R22AS00026 WaterSMART Environmental Water Resources FY2022

MUDDY CREEK RESTORATION AND RESILIENCE PROJECT, PHASE I

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D.2.2.4.Technical Proposal and Evaluation Criteria

D.2.2.4.1. Executive Summary

Project: Muddy Creek Restoration and Resiliency, Phase I
Date: December 9, 2021
Applicant: Sun River Watershed Group (Category B, watershed group)
Supported by Greenfields Irrigation District (Category A, irrigation district)
See support letter, included
Location: Teton and Cascade Counties, Montana

This project builds on SRWG's Muddy Creek Master Plan, funded by WaterSMART Cooperative Watershed Management Phase I Grant (R19AP000263).

The Sun River Watershed Group (SRWG), in partnership with Greenfields Irrigation District (GID), will *benefit ecological values by improving water quality, enhancing fish and wildlife habitat, and restoring hydrologic processes* in Muddy Creek, a severely degraded tributary to the Sun River in Central Montana through two strategies: 1) reducing excess water that causes erosion and unnatural flow conditions through improved irrigation infrastructure; and, 2) implementing stream restoration on lower Muddy Creek, where long-term, massive erosion has occurred and natural ecological conditions and processes are severely degraded. Other benefits of this project include *water conservation and efficiency improvements that result in quantifiable and sustained water savings* and *mitigation of drought-related impacts on ecological values*. Muddy Creek's natural flow regime has been modified by over 100 years of intense irrigation, which results in flow fluctuation and unnaturally high stream flow events due to irrigation returns. These high, fluctuating flows stress the stream banks resulting in massive erosion, which activates sediment and nutrients into the creek. Muddy Creek flows into the Sun River, which flows to the Missouri, extending the reach and negative impacts of these impairments. This project includes treatment at the source of the issue – excessive and unnatural stream flows due to irrigation returns – as well as treating stream banks where erosion occurs. Irrigation infrastructure will be improved by the expansion of a re-regulation facility to allow for attenuation and more efficient management of excess irrigation water, reducing the volume and fluctuation of flows in Muddy Creek, thus reducing erosion and improving water quality, habitat, and restoring a more natural hydrologic regime. On-the-ground restoration techniques on three miles of the most severely eroded stream banks along Muddy Creek will also reduce erosion, improve water quality, enhance riparian and aquatic habitat, restore vegetation, and reconnect floodplain, further restoring hydrologic processes and habitat.

Muddy Creek is widely recognized as one of the largest contributors of nonpoint source pollution in Central Montana. Many other efforts to restore Muddy Creek and improve water management are underway by SRWG, GID, the Natural Resources Conservation Service (NRCS) and other partners that will expand the effects of this work for an aggregate benefit

to natural resources, mitigation of drought-related impacts, and long-term water security for ecological values and irrigation.

This project will begin upon notice of this award and will be complete by September 2025 (or three years from award date). The project is located on a Federal facility owned by the US Bureau of Reclamation, managed by GID.

D.2.2.4.2. Project Location

This project is located in the Muddy Creek subwatershed to the Sun River watershed in central Montana, between the towns of Fairfield and Great Falls, Montana, at approximately: 47.588179, -111.575857 (stream restoration site) and 47.659236, -111.820202 (re-regulation site).

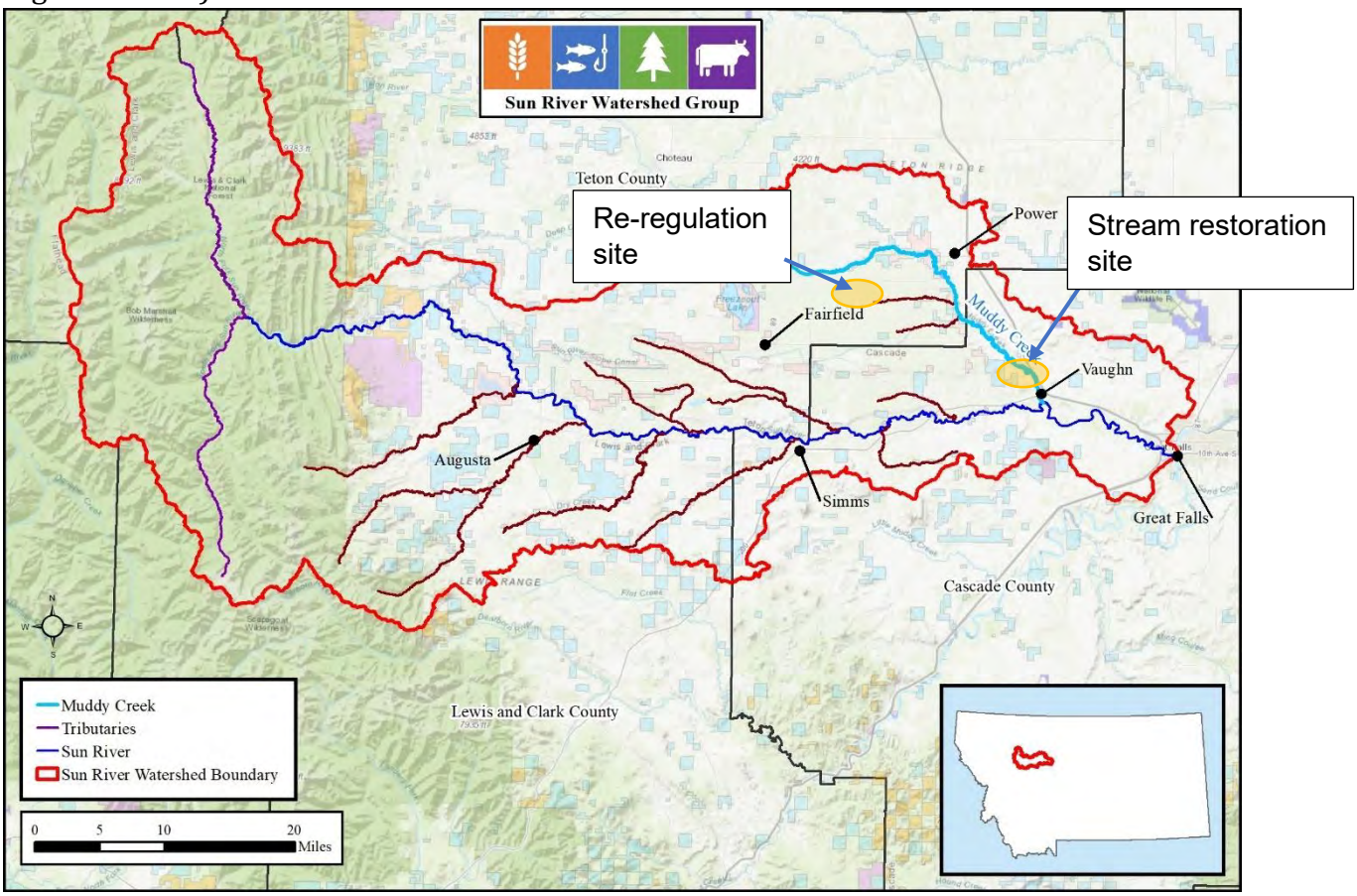


Fig. 1. Map of Sun River Watershed including project sites. Inset: location of Sun River watershed within the state of Montana.

D.2.2.4.3. Technical Project Description

SRWG obtained WaterSMART CWMP funds in 2020 to complete a Master Plan for Muddy Creek. The projects described in this proposal are the top-priority projects described in the Master Plan, due to their anticipated positive impacts on ecological values and water reliability.

This project includes two approaches:

1. Improved irrigation infrastructure. SRWG and GID will expand the J-Wasteway reregulation facility to allow for better management, reducing flow-induced erosion, and improving water conservation.
2. Stream restoration. SRWG and hired team will implement multiple on-the-ground restoration techniques to ~3 miles of Muddy Creek to reduce erosion and restore healthy riparian and in-stream conditions.

It is important to consider these two approaches together. Conditions on stream banks in the proposed restoration area are severely degraded, so even with improved irrigation infrastructure upstream, erosion would continue. And the stream restoration techniques proposed are most effective if flows and bank stress are reduced through improvements to infrastructure to conserve and reduce fluctuation and volume of flows.

Improved irrigation infrastructure

The J-Wasteway component of GID's infrastructure represents the confluence of a large canal (GM-100) and a large, constructed drain (Drain B) that flows year-round. This confluence forms a pond as the outlet for the continuation of GM–100 and the waste way for Drain B are both checked and regulated. This pond is held at a constant level so the discharge downstream through the GM-100 headworks remains constant. As a result, any combined inflows into the pond greater than that needed to satisfy irrigation deliveries downstream along GM-100 are released, discharged, or otherwise spilled through the waste way overflow skimmer into a natural drainage: the headwaters of the Spring Coulee. Water released to Spring Coulee is considered lost and unrecoverable water and ultimately drains to Muddy Creek. Muddy Creek experiences environmental impacts from erosion caused by excess inflows being introduced from irrigation operations. The J-Waste Way facility is shown below in Figure 3.

GID has long envisioned to convert the confluence pond into a fully functioning re-regulation structure such that the magnitude of unrecoverable water lost to Spring Coulee and Muddy Creek could be drastically reduced. Re-regulation of inflows or the temporary detention of excess inflows would allow GID to use this water for irrigation as originally intended rather than lose it off-District to natural drainages with ongoing environmental issues. Previous engineering studies estimated an annual water savings of 8,000 acre-feet could be captured then re-released down the continuation of GM-100 for irrigation. The water savings and re-regulation potential would occur at an elevation of up to five feet higher than the current normal operating level of J-Wasteway and over a larger footprint. Because of the magnitude of the scope of work for the re-regulation facility project, it was divided into three phases. This phased approach was important as it allows GID crews to perform much of the construction themselves. It is also important because all construction must be completed during offseason and must be completed prior to the start of the next water season.

The first phase is complete (2020-2021 off-season) and consists of a new check control structure that is self-regulating and programmable with respect to time. The original check was manually operated, and a constant upstream pond level maintained a constant discharge through that old check. With a fluctuating pond level associated with true regulation, a self-monitoring, and self-regulating check structure, i.e. "a smart check", was warranted which can adjust itself to maintain the desired discharge flow based on downstream demand. The first phase was constructed and partially funded using a WaterSmart Grant.

The second phase will be completed this current offseason (2021 to 2022) and consists of a new waste way control structure on Spring Coulee which will operate in coordination with the fluctuating pond levels. This structure will control and minimize operational releases to the Spring Coulee drainage that now becomes unrecoverable or lost water. The primary purpose for this check structure is to self-regulate discharges and avoid over-topping of the wasteway facility. This second phase is being funded by a Renewable Resource Grant (RRG) from the Montana Department of Natural Resources and Conservation (DNRC). Construction is scheduled to begin December 13th.

Figure 2. Phase I: Smart Check on GM100 constructed by GID 2020-21 funded in part by WaterSMART

The third and final phase of the J-Waste Way Reregulation Project, which financial assistance is being sought under this funding opportunity, is the pond excavation and containment berm construction. Reregulation capacity will be obtained by enlarging the pond footprint and raising and/or constructing a containment berm to raise the maximum pond level by an additional five feet. The new earthen berm will be approximately 4,200 lineal feet in length and will encompass the enlarged pond. Bank armoring is proposed along the eastern berm to protect against wave action. The eastern berm will also be the tallest becoming gradually less towards the west or upstream stream. This work will be completed by GID using heavy equipment (excavators, dozer, loader, compactor) to construct a berm around the existing J-Wasteway, enlarging it to increase capacity, as depicted in Figure 3 by an orange dashed line.

A small amount of rock will be placed to avoid erosion of the berm due to wave scour. A full description of Phase II is included in Attachment A.

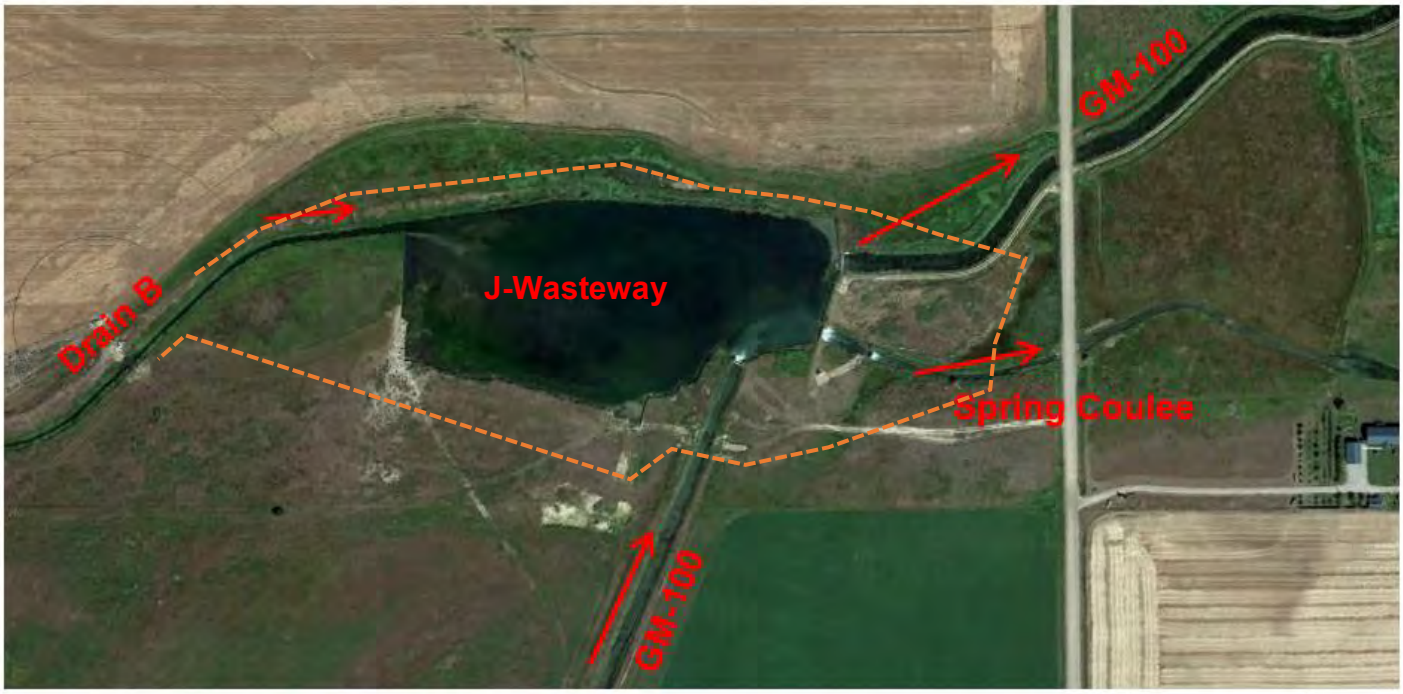


Figure 3. J-Wasteway re-regulation facility including inflows and outflows. Muddy Creek is located to the east outside the frame and receives water from Spring Coulee. The orange dashed lines indicate the berm alignment to enlarge the re-regulation capacity.

Stream restoration

Designs for stream restoration are included in Attachment B.

In the mid-1990s, the Muddy Creek Task Force (now SRWG) worked on a project to "stabilize the planform and gradient of the stream." This included work on about four miles of Muddy Creek and included one large rock structure to hold gradient at the downstream extent of the project, 10 rock grade control structures, over 160 barbs over eight more miles of creek, and a series of bank revetments. These structures functioned and continue to function as intended, however have begun showing clear signs of decay and have become increasingly associated with excessive lateral scour, eddy erosion, and hillslope failures. These structures were built to work together, so the failure of any one aging structure would jeopardize the whole structure system.

Simultaneous to this project, GID is pursuing a re-regulation project that will reduce GID inputs to the Muddy Creek system ("unused" water). Addressing flow inputs simultaneously with stream restoration is a critical aspect of this project. Although the reduction of inputs will reduce the magnitude and/or duration of high flows, this alone will not maintain stability or restore resiliency to Muddy Creek due to the current geomorphic state of the channel. As such, this project is designed to accommodate substantial uncertainty in terms

of the future flow regime, while optimizing conditions to re-invigorate natural evolution and the achievement of an equilibrium state under that flow regime. The foundation for the project is sound grade stabilization in this otherwise vulnerable system. This in turn provides opportunities to increase floodplain access and complexity, conditions which can be capitalized on to promote system resiliency and optimal ecological function in this highly altered environment.

This proposed project uses modern concepts of riffle-based grade control, flow dispersal via floodplain reconnection, stream power reduction, and habitat renewal in an area that was originally heavily engineered purely to resist amplified hydraulic forces on the bed and banks.

The following treatments will be included in the stream restoration. Specific locations for treatments are included in the preliminary project designs, Attachment B.

A. Riffle Grade Controls

Riffle Grade Controls are the most important feature in this project design as they will set the reach grade and work in conjunction with one another and other treatments throughout the reach. They generally correspond to an existing riffle bedform and since they are more frequently spaced with lower drop elevations than the existing (prior project) grade control structures, a more natural river rounded rock gradation can be used. Riffles will be constructed with well-graded over-sized river rounded alluvium. Final design will require a hydraulic model to evaluate floodplain surface frequency of inundation to calibrate and set final riffle elevations.

These stabilized riffles provide vertical stability and effectively increase (lift) the elevation of the existing streambed to provide connectivity to an existing abandoned floodplain that exists throughout most of the reach. They also prevent channel incision because they are constructed with an immobile rock gradation. The shape, frequency, geomorphic position, and elevation drop across these structures allows them to behave like natural riffles. The local water surface slope steepens across the structures at low flows but progressively flattens ("washes out") as water flows increase, eliminating the high energy loss conditions present at the existing grade controls and the associated scour and lateral erosion.

B. Terrace Toe Protections

Toe protections include multiple methods from preservation/enhancement of existing barbs to construction of bankfull floodplain surfaces along the toe of a high terraces. Toe treatments include:

1. Sod Stacking: Sod will be a readily available material along the project reach. Muddy Creek is a low-energy system and there are numerous examples of vegetated toe benches naturally establishing at the base of terrace surfaces. Using readily available material that can be placed efficiently enables treatment of extensive reaches at a lower cost. Shod is stacked and shaped to create a small bench and gently sloping bank face to facilitate vegetation

establishment. Additional stabilization can be derived from live staking with shroud line interwoven between stakes or blanketing with coir mats.

2. Bankfull Bench Construction: A stable channel bank will be established some distance off the toe of a high terrace. In the concept drawings, a brush/wood toe construction is described, but multiple methods may be used. Between the constructed bank face, fill will be placed to create a floodplain surface at the bankfull elevation. The width of the surface will vary depending on the existing channel width at a given cross-section. The bankfull bench reduces sheer stress at terrace toes and provides a flat surface to capture eroded materials and slumps, keeping additional soil from entering the stream.

3. Modified Barb with Bruss Mattress Post Lines: Barbs are discontinuous treatments; some material requirements are lower than other continuous treatments. Rock barbs move the channel thalweg away from the bank toe but they can increase velocities in the main channel. In keeping with the project objectives of reducing stream energy, and alternative barb plan is proposed as shown in the concept drawings (Figure 4). The proposed structures use an alternative construction method, materials, and modified function.

4. Existing Terrace Toe Revegetation: Willow stake and containerized plantings where toe bench is present. At numerous locations along the project reach a narrow, vegetated bench is present along the toe of terrace banks. These areas will be targeted with live willow cutting and containerized tree and shrub plantings. Stabilizing these existing surfaces with a riparian fringe is a comparatively low-cost endeavor to increase system roughness and prevent future erosion of terrace surfaces.

Toe protections prevent fluvial entrainment of bank materials that cause undermining and collapse of terrace banks. Treatments that create a bankfull bench also provide a flatform to store bank materials that collapse for other reasons (Freeze/thaw, dry ravel, etc). Toe protections are applied to vertical banks (terraces) that occur opposite of a well-developed floodplain surface.

C. Floodplain Expansion

A floodplain of variable width occurs along the project reach. The projects seeks to maximize the floodplain area that is saturated or inundated during high frequency floods to support a riparian community. Sod is a high value locally available building material that can be used in multiple treatments. Sod excavations will be specified at the margins of existing floodplain surfaces so that the excavation of sod will expand the outer limit of the floodplain.

Floodplain expansion treatments can be a cost-effective approach to provide resiliency to a reach of stream. Expanding floodplain width spreads flood flows across the shallow surface, reducing flood water surface elevation and stream power, and the shallow flows deposit sediment and seed providing a natural source of riparian colonization.

D. Floodplain Revegetation & Roughness

The purpose of this treatment is to replicate a diverse mature riparian area that includes diversity of topography and roughness elements. Topographic diversity includes depressions, furrows and ridges. Roughness elements include logs and woody debris placements, live willow cutting trenches, and live plantings. Active revegetation will jumpstart the riparian community recovery.

Floodplain treatments increase the retention of organic and inorganic sediments and promote the natural colonization of a riparian community during floods. These treatments also increase system roughness during flooding and reduce stream energy. Woody materials are scarce in the project area but may be available opportunistically through road maintenance (cutting clearing roadside ditches), slash from timber harvest, brush piles in municipal waste dumps or targeted thinning of healthy riparian areas.

E. Increase Channel Length/Reactivate Meanders

Numerous abandoned meanders occur along the project reach and throughout Muddy Creek. These meanders occur at a variety of elevations relative to the active channel. Where meanders occur at or near the present-day floodplain elevation reactivation of the meander is a viable approach to achieve the project objectives.

Re-establishing abandoned meanders increases channel length and decreases channel gradient resulting in decreased stream energy

F. Stabilization of Tributary Headcuts

A lateral tributary has its confluence with the reactivated meander within the project reach near Station 145+70. Ephemeral draws such as this one are common along the Muddy Creek corridor. They are easily identified, inexpensive to fix, and can double as livestock watering "tanks" at the detention basin location.

Reducing and eliminating non-point sources of sediment such as this one is a key element to the over-all success of reach-wide restoration treatments.

Preliminary design, construction cost estimates, and permitting estimates for this work have been completed. Additional design criteria, spacing, dimensions, and material specifications will be developed in final design following analysis of bank and bed material.

D.2.2.4.4. Performance Measures

Performance of this project will be evaluated through water quality, stream flow monitoring, and photo records. SRWG has been conducting water quality and stream flow monitoring, as well as photo records at key locations in the Muddy Creek subbasin. In the spring of 2022, SRWG will add additional monitoring as described below to gather additional baseline data specific to the immediate area of influence of this project. This proposal includes funding to continue this monitoring through the project term, and SRWG will continue monitoring

performance after the project is complete. Existing water quality, stream flow monitoring, and photo points can be found at: www.sunriverwatershed.org/river-conditions.

Water Quality

SRWG has been collecting water quality samples at long-term monitoring locations across the watershed for over 15 years through a combination of in-situ measurements and lab analyzed samples. Stations key to this project are located on Muddy Creek and in the Sun River above and below Muddy Creek. The current monitoring stations help SRWG understand what proportion of impairment Muddy Creek is contributing and how that proportion changes over time. In 2022, additional monitoring stations will be added on Muddy Creek above and below the project area so we can collect baseline data and, once the project is underway, assess its impact on water quality in Muddy Creek. SRWG will work with water quality experts from Montana Department of Water Quality (DEQ) and Montana State University Extension Water Quality Division to determine exact locations for 2 to 3 project-specific monitoring stations. Monitoring techniques for water quality around this project site will focus on sediment loads to determine load reductions using methodology to be recommended by Montana DEQ.

Stream Flow

SRWG, USGS, and other partners manage a network of stream gages across the Sun River Watershed, ranging from year-round to seasonal real-time gages. These gages are primarily used for water management, drought/flood information, and water rights. There are currently two stream gages on Muddy Creek. In 2022, SRWG will begin monitoring stream flow near the proposed project site to record current, pre-project, flows before, during, and after the irrigation season. Monitoring will continue throughout the project and after completion so flow reduction improvements can be quantified. In addition, there are multiple gages on the Sun River that will can be used to quantify improvements to in-stream flows that may result as a benefit from this project, as more efficient use of water at Muddy Creek should result in less water removed from the Sun River during summer months.

Photo Records

SRWG has photo points established at our six long-term water quality monitoring stations and at two locations on Muddy Creek where past projects have occurred. SRWG will establish additional photo points in and around the proposed project area and begin taking annual photos at these locations in 2022. This will document pre-project conditions. Throughout the project and after completion, SRWG will continue taking photos at established photo points to provide visual monitoring of site conditions and improvements as a result of this project.

In addition, Montana Fish, Wildlife and Parks conducts fish population sampling on the Sun River each year and on Muddy Creek and its tributaries some years. SRWG is working with FWP to estimate positive impacts on the fish population as a result of this project. Assuming

Muddy Creek and Sun River migratory trout populations are connected, and we know Sun River and Missouri River trout populations are connected, so improvements to Muddy Creek are likely to improve Sun River and Missouri River populations.

D.2.2.4.5. Evaluation Criteria

Sub-Criterion A.1—Benefits to Ecological Values

The project will use the application of modern concepts of riffle-based grade control, flow dispersal via floodplain reconnection, stream power reduction, and habitat renewal in an area that was originally heavily engineered to purely resist the amplified hydraulic forces on the bed and banks. Anticipated benefits include improved complexity and channel structure, reduced sediment production rates, restored vegetation, enhanced riparian habitat, and expanded wetlands and backwaters.

The project reach was selected for the following reasons:

1. There is no evidence that the reach is on any natural trend of geomorphic recovery.
2. Loss of grade controls at this location in the lower segments of the creek will have a cascading effect upstream by creating a new cycle of incision.
3. Channel incision is severe in this reach such that gravitational bank collapse and associated sediment loading is common.
4. Inset floodplain surfaces have locally developed and can be opportunistically reconnected to the creek along the length of the project, serving to expand floodplain access, reduce in-channel stream power, and promote riparian recovery.
5. The reach has a clear lack of fish habitat including backwater areas for larval and juvenile fish.

The following project objectives were developed during the simultaneous master planning process:

1. Improve long-term grade stability
2. Improve hydrologic connectivity between the creek and adjacent inset floodplain
3. Create geomorphic and hydraulic conditions amenable for woody riparian recovery
4. Implement a series of bank treatments that have the potential to improve bank stability and enhance riparian conditions.
5. Add project elements to improve aquatic and riparian habitats such as floodplain roughness, riparian plantings, topographic complexity etc.

Specific ecological values benefited by this project include:

- Stream and riparian habitat conditions to benefit plant and animal species, fish and wildlife habitat, riparian areas, and ecosystems: This project will benefit fish, wildlife, and vegetation across the Sun River watershed. Habitat will be improved by reducing erosion, which improves water quality, benefiting the fish in the creek and wildlife that drink the water. Erosion will be reduced in part by stabilizing banks, which includes enhancing vegetation. Vegetation will provide fish with shade (cooling water temperatures) and cover from predation, as well as food supply as insects are introduced to the water from vegetation. Vegetation provides a food source for deer, and cover and

food for birds as well. Stream-side improvements will provide riparian corridor habitat, which is important for habitat connectivity, cover, food supply for terrestrial wildlife, and improves stream health to benefit fish and aquatic wildlife.

- Improving stream channel structure and complexity
  This project includes elements to improve habitat through increasing channel complexity and adding structure and roughness. This is important for aquatic and riparian fish and wildlife, as it will promote diverse habitat conditions that are required for these animals at different life stages. Roughness and complexity also help to dissipate stream power and velocity, which will help reduce pressure on banks that contributes to erosion. Structures to add complexity, such as riffle grad controls, also help improve fish passage.

- Improving channel/floodplain connectivity and stream restoration to improve groundwater recharge and riparian habitat: Improved hydrologic regime including groundwater storage achieved through floodplain reconnection will improve vegetation, meaning cover, shade, and food for fish and wildlife. Natural attenuation of groundwater, as well as shade from improved vegetation, will help reduce water temperatures. Past projects on Muddy Creek have helped develop "inset floodplains", areas where the creek is connected with a newly developed floodplain within the incised channel (Fig. 4). Riparian health is recovering within these inset floodplains, as evidenced by the re-establishment of vegetation and presence of more natural conditions that provide habitat for fish and wildlife. However, these inset floodplains are not fully re-connected, and this project seeks to improve that and broaden the riparian health benefits that are in evidence where connection has taken place. Reconnecting the channel to floodplain and improving groundwater recharge will also improve ecological resilience, by adding groundwater storage capacity, for natural drought mitigation, and activating floodplains to help with flood attenuation.

Figure 4. Inset floodplain in the stream restoration project area showing areas of limited recovery and revegetation.

- Protecting and stabilizing stream and river bank: Techniques proposed, such as terrace toe protection, will reduce the risk of slumping or mass wasting, reducing erosion thus reducing sediment inputs and improving water quality. Stable banks and benches will promote colonization of vegetation for long-term stability and benefits to ecological values as described earlier in this section.

- Reducing erosion: Reducing erosion through stabilizing banks and other techniques will help improve water quality not just in Muddy Creek, but to the Sun River and Missouri River, which are downstream and connected to Muddy Creek. Many benefits to reducing erosion are described earlier in this section as ancillary benefits to other ecological value improvements. The main benefits to reducing erosion are to reduce sediment and associated nutrient inputs into Muddy Creek, thereby improving water quality for the benefit of fish and wildlife, and reducing stream temperatures.

- Restoring backwater/floodplain areas (for larval and juvenile fish and other wildlife species to enhance and maintain rearing as well as feeding and foraging habitats
  As described earlier in this section, one reason this reach was selected as a first-priority for stream restoration was because of a lack of backwater/floodplain habitat. While this will benefit a wide suite of species, one example is brown trout. Historic surveys of Spring Coulee, a tributary of Muddy Creek, revealed mostly large trout while juvenile fish were largely absent. Though further research is needed, one suggestion has been that this may be due to a lack of habitat suitable for young fish. Quiet, small habitat areas with good cover from predation are important for larval and juvenile fish, as well as insects (fish food) and other wildlife species. Backwater/floodplain areas can also provide wetlands habitat for waterfowl, which are present though not abundant in the project area and surrounding landscape.

- Restoring natural wetlands, construction or improvement of wetlands for improving other natural features to reduce water supply and demand imbalances or the risk of drought or flood: This will be achieved through two key features of the stream restoration proposed here – floodplain reconnection and meander reactivation. The project area includes many incised banks, where excavation, surface enhancements, and plantings will help lower perched point bars and increase floodplain function. This includes restoring connectivity to multiple perched meanders that are currently cut off, resulting in additional channel length and restoration of historic wetlands and channel. Restored floodplain connectivity and reconnected meanders will create or restore wetlands that are good habitat for waterfowl, backwater areas that benefit small fish, and restore natural hydrologic processes that create resilience through flood attenuation and groundwater storage for drought mitigation.

This project will increase water supply reliability for ecological values by improving the timing and quantity of water available, improving water quality and temperature, and improving stream or riparian conditions for the benefit of plant and animal species, fish and wildlife habitat, riparian areas, and ecosystems. Through increased re-regulation capabilities created through expanding J-Wasteway, GID will be able to manage the timing and quantity of available water not only to meet irrigation needs, but to enhance ecological values as well. This improved management includes reducing unused water into Muddy Creek, which will result in less stress on Muddy Creek stream banks (less erosion and less sediment inputs) as well as the need to take less water out of the Sun River. In this way, the re-regulation portion of this project will help improve water reliability, water quality, and temperature in Muddy Creek as well as in the Sun River. The stream restoration portion of this project will seek to heal the heavily damaged stream and banks of lower Muddy Creek and restore ecological processes, resulting in more groundwater storage, better flood attenuation capacity, and improvements to fish and wildlife habitat as described throughout this section.

In addition to benefiting ecological values as described above, this project will benefit other water uses including municipal and agricultural water supplies. The town of Power relies on Muddy Creek as its municipal water source. In addition, Muddy Creek and the Sun River supply agricultural water to over 116,000 irrigated acres. Fort Shaw Irrigation District, Broken O Ranch, Rocky Reef Water Users, and Sun River Valley Ditch water users, to name a few of the larger water users, all draw water from the Sun River for agricultural purposes. By improving GID's ability to manage water with less unused water returned to Muddy Creek, this project helps improve water reliability for municipal and agricultural water uses.

Sub-Criterion A.2—Quantification of Specific Project Benefits by Project Type

Project benefits for water efficiency projects that result in quantifiable and sustained water savings or improved water management—and which increase water supply reliability for ecological values.

Phases I, II, and III of the J-Wasteway re-regulation project are estimated to save approximately 8,000 acre-feet of water, that could be captured, detained, and re-released as needed. This estimation was derived from the multiple engineering reports completed in the development of this project. As a reminder, Phase I has been completed, Phase II will be complete in early 2022, and Phase III is included in this proposal. The original engineering report describing these calculations is included as Attachment C. This report was updated in 2014 and 2020 as part of grant applications to fund Phases I and II. Those updates each exceed 200 pages so are not included, but can be provided if requested.

Water is conserved and increases reliability for ecological values through this project in multiple ways:

Water will be conserved at the J-Wasteway re-regulation facility through improved management. The water flowing into this facility was removed from the Sun River, conveyed across the watershed for irrigation, and the unused portion is spilled down Muddy Creek (via Spring Coulee). This project will allow for the reregulation and attenuation of this water, resulting in 1) less unused water spilled down Muddy Creek, and 2) less water needing to be

pulled from the Sun River. This is important for two reasons. First, increasing the size of J-Wasteway will allow GID to release water in better accordance with demand, instead of needing to release water due to lack of storage (i.e. "unused" water). Instead, this water can be conserved and released as needed either for ecological or irrigation needs. Second, because GID will be able to better manage flows out of J-Wasteway, less water will need to be removed from the Sun River and transferred in to J-Wasteway during peak hot, low-flow summer months or in times of drought. In this way, water can remain in the Sun River where it can benefit trout and wildlife habitat. For example, Sun River trout suffer each year during low-flows due to increased water temperature and reduced habitat area. Montana FWP has documented that increased flows in the Sun River will benefit trout populations by increasing food productivity and reducing stress on individual fish that occurs with higher water temperatures.

Another way this project will help conserve water to benefit water supply for ecological values is through the stream restoration portion of the project. This restoration will include reconnection of floodplain to Muddy Creek, which is anticipated to improve groundwater storage/capacity. This will restore more natural hydrologic process, where groundwater reserves provides water security in times of drought, storage capacity for floods, and a supply of water for use by fish, wildlife, and vegetation.

There are no plans for a formal mechanism to document an arrangement for conserved water to benefit ecological values as a result of this project However: SRWG and partners, including the Bureau of Reclamation, have an Operations Guide for Gibson Dam and the Sun River that describes the minimum and optimal flows in the Sun River for the benefits of fish and wildlife (Attachment D). The Sun River Water Management Working Group, which consists of water managers, water users, and representatives from fish and wildlife interests (FWP and Trout Unlimited), meets twice a year and communicates through SRWG in between meetings to collectively manage and inform Sun River flows. More information about this working group can be found at: https://www.sunriverwatershed.org/wmwg. SRWG, GID, and partners have a good history of improving flows in the river when conditions permit. In 2001, FWP presented GID and Reclamation with a letter recommending a minimum of 100 cfs in the river to benefit fish, at a time when river flows could be as low as 50 cfs. Since this letter, thanks to collaboration through the working group mentioned above, the 100 cfs minimum has been incorporated into the river operations guide and the river is managed for a minimum flow of 100 cfs. Because of this history of working together to benefit ecological values as water is conserved through irrigation efficiencies, SRWG is confident that water savings from this Muddy Creek project will be realized as improved instream flows.

Project Benefits for Drought Resiliency Projects Related to Fish and Wildlife

The direct acreage improved by this proposed stream restoration is ~40 acres and three stream-miles, as described in the technical section of this proposal. However, the wildlife species, such as deer, pheasants, and water fowl, and the fish in the stream are connected to populations that range beyond the improved area, thus the project benefits are immeasurable.

The re-regulation portion of this project, when combined with Phases I and II, will result in 8,000 acre-feet water savings, or ~20 cfs. The immediate benefits to fish and wildlife for this portion of the work include approximately three miles of Muddy Creek within the project area, as well as the approximately 80 miles of the Sun River downstream of GID's diversion site, where flows will be improved through conserved water. As Muddy Creek fish populations are connected to the Sun River and Missouri River the benefits are extended as well. Though no recent population surveys have been done on Muddy Creek, annual surveys are conducted on the Sun River and data for recent years can be found in Attachment E. Note this includes only fish longer than 8 mm and populations are estimated in fish per mile, so to estimate the number of fish would need to be multiplied by stream miles in the surveyed reach. Estimates for wildlife were not available in time for this proposal, but the Sun River watershed is approximately X square miles and includes many species of wildlife: deer, elk, grizzlies, beaver, pheasants, waterfowl, etc. that all benefit from improved habitat and water reliability that are anticipated as a result of this project – through improvements on Muddy Creek or by improving Sun River flows through irrigation efficiency.

The stream restoration portion of the project will benefit fish and wildlife across 2,200 square miles of the Sun River watershed, as these animals are not stationary but move around and interact with other parts of the landscape, not limited to the immediate project area. The stream restoration project directly benefit ~40 acres and three miles of stream where white tail and mule deer, pheasant, beaver, and many other fish and wildlife species are present. Improved hydrologic regime including groundwater storage achieved through floodplain reconnection will improve vegetation, meaning cover, shade, and food for these species.

While fish and wildlife species in the direct project area are not usually impacted by drought, as the problem in Muddy Creek is typically *too much* water, fish and wildlife in the Sun River main-stem are often affected by drought or water scarcity due to water being removed from the river for irrigation. In the Sun River, low flows in the summer or during drought result in less habitat for fish and warmer water temperatures, which stress fish health and disrupt connectivity between habitat patches. Lower flows also result in lower fish food productivity. The re-regulation of water removed from the Sun River for irrigation will result in more efficient water use GID will be able to divert less water from the Sun River during hot summer months when flows are naturally low. This means more water can stay in the Sun River during the summer or times of drought for the benefit of fish and wildlife. Fish habitat is affected by low flows or drought in the winter, too, when it's important to keep water flowing over fish eggs that are laid in the fall. Low flows in the winter can result in eggs drying up or not getting enough oxygen and nutrients, and can also increase ice scour, which can reduce aquatic insects (limiting productivity and availability) and scouring fish eggs laid in the fall. By using less water in the summer, more water can be retained in the reservoir to supplement winter flows if the need arises (as it often does, see Attachment F, FWP Letter to Reclamation).

Fish populations in the Sun River are surveyed annually by FWP, so changes to population trends are measured and documented. As flows increase in the Sun River, measurable impacts on the trout populations can be documented by comparing flows to trout survey results over time. As stated in Attachment F, stream flows are the most important factor in improving fish habitat and populations in the Sun River.

Project Benefits for Watershed Management Projects

This project will result in long-term improvements to water quality, improved water temperature, and mitigation of impacts from drought and flood. The benefits of the project are thoroughly described in earlier sections of this proposal.

The geographic extent of the improvements include the approximately 40 miles of Muddy Creek affected by re-regulation, overlapped with three miles of stream restoration within that area. Approximately 17 miles of the Sun River, the portion below its confluence with Muddy Creek, will also benefit from these improvements, as will the portion of the Missouri River below the mouth of the Sun River.

The Sun River TMDL estimates that sediment loads to the Sun River from Muddy Creek were approximately 35,000 tons/yr in 1995. The consultants developing the Muddy Creek Master Plan (2020-22) performed calculations and estimated the following loads for the future:

- 35,000 tons/year was the last estimate of Muddy Creek sediment loads (1995)
- Estimated increase to 85,000 tons/year, assuming 25% of the current grade control and barb structures continue to degrade or fail and no channel work is done (No Action)
- Stream restoration can reduce this estimate by 50,000 tons/year through channel bed stabilization work and stream restoration work
- 5,000 tons/year estimated additional reduction through flow management improvements (including re-regulation)
- This equates to an approximately 90% reduction in anticipated sediment loads when compared to taking no action at all.

As described elsewhere in this proposal, the re-regulation portion of this project will conserve approximately 8,000 acre feet of water per year, resulting in an estimated 20 cfs conserved.

The Sun River Watershed supports a wide range of fish and wildlife species that will benefit from improved habitat. Some key species that will directly benefit in the Muddy Creek project region include Brown and Rainbow trout, a wide range of non-game fishes, pheasants, white tail and mule deer, a wide range of ducks and other water fowl, small mammals, reptiles (an abundance of rattle snakes), and insects. Upstream, where the ecosystem will benefit due to improved in-stream flows as a result of less water being diverted for irrigation, species include those listed above plus elk, grizzly bears, antelope, and big horned sheep.

Project benefits for multi-benefits projects: If applicable, please describe the extent to which the project will benefit multiple water uses. Please do not repeat information included in your prior responses.

In addition to the agricultural and municipal water uses described earlier in this proposal, SRWG has recently learned that sediment inputs from the Sun River are impacting the city's wastewater treatment discharge plant and Northwestern Energy's dam maintenance requirements. SRWG is working with the City of Great Falls to coordinate our monitoring so the full extent of this impact can be assessed, and so improvements related to projects like the one proposed her are implemented. SRWG is also aware that the West Great Falls Flood Association's infrastructure at a flood mitigation pond, which is fed by the Sun River, is frequently disabled due to sediment build-up. By reducing sediment inputs to Muddy Creek, this project is impacted to improve conditions causing the problems described here.

This project will also benefit recreational uses. Game species that live in the Sun River watershed including deer, elk, antelope, big horned sheep, waterfowl, pheasants, rainbow trout, and brown trout, will benefit from habitat improvements that result from this project. This is important because spending by elk, deer, and antelope hunters alone support nearly 3,300 jobs and contribute $324 million to the Montana economy annually (Montana FWP report). Overall, Montana's outdoor recreation industry accounts for $7.1 billion in consumer spending and more than $71,000 jobs. By improving wildlife habitat and water quality, this project will help attract recreation enthusiasts and support the state's economy.

Evaluation Criterion B—Collaborative Project Planning

This project was developed through a collaborative process led by Sun River Watershed Group and funded by a WaterSMART CWMP Phase I grant to develop a Master Plan for Muddy Creek. As part of the Master Planning process, SRWG coordinated communications between the hired consultants and stakeholders with an interest in Muddy Creek. This included an open house meeting and several one-on-one meetings and other correspondence. The Consulting team received input about Muddy Creek history and ongoing issues from:

- The Sun River Watershed Group
- Montana Fish, Wildlife and Parks (FWP)
- Greenfields Irrigation District (GID)
- US Bureau of Reclamation
- Montana Department of Environmental Quality (DEQ)
- Montana Department of Natural Resources and Conservation (DNRC)
- Cascade Conservation District
- Teton Conservation District
- Natural Resources and Conservation Service (NRCS)
- Local landowners
- The Town of Power
- Irrigators / water managers
- Other stakeholders

This Master Plan is still being finalized, but the consultants have provided a technical memo summarizing the Plan, which is attached here as Attachment B. The Master Plan includes

identification of natural resource issues, opportunities for improvement, and prioritization of projects to address these issues. Poor water quality, habitat degradation, erosion, and disruption of natural hydrologic processes are key natural resource issues identified. The Master Plan will also identify opportunities for water conservation, water security for irrigation and ecological values, and drought-related ecological value and irrigation mitigation. Furthermore, the Plan describes how water conservation measures implemented would result in less water will diverted from the Sun River during times of typical low flows, leaving more water in the river for the benefit of fish and wildlife, increasing instream flows and reducing water temperatures during crucial summer months. The projects described in this proposal are the top-priority projects described in the Master Plan due to their anticipated positive impacts on natural resources as well as water reliability.

Evaluation Criterion C—Stakeholder Support

SRWG has included letters of support for the proposed project. Greenfields Irrigation District, the Category A Supporter, is contributing a significant amount of labor to the project. A large portion of the stream restoration is on property owned by Michael Botha, who intended to provide a letter of support, but was unable to make the grant deadline. If permitted, an award could be provided at a later date. Mr. Botha contributed financially to a past project on Muddy Creek and can be counted on for financial support should the need arise for this project. The Missouri River Flyfishers have also financially supported past projects to improve Muddy Creek and can be counted to do so again, as described in the Budget Narrative. SRWG has a core group of volunteers who can also be counted on to help with any revegetation or other tasks as needed.

This project is supported by a diverse set of stakeholders who participated in the Master Planning process, including irrigation interests (GID, Reclamation); fish, wildlife, and recreation interests (FWP, MRF); water quality (DNRC, DEQ); other natural resource organizations (conservation districts, NRCS); and many local landowners and agricultural producers. A group of landowners submitted a letter of support for SRWG's WaterSMART CWMP planning grant and that letter is included with this proposal, as the comments from the group are still relevant and many of the same people continue to attend Muddy Creek stakeholder outreach meetings. This project is consistent with the policies of organizations that manage natural resources in this area.

This proposed project complements ongoing projects led by other entities: NRCS recently began a Targeted Implementation Plan to improve water efficiency in the Muddy Creek basin by providing cost-share to irrigators changing from flood to sprinkler irrigation or implementing other approved irrigation efficiency practices. This TIP is included as Attachment G. GID has multiple projects recently completed and in progress on Spring Coulee Creek, a major tributary to Muddy Creek, including replacement of a headgate and waste water re-regulation, to improve water management and reduce return flows and flow fluctuation on Spring Coulee Creek and Muddy Creek. In addition, GID has applied for funding through the 2022 WaterSMART WEEG program for a project that will improve irrigation infrastructure and help progress towards 50,000 acre-feet per year water savings, to be used to provide drought resiliency during water-short years and augmenting natural flows in the

Sun River during normal years. Documentation for GID projects is quite extensive but can be provided upon request. In recent years, SRWG has implemented other projects to improve water quality and habitat on Muddy Creek. This project will add to the positive impacts of those projects, which include installation of riparian fencing to keep livestock off banks and out of the creek, replacement of aging culverts with a bridge, and revegetation of stream banks in an area degraded by cattle grazing. SRWG is also working with multiple partners to implement a series of Process Based Restoration structures on a Muddy Creek tributary to help restore natural hydrologic processes, stabilize banks, reduce sediment inputs, and increase groundwater storage.

SRWG works closely with all of these entities to ensure efforts are not duplicated and are complementary to one another for increased benefits to ecological values and water security. Some portion of the projects described above are on Federal land (Reclamation). That land is managed and used by GID for irrigation and water management and GID has many projects planned and in progress that complement this work. SRWG is not aware of any opposition to the proposed project or any of the complementary projects described here.

Evaluation Criterion D—Readiness to Proceed

This project will begin upon notice of award. SRWG will work with the consultants who developed the preliminary design to complete designs for stream restoration and will hire a construction team through a competitive bid process to do the restoration construction. SRWG will also work with Reclamation to obtain cultural and historic clearances and with the hired consultants to acquire necessary permits.

Fall/Winter 2022:	Finalize grant paperwork
	Work with consulting team to complete designs for stream
	GID completes designs for re-regulation pond
Winter/Spring 2023:	Begin cultural clearances
	Selection process for construction team
	Permitting applications
	Pre-project monitoring
	Consultants and construction team finalize designs
	Re-regulation pond construction occurs
Summer 2023:	Permitting and site clearances complete
	Continue project monitoring
	Site preparation and mobilization
Fall 2023:	Continue project monitoring
	Stream construction
Winter 2023:	Stream construction
Spring 2024:	Stream construction complete
	Revegetation begins

	Monitoring continues
Fall 2024:	Revegetation complete
	Monitoring continues
Winter 2024/Spring 2025:	Project wrap-up, grant completion tasks

Irrigation Improvement Readiness

The J-Wasteway Re-regulation Expansion will be ready for construction by the Spring of 2022 (or upon award). Project description, tasks, and cost estimates are included in Attachment A. By Spring 2022, the Phase II, Spring Coulee Smart Check/Headworks, will have been completed. Construction of the containment berm and pond enlargement, this funding request, would follow the completion of Phase II. Preliminary engineering has been completed but final design details and construction staking will need to be performed. In November 2018, Reclamation issued the *Final Environmental Assessment and Finding of No Significant Impact for the J-Lake Improvement Project*. In addition, Reclamation staff have provided a review of the overall reregulation development strategy and preliminary project drawings.

Stream Restoration Readiness

Engineering and design developed for this project can be found in Attachment B, including preliminary design drawings, materials, treatment descriptions, tasks and cost estimates. Design for river restoration is preliminary (appx. 30% complete).

Project budget, including specific tasks and costs and all contractor costs are described in Section D.2.2.5., Project Budget.

No portion of this project lies within the mapped floodplain, so permits are minimal. SRWG will obtain a 310 permit from Cascade County and fish and wildlife clearances from FWP, as well as required permits or clearances from the US Army Corps of Engineers.

SRWG has access and landowner permission to land and water where this project is located. No easements are required.

Cultural and Historic clearances have already been provided for the J-Wasteway portion of work as part of Phase I. Stream restoration clearances will be performed upon award. SRWG has contacted Rick Hanson, Reclamation's Montana Area Archaeologist, and received a list of Reclamation-authorized contractors to perform cultural surveys, one of whom provided the estimate included in the budget for this project (Attachment H).

Evaluation Criterion E—Performance Measures

SRWG will measure and monitor project efficacy by collecting stream flow, water quality, and photo point data. SRWG has long-term data for these parameters that will serve as a

baseline, in addition to data that will be collected in 2022 from new project-specific locations. To keep this proposal within the page limitation, please see Section D.2.2.4.4. Performance Measures, where monitoring project performance is described more thoroughly.

Monitoring project efficacy is one of SRWG's Strategic Values and performing monitoring tasks is built into our annual budget. SRWG will ensure this project is monitored for at least five years upon completion. SRWG has a long-running data set for stream flow and water quality (over 25 and 15 years, respectively) and will build monitoring for this project into that effort. SRWG has hired interns or seasonal staff and recruited volunteers to carry out monitoring tasks when needed, and hopes to soon hire a full-time staff to continue monitoring. Funds for monitoring are acquired annually through grants from BLM and DEQ, and donations from SRWG supporters.

Evaluation Criterion F—Presidential and Department of the Interior Priorities

This project will improve groundwater storage by reconnecting floodplain, and in this way is likely to improve resistance to drought, though SRWG has not calculated the extent of these benefits.

Similarly, reconnection and establishment of floodplains will help mitigate flooding, though the extent of this benefit has not been calculated.

In general, the restoration of natural hydrologic processes that will be enabled by this project will make this ecosystem more resilient to natural hazards.

This project includes revegetation and restorations of conditions that will enourage natural recolonization of trees, grasses and shrubs, and wetlands. SRWG recognizes that this restoration will reduce greenhouse gas emissions by sequestering carbon, however we have not attempted to quantify these improvements.

This project seeks to improve water quality by reducing sediment and nutrient inputs and reducing water temperatures. By restoring natural processes and riparian zones, this project will also naturally filter contaminants that otherwise wash into the stream through vegetation and wetlands. Contaminants in this area are largely sediment, fertilizers, and agricultural byproducts that enter the stream through nonpoint sources.

Disadvantaged or Underserved Communities

Affected stakeholders, as defined in Section 1015 of the Cooperative Watershed Act, who will benefit from this project include the a disadvantaged or historically underserved community of "persons who live in rural areas" by improving public health and safety through water quality improvements. The US Census Bureau defines rural as any population, housing, or territory not in an urban area. This definition fits Cascade and Teton Counties. The annual median household income for Cascade County ($49,913) is less than 100 percent of the

annual median household income for the state of Montana ($54,970), according to the US Census Bureau (www.census.gov). See Attachment I.

Tribal Benefits

There are no tribal entities immediately affected by this project.

D.2.2.5. Project Budget

D.2.2.5.1. Funding Plan

Non-Federal cost share will come from three sources: state and other non-federal grants, in-kind contributions, and SRWG funds.

State and Non-Federal Grants: State grants anticipated include Future Fisheries Funds from Montana FWP, and funding from the following DNRC programs: HB223 and Renewable Resources Grants. Other non-Federal funds are anticipated from Montana Watershed Coordination Council, Montana Trout Unlimited and the Missouri River Flyfishers. Letters of commitment are not yet available because these grant cycles do not open until spring of 2022 so SRWG has not applied yet. We did not apply prior to this proposal because all of these grant typically have a 1-2 year cycle in which the funds have to be used, so funds would have expired too soon after this award notification is announced for us to use the funds. SRWG has excellent relationships with the grant funding entities mentioned in this funding plan, has a history of being awarded grants from all of them, and this project is in-line with their funding objectives so we anticipate we will be successful in acquiring funds. If full funds are not awarded or matched, the stream restoration portion of the project can be modified to fit the available budget.

Funds will be applied for as follows:
DNRC HB223 – spring 2022, $30,000
DNRC Renewable Resources – May 2022, $125,000
Montana Trout Unlimited – Spring 2022, $5,000
Missouri River Flyfishers – Summer 2022, $5,000
MWCC – Spring/summer 2022, $20,000
FWP Future Fisheries – June 2022, $50,000

In-kind Contributions: In-kind contributions in budget for this project include –

- GID manager time for completing engineering details and overall project development strategy ($800)
- GID labor hours associated with preparing the construction site and building the berm ($122,661)
- GID manager time for construction oversight of re-regulation berm ($1,123)
- GID manager and office manager time for project administration support ($1306)
- Volunteer hours to harvest and plant willow stakes on stream restoration project site ($23,000)
- Value of willows harvested locally and used in the project ($37,785)
- Value of sod mats harvested on site and re-used in the project ($76,975)
- Value of gage maintenance contractor time and materials for annual stream gage maintenance ($900 per year for three year, $2,700)

- Flowmeter to be donated by NorthWestern Energy for use in streamflow monitoring (value $1,600)
- SRWG technician will perform water quality monitoring; a portion of their salary will be covered through the Big Sky Watershed Corps program ($6,000)
- Fisheries monitoring conducted annually on the Sun River ($2500/day, 3 days/year, 3 years, total $22,500)

SRWG Funds: SRWG will contribute matching/in-kind contributions as follows

- Portion of Project Manager time spent on this project ($3,000)
- Portion of fringe benefits ($2560)
- Portion of travel expenses to attend conferences and trainings directly related to this project ($1,200)
- Supplies for water quality monitoring such as batteries and ice ($100 per year, total $300)
- New laptop for technician to be purchased in 2022 ($700)

No costs associated with this project have been incurred to date with the exception of cultural and historic clearance for the re-regulation portion of the project, which is not included in this budget.

D.2.2.5.2. Budget Proposal

Table 1. Total Project Cost

TOTAL PROJECT COST TABLE

SOURCE	AMOUNT
Costs to be reimbursed with the requested Federal funding	$ 1,769,322.75
Costs to be paid by the applicant	$ 7,459.00
Value of third-part contributions	$ 543,251.00
TOTAL PROJECT COST	**$ 2,320,032.75**

Table 2. Summary of Non-Federal and Federal Funds

SUMMARY OF NON-FEDERAL AND FEDERAL FUNDING

FUNDING SOURCES	AMOUNT
Non-Federal Entities	
DNRC	$188,000.00
BSWC	$6,000.00
SRWG	$7,459.00
AFS/MWCC	$ 1,500.00
Northwestern Energy	$ 1,600.00
GID	$ 125,891.00
MTU	$ 5,000.00

MRF	$	5,000.00
FWP FF	$	50,000.00
volunteers	$	23,000.00
stream gage maintenance	$	2,700.00
reuse on-site materials	$	114,760.00
FWP in kind	$	19,800.00
Non-Federal Subtotal	$	550,710.00
REQUESTED RECLAMATION FUNDING	**$**	**1,769,322.75**

Table 3. Budget Proposal

DIRECT COSTS	COMPUTATION				
BUDGET ITEM	$/UNIT	QUANTITY	TYPE	TOTAL COST	REQUESTED THIS GRANT
SALARIES AND WAGES					
Wendt, Tracy - project manager	$30.00	1500	$/hour	**$45,000.00**	$42,000.00
Employee 2 - technician	$23.00	825	$/hour	**$18,975.00**	$12,975.00
					$54,975.00
FRINGE BENEFITS					
Full-Time Employees	20%	$63,975.00	% of salary	**$12,795.00**	$10,236.00
Part-Time Employees					
					$10,236.00
TRAVEL					
Trip 1 - AFS Conference	$3,000.00	1	est. trip costs	**$3,000.00**	$1,500.00
Trip 2 - Watershed Conference	$3,000.00	1	est. trip costs	**$3,000.00**	$0.00
Trip 3 - Misc. mileage	$0.56	5300	$/mile	**$2,968.00**	$2,968.00
					$4,468.00
EQUIPMENT					
none					
					$0.00
SUPPLIES AND MATERIALS					
Water sampling supplies	$400.00	3	cost per year	**$1,200.00**	$0.00
Item A - Laptop	$700.00	1	cost per unit	**$700.00**	$0.00
Item B - Flowmeter	$1,600.00	1	cost per unit	**$1,600.00**	$0.00
					$0.00
CONTRACTUAL / CONSTRUCTION					
GID - Re-regulation costs	$458,981.00	1	est. project cost	**$458,981.00**	$333,090.00
Restoration Engineering - designer				**$300,062.75**	$270,062.75
TBD - Construction contractor				**$1,200,251.00**	$1,085,491.00
Compliance	$11,000.00	1	per unit cost	**$11,000.00**	$11,000.00
Willow planting by volunteers	$1,000.00	$23.00	$/hr	**$23,000.00**	$0.00
Gage maintenance contractor	$900.00	3	fee per year	**$2,700.00**	$0.00
				$1,995,994.75	**$1,699,643.75**
OTHER					
Fisheries monitoring time & materials	$2,500.00	9	cost per day	**$22,500.00**	$0.00
					$0.00

TOTAL DIRECT COSTS			$1,769,322.75
INDIRECT COSTS			
TYPE OF RATE	%	$BASE	TOTAL COST JESTED THIS GI
TOTAL INDIRECT COSTS			
TOTAL ESTIMATED PROJECT COSTS			$1,769,322.75

D.2.2.5.3. Budget Narrative

D2.2.5.3.1. Salaries and Wages

Describe salaries and wages, include grant admin as line item or indirect cost

Personnel	**Salary/wage**	**Hours/% time**	**Compensation rate**
Tracy Wendt, Project Manager	$50,000/yr	20%	$30/hr
SRWG Natural Resources Technician	$30,000/yr	825 hrs	$23/hr

D2.2.5.3.2. Fringe Benefits

Fringe benefits are estimated at 20% of employee salary/wage. This includes state and federal payroll taxes and employee retirement (8% of salary).

D2.2.5.3.3. Travel

Anticipated trips associated with this proposal include:

- American Fisheries Society Conference, $3000 estimated cost, half to be cost-shared by SRWG. This annual conference includes workshops, demonstrations, and trainings of stream restoration techniques to benefit fish habitat.
- Watershed Conference, $3,000 estimated cost, SRWG or scholarship to cover. This conference includes workshops, demonstrations, and trainings of stream restoration techniques to benefit a range of ecological values.
- Misc. local travel – Estimated at 5300 miles, 2021 mileage reimbursement rate of $.56. 4,300 miles for travel to attend Montana-based workshops, trainings, meetings, and conferences directly related to this project; 1,000 miles for travel related to water quality and stream flow monitoring.

D.2.2.5.3.4 Equipment

Budget does not include any equipment over $5,000.

D.2.2.5.3.5. Materials and Supplies

Materials and Supplies anticipated for this project include:

- Water sampling supplies (batteries and probes for YSI meter, ice for transport of samples) (funded by other sources)

- Laptop for SRWG staff use, to be purchased in 2022 (funded by other sources)
- Flowmeter for measuring stream discharge as part of project monitoring (donated to SRWG)

D.2.2.5.3.6. Contractual

J-Wasteway Re-regulation work will be performed by GID. Tasks and costs are described in Table 4.

Table 4 – J-Waste Way Reregulation Project

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT COST SHARE	RECLAMATION FUNDING	TOTAL COST
	Unit/price	Quantity			
WAGES					
District Manager	$ 80.19	34 hrs	$2,726.40		$2,726.40
Office Worker	$ 33.60	15 hrs	$504.00		$504.00
General Laborers	$ 30.16	940 hrs	$28,350.40		$28,350.40
Equipment Operators	$ 34.79	2160 hrs	$75,146.00		$75,146.00
Truck Drivers	$ 31.94	600 hrs	$19,164.00		$19,164.00
Fringe benefits					
Included above rates			$0	$0	$0
EQUIPMENT					
CAT 320 Excavator	$ 57.61	200 hrs		$11,522.00	$11,522.00
CAT 326 Long Boom Ex	$ 67.00	440 hrs		$29,480.00	$29,480.00
CAT 960M Pay Loader	$ 58.08	640 hrs		$37,171.20	$37,171.20
CAT D-7 Dozer	$ 150.14	640 hrs		$96,089.60	$96,089.60
Vib Wheeled Compactor	$ 72.00	640 hrs		$46,080.00	$46,080.00
Vib. Bomag Compactor	$ 37.50	240 hrs		$9,000.00	$9,000.00
Miscellaneous Trucks	$ 101.50	600 hrs		$60,900.00	$60,900.00
SUPPLIES/MATERIALS					
Non-Woven Geotextile	$ 5.02	735 SY		$3,689.70	$3,689.70
Woven Geotextile	$ 1.42	480 SY		$681.60	$681.60
Bi-Axial Geogrid	$ 2.64	480 SY		$1,267.20	$1,267.20
Pit Run Gravel	$ 15.23	75 CY		$1,142.25	$1,142.25
Cr. Base Course Gravel	$ 31.47	950 CY		$29,896.50	$29,896.50
6-in Canal Armoring	$ 15.23	150 CY		$2,284.50	$2,284.50
Class II Rip Rap	$ 55.83	650 CY		$36,289.50	$36,289.50
Common Fill, Imported	$ 2.28	8400 CY		$19,152.00	$19,152.00
CONTRACTUAL					
NEPA/NHPA	$0	0	$0	$0	$0
Engineer Assistance	$ 8,500	1 LS		$8,500	$8,500
OTHER					
TOTAL DIRECT COSTS			**$125,891.26**	**$333,090.05**	**$458,981.31**
Contingency funds			**$0**	$0	$0

INDIRECT COSTS		0%	$0	$0	$0
TOTAL PROJ. COSTS			**$125,891.26**	**$333,090.05**	**$458,981.31**

Stream Restoration work will be performed as follows:

- Completion of design, permitting, and construction oversite will be performed by Restoration Engineering (RE). RE developed the Muddy Creek Master Plan and preliminary designs and has specialized knowledge of the area.
- Construction will be performed by a contractor yet-to-be selected. SRWG will follow 2 CFR Part 200.320 in procuring said contractor.

Tasks and costs are described in Table 5 which also appears in Attachment B.

Table 5. Costs for stream restoration

Work Item	CONSTRUCTION COSTS - RIFFLE GRADE CONTROLS					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Mobilization	LS	$ 4,500.00	1	$ 4,500	For all project tasks
2	Haul road improvements, creation and finish grading, GPS enabled	LS	$ 10,150.00	1	$ 10,150	Includes all machinery needed by contractor to get the work completed
3	Excavation, Machinery & Installation, GPS enabled	LS	$ 9,600.00	31	$ 297,600	Includes all machinery needed by contractor to get the work completed
4	Water Management	LS	$ 9,920.00	1	$ 9,920	Notch Existing Grade Control, Pump around systems, coffer dams, and labor to complete
5	Sod - Material Cost	FT^2	$ 0.50	16650	$ 8,325	On-Site Landowner Match
6	Materials (Graded Streambed Mix)	CY	$ 35.00	8,990	$ 314,650	Delivered to project site--350 yards per riffle
7	Willow Cuttings	EA	$ 2.00	9300	$ 18,600	Cut on and off site; Installed on-site during appropriate season
				Task 1 Cost	$ 663,745	
	note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly					

Work Item	CONSTRUCTION COSTS - FLOODPLAIN EXPANSION/EXCAVATION					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Excavation, GPS enabled	CY	$ 6.00	10,671	$ 64,024	Assumes disposal of excavated materials is locally for use in other tasks
2	Sod - Material Cost	FT^2	$ 0.50	35000	$ 17,500	Fill areas on inside bends to expand floodplain (Sheet 5)
3	Containerized Trees	EA	$ 15.00	330.7	$ 4,961	Installed
4	Containerized Shrubs	EA	$ 12.00	992.1	$ 11,905	Installed
5	Large Woody Debris	LS	$ 7,672.24	1	$ 7,672	
				Task 2 Cost	$ 106,061	
	note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly					

Work Item	CONSTRUCTION COSTS - MEANDER REACTIVATION					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Excavation, GPS enabled	CY	$ 10.00	4720	$ 47,200	Includes haul to disposal
2	Riffle Installation	NA	$ -	0	$ -	4 Riffles Included in Task 1 costs
3	Sod - Material Cost	FT^2	$ 0.50	21000	$ 10,500	Channel plug area
4	Finish Grading	HRS	$ 155.00	80	$ 12,400	Finsihing channel margins and stream bed grading
5	Structural Fill	CY	$ 35.00	500	$ 17,500	
				Task 3 Cost	$ 87,600	
	note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly					

Work Item	CONSTRUCTION COSTS - FLOODPLAIN BENCH TERRACE TOE PROTECTION					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Excavation/Installation GPS enabled	LF	$ 120.00	600	$ 72,000	
2	Sod - Material Cost	FT^2	$ 0.50	12000	$ 6,000	
3	Large Wood/Willow Clumps/Russian Olive	EA	$ 58.00	565	$ 32,770	
4	Small brush	LS	$ 8,000.00	1	$ 8,000	
5	Live Willow Cuttings	EA	$ 2.00	3000	$ 6,000	
6	Containerized Trees	EA	$ 15.00	21	$ 310	Installed
7	Containerized Shrubs	EA	$ 12.00	62	$ 744	Installed
				Task 4 Cost	$ 124,770	
	note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly					

Work Item	CONSTRUCTION COSTS - STACKED SOD BANK TERRACE TOE PROTECTION					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Excavation & Installation GPS enabled	CY	$ 6.00	2992	$ 17,952	Assumes Sod is Delivered to work area from Floodplain Excavation Activities
2	Sod - Material Cost	FT^2	$ 0.50	69300	$ 34,650	
3	Live Willow Cuttings	EA	$ 2.00	4620	$ 9,240	
4	Containerized Trees	EA	$ 15.00	27	$ 398	
5	Containerized Shrubs	EA	$ 12.00	80	$ 955	
				Task 5 Cost	$ 63,194	
	note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly					

Work Item	CONSTRUCTION COSTS - MODIFIED BARB TERRACE TOE PROTECTION					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Excavation & Installation	LS	$ 14,531.25	1	$ 14,531	Assumes 40 foot spacing on structures
2	Materials (Graded Streambed Mix)	CY	$ 35.00	1500	$ 52,500	
3	Timber Posts	EA	$ 15.00	563	$ 8,438	
4	Brush/Small Logs	EA	$ 25.00	562.5	$ 14,063	
5	Containerized Trees	EA	$ 15.00	38	$ 563	
6	Containerized Shrubs	EA	$ 12.00	94	$ 1,125	
7	Live Willow Cuttings	EA	$ 2.00	563	$ 1,125	
				Task 6 Cost	$ 90,094	
	note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly					

Work Item	CONSTRUCTION COSTS - EXISTING TOE BENCH REVEGETATION					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Containerized Trees	EA	$ 15.00	49	728	
2	Containerized Shrubs	EA	$ 12.00	146	1,748	
3	Live Willow Cuttings	EA	$ 2.00	1410	2,820	
				Task 7 Cost	5,296	
note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly						

Work Item	CONSTRUCTION COSTS - RIPRAP					
	Task	Unit	Unit Cost	Quantity	Total	Comments
1	Excavation & Installation	LS	$ 15,500.00	1	$ 15,500	
2	Materials (Angular Quarry Rock Gradation)	CY	$ 80.00	500	$ 40,000	
3	Materials (Pit Run Bedding)	CY	$ 35.00	114	$ 3,990	
				Task 8 Cost	$ 59,490	
note: LS= lump sum; CY= cubic yards; EA= each; HRS= hourly						
				Total Project Cost	$1,200,251	

D.2.2.5.3.7. Third-Party In-kind Contributions

In-kind contributions in budget for this project include –

In-kind Contributions: In-kind contributions in budget for this project include –

- GID manager time for completing engineering details and overall project development strategy ($800)
- GID labor hours associated with preparing the construction site and building the berm ($122,661)
- GID manager time for construction oversight of re-regulation berm ($1,123)
- GID manager and office manager time for project administration support ($1306)
- Volunteer hours to harvest and plant willow stakes on stream restoration project site ($23,000)
- Value of willows harvested locally and used in the project ($37,785)
- Value of sod mats harvested on site and re-used in the project ($76,975)
- Value of gage maintenance contractor time and materials for annual stream gage maintenance ($900 per year for three year, $2,700)
- Flowmeter to be donated by NorthWestern Energy for use in streamflow monitoring (value $1,600)
- SRWG technician will perform water quality monitoring; a portion of their salary will be covered through the Big Sky Watershed Corps program ($6,000)
- Fisheries monitoring conducted annually on the Sun River ($2500/day, 3 days/year, 3 years, total $22,500)

SRWG Funds: SRWG will contribute matching/in-kind contributions as follows

- Portion of Project Manager time spent on this project ($3,000)
- Portion of fringe benefits ($2560)
- Portion of travel expenses to attend conferences and trainings directly related to this project ($1,200)
- Supplies for water quality monitoring such as batteries and ice ($100 per year, total $300)
- New laptop for technician to be purchased in 2022 ($700)

D.2.2.5.3.8. Environmental and Regulatory Compliance Costs

There are no environmental and regulatory compliance costs associated with the J-Wasteway Re-regulation portion of this project as that work was completed with Phase I of that project.

For stream restoration, SRWG cost for compliance has been estimated as $11,000.59 (See Attachment H).

D.2.2.5.3.10 Indirect Costs
Indirect costs for this project are built into Project Manager's budget line item.

D.2.2.6. Environmental and Cultural Resources Compliance

Cultural compliance clearance for the re-regulation portion of this project has been obtained. SRWG has contacted Reclamation's local archaeologist and an approved contractor to receive a cost estimate for clearing the stream restoration portion of this project. SRWG will pursue this clearance upon notice of award.

D.2.2.7. Required Permits or Approvals

This project will require a 310 Permit for Proposed Work in Montana's Streams, Wetlands, Floodplains, and Other Waterbodies, SPA 124 Permit from FWP, and a US Army Corps of Engineers Nationwide 27. The project is not within the mapped floodplain, so no county floodplain permit is required.

D.2.2.8. Letters of Support and Partnership

Greenfields
STRICT

December 7, 2021

Bureau of Reclamation
Financial Assistance Support Section
Attn: Robin Graber
P.O. Box 25007, MS 86-69200
Denver, CO 80225

RE: WaterSMART- FY2022 Environmental Water Resources Projects, NOFO R22AS00026,
Sponsorship Commitment Letter on Behalf of the Sun River Watershed Group

Dear Ms. Graber:

The Greenfields Irrigation District (GID) is writing this Sponsorship Commitment Letter on behalf of the Sun River Watershed Group's (SRWG) application for funding assistance under NOFO R22AS00026. GID is pleased to commit to being a Category A Sponsor for this effort. GID and the SRWG have worked together on numerous water resource projects since the mid-1990s; well over 25 years. GID is knowledgeable of the full scope of this funding request and has assisted the SRWG in developing several of the project tasks.

The purpose of this effort is to drastically reduce the negative and detrimental, environmental impacts caused to Muddy Creek from irrigation operations related to GID. A large portion of funding will be applied directly to the remediation of on-going erosion and subsequent sediment deposition resulting from excess return flows and emergency releases originating from District operations and its water users. A second portion of the Grant will be used to assist with the modernization of District operations and critical infrastructure thus helping to reduce these waste flows from being introduced to the Muddy Creek drainage.

Since GID benefits directly from this effort, the GID management will assist the SRWG with the implementation of the various work tasks and will communicate with SRWG Executive Director regularly to ensure a successful project. GID is also confident in the ability of the SRWG to deliver a successful project.

GID equipment and crews will be instrumental with the implementation of many of the infrastructure improvements and the remediation of the on-going Muddy Creek issues. A significant portion, of the in-kind resources will be provided by GID's maintenance/construction crews and its fleet of heavy equipment. The GID District Manager is a licensed engineer with +35 years of design and construction management experience. The staff and management of GID, 18 FTEs, are very experienced in heavy, civil construction having completed numerous infrastructure replacement and repair projects. USBR quality assurance personnel located in the Montana Area Office can attest to GID's ability to complete major construction projects.

Please feel free to contact me should you have any questions regarding either GID's qualifications and willingness to act as a Grant Sponsor or the specifics of the water resource work tasks, their benefits, and SRWG's ability to manage the Grant.

Respectfully,
Greenfields Irrigation District

Erling A. Juel, P.E.
District Manager

c: SRWG Executive Director
GID Board

United States Bureau of Reclamation
WaterSMART Cooperative Watershed Management Program (CWMP)
Phase I Grant Program
RE: 2020 Sun River Watershed Cooperative Watershed Management Phase I Grant

Dear Grant Administrator,

As landowners affected by the ever-changing Muddy Creek, we strongly support the Sun River Watershed Group's (SRWG) application for a CWMP Watershed Management Project Design for the Muddy Creek.

Muddy Creek landowners are suffering from the erosion caused by the fluctuating water flows seen on the creek. Several projects were completed along the Muddy Creek over the past few decades, but multiple issues still remain. Some issues currently facing landowners: fence lines and large areas of shoreline falling into the creek, structures and septic systems in jeopardy, land being divided by the flows and creek crossings being washed away by the changing water levels. A long-term commitment to proper management and continuous improvement of the entire watershed are key ingredients to improving water quality and protecting landowners property.

We understand this is the first phase of a project to identify solutions, prioritize project areas, and prepare designs for future construction. As landowners, we will work with the SRWG to provide information about our properties and identify our concerns while allowing access to the project team for the purpose of furthering this effort. Our commitment is to assist the SRWG in achieving the overall improvement of the watershed while protecting our properties.

It is our belief, the SRWG is a consensus-based organization that looks to resolve watershed issues. We look forward to being active members of the group and providing a positive impact to the watershed. We appreciate your time and the opportunity to voice our concerns and look forward to your support of this very important issue.

Respectfully,

Skip Neuman
SKIP NEUMAN
1490 2nd Road NE
Vaughn, MT 59487

WAYNE TONNE
224 North Vaughn Frontage Road
Vaughn, MT 59487

MICHAEL REID
102 North Vaughn Frontage Road
Vaughn, MT 59487

JOHN SCOTT
68 Wibaux Road
Vaughn, MT 59487

Not available for signature.
JENNIFER HENNING
34 Wibaux Road
Vaughn, MT 59487

See attached email
SUSAN OVERFIELD
251 Gordon Road
Vaughn, MT 59487

RUSSELL LEITHEISER
440 North Vaughn Frontage Road
Vaughn, MT 59487
Russell Lei

STEVEN KERLING
150 North Vaughn Frontage Road
Vaughn, MT 59487

See Additional Signature Page:

Additional LAND OWNERS:

Linda Berger
1 Second St
Vaughn MT 59487

Daniel Rhodes
1 Second St
Vaughn MT 59487

Steven Feist
446 N Vaughn Frontage Rd
Vaughn, MT 59487

Gmail

Kelley Kerling <kerlingk@gmail.com>

Support Letter for the SRWG

Steve Kerling <kerling70@gmail.com>
To: Kelley <kerlingk@gmail.com>

Fri, Nov 8, 2019 at 2:40 PM

---------- Forwarded message ---------
From: **Susan Overfield** <stockdog@3rivers.net>
Date: Fri, Nov 8, 2019, 6:37 AM
Subject: Re: Support Letter for the SRWG
To: Steve Kerling <kerling70@gmail.com>

The letter, with my name attached, is fine.

Thanks, Steve.

Susan

On Thu, Nov 7, 2019 at 12:12 PM Steve Kerling <kerling70@gmail.com> wrote:
How about this..

---------- Forwarded message ---------
From: **Steve Kerling** <kerling70@gmail.com>
Date: Tue, Nov 5, 2019, 12:48 PM
Subject: Support Letter for the SRWG
To: <neumanfarms@hotmail.com>, <hhbar@hotmail.com>, <gopheranch@yahoo.com>, <jenhenning@ymail.com>, <stockdog@3rivers.net>, <russellleitheiser@gmail.com>, Kelley <kerlingk@gmail.com>

All,

Please take a moment to review the attached letter. If you want something changed or added please let me know. I am gonna try and get it signed as soon as everyone gets back to me. Tracy Wendt from the water
shed needs it by COB Friday, but I might be able to get it to her on Saturday. Please check to make sure your address is right and I didn't misspell your name.

There is a meeting at the Sun River Valley Community Center this Thursday at 6:30; it will be a good time to raise our concerns.

We are trying to have a meeting of landowners on Saturday at 1000 at our house.
150 north Vaughn frontage road....the tan and green place by the underpass for Neuman school road.

Thanks and as also if you have a neighbor or know someone effected by this please get them involved.

steve

Cascade Conservation District
www.cascadecd.com

600 6th St NW, Suite 1
Great Falls, Montana 59404
Tel: 406-866-0028
Email: tenlee@cascadecd.com
www.cascadecd.com

December 8, 2021

US Bureau of Reclamation
WaterSMART Environmental Water Resources Program
Josh German
PO Box 25007, MS 86-69200
Denver, CO 80225

RE: 2022 Sun River Watershed Environmental Water Resources Proposal – Muddy Creek

Dear Mr. German:

Cascade Conservation District (CCD) supports the Sun River Watershed Group's (SRWG) proposal for Environmental Water Resources funding for **Muddy Creek Restoration and Resiliency Project, Phase I**. This project will address erosion and degradation on Muddy Creek through improved water efficiency and conservation, and by implementing stream bank restoration techniques. CCD appreciates the strategic planning process SRWG has followed to identify and prioritize this work, and we recognize this important opportunity to restore ecological values – including water quality, fish and wildlife habitat, riparian function, and hydrologic processes – in and around Muddy Creek. This will also improve water supply reliability and supply during drought for irrigation, habitat, and natural processes.

Muddy Creek has long been a central area of concern in the watershed. SRWG makes a significant impact through their strategic planning efforts by engaging landowners and other land stewards. In recent years, the City of Great Falls has reached out regarding the sediment loads that are being carried downstream by the Muddy Creek drainage. These sediment loads are impacting the city's wastewater treatment discharge plant, Northwestern Energy's dam maintenance requirements and more thus, costing taxpayers and other consumers a great deal. SRWG leadership is paramount to successful strategies prioritized for this drainage.

SRWG is a consensus-based group comprised of a diverse array of stakeholders, including agencies, private property owners, state and local governments, and other entities concerned with the resources of the basin. CCD has worked closely with the Sun River Watershed Group in the past and is confident the organization has the ability to carry out this project and that the project will have long-term, watershed-scale benefits to water quality. CCD has worked closely with SRWG and seen firsthand how SRWG is able to turn relationships into on-the-ground conservation. This aligns perfectly with the mission of CCD as well of locally lead conservation and stewardship.

Issues on Muddy Creek are far-reaching: Muddy Creek flows into the Sun River, which feeds the Missouri. Addressing water quality and supply and restoring natural processes in Muddy Creek should have extended benefits to these waters and to the people, fish, and wildlife that rely on a reliable supply of clean water. CCD is committed to supporting SRWG as they work to implement a sustainable, resilient solution. Thank you.

Cordially yours,

CASCADE CONSERVATION DISTRICT

Tenlee Atchison, Executive Director

4600 Giant Springs Road
Great Falls, MT 59405
November 18, 2021

US Bureau of Reclamation - Josh German
WaterSMART Environmental Water Resources Program
PO Box 25007, MS 86-69200
Denver, CO 80225

RE: 2022 Sun River Watershed Environmental Water Resources Proposal – Muddy Creek

Dear Mr. German:

Montana, Fish Wildlife and Parks (FWP) supports the Sun River Watershed Group's (SRWG) proposal for Environmental Water Resources funding for **Muddy Creek Restoration and Resiliency Project, Phase I**. This project will address erosion and degradation on Muddy Creek through improved water efficiency and conservation, and by implementing stream bank restoration techniques. Montana Fish, Wildlife and Parks appreciates the strategic planning process SRWG has followed to identify and prioritize this work, and we recognize this important opportunity to restore ecological values – including water quality, fish and wildlife habitat, riparian function, and hydrologic processes – in and around Muddy Creek. This will also improve water supply reliability and supply during drought for irrigation, habitat, and natural processes.

Excess irrigation returns from Muddy Creek are particularly detrimental to the water quality in the Sun River and the Missouri River, including the associated sediment and nutrient loading. Disconnection from the floodplain and loss of riparian habitat has led to increased bank instability and erosion. Projects identified within the Muddy Creek Restoration and Resiliency Project aim to address and repair the continual degradation of this Sun River tributary. FWP encourages the SRWG to conduct monitoring to evaluate and report on the success of these projects. Specifically, monitoring should be completed to evaluate if the projects are successful in improving habitat quality, water quality, and water quantity.

Issues on Muddy Creek are far-reaching: Muddy Creek flows into the Sun River, which feeds the Missouri River. Addressing water quality and supply and restoring natural processes in Muddy Creek should have extended benefits to these waters and to the people, fish, and wildlife that rely on a reliable supply of clean water. Montana Fish, Wildlife and Parks is committed to supporting SRWG as they work to implement a sustainable, resilient solution.

Thank you.

Gary Bertellotti
Regional Supervisor
Montana Fish, Wildlife and Parks

Missouri River Flyfishers

November 15, 2021

US Bureau of Reclamation
WaterSMART Environmental Water Resources Program
Josh German
PO Box 25007, MS 86-69200
Denver, CO 80225

RE: 2022 Sun River Watershed Environmental Water Resources Proposal – Muddy Creek

Dear Mr. German:

The Missouri River Flyfishers support the Sun River Watershed Group's (SRWG) proposal for Environmental Water Resources funding for **Muddy Creek Restoration and Resiliency Project, Phase I**. This project will address erosion and degradation on Muddy Creek through improved water efficiency and conservation, and by implementing stream bank restoration techniques. MRF appreciates the strategic planning process SRWG has followed to identify and prioritize this work, and we recognize this important opportunity to restore ecological values – including fish and wildlife habitat, water quality, riparian function, and hydrologic processes – in and around Muddy Creek. This will also improve water supply reliability and supply during drought which is important for fish habitat.

The Missouri River Flyfishers [MRF] is an affiliate of Trout Unlimited, committed to promoting stream access, trout habitat, public education, and the conservation of the sport of fly fishing. SRWG has been an important partner for MRF in recent years, leading trout habitat improvement projects on Muddy Creek and at Nilan Reservoir, as well as a river cleanup and public education about aquatic invasive species. The project described in this WaterSMART proposal would benefit our membership, as it will improve water quality and fish habitat, and help restore a more natural flow regime in Muddy Creek. As Muddy Creek flows into the Sun River and the Sun into the Missouri, the project SRWG proposes will have benefits far beyond the immediate project area, and will benefit the trout in all three water bodies, as well as migratory trout who move through these streams.

MRF is committed to supporting SRWG as they work to implement a sustainable, resilient solution to restoring ecological values at Muddy Creek.

Thank you.

Brian Neilsen
Missouri River Flyfishers, Vice-President

TETON CONSERVATION DISTRICT

1102 Main Avenue N. Choteau, MT 59422
406 466-5722 x103
tetoncd@yahoo.com

November 15, 2021

Josh German
US Bureau of Reclamation
WaterSMART Environmental Water Resources Program
PO Box 25007, MS 86-69200
Denver, CO 80225

RE: 2022 Sun River Watershed Environmental Water Resources Proposal – Muddy Creek

Dear Mr. German:

The Teton Conservation District was established in 1947 to work cooperatively with local landowners for ensuring the wise management of our natural resources in a responsible and efficient manner. This includes soil and water conservation best practices on agricultural lands.

Teton Conservation District supports the Sun River Watershed Group's (SRWG) proposal for Environmental Water Resources funding for **Muddy Creek Restoration and Resiliency Project, Phase I**. This project will address erosion and degradation on Muddy Creek through improved water efficiency and conservation, and by implementing stream bank restoration techniques.

SRWG has utilized a strategic planning process to identify and prioritize this work, and we recognize this important opportunity to restore ecological values – including water quality, fish and wildlife habitat, riparian function, and hydrologic processes – in and around Muddy Creek. This will also improve water supply reliability and supply during drought for irrigation, habitat, and natural processes.

Sun River Watershed Group is a consensus-based group comprised of a diverse array of stakeholders, including agencies, private property owners, state and local governments, and other entities concerned with the resources of the basin. Teton Conservation District has worked closely with the Sun River

Watershed Group in the past and is confident the organization can carry out this project creating long-term, watershed-scale benefits to water quality.

Teton Conservation District continues to partner and support SRWG as they work to implement a sustainable, resilient solution.

Sincerely,

Ross Salmond

Ross Salmond
Chair
Teton Conservation District

D.2.2.9. Official Resolution

SUN RIVER
WATERSHED GROUP

SRWG BOARD RESOLUTION, 2021

Sun River Watershed Group Board of Directors
Great Falls, MT 59443

RESOLUTION SPONSORING FOA R22AS00026 BUREAU OF RECLAMATION 2022 WATERSMART ENVIRONMENTAL WATER RESOURCES GRANT FOR MUDDY CREEK WATERSHED RESTORATION PROJECT

WHEREAS the Muddy Creek basin suffers from substantial annual bank erosion and altered natural flow regime, and

WHEREAS said erosion and altered regime has a negative effect on water quality, fish and wildlife habitat, riparian health, and natural hydrologic processes, affecting Muddy Creek, the Sun River, and the Missouri River, and

WHEREAS the consultant team hired by Sun River Watershed Group (SRWG) has recommended a project approach to address these issues through a Master Planning Process, therefore

BE IT RESOLVED, the Sun River Watershed Group's Board of Directors has reviewed the WaterSMART Grant requirements (FOA R22AS00026) and authorizes its Coordinator to pursue a Bureau of Reclamation 2022 WaterSMART Environmental Water Resources Grant; and

BE IT FURTHER RESOLVED that the Sun River Watershed's Board of Directors will commit the necessary resources to complete the project by the deadlines established in the cooperative agreement.

Dated this 20th day of October 2021.

Chairman, Erling Juel

Attest:
Perk Perkins, Secretary-Treasurer

PO Box 7312
Great Falls, MT 59406
www.sunriverwatershed.org

(406) 214 2868
tracy@sunriverwatershed.org

D.3. Unique Entity Identifier and System for Award Management

SRWG is registered in SAM and the account is active.
DUNS: 140878120
CAGE Code: 3NAT0

J-WASTE WAY REREGULATION POND PROJECT

Introduction and Project Description:

The J-Waste Way component of GID's infrastructure represents the confluence of a large canal (GM-100) and a large, constructed drain (Drain B) that flows year-round. This confluence forms a pond as the outlet for the continuation of GM–100 and the waste way for Drain B are both checked and regulated. This pond is held at a constant level so that the discharge downstream through the GM-100 headworks remains constant. As a result, any of the combined inflows into the pond greater than that needed to satisfy irrigation deliveries downstream along GM-100, are released, discharged, or otherwise spilled through the waste way overflow skimmer into a natural drainage that represents the headwaters of the Spring Coulee. Water released to Spring Coulee is considered lost and unrecoverable water and ultimately drains to Muddy Creek. Muddy Creek experiences environmental impacts from erosion caused by excess inflows being introduced from irrigation operations. The J-Waste Way facility is shown below.

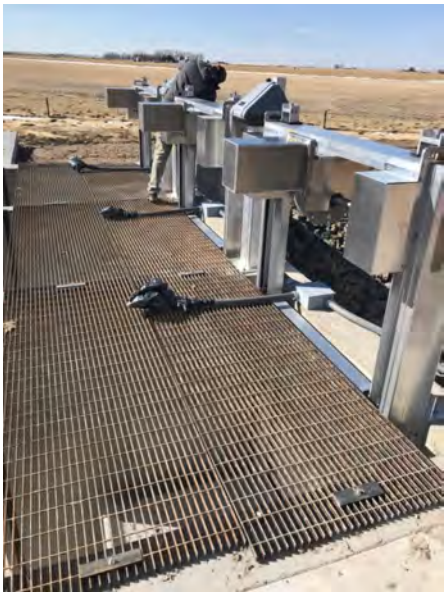
J-Waste Way Facility/Proposed Reregulation Structure

It has long been envisioned to convert the confluence pond into a fully functioning re-regulation structure such that the magnitude of unrecoverable water lost to Spring Coulee and Muddy Creek could be drastically reduced. Re-regulation of inflows or the temporary detention of excess inflows, would create the opportunity to use this water for irrigation as originally intended rather than lose it off-District to natural drainages with ongoing environmental issues. Previous engineering studies calculated that an annual water savings on the order of 8,000 acre-feet could be captured, detained, and then re-released down the continuation of GM-100 for irrigation. The water savings and re-regulation

potential would occur at an elevation of up to five feet higher than the current normal operating level as well as acting over a larger footprint.

Because of the magnitude of the scope of work for the proposed re-regulation facility project, it was divided into three phases of development. This phased approach was important as this allows GID crews to perform as much of the construction themselves. It is also important because all construction must be completed during offseason, during winter months and must be completed prior to the start of the next water season.

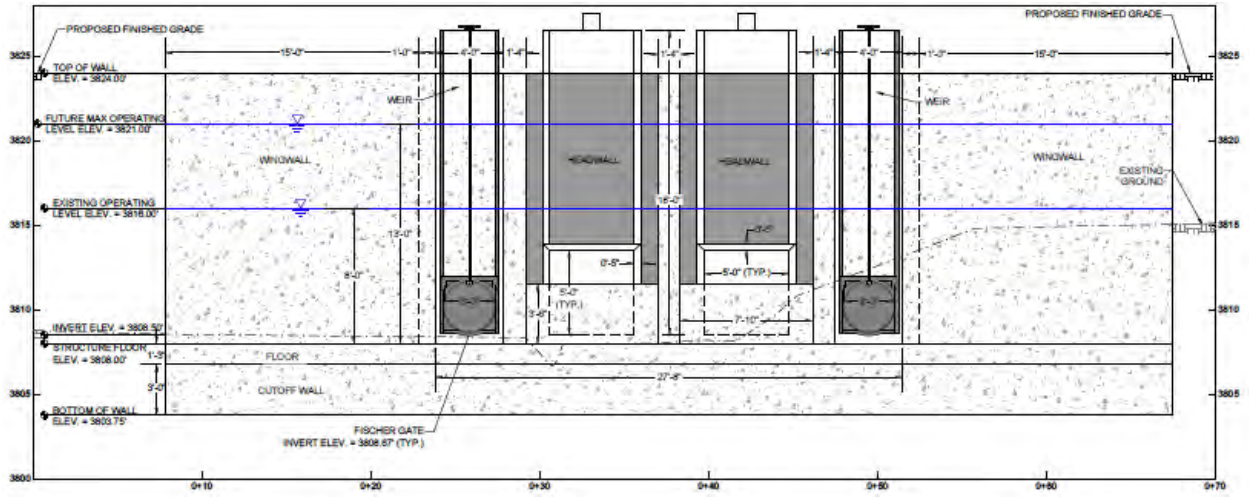
The first phase has already been completed (2020-2021 off-season) and consists of a new check control structure that is self-regulating and programmable with respect to time. The original check was manually operated, and a constant upstream pond level maintained a constant discharge through that old check. With a fluctuating pond level associated with true regulation, a self-monitoring, and self-regulating check structure, i.e., “a smart check”, was warranted which can adjust itself to maintain the desired discharge flow based on downstream demand. The first phase was constructed and partially funded using a WaterSmart Grant and the photos below show the nature of the construction.



Phase 1 – Smart Check on GM-100 Constructed by GID (2020-2021) and Partially Funded by WaterSmart Grant

The second phase of the overall reregulation development will be completed in this current offseason 2021 to 2022 and consists of a new waste way control structure on Spring Coulee which will operate in coordination with the fluctuating pond levels. This structure will control and minimize operational releases to the Spring Coulee drainage that then becomes unrecoverable or lost water. The primary purpose for this check structure is to self-regulate discharges and avoid over-topping of the waste way facility. The check minimizes discharges while controlling the rate of detrimental filling when the reregulation pond reaches capacity. This second phase is being funded using a

Renewable Resource Grant (RRG) from the Montana Department of Natural Resources and Conservation (DNRC). To date, the precast, cut-off walls have been poured and construction is scheduled to begin December 13th. The figure below shows the proposed Spring Coulee headworks, Phase 2.



Proposed Spring Coulee Headworks Check Structure

The third and final phase of the J-Waste Way Reregulation Project, which financial assistance is being sought under this funding opportunity, is the pond excavation and containment berm construction. Reregulation capacity will be obtained by enlarging the pond footprint and raising and/or constructing a containment berm to raise the maximum pond level by an additional five feet The new earthen berm will be approximately 4,200 lineal feet in length and will encompass the enlarged pond. Bank armoring is proposed along the eastern berm to protect against wave action. The eastern berm will also be the tallest becoming gradually less towards the west or upstream stream.

Proposed Reregulation Containment Berm Alignment

Readiness:

The 3rd Phase will be ready for construction by the Spring of 2022. By Spring 2022, the Phase 2 Spring Coulee Smart Check/Headworks, will have been completed. Construction of the containment berm and pond enlargement, this funding request, would follow the completion of Phase 2. Preliminary engineering has been completed but final design details and construction staking will need to be performed.

Phase 1, GM–100 Smart Check, was funded using a Reclamation WaterSmart Grant. At that time, Environmental and Cultural Resources Clearances and Compliance Documentation was obtained for the entire project. In November 2018, Reclamation issued the *Final Environmental Assessment and Finding of No Significant Impact for the J-Lake Improvement Project*. In addition, Reclamation staff have provided a review of the overall reregulation development strategy and preliminary project drawings.

PROJECT BUDGET – J-WASTE WAY REREGULATION PROJECT

The District contributions to this task will be $125,891 for in-kind services of labor to finish the J-Waste Way Reregulation Pond. Program grant funds for $333,090 are requested. Total task cost is $458,981.

These non-Reclamation funds and in-kind services exceed the 25% match required from this Drought Grant program.

General Requirements

Task 1 - BoR already completed NEPA and NHPA compliance & clearance documents for the J-Waste Way Reregulation Pond.

Task 2 - District to complete final engineering details and construction staking. BoR has already completed reviews of construction drawings and overall development strategy.

- Final construction details and construction staking - $8,500 – Grant
- District manager - 10 hours @ $80.19/hour - $801.90 - In-kind

Task 3 – Construct containment berm and enlarge reregulation pond

- *District Personal*
  - District labor to accomplish core work (best estimates for tasks) including:
  - clearing & grubbing, remove materials, import fill and aggregates, pond excavation, compact fill and aggregates, road surfacing, slope armoring, clean up, and seed
    - 940 hours, general laborer @ $30.16/hour - $ 28,350.40 - In-kind
    - 2,160 hours, equip. operators @ $34.79/hour - $ 75,146.40 - In-kind
    - 600 hours, truck drivers @ $31.94/hour - $ 19,164.00 - In-kind
  - District manager - to oversee containment berm construction
    - 14 hours @ $80.19/hour - $ 1,122.66 - In-kind

- *District Equipment*
  - 200 hours, CAT 320 Excavator @ $57.61/hour - $ 11,522.00 - Grant
  - 440 hours, CAT 326 Lg Boom Excav @ $67.00/hour - $ 29,480.00 - Grant
  - 240 hours, D-7 dozer @ $150.14/hour - $ 36,033.60 - Grant
  - 640 hours, CAT 926 loader @ $58.08/hour - $ 37,171.20 - Grant
  - 640 hours, Vib. Wheeled Compactor @ $72.00/hour - $ 46,080.00 - Grant
  - 240 hours, Vib. Bomag Compactor @ $37.50/hour - $ 9,000.00 - Grant
  - 600 hours, trucks @ $101.50/hour - $ 60,900.00 - Grant

- *District Materials*
  - 735 SY, Non-Woven Geotextile @ $5.02/SY - $ 3,689.70 - Grant
  - 480 SY, Woven Geotextile @ $1.42/SY - $ 681.60 - Grant
  - 480 SY, Bi-Axial Geogrid @ $2.64/SY - $ 1,267.20 - Grant
  - 75 CY, Pit Run Gravel @ $15.23/CY - $ 1,142.25 - Grant
  - 950 CY, Cr. Base Course @ $31.47/CY - $ 29,896.50 - Grant
  - 150 CY, 6-in Canal Armoring @ $15.23/CY - $ 2,284.50 - Grant
  - 650 CY, Class II Rip Rap @ $55.83/CY - $ 36,289.50 - Grant
  - 8400 CY, Common Fill/Imported @ $2.28/CY - $ 19,152.00 - Grant

Task 4 - Reporting, compliance review and monitoring
- District manager and secretary accomplish required grant and project monthly and final reporting and billing
  - District manager 10 hours @ $80.19/hour - $ 801.90 - In-kind
  - Office Worker 15 hours @ $33.6/hour - $ 504.00 - In-kind

Other expenses - contingency and indirect
- NONE

TOTALS **$125,891 In-Kind Match (27.4%)** **$333,090 Grant (72.6%)**

Budget Proposal:
Table 1. – Total Project Cost Table

SOURCE	AMOUNT
Costs to be reimbursed with the requested Federal funding	$ 333,090
Costs to be paid by the applicant	$ 125,891
Value of third-party contributions	-0-
TOTAL PROJECT COST	$458,981

Table 2. – Summary of Non-Federal and Federal Funding Sources

FUNDING SOURCES	AMOUNT
Non-Federal Entities	
1. Greenfields Irrigation District	$125,891
REQUESTED RECLAMATION FUNDING	$333,090
TOTAL PROJECT COST	$458,981

Table 3. - Budget Proposal – J-Waste Way Reregulation Project

BUDGET ITEM DESCRIPTION	COMPUTATION		RECIPIENT COST SHARE	RECLAMATION FUNDING	TOTAL COST
	Unit/price	Quantity			
WAGES					
District Manager	$ 80.19	34 hrs	$2,726.40		$2,726.40
Office Worker	$ 33.60	15 hrs	$504.00		$504.00
General Laborers	$ 30.16	940 hrs	$28,350.40		$28,350.40
Equipment Operators	$ 34.79	2160 hrs	$75,146.00		$75,146.00
Truck Drivers	$ 31.94	600 hrs	$19,164.00		$19,164.00
Fringe benefits					
Included above rates			$0	$0	$0
EQUIPMENT					
CAT 320 Excavator	$ 57.61	200 hrs		$11,522.00	$11,522.00
CAT 326 Long Boom Ex	$ 67.00	440 hrs		$29,480.00	$29,480.00
CAT 960M Pay Loader	$ 58.08	640 hrs		$37,171.20	$37,171.20
CAT D-7 Dozer	$ 150.14	640 hrs		$96,089.60	$96,089.60
Vib Wheeled Compactor	$ 72.00	640 hrs		$46,080.00	$46,080.00
Vib. Bomag Compactor	$ 37.50	240 hrs		$9,000.00	$9,000.00
Miscellaneous Trucks	$ 101.50	600 hrs		$60,900.00	$60,900.00
SUPPLIES/MATERIALS					
Non-Woven Geotextile	$ 5.02	735 SY		$3,689.70	$3,689.70
Woven Geotextile	$ 1.42	480 SY		$681.60	$681.60
Bi-Axial Geogrid	$ 2.64	480 SY		$1,267.20	$1,267.20
Pit Run Gravel	$ 15.23	75 CY		$1,142.25	$1,142.25
Cr. Base Course Gravel	$ 31.47	950 CY		$29,896.50	$29,896.50
6-in Canal Armoring	$ 15.23	150 CY		$2,284.50	$2,284.50
Class II Rip Rap	$ 55.83	650 CY		$36,289.50	$36,289.50
Common Fill, Imported	$ 2.28	8400 CY		$19,152.00	$19,152.00
CONTRACTUAL					
NEPA/NHPA	$0	0	$0	$0	$0
Engineer Assistance	$ 8,500	1 LS		$8,500	$8,500
OTHER					
TOTAL DIRECT COSTS			**$125,891.26**	**$333,090.05**	**$458,981.31**
Contingency funds			**$0**	$0	$0
INDIRECT COSTS		**0%**	**$0**	**$0**	$0
TOTAL PROJ. COSTS			**$125,891.26**	**$333,090.05**	**$458,981.31**

PRELIMINARY DESIGN MEMORANDUM

TO:	Tracy Wendt, Sun River Watershed Group
FROM:	Tom Coleman, P.E., Karin Boyd, Tony Thatcher, Robert Sain
DATE:	December 8, 2021
SUBJECT:	Muddy Creek – **Preliminary** Design Documentation

INTRODUCTION

The following memorandum summarizes a preliminary design effort to restore lost functions to a reach of Muddy Creek near Vaughn, Montana. Muddy Creek extends approximately 40 miles upstream from its confluence with the Sun River. Along much of its path, Muddy Creek flows along the eastern margin of the Fairfield Bench, which is a major part of The Sun River Project, a large irrigation project that was originally envisioned and surveyed by the US Government in the late 1800s (Figure 1). Gibson Dam was built on the Sun River in 1929, and Sun River flows have been diverted via Pishkun Canal to irrigate the Fairfield bench ever since the distribution system was initially completed in the late 1930s. Subsequent decades saw massive changes in the hydrology of Muddy Creek, as irrigation return flows entered the small stream, described in August 1869 by General Land Office surveyors as dry. The increased magnitude and duration of flows has driven systemic downcutting of the stream that previously flowed on top of highly erodible fine sediment deposits of Glacial Lake Great Falls. Downcutting was rapid and dramatic, with up to 30 feet of incision into the erodible valley bottom. The historic floodplain is now perched as a high terrace well above the creek.

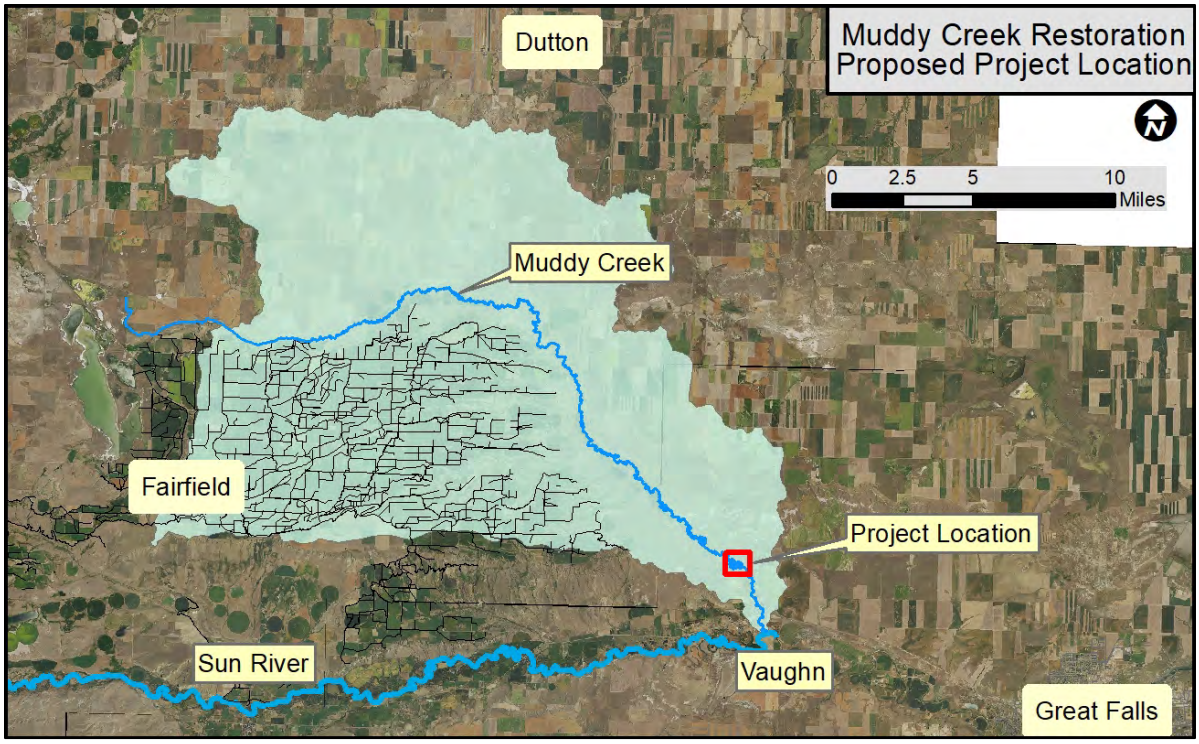


Figure 1. Muddy Creek watershed showing Greenfields irrigation distribution system in black and proposed project location.

In the mid-1990s, the Muddy Creek Conservation District in collaboration with the Cascade Conservation district worked on a project to "stabilize the planform and gradient of the stream". This included two phases of work, the first consisting of work on about four miles of channel beginning about 3 miles upstream of the mouth. This Phase 1 project was anchored by a large rock sill structure built in February 1994 at RM 3.15 to hold gradient at that location (Photo 1). An additional 10 rock grade control structures were built upstream of the sill to accommodate additional downcutting. Although the structures were constructed largely at grade, the additional downcutting caused them to become steep drops, rapidly reaching a cumulative drop of 15 feet as of October 1996. The project also included the construction of over 160 rock barbs over about 8 miles of channel. Several additional bank revetments were built, some of which were designed to prevent meander cutoffs.

Photo 1, April 29, 2021. View downstream showing Muddy Creek drop structure within incised channel.

A review of the stabilization project concluded that, in 1998, the project elements were functioning well, including during ice jams. Reviewers concluded that the grade control structures had stopped headcuts from migrating upstream, which would have caused additional instability and fine sediment production. The group made recommendations at that time for additional grade controls, barbs, longitudinal dikes to control slip failures, cutoff prevention efforts, erosion suppression, and revegetation. Subsequent revegetation efforts in the reach have been largely unsuccessful.

The conclusion that the grade controls remain functional largely remains the case, although they have become increasingly associated with excessive lateral scour and some hillslope failure, increasing their risk of failure in coming years (Photo 2).

Photo 2, November 2, 2021. Drone image of hillslope destabilization below grade control, Muddy Creek (flow direction is top to bottom).

The mid-1990's grade and bank stabilization efforts on Muddy Creek have proven to be an effective means of arresting additional downcutting and reducing rates of bank erosion. As they were built ~25 years ago, the appear to have met primary project objectives regarding channel stabilization. This largely stabilized condition now can provide a foundation upon additional work can be performed to improve the longevity of that work while adding additional objectives that integrate both stability and ecological function. To achieve this, it is important to consider the current geomorphic condition on the creek in terms of current functions and limitations to those functions.

Current Geomorphic Conditions on Muddy Creek—Grade Stability

As described above, the initial grade control structures are over 25 years old and are showing obvious signs of decay. Although they can be described as "functional," the steep structure profiles and associated high velocity streaming flows create strong lateral eddies that cause bank erosion that threatens their integrity. The structures are also associated with a deep scour pool, downstream of which scoured streambed materials generally settle and form central bars (Photo 3) driving further lateral erosion. The structures were unevenly spaced along the channel

but the structure crests generally conform to the average channel gradient. The infrequent structure spacing has created a stepped longitudinal profile where the channel is most closely connected to an inset floodplain surface immediately upstream of each structure and most disconnected immediately downstream of the structures. Barbs that were installed concurrently to the grade controls are mostly still in place and functioning although they are generally associated with a scalloped bank pattern due to eddy erosion between the structures (Photo 4). Herbaceous vegetation has become established on some of the barbs adding additional stability.

Photo 3, November 2, 2021. Existing Grade Control Structure (left) and Photo 4, November 2, 2021. Barb Series (right)

Any grade control failure in this section of stream would drive additional channel incision, downcutting, floodplain disconnection, and bank erosion. Failure of any one structure would immediately jeopardize the structure upstream. As a result, it is critical that any project on Muddy Creek ensure that the grade control system is functional for a project life that exceeds the current condition. Enhancing grade stability can then provide a primary project foundation upon which additional project elements and ecologically beneficial outcomes can be pursued.

Current Geomorphic Conditions on Muddy Creek—Floodplain Connectivity

A primary aspect of geomorphic function when considering riparian health is the level of connectivity between a channel and its floodplain. Although Muddy Creek has incised deeply below its historic floodplain, it has also developed new "inset floodplain" surfaces adjacent to the channel. Photo 5 shows an example of a large meander tab that is at an elevation below the historic floodplain surface. Although surfaces such as the one shown in Photo 5 appear to provide some connected areas that may be amenable to riparian recovery, many of them slope steeply towards the channel. This indicates that the river was migrating laterally as it was rapidly downcutting, leaving a point bar in its wake. Figure 2 shows a topographic profile through the same meander, and Figure 3 captures the meander topography via a Relative Elevation Model (REM) derived from the Lidar. These images capture how much of the "inset floodplain" is actually an older surface that is over five feet above the creek and thus is substantially disconnected and likely inhospitable to woody riparian colonization.

Another feature that is evident on the photos and figures below is the presence of a steep channel bank where the meander tab meets the active channel. This records the final phase of additional downcutting that occurred once the planform was stabilized. Point bars typically grade smoothly from a bankfull elevation into a channel without any distinct grade break

forming a discreet bankline. In this case, the meander core drops steeply to the channel, indicating that the entire meander tab is somewhat disconnected from the creek. This is the case throughout the system (Photo 6), it appears little of the grassed surface that appears as an inset floodplain is actually hydrologically connected to the river and thus capable of supporting riparian functions. Previous work has estimated the effective discharge on Muddy Creek to be about 300 cubic feet per second (CFS). A preliminary HEC RAS model was built with geometry taken from the 2020 Montana Department of Natural Resources and Conservation (MDNRC) LiDAR and a GPS survey conducted by this design team. The model indicates no inundation of inset floodplain surfaces at the effective discharge and the lowest elevation floodplain surfaces just begin to inundate at a flow somewhere between the 5-yr to 10-yr recurrence interval flood.

These observations have been used to develop techniques that will integrate directly with previous work to help the system recover as quickly possible. This includes considering the condition of that previous work.

Photo 5, November 2, 2021. View upstream at RM 3.5 showing inset floodplain surfaces adjacent to channel.

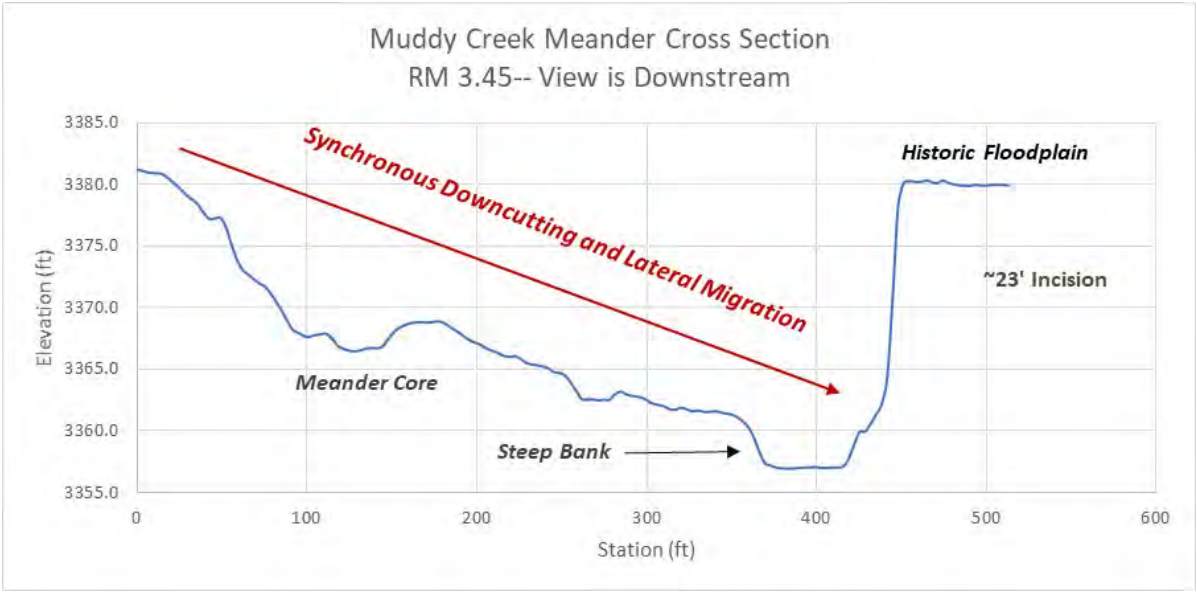


Figure 2. Cross section showing sloping meander core at RM 3.45 showing process of synchronous channel downcutting and migration; note steep left bank on edge of meander tab.

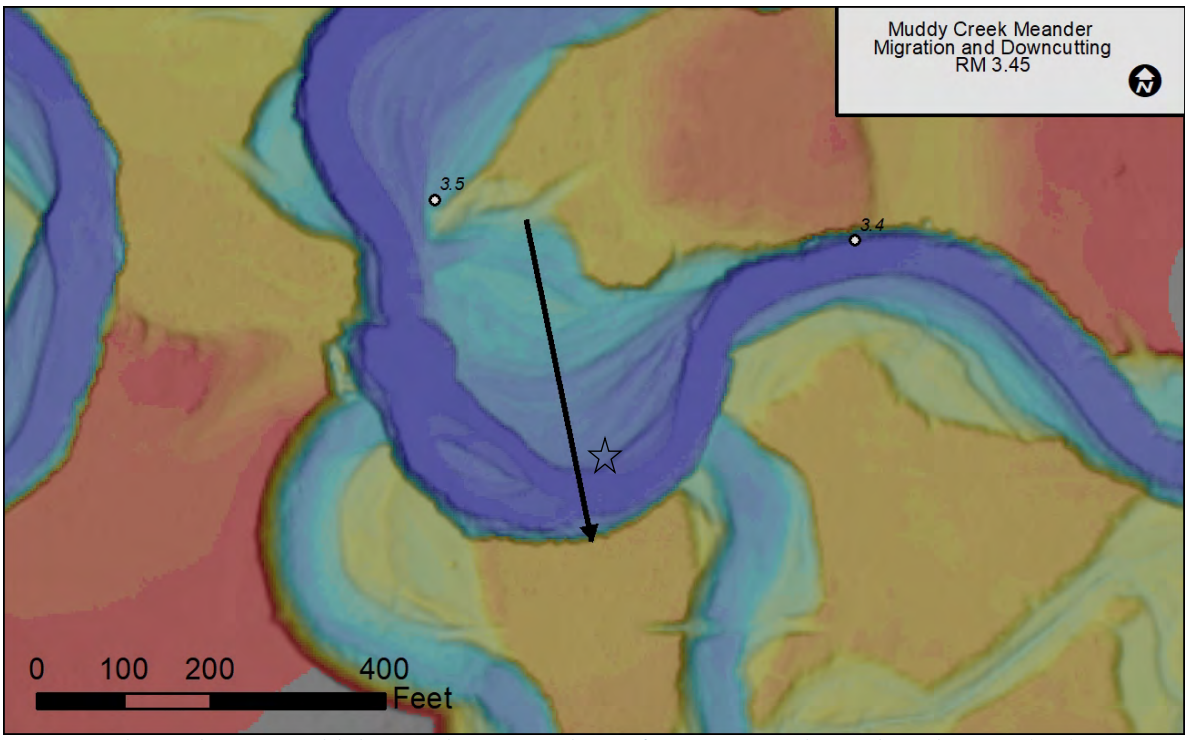


Figure 3. Relative Elevation Model showing sloping point bar surface; note steep edge on channel margin (star).

Photo 6, November 2, 2021. View upstream showing steep channel margins on passive edge and island; preliminary hydraulic modeling shows little hydrologic connectivity between these surfaces and the creek.

Proposed Project Location and Objectives

This project extends from the lowermost rock sill at RM 3.15 for about three miles upstream, in a section of stream that is at risk of grade destabilization and systemic loss of function upstream (See Sheet 2 of the Preliminary Design Drawings). The project is intended to demonstrate the application of modern concepts of riffle-based grade control, flow dispersal via floodplain reconnection, stream power reduction, and habitat renewal in an area that was originally

heavily engineered to purely resist the amplified hydraulic forces on the bed and banks. In doing this, benefits are sought to improve complexity and channel structure, reduce sediment production rates, restore vegetation, improve riparian habitat, and expand wetlands and backwaters.

The project reach was selected for the following reasons:

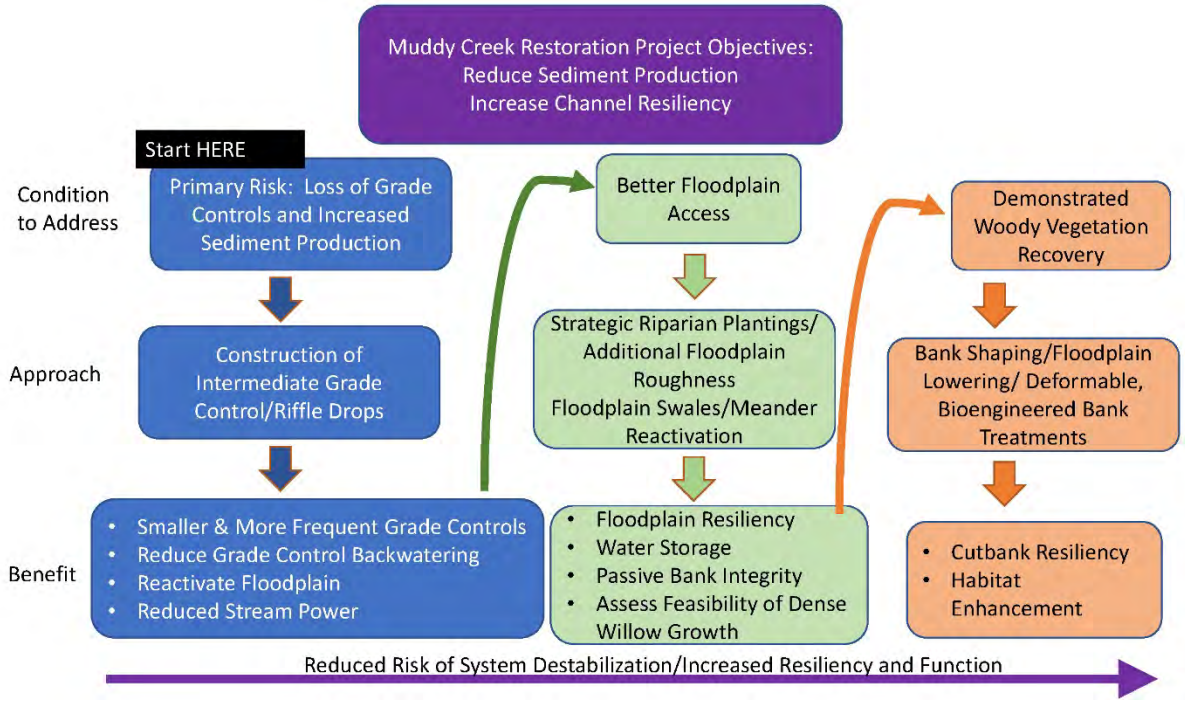
1. There is no evidence that the reach is on any natural trend of geomorphic recovery.
2. Loss of grade controls at this location in the lower segments of the creek will have a cascading effect upstream by creating a new cycle of incision.
3. Channel incision is severe in this reach such that gravitational bank collapse and associated sediment loading is common.
4. Inset floodplain surfaces have locally developed and can be opportunistically reconnected to the creek along the length of the project, serving to expand floodplain access, reduce in-channel stream power, and promote riparian recovery.
5. The reach has an obvious lack of fish habitat including backwater areas for larval and juvenile fish.
6. The range of opportunities allow the demonstration of a variety of restoration methods that can be applied throughout the watershed

The following project objectives were developed during a simultaneous master planning process:

1. Improve long-term grade stability
2. Improve hydrologic connectivity between the creek and adjacent inset floodplain
3. Create geomorphic and hydraulic conditions amenable for woody riparian recovery
4. Demonstrate a series of bank treatments that have the potential to improve bank stability and enhance riparian conditions.
5. Add project elements to improve aquatic and riparian habitats such as floodplain roughness, riparian plantings, topographic complexity etc.

Design Approach

Simultaneous to this project, the Greenfields Irrigation District (GID) is pursuing an irrigation pumpback project that will reduce GID inputs to the Muddy Creek system. Addressing flow inputs simultaneously with stream restoration is a critical aspect of this project. Although the reduction of inputs will reduce the magnitude and/or duration of high flows, this alone will not maintain stability or restore resiliency to Muddy Creek due to the current geomorphic state of the channel. As such, this project is designed to accommodate substantial uncertainty in terms of the future flow regime, while optimizing conditions to re-invigorate natural evolution and the achievement of an equilibrium state under that flow regime. The following general framework flow chart describes the project approach. The foundation for the project is sound grade stabilization in this otherwise vulnerable system. This in turn provides opportunities to increase floodplain access and complexity, conditions that can be capitalized on to promote system resiliency and optimal ecological function in this highly altered environment.



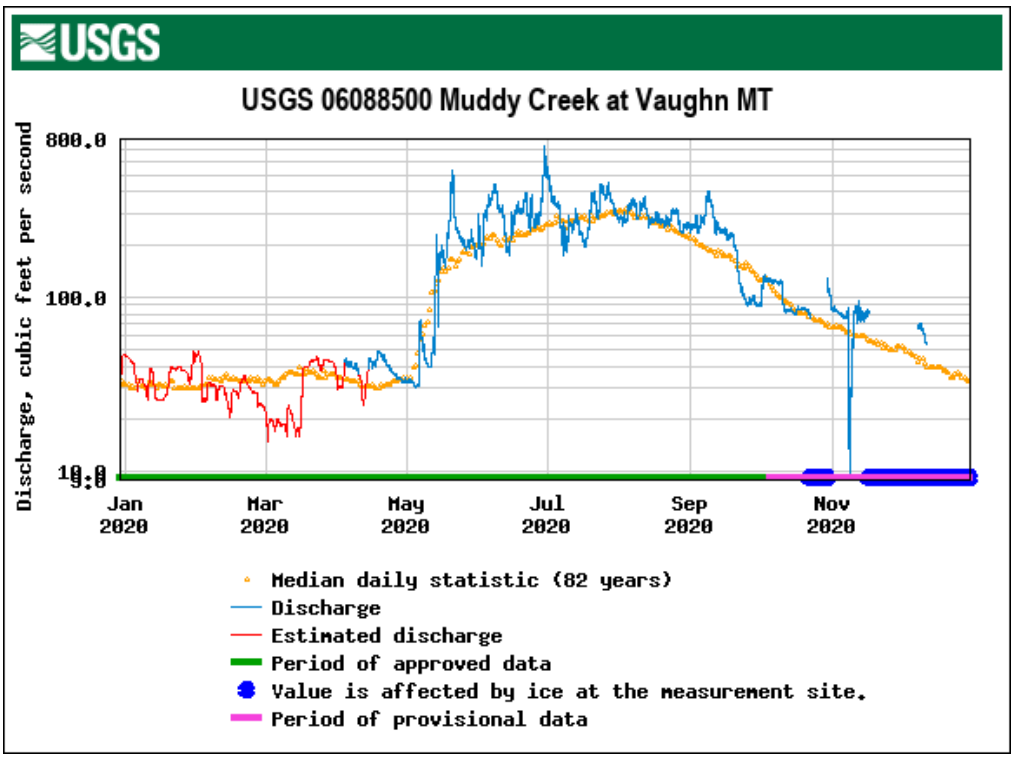
Design Considerations—Hydrology

The current irrigation enhanced hydrologic regime is the primary driver of system degradation on Muddy Creek, as irrigation wastewater flows from the GID significantly alter the natural hydrograph. As the proposed GID pumpback project will complement this effort, it is important to consider the existing and anticipated future hydrologic regime in design. The overall impact of irrigation flow augmentation is summarized in Table 1, which shows the flood frequencies for Muddy Creek calculated from regional regression equations using basin characteristics (considered "pristine") compared with the actual gage record-derived flood frequencies from the Muddy Creek gage near Vaughn (06089000). The results show, for example, that the 2-year flood event on Muddy Creek would be estimated at 176 CFS based on basin characteristics, but the actual flow record indicates a 2-year discharge of 646 CFS, a 267% increase. The relative impact of the augmented flows on flood frequencies decreases with higher flows as one would expect.

Table 1. Estimate flood recurrence discharges based on flow data and basin characteristics (USGS Streamstats).

Flood Frequency	Flow Data-Based (CFS)	Basin Characteristics-Based (CSF)	Difference (CFS)	Difference (%)
2-yr	646	176	470	267%
5-yr	1180	571	609	107%
10-yr	1720	1060	660	62%
25-yr	2700	2150	550	26%
50-yr	3730	3450	280	8%
100-yr	5080	5190	-110	-2%

GID wastewater inputs strongly skew flood magnitudes higher up to the 10-year flow event. Irrigation inputs also increase the duration of high flows through the entire growing season. Graphically, effects of the irrigation wastewater inputs can be seen in a hydrograph of daily median flows through the 82-year period of record. Figure 1 shows the Muddy Creek near Vaughn hydrograph compared to the Sun River near Vaughn, which is less influenced by irrigation returns. The Sun River gage is downstream of Muddy Creek and while the hydrograph is more typical of a natural hydrograph the influence of Muddy Creek can be seen in the summer months. The net effect of the GID inputs is an extended duration high flow condition (often exceeding the basin generated peak) that occurs each year through the entire summer season. As a result, our approach to this project is to improve connectivity while also effectively capitalizing on the benefit of long flow durations during the growing season. This will include integrating pumpback volumes into the hydrologic analysis and modeling those flows accordingly. In addition, substantial variability will be integrated into floodplain surfaces to accommodate flow fluctuations.



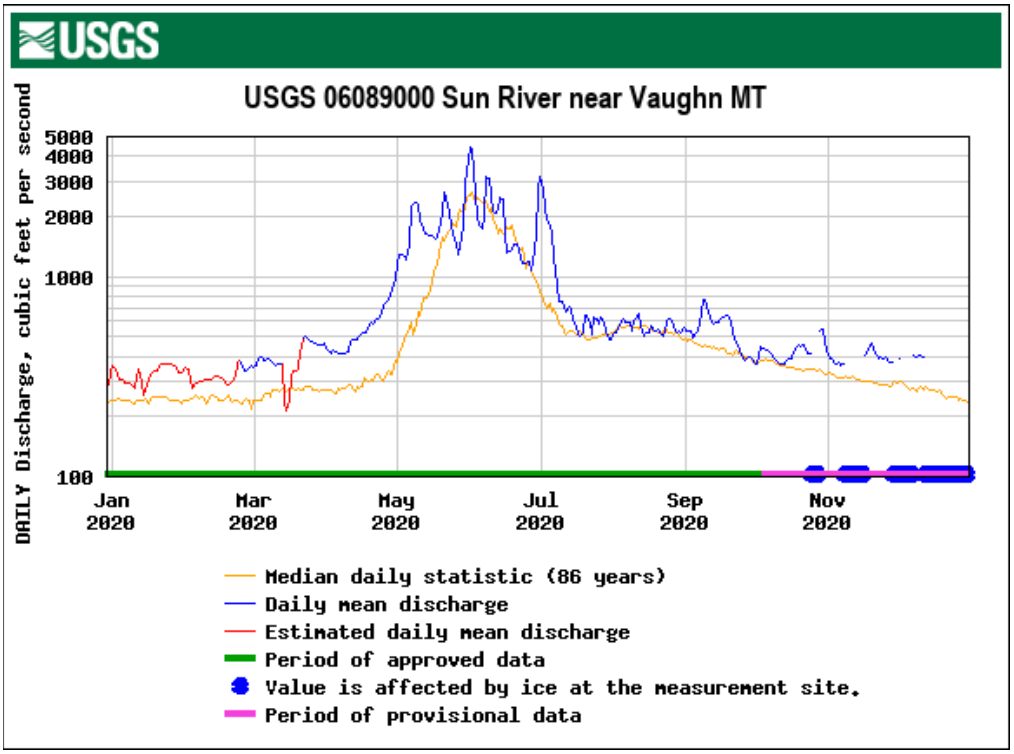


Figure 4. 2020 annual hydrographs for Muddy Creek (top) and Sun River (bottom) showing difference in shape from irrigation augmented system (Muddy Creek) to typical snowmelt runoff pattern (Sun River).

Preliminary Design Elements

Impairments in the Muddy Creek watershed are extensive and watershed scale restoration, as envisioned, in the Muddy Creek Master Plan are costly. Accordingly, the objective of this project is to demonstrate cost effective techniques to be efficient in the use of locally available materials and treatment methods. By way of example, where sod materials are prescribed as a building material, sod will be excavated at the limits of an active floodplain surface so that obtaining materials serves a dual purpose of expanding the floodplain. Further, the plan explores methods to direct dump materials at treatment sites to avoid costly inter-project stockpiling, re-loading, and hauling.

Grade control is the core element of this preliminary restoration plan. Controlling grade protects against future cycles of incision, the largest source of sediment to downstream reaches. Conceptually the plan is to strategically lift the system vertically, narrow it laterally, and lower inset floodplain tabs such that broad floodplain surfaces can be regularly inundated or saturated for a sufficient duration to support riparian vegetation plantings and natural vegetation colonization. Reconnection of a floodplain surface and establishment of riparian vegetation will decrease stream energy during floods and improve system resiliency.

Other design elements are complementary to the grade control and create a platform for system recovery that can only come from a robust riparian community that is naturally regenerated through flood processes. The project seeks to reduced high terrace erosion as vulnerable high terrace banks are common in the project reach and a significant source of sediment to downstream reaches. Multiple Bendway Terrace Toe Protections methods are proposed to demonstrate tools available for future projects and to explore effective and efficiency of each method at scale. Multiple methods also allow for selection of bank treatments that utilize the

most locally available materials at the time of construction, which will allow some mitigation of project costs. Where the channel corridor is narrow with little established floodplain; no Terrace Protection measures are proposed to allow for natural corridor expansion and floodplain development.

Deep rooted woody riparian vegetation is sparse throughout the project reach and since riparian vegetation establishment is essential for long term stability and resiliency the project proposes installation of containerized plantings in all treatments. Table 2 summarizes the proposed project treatments. Project Costs are provided in Appendix A as a total reach cost and an approximate cost for each Riffle Control complex (defined as the suite of treatments applied to a reach between two of the existing grade controls). Project treatments are illustrated and further defined on the Preliminary Design Sheets in Appendix B.

Table 2. Proposed project treatments

Type	Treatment	Description	Locations	Objectives	Potential Challenges in Implementation
A	Riffle Grade Controls (RGC)	Place intermittent grade controls (riffle analogs) between rock drops	Typical riffle locations	Contribute to grade stability, increase water surface elevation to improve connectivity, backwater older rock drops, improve fish passage and habitat	Access to site, importing gravel substrate, working in-channel.
B.1	Terrace Toe Protection: Stacked Sod	Use salvaged sod to create bank toe on opposite cutbanks; incorporate live willow cuttings/clumps at slope	Cutbanks	Create bank toe on outer banks to reduce risk of mass failure and improve riparian conditions and system roughness	Access, importing willow clumps, working in active channel
B.2	Terrace Toe Protection: Bankfull Bench	Construct bankfull bench using alluvium and brush, incorporate live willow clumps and cuttings	Cutbanks & Adjacent to riffle grade controls	Create coarse alluvial bench amenable to riparian colonization retain eroded materials from terrace slumps and collapses	Access, importing alluvial material and willows to site
B.3	Terrace Toe Protection: Modified Barbs	Construct discontinuous barbs along eroding terrace toes using oversize alluvium (or quarry rock) and brush matrix secured	Cutbanks	Create stable toe along terrace toes with a discontinuous treatment. Increase system roughness and enourage deposition.	Access, importing alluvial materials to the site. Brush avaiablility.
B.4	Terrace Toe Protection: Existing Terrace Toe	Plant containerized shrubs, trees and live cuttings on existing terrace toe benches	Cutbanks with established toe bench	Stabilize existing floodplain surfaces. Increase system roughness	Access
C.	Floodplain Expansion	Excavate perched floodplain surfaces and scalp sod for use in bank treatments	Meander cores and perched lateral surfaces	Lower perched point bars while salvaging sod for bank treatments.	Access
D.	Floodplain Surface Enhancement	Add complexity to connected floodplain with wood, topographic diversity, riparian plantings	Expanded floodplain areas	Increase floodplain function	Access, importing materials
E.	Meander Reactivation	Raise water surface elevation and excavate perched meander cutoffs to restore connectivity	Perched meanders that are topographically accessible	Add channel length and restore historic wetlands/channel environments	Access
F.	Tributary headcuts	Use detention ponds and bio-swales to slow and attenuate flow, stabilize headcuts with wetsod or wood terracing	Adjacent to Muddy Creek alignment	Eliminate these additional sediment sources to Muddy Creek.	Land use related to fencing and livestock grazing can greatly reduce timeline of

Montana Fish, Wildlife & Parks

4600 Giant Springs Road
Great Falls, MT 59405

May 8, 2001

Maryanne C. Bach
Regional Director, Great Plains Region
U.S. Bureau of Reclamation
Box 36900 (GP-1000)
Billings, MT 59107

Dear Director Bach:

I would like to express our Department's appreciation for the efforts of your agency in working to maintain a minimum instream flow of 100 cubic feet per second (cfs) in the Sun River below Diversion Dam during the summer and fall of 2000. We feel that without your efforts, it is very likely the Sun River would have had substantially lower flows.

Unfortunately, flows could not be maintained at the recommended 100 cfs minimum level through the winter. Although runoff forecasts have improved recently, we are still facing another drought in the coming year. According to the May 1 forecast provided by your agency, runoff is expected to be 68% of average, which is an improvement from the 54% estimate predicted on March 1. The May 1 forecast predicts that river flows will increase above 100 cfs in May and June but could return to 50 cfs during July through October. One of my staff members, Steve Leathe, discussed this with Tim Felchle today and Tim was fairly optimistic that a minimum of 100 cfs can be maintained this summer and fall. Fortunately, it now appears Gibson will fill this year, or very nearly so.

We have participated in Sun River Watershed group meetings for several years and have funded numerous fish habitat improvement projects on the river and its tributaries through our Future Fisheries Program. Like others in the group, we have long hoped that the substantial investments of public funds over many years to improve irrigation efficiency on the Fairfield Bench would "free-up" water to provide minimum flows for fish, wildlife and recreation in the Sun River.

We have continually advocated for improved flow conditions in the Sun River because we firmly believe that trout populations in the river are depressed, and this is primarily due to inadequate stream flows and associated impacts of irrigation (high water temperature and turbidity in irrigation return waters). Angling use on Montana's "blue-ribbon" trout rivers has increased dramatically, particularly by non-residents, in recent years. This reflects a strong national interest in these unique resources. We feel that in

its natural state, the Sun River was a high quality trout stream and it retains that potential. Improvement of depressed fisheries in rivers like the Sun is important because it will help accommodate increasing public demand and will also help diversify Montana's economy by promoting tourism.

We have conducted fish population surveys in several sections of the Sun River below Diversion Dam periodically and typically have found very low trout densities. The most recent work was done in the spring of 2000 when we found trout densities of roughly 50-150 per mile. For comparison, trout populations in the forks of the Sun River upstream from Gibson Dam are excellent and range from 400-1000 fish per mile. The few trout that do exist in the river below Diversion have good growth rates, indicating the river is capable of supporting a healthy trout population. Rainbows up to 20 inches and brown trout up to 23 inches long were captured in our surveys below Diversion.

We conducted "wetted perimeter" analysis during the late 1980's as part of the Missouri River Water Reservation proceeding to determine minimum flow requirements of the Sun River to protect and maintain fisheries resources. We divided the lower 90 miles of the Sun River below Diversion Dam into two reaches for that proceeding. The wetted perimeter analysis indicated preferred flows of 220-360 cfs (upper inflection point) and absolute minimum flows of 100-130 cfs (lower inflection point) for these two reaches. The wetted perimeter curves show there are dramatic reductions in wetted surface area (and habitat for fish and aquatic invertebrates) as flows dip below the lower inflection points. It should be emphasized that the lower inflection point flows should be viewed as absolute minimums, and not as "preferred" minimums.

It is our understanding that from time to time the Bureau revises the standard operating procedures for its reservoir systems. When this occurs, we recommend establishment of the following flow targets. For non-drought years, we recommend a summer flow of at least 220 cfs and a range of 220-360 cfs. During drought years, we recommend an absolute minimum flow of 100 cfs. Provision of adequate minimum flows in the Sun will also augment minimum flows downstream in the Wild and Scenic Missouri River where a number of sensitive fish species reside, including the endangered pallid sturgeon.

We very much appreciate the Bureau's active involvement in water management on the Sun River in recent years and we look forward to working with you and other interests to improve the compatibility of fisheries and irrigation in the drainage. We recognize that the BOR is only one of several major players in the Sun River drainage and it will require commitments from other major irrigators to maintain minimum flows initiated by releases from Gibson/Diversion. We hope this cooperative relationship will be refined and consolidated through the efforts of the Sun River Watershed group.

We believe the Sun River has excellent fisheries potential. Improved river flow and screening of major irrigation diversions are critical to fisheries restoration. We are encouraged by the steady progress being made, and some very large challenges (particularly screening major diversions) lie ahead. We recommend that flows in the river below Diversion be returned to at least 100 cfs as soon as possible and that

operational adjustments be made to ensure a minimum of 100 cfs henceforth. Thanks for considering these recommendations.

Sincerely,

Mike Aderhold

Mike Aderhold
Region 4 Supervisor

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