? Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the project area. Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.

Impacts will be those associated with the lining project. The proposed project improvements will take place entirely within the existing right-of-ways. In the past, similar projects have had minimal impacts. The surface vegetation will be restored upon completion of the project.

Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project?

HMID is not aware of any impacts concerning threatened or endangered species in this area.

Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as "Waters of the United States?" If so, please describe and estimate any impacts the proposed project may have.

HMID is not aware of any impacts to wetlands in this area.

When was the water delivery system constructed?

Many improvements have been made over the years. As part of the completed environmental document, the required historical documentation for the project will be completed.

Will the proposed project result in any modification of or effects too, individual features of an irrigation system (e.g., headgates, canals, or flumes)? If so, state when those features were constructed and describe the nature and timing of any extensive alterations or modifications to those features completed previously.

The area beside the canal liner will be reconstructed as a result of this project.

Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places? A cultural resources specialist at your local Reclamation office or the State Historic Preservation Office can assist in answering this question.

HMID is not aware of any building, structures or features that would qualify. A cultural resource inventory will be completed as part of the submitted environmental document.

Are there any known archeological sites in the proposed project area?

HMID is not aware of any impacts to or locations of archeological sites.

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

No, the project will not require a right-of-way or relocations from adjacent properties and will have no impact on residential uses within the study area.

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

HMID is not aware of any impacts to or locations of any of these types of sites. An inventory will be completed as part of the submitted environmental document.

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.

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.

The crossfloat hydropower turbine will require a conduit exemption from FERC. No other permits will be required.

Letters of Support

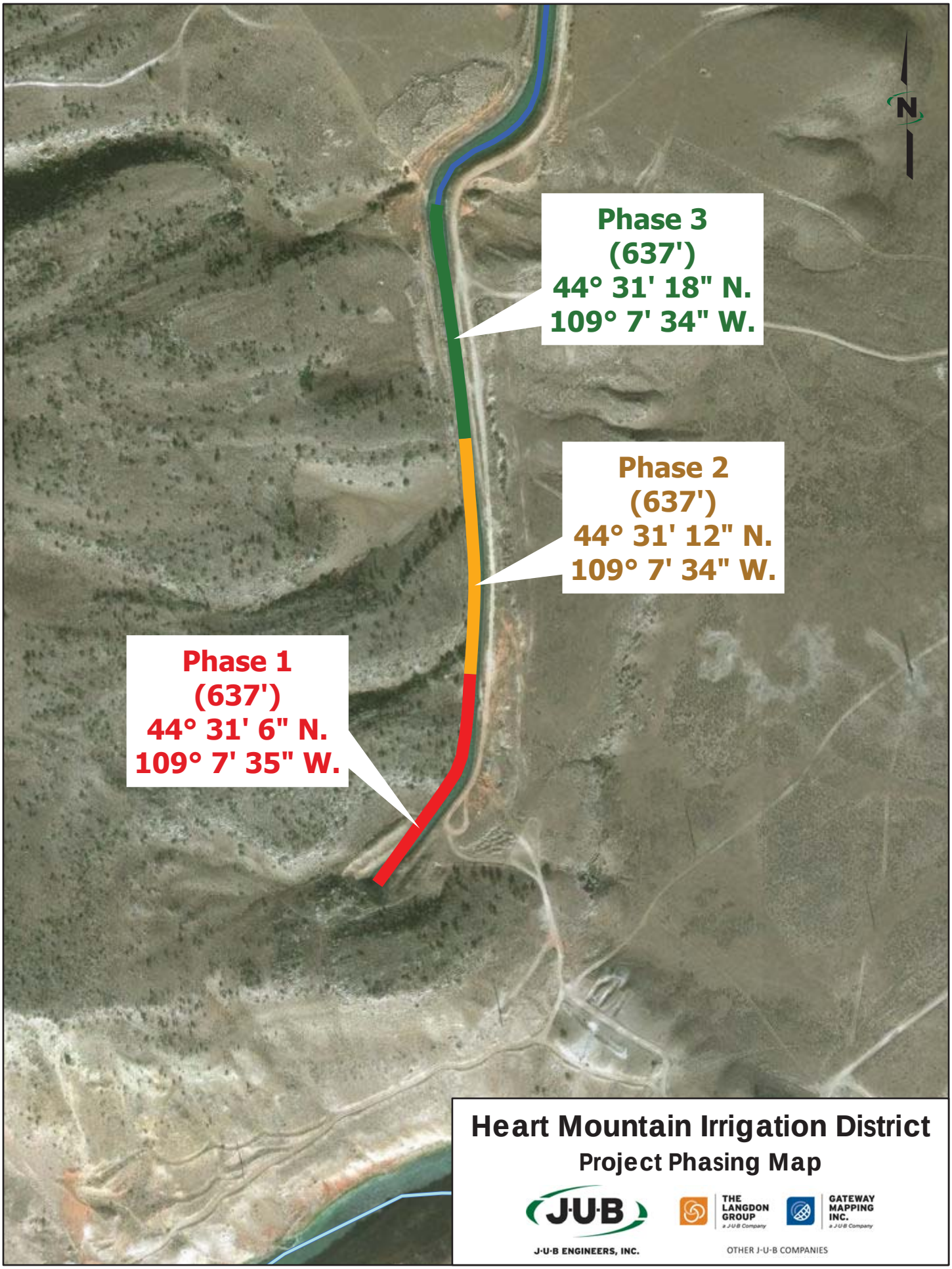
Include letters of support from interested stakeholders supporting the proposed project.

N/A

Official Resolution

Include an official resolution adopted by the applicant's board of directors or governing body. The official resolution may be submitted up to 30 days after the application deadline.

The official resolution will be submitted by June 10, 2018



Heart Mountain Irrigation District

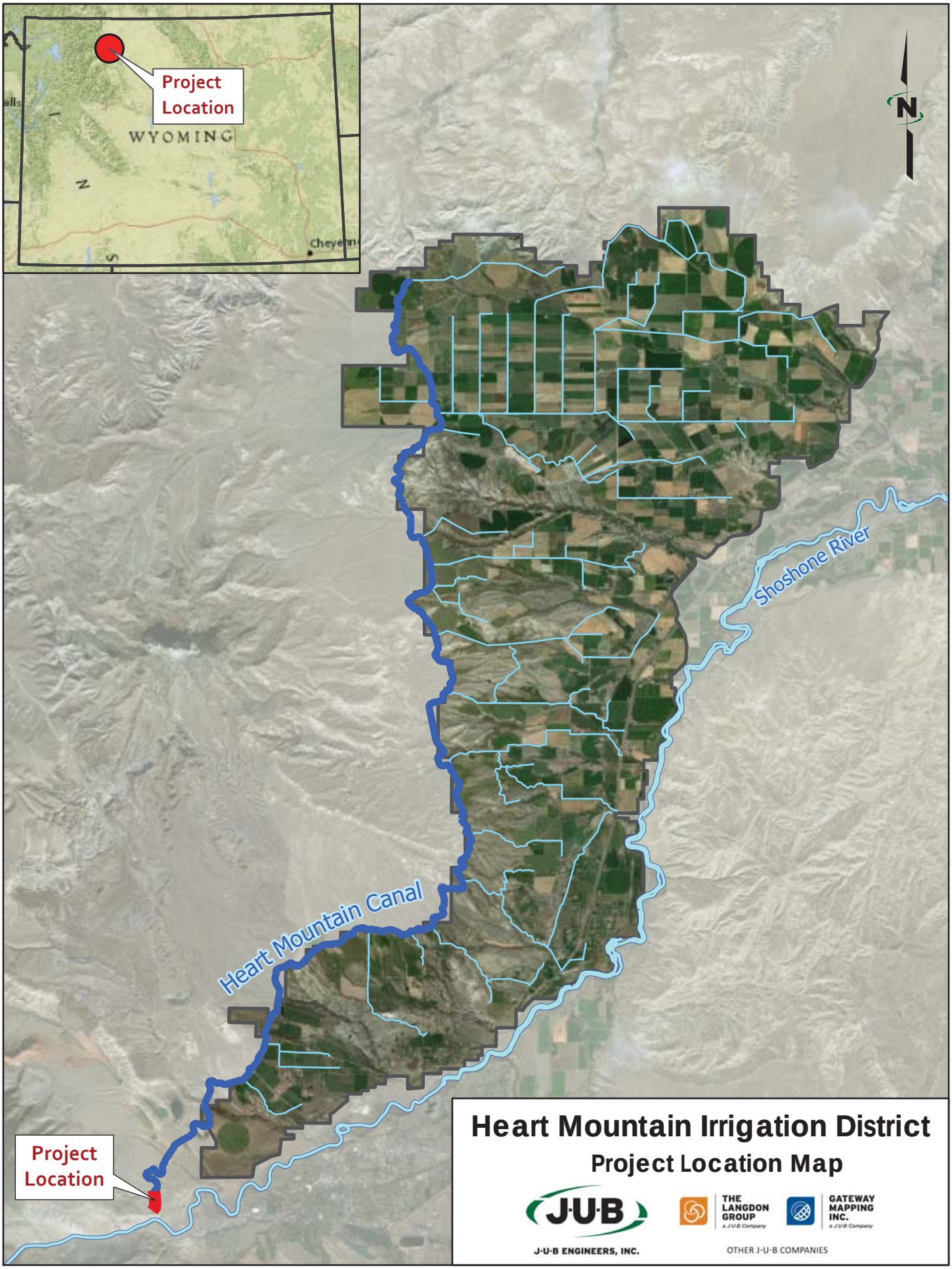
Project Phasing Map

J-U-B ENGINEERS, INC.

THE LANGDON GROUP a J-U-B Company

GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES


Project Location
WYOMING
N
Shoshone River
Heart Mountain Canal
Project Location
Heart Mountain Irrigation District
Project Location Map
J-U-B ENGINEERS, INC.
THE LANGDON GROUP
GATEWAY MAPPING INC.
OTHER J-U-B COMPANIES

Heart Mountain Irrigation District

Phase 3

J-U-B ENGINEERS, INC.

THE LANGDON GROUP a J-U-B Company

GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

Mailing Address:
Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

Physical Address:
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

Phone: (307) 766-6651
Fax: (307) 766-3785

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HEART MOUNTAIN CANAL REHABILITATION
LEVEL II STUDY

JULY 2016

EXECUTIVE SUMMARY

Prepared for
WYOMING WATER DEVELOPMENT COMMISSION

Prepared by
Engineering Associates
P.O. Box 1900
Cody, WY 82414

ENGINEERING ASSOCIATES
CODY, WYOMING

HEART MOUNTAIN CANAL REHABILITATION
LEVEL II STUDY

EXECUTIVE SUMMARY

FUNDED BY: Wyoming Water Development Commission

DIRECTOR: Harry C. LaBonde, Jr., PE

COMMISSIONERS: Nick Bettas
Travis Brockie
Karen Budd-Falen
Floyd Canfield
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A. PURPOSE

Wyoming Water Development Commission (WWDC) contracted with Engineering Associates (EA) in June 2015 to complete a study for Heart Mountain Irrigation District for the Canal Liner directly downstream of the Rattlesnake Mountain Tunnel.

The scope of the study included:

1. Review of existing information.

2. Evaluation of the canal liner including visual inspection, ground penetrating radar (GPR), and non-destructive investigations.

3. Using hydraulic analyses to look at cross section design, slope, velocities, and water depths to verify the design capacity of the canal and look at options to use a closed-conduit system.

4. Develop multiple rehabilitation options.

5. Create conceptual designs and construction cost estimates for improvement options to the canal liner.

6. Investigate different project financing options for canal rehabilitation.

Figure 1

B. FINDINGS

EA evaluated the full length of the concrete liner visually, with ground penetrating radar, and non-destructive testing. The findings are:

- Visual Inspection

The concrete lined section of the HMID canal was visually inspected in dry condition from November, 2015 to March, 2016 and during the irrigation season from July, 2015 to September, 2015. During the dry inspection, large cracks, exposed rebar, and deteriorating concrete were located at numerous locations. 95 concrete panels on the west side of the liner and 87 concrete panels on the east side of the liner have extensive cracking.

Figure 2

- Ground Penetrating Radar

Jorgensen Geotechnical conducted a site investigation along the concrete liner section of the Heart Mountain Canal. The site investigation consisted of two separate site visits. The first site visit occurred on November 10th and 11th, 2015 and the second site investigation was completed on January 5th, 2016. The site investigation included visual observations of the surrounding ground conditions and a Ground Penetrating Radar (GPR) survey of the concrete lined canal section.

When using the GPR, any anomaly found was marked in the field with spray paint and then surveyed and recorded with GPS. During this mapping with the GPR, the bedding planes of the bedrock were visible in multiple locations. See the report found in Appendix A of the Final Report for the complete information on the GPR investigation.

A total of nine possible void areas were identified by correlation with other investigation efforts. Other anomalies that were not identified as possible void areas could be the result of large boulders, small voids, reflection of rebar, change in material composition, or change in material moisture content.

Figure 3

- Non-destructive Investigation

After using the ground penetrating radar method, EA decided to use another non-destructive exploration approach to evaluate the current physical conditions of the canal liner. This method used a 4-pound sledge hammer and a chain to conduct sounding tests. Sounding involves striking the concrete surface and interpreting the sound produced. Solid concrete will produce a ringing sound, while concrete that is delaminated, spalled, or has separation from the base material will produce a flat or hollow sound. Subgrade voids will also produce a flat or hollow sound. Sounding of vertical areas is best achieved by using a hammer or steel rod. A steel chain was drug over the floor of the canal. Results from the hammer and chain tests located twenty-nine sections of the wall and floor of the liner with suspected hollow areas.

Figure 4

C. RECOMMENDATIONS

With the amount of cracking, poor subgrade, and overall age of the existing liner, another major failure is definitely likely. It is the recommendation of this study that the existing liner should be completely removed and replaced. Trying to "Band-Aid" the existing liner will only postpone the inevitable replacement.

If the total construction cost of this project is a concern due to funding availability, Option 3 (concrete liner replacement) should be utilized. The total costs for construction, design engineering, permitting and mitigation, legal fees, and construction engineering is $2,001,874.38. A breakdown of the costs is listed below:

OPTION 3

HMID Canal Reconstruction - Full Liner Replacement

Probable Cost of Project Components:	Qty	Unit		Cost		
Mobilization	1	LS	$	80,000.00		
Contract Bond	1	LS	$	127,100.00		
Remove 1862 FT Existing Channel	1	LS	$	120,000.00		
Fill material - road base with cement mix	4000	CY	$	140,000.00		
Canal Lining - 4,000 PSI	1862	LF	$	931,000.00		
Total Cost of Project Components			$	1,398,100.00		
Probable Consultant Fees:						
Preparation of Final Design and Specifications (10%)					$	176,859.65
Permitting and Mitigation (0%)					$	-
Legal Fees (0%)					$	-
Acquisition of Access and Rights of Way (0%)					$	-
Total Cost of Project Components			$	1,398,100.00		
Construction Costs Subtotal #1			$	1,398,100.00		
Engineering Costs = CCS#1 x 10%			$	139,810.00		
Subtotal #2			$	1,537,910.00		
Contingency = Subtotal #2 x 15%			$	230,686.50		
Construction Cost Total			$	1,768,596.50		
Project Cost Total 2016					$	1,945,456.15
Project Cost Total 2017 (2.9% increase)					$	2,001,874.38
Project Cost Total 2018 (5.8% increase)					$	2,058,292.61
WWDC Loan - Year 2017				33%	$	660,618.54
WWDC Grant - Year 2017				67%	$	1,341,255.83

Funding Agency	Interest	Years	Percentage of Eligible Funding	Grant/ Loan Amounts	Capital Recovery Factors	Annual Debt Service	Annual Debt Service Per Acre
WWDC Grant			67%	1,341,255.83	0	-	-
WWDC Loan 4% @ 20 Years	4%	20	33%	660,618.54	0.0735818	$48,609.47	$1.55
WWDC Loan 4% @ 40 Years	4%	40	33%	660,618.54	0.0505235	$33,376.75	$1.06
WWDC Loan 6% @ 40 Years	6%	40	33%	660,618.54	0.0664615	$43,905.72	$1.40
No Loan	0%	0	33%	660,618.54	0	$0.00	$0.00

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ANNUAL DEBT SERVICE PER ACRE IS BASED ON 31,345 ASSESSED ACRES.

If sufficient funding is available, the rebuilding of this canal section should be completed utilizing Option 7 (9' x 18' box culvert). This is the most prudent option with the longest life span and would minimize future maintenance. The total costs including construction, design engineering, permitting and mitigation, legal fees, and construction engineering is $7,716,469.71. A breakdown of the costs is listed below:

OPTION 7

HMID Canal Reconstruction - 9' x 18' Box Replacement

Probable Cost of Project Components:	Qty	Unit		Cost
Mobilization	1	LS	$	220,000.00
Contract Bond	1	LS	$	489,922.50
Remove 1400 FT Existing Channel	1	LS	$	80,000.00
Excavation	7500	CY	$	97,500.00
Bedding Gravel	2300	CY	$	69,000.00
Trench Foundation Material	1500	CY	$	30,000.00
Select Backfill - Grading W	4800	CY	$	144,000.00
9' x 18' box	1671	FT	$	4,135,725.00
Seeding/Fertilizer Type 1/Mulching	1.5	AC	$	3,000.00
Concrete Inlet Structure - 4,000 PSI	1	LS	$	60,000.00
Concrete Outlet Structure - 4,000 PSI	1	LS	$	60,000.00
Total Cost of Project Components			$	5,389,147.50

Probable Consultant Fees:		
Preparation of Final Design and Specifications (10%)		$ 681,727.16
Permitting and Mitigation (0%)		$ -
Legal Fees (0%)		$ -
Acquisition of Access and Rights of Way (0%)		$ -
Total Cost of Project Components	$ 5,389,147.50	
Construction Costs Subtotal #1	$ 5,389,147.50	
Engineering Costs = CCS#1 x 10%	$ 538,914.75	
Subtotal #2	$ 5,928,062.25	
Contingency = Subtotal #2 x 15%	$ 889,209.34	
Construction Cost Total	$ 6,817,271.59	
Project Cost Total 2016		$ 7,498,998.75
Project Cost Total 2017 (2.9% increase)		$ 7,716,469.71
Project Cost Total 2018 (5.8% increase)		$ 7,933,940.67

WWDC Loan - Year 2017	33%	$ 2,546,435.00
WWDC Grant - Year 2017	67%	$ 5,170,034.71

Funding Agency	Interest	Years	Percentage of Eligible Funding	Grant/ Loan Amounts	Capital Recovery Factors	Annual Debt Service	Annual Debt Service Per Acre
WWDC Grant			67%	5,170,034.71	0	-	-
WWDC Loan 4% @ 20 Years	4%	20	33%	2,546,435.00	0.0735818	$187,371.14	$5.98
WWDC Loan 4% @ 40 Years	4%	40	33%	2,546,435.00	0.0505235	$128,654.78	$4.10
WWDC Loan 6% @ 40 Years	6%	40	33%	2,546,435.00	0.0664615	$169,239.98	$5.40
No Loan	0%	0	33%	2,546,435.00	0	$0.00	$0.00

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Heart Mountain Irrigation District (HMID)
On-farm Intent Signatures - Rattlesnake Liner Project
FOA# BOR-DO-18-F006

Landowner Name	Claimable Acreage	Landowner Signature I have an interest to install a high-efficiency irrigation system when sufficient water quantity, quality, and application requirements are met.
BRIAN Duyck	550	Brian Duyck
Michael Forman	450	Michael H Forman
Jim Davis	500	
Wayne McClain	150	Wayne McClain
Corey Forman	430	Corey Forman
Joel Schaefer	150	Joel Schaefer
Kelly Spriggs	600	Kelly Spriggs
Britt M DeBoer	550	Britt M DeBoer
Tak Ogawa	500	TAK OGAWA
DAVid L. Zuercher	128	