Morrison Maierle
engineers ▪ surveyors ▪ planners ▪ scientists

Bitterroot Conservation District

Bitterroot River Irrigation Management Study

December 2022

Bitterroot Conservation District
Bitterroot River Irrigation Management Study

TABLE OF CONTENTS

APPENDICES

Bitterroot Conservation District

Bitterroot River Irrigation Management Study
Executive Summary

The Bitterroot Irrigation Management Study provides guidance for the irrigators in the Bitterroot Valley. The Study extents include Bell Crossing to Painted Rocks Reservoir along the Bitterroot River. There are 20 intake facilities off the Bitterroot River in this project area, each typically having a diversion, headgate, and means of flow measurement. The Study presents an evaluation of the existing irrigation system infrastructure, hydraulic assumptions, and a capital improvements plan with concept design. The information and costs presented in this report will assist the irrigators with infrastructure replacement needs and help establish infrastructure improvement priorities in the Valley.

The primary objectives of the Study included:

1. Gathering and analyzing background data related to irrigation use in the Bitterroot Valley;
2. Inventorying and assessing the irrigation system diversions, headgates and flow measurement for the purpose of identifying priority needs;
3. Providing concept design assumptions and hydraulics for the priority site recommendations; and
4. Recommend improvements as part of a Capital Improvement Plan with the goals of optimizing surface water management, which will result in surface water conservation and preservation of aquatic habitat.

This report focused on the highest priority sites determined from ranking criteria identified by the Bitterroot Conservation District and irrigators. Ultimately, the highest priority sites advanced to concept design as part of this Study.

The Bitterroot River Irrigation Management Study is organized into four chapters corresponding to the objectives summarized above.

Chapter 1: Information Collection and Literature Review

The Bitterroot Conservation District Irrigation Management Study commenced with summarizing background information related to irrigation in the Bitterroot Valley. Chapter 1 includes an overview of the background of the efforts leading up to this Study, summary of irrigation in the Bitterroot Valley, stakeholder engagement during the Study, review of applicable governing statutes, and a summary of numerous financial grant and loan assistance programs.

Chapter 2: System Inventory and Assessment

The System Inventory and Assessment Chapter includes detailed assessments of each irrigation structure. The assessment included 20 irrigation systems along the Bitterroot River and generally includes the irrigation system diversion, headgate/intake structure, and flow measurement structure or device. Three irrigation systems declined to participate, resulting in assessment of 51 structures at 17 irrigation system interfaces with the Bitterroot River. The diversion at the East Channel was also included, resulting in 52 total structures assessed. Some irrigation systems lacked infrastructure such as flow measurement or a structure associated with a diversion. In those cases, the condition assessment noted the lack of infrastructure or the alternative means for delivering water. For most site visits, an irrigation system representative attended the condition assessment and offered input on operational and functional challenges associated with the irrigation structures. Each irrigation structure was evaluated using a standardized assessment form. This chapter organized the results of the assessment by irrigation system to include findings for each system’s headgate, diversion, and flow measurement.

Chapter 3: Hydraulic Assessment

This Chapter describes survey efforts and hydraulic assumptions for the fifteen prioritized projects, as chosen in Chapter 4, Capital Improvements Plan. These assumptions were used to develop the conceptual design plans and cost estimates that are included in the next chapter. This chapter was organized by flow measurement, headgate, and diversion projects to generalize design assumptions and to document unique characteristics of each project that were considered during design.

The intent of this chapter is to document technical assumptions and provide insight on design and cost estimating decisions. Design of proposed improvements are at a conceptual level and will require further investigation before implementation.

Chapter 4: Capital Improvements Plan

Chapter 4 is a Capital Improvements Plan (CIP), which is a resource that documents the irrigation needs within the Bitterroot River system and identifies the highest priority projects with associated costs, prioritization, and funding sources. The irrigation water users may use this plan to facilitate implementation of projects for infrastructure improvement. The potential projects from this study include improvements to select headgates, diversions, or flow measurement sites at 18 irrigation system intakes along the Bitterroot River.

Each site underwent comprehensive scoring using standard criteria, which results in a ranking score. By using weighted criteria, each project will be carefully considered during ranking so that the highest priority sites will have the most beneficial impact on the objectives of this Study. The fifteen highest ranking sites have been deemed “priority projects” and will proceed into hydraulic assessment and concept design. The concept design, cost estimating, and hydraulic information is assessable to irrigators to support implementation of projects.

The intent of this CIP is to provide a tool for irrigators to plan financially and methodically to improve water measurement and diversion efficiency from the Bitterroot River. This document also provides justification to funding agencies for the relative importance of the recommended improvements at the watershed scale of this Study.

This Study identified and provided additional concept design for the fifteen highest-scoring projects. The table below lists the sixteen top-priority projects. Conceptual design drawings and additional engineering details for each of the top-priority projects are provided in Appendix C of this Study.

Rank	Ditch Name	Structure
1	Union	Headgate
2	Etna	Headgate
3	Hoyt	Headgate
4	Union	Diversion
5	Etna	Diversion
6	Webfoot	Measurement
7	East Channel	Diversion
8	Spooner	Measurement
9	Gerlinger	Measurement
10	Tucker	Diversion
11	Tucker	Measurement
12	Webfoot	Headgate
13	Ward	Diversion
14	Corvallis Canal	Measurement
15	Overturf	Diversion

Bitterroot Conservation District
Bitterroot River Irrigation Management Study

CHAPTER 1 BACKGROUND INFORMATION

The Bitterroot Conservation District (BCD) is committed to supporting conservation and enhancement of soil and water resources in Ravalli County. The BCD is a collaborator with local organizations and irrigators to sustain and improve irrigation delivery in the Bitterroot Valley. In 2021, the BCD applied for and received a Renewable Resource Grant through the Montana Department of Natural Resources and Conservation to prepare this Study to identify opportunities for optimizing irrigation water delivery on the Bitterroot River. This Study involves condition assessment of irrigation structures, and for high priority sites, conceptual designs and preliminary hydraulic assessments are also included. This guidance document provides irrigators with a tool to plan future projects for improving irrigation structures and to support funding applications for any such projects.

This Study focuses on the 20 irrigation turnouts on the Bitterroot River from Painted Rocks Reservoir to Bell Crossing, and is limited to diversions, headgates, and flow measurement devices associated with these system turnouts. Over 90% of the water diverted from the Bitterroot River for irrigation occurs in this reach ; however, delivery to water users is compromised by antiquated infrastructure, river migration, impediments such as sediment and weeds, and lack of accurate flow measurement. The lack of flow measurement results in the inability to effectively manage water entitlements throughout the watershed including irrigation water rights; in-stream water rights by Montana Fish, Wildlife and Parks from Lake Como and Painted Rocks Reservoir; and purchased irrigation water from Painted Rocks Reservoir. Management of the irrigation system is further challenged during late summer when demands for all water rights are compromised by low river flows and low reservoir storage.

1.1. IRRIGATION IN THE BITTERROOT VALLEY

Irrigation water is diverted from the Bitterroot River in accordance with adjudicated water rights and through purchase of water stored in Painted Rocks Reservoir and Lake Como. Three thousand acre-feet of water stored in Lake Como is managed by Montana Fish, Wildlife and Parks (FWP) and is usually released between mid-September and mid-October to supplement late season flow in the Bitterroot River for ecological and recreational purposes. Fifteen thousand acre-feet of FWP water stored in Painted Rocks is also released during the irrigation season, usually between mid-July and mid-September. This water is used to supplement natural flow of the river to enhance aquatic habitat and improve river flow for recreational users. Release of stored FWP-controlled water must be protected from diversion into irrigation canals. This requires reliable control and accurate measurement of inflow into each canal. The

Painted Rocks Water Users Association has purchased ten thousand acre-feet of water stored in the Painted Rocks Reservoir for its irrigation members. This water is used to supplement water rights and is particularly important to junior water right holders who may not have enough water to produce an economic crop during droughts. This purchased water must be accurately controlled and measured so that the correct amount can be delivered to each purchaser.

Montana Code Annotated 85-5-302 requires functional flow measurement devices and headgates for water sources that have a lawfully appointed water commissioner. However, multiple sites in the study area either completely lack flow measurement, do not have reliable devices for flow measurement and/or do not have fully functioning headgates. Water right holders are required to demonstrate that the amount of water they receive is put to beneficial use as well as complying with other provisions of their water right such as rate and volume of water being diverted and period of use. This is monitored and documented by a water commissioner. Adequate water control and measurement and appropriate record collection and maintenance also aids water right holders in protecting against challenges from other users.

Snowpack accumulation and spring runoff in the Bitterroot and Sapphire mountains dominates the hydrology of the Bitterroot River. Approximately 55% of the annual flow is discharged during peak snowmelt in May and June. During late summer and fall, groundwater inflow is an important component of Bitterroot River flows. Management of flows throughout the irrigation season is challenging, especially during late summer flows. Late season surface water deliveries in the subject reach of the Bitterroot River are often insufficient, resulting in water supply issues to irrigators and critically low flows in the Bitterroot River that affect fish habitat. Within the subject area, twenty irrigation systems with irrigation water rights are entitled to a total of 950 cubic feet per second (cfs) during high water with actual demands up to 750 cfs. At Bell Crossing, the target baseflow rate during late irrigation season is 400 cfs. However, water commissioners tasked with monitoring river and irrigation ditch flows may set a different goal during low water years; due to water right needs and changing climate, a more realistic goal is 250-275 cfs. Effective delivery of limited water from the Bitterroot River, including released reservoir water for irrigation and aquatic benefits, is further compromised by the lack of flow measurement capabilities and inefficient irrigation headworks infrastructure.

In addition to the challenge of insufficient water to meet irrigation demands, irrigators in the Bitterroot Valley face impacts of river migration and sediment deposition near their intakes. Many irrigation systems utilize temporary earthen and river rock diversion dams, which must be re-built each year as high velocity runoff flows in the migrating river channel wash them away each spring. Irrigators can spend up to a week excavating rock from the river to create a dam and a flow path to deliver water to their headgate. In some cases, downstream water users may need to dam across the entire width of the channel to capture their water right. In other locations, channels off the mainstem Bitterroot, such as the East Channel, can be affected by river migration, and as a result may struggle to access water during late season as water levels drop. Channel migration near the East Channel Diversion has diminished the ability for lower late season flows to reach the entrance to the channel. Without flows to the East Channel, several irrigation system diversions off the East Channel and Mitchell Slough are without water. The rate of river migration in this area makes a permanent structure subject to a high risk of being rendered ineffective. The risk of the river migrating away from irrigation headgates, such that they no longer receive sufficient water, is not unique to the East Channel split and affects other systems under study as well.

Due to the differences in natural migration patterns of the river, some irrigation systems have the opposite concern, namely that their headgate and diversion structures will be damaged or swept away due to bank erosion. The river migration and sedimentation challenges presented by the overall river system dynamics will likely require solutions beyond the scale of a single structure.

1.2. PREVIOUS IRRIGATION MANAGEMENT EFFORTS

Irrigators and stakeholders have been working to improve management and supply of water throughout the valley since the first farms were established in the late 1800s. Some notable irrigation projects are described below.

In the early 1900s, numerous small dams were constructed in the Bitterroot and Sapphire Mountains to create reservoirs for storage and delivery of irrigation water. Several of these backcountry reservoirs are still maintained and used primarily for irrigation. Water from Burnt Fork Lake in the Sapphires is also used to serve the municipal needs of Stevensville.

Baseflows in the Bitterroot River are supplemented with additional flows from Painted Rocks Reservoir and Lake Como. Painted Rocks Dam was built in 1940 to provide additional irrigation water to 30,000 acres of arable land and reduce water use conflicts, as the Bitterroot's channel was depleted every summer. Lake Como is owned by the Bitter Root Irrigation District and feeds the District's main canal. Lake Como Dam was constructed in 1910 and rehabilitated in the 1990's to increase storage capacity and improve dam operations. Flows from Lake Como and Rock Creek also supplement baseflows in the Bitterroot River.

Numerous ditch companies are upgrading their headgate structures to improve quality, structural integrity, seepage, and ease of maintenance and operability. The Corvallis, Ward, and Supply ditch companies each have recently improved their headgates with hydraulic gates, debris racks, and safety features. Supply has also rebuilt its diversion structure to improve safety.

1.3. STAKEHOLDER INFORMATION

The BCD sponsored this Study for the benefit of irrigators in the Bitterroot Valley. Input from irrigators on the functionality and deficiencies of the systems was a critical component of this Study. Bitterroot River commissioners monitor all sites in the study area and can also provide invaluable information about the workings and inefficiencies of the overall irrigation network. Many organizations are dedicated to conservation on the Bitterroot and were welcomed to participate and provide feedback throughout the study process.

1.3.1. Bitterroot Conservation District

The BCD promotes conservation of resources by engaging with the public and providing resources to landowners in Ravalli County. The BCD often occupies the role of representing irrigators and landowners in the pursuance of government funding. By initiating this Study, irrigators and ditch companies will receive conceptual design and technical information to support potential future grant applications.

1.3.2. Bitterroot River Water Commissioners

The Bitterroot River water commissioners are responsible for monitoring flows in the Bitterroot River and monitoring allocated flows through irrigation turnouts. The commissioner determines if irrigation intakes align with the allocated amounts and notifies irrigators when their supply must be limited to accommodate the falling river level in the summer.

The Bitterroot River commissioners have observed damaged and worn headgates that allow water leakage. Water is wasted through canal seepage during non-irrigation season, which diverts unnecessary water from critical baseflows that need to be maintained in the River. Many turnouts do not have flow measurement as required by state law. Given the lack of measurement, irrigators and the river commissioner cannot determine the true amount of flow that is being diverted at each intake.

The water commissioners know each system on the Bitterroot well and provide valuable information for use in this Study.

1.3.3. Irrigators and Irrigation Districts

Participation from irrigators and representatives of each system is an important factor in the outcome of this Study. Once the Study is released, the information can be used to support grant funding requests for improvements to irrigation headworks. Irrigators willing to coordinate with the BCD and other stakeholders throughout this process will benefit with assessment of their infrastructure and potentially topographic survey and conceptual design of improvements for their structures. The 20 irrigation structures included in the study area are managed by many water users and ditch companies.

Three irrigator meetings occurred during the planning process and included a kickoff meeting, an open house to present system assessment findings, and an open house meeting to discuss concept designs for the priority ranked projects. A summary of the meeting content is described below.

A kickoff meeting to introduce the study to irrigators was held on November 2, 2021 at the Corvallis Fire Department. The meeting reviewed the study objectives, schedule, and expected outcomes with the group, and then provided time for individual meetings with irrigators to record their concerns with their respective intake facilities, update contact information, and discuss access to intake structures for assessment. All irrigation representatives were able to decide if they would like to participate in this Study. One ditch company, Daly Ditches, declined to participate and will not be assessed further in this Study. Plans were made to organize site meetings at each intake to conduct a condition assessment. The BCD requested that the East Channel Diversion also be assessed as a potential project.

Table 1-1: Participating Irrigation Systems

Ditch Name	Water Right (CFS / Miner's Inches)
Bill Strange	6.4 / 256
C&C	8 / 320
Corvallis	125 / 5000
East Channel Diversion	208.9 / 8356
Etna	39 / 1560
Gerlinger	12.5 / 500
Hoyt	3 / 120
Orr	12.6 / 504
Overturf	10.4 / 416
River	18 / 720
Spooner	14 / 560
Supply	202 / 8080[1]
Tiedt Nicholsen	7.8 / 312
Tucker	176 / 7040
Union	71 / 2840
Ward	132.5 / 4940 (est. capacity 30 / 1200[2])
Webfoot	40 / 1600
Woodside	50 / 2000
Woods-Parkhurst	202 / 8080[1]

The second open house format with irrigators occurred on April 25, 2022 at the Corvallis Fire Department. The meeting reviewed the condition assessment of irrigation structures and recommendations for infrastructure improvements. The format of the meeting allowed the technical team to meet with irrigators on a one-on-one basis to discuss specific findings for the site assessments and obtain any additional input the irrigators had regarding issues and functionality of the structures. This meeting also included a discussion with irrigators to query their level of engagement on pursuing a project such that the ranking process for priority projects could incorporate a criterion for stakeholder engagement. Based on this input, the technical team was able to proceed with the priority project ranking process.

---

[1] Supply Ditch and Woods-Parkhurst ditch share a diversion and intake structure; therefore, they are considered one linked system for the purposes of this study.

[2] While the Ward water right is reported to be 132.5 cfs, the ditch's maximum capacity is estimated at approximately 30 cfs. Accordingly, 30 cfs was used to calculate the influence score and project ranking.

A final irrigator open house meeting occurred on October 24, 2022, also at the Corvallis Fire Department. This meeting focused on priority project concept designs. Irrigators provided input on the concept designs for the technical team to incorporate into the final report.

1.3.4. Other Parties

Numerous organizations, including Bitter Root Water Forum, Trout Unlimited, Clark Fork Coalition, and others have expressed interest is this study and the resulting data.

1.4. APPLICABLE STATUTES, RULES, REGULATIONS, AND STANDARDS

Because the Bitterroot River has an appointed water commissioner, water users are required to follow applicable codes under Montana Code Annotated Title 85, Water Use. In particular, MCA 85-5-302, Maintenance of Headgates and Measuring Devices, reads as follows:

> *All persons using water from any stream or ditch for which a water commissioner is appointed are required to have suitable headgates at the point where a ditch taps a stream and shall also, at some suitable place on the ditch and as near the head as practicable, place and maintain a proper measuring box, weir, or other appliance for the measurement of the waters flowing in the ditch. If a person fails to place or maintain a proper measuring appliance, it is the duty of the water commissioner not to apportion or distribute any water through the ditch. The commissioner shall notify all parties interested by certified mail or in person 1 week before making the annual repair or cleaning of a stream or ditch or performing necessary labor or expenses to divert water to a ditch. The sending of a certified letter to the last-known post-office address of any interested party is prima facie evidence of the fact that the party was duly notified. Any work in the way of repairing a ditch made necessary by an emergency may "be done without notice when injury would result from a delay."*

With improvements in flow measurement, headgates, and diversions, it can be ensured that the allocated amount of surface water is being diverted from the Bitterroot River. This will benefit aquatic habitat, downstream water users, and surface water conservation.

1.4.1. Resources

The following reference materials can be utilized by irrigators, organizations, or other stakeholders seeking more information on irrigation in the Bitterroot Valley.

Ravalli County Water Resources Survey, 1958

This survey, completed in 1958 by the State of Montana, outlines history of land and water use, irrigated lands, and water rights in Ravalli County. Information on water sources and irrigation companies are also included.

Irrigation in Montana – Program Overview and Economic Analysis, 2008

This report was prepared by a consultant for the Montana Department of Natural Resources and Conservation (DNRC). It explores the relationship between irrigated agriculture and Montana's economy. A case study on the Bitterroot Valley is included.

Historic Legacies, Current Challenges, and an Unknown Future, 2020

This interactive story map, prepared by a University of Montana graduate student, explores irrigation in the Bitterroot Valley and the various challenges it may face regarding future changes such as rising temperatures, drought, and snowpack decline.

Bitterroot Watershed Restoration Plan, 2020

This Watershed Restoration Plan, prepared by the Bitter Root Water Forum, was guided by the U.S. Environmental Protection Agency (EPA) and Montana Department of Environmental Quality (DEQ) standards to assess water quality and nonpoint source pollution on the Bitterroot.

Montana Code Annotated, Title 85

Title 85, "Water Use", of the Montana State Code contains the fundamentals of Montana's water right system.

1.5. FINANCIAL ASSISTANCE PROGRAMS

Opportunities for financial assistance for design and construction of irrigation improvement projects are outlined in this section. These opportunities often require upfront effort to prepare an application and a cost share from the applicant. Irrigators are encouraged to use the results of this study as supporting information during their pursuit of funding. Each program has different deadlines, cost share requirements, and eligibility requirements. Irrigators should be available for cooperation and anticipate a lengthy planning period to assess eligibility, prepare an application, and allow agency review before a grant is awarded.

Irrigation Development Grant Program (IDG)

This Montana DNRC grant program provides funding for irrigation projects that increase or sustain irrigated agriculture in Montana and display water conservation or measurement efforts. Awards to eligible public or private entities typically do not exceed $20,000. Application cycles are ongoing.

Renewable Resource Grant and Loan Program (RRGL)

This Montana DNRC grant program funds projects that conserve, manage, develop, or protect Montana's renewable resources. Applicants must be a government entity such as an incorporated city or town, conservation district, or irrigation district. Awards are limited to $125,000 per project. Applications are due on May 15th of even-numbered years.

Renewable Resource Grants to Private Entities

This Montana DNRC grant program is applicable for any individual, association, partnership, or corporation seeking financial assistance for a project that promotes the objectives of the RRGL program. Awards are limited to 25% of the project cost, up to $5,000, and are awarded on a first come-first served basis as funding allows.

Renewable Resource Loans to Private Entities

This Montana DNRC grant program is applicable for any individual, association, partnership, or corporation seeking financial assistance for a project that promotes the objectives of the RRGL program. Funds must be used for private water development projects. Loan amounts cannot exceed the lesser of $400,000 or 80% of the fair market value of the security given for the project. Loans application cycles are ongoing and based on available funding.

Renewable Resource Project Planning Grant Program

This Montana DNRC grant program provides financial assistance to governmental entities preparing RRGL applications or Capital Improvements Plans. Funds can be used to hire a technical consultant to produce or update a Technical Narrative meeting the Step 4 Requirements of the RRGL program application. Awards are limited to $15,000 per new RRGL Step 4 Technical Narrative; $8,000 per existing Step 4 Technical Narrative Update; or $8,000 per Capital Improvement Plan, Growth Plan, or other management tool that may lead to an RRGL grant application. Application cycles are updated quarterly.

Future Fisheries Improvement Program Grants (FFI)

This Montana FWP grant program provides funding to projects that restore essential habitats for the growth of wild fish populations in lakes, rivers, and streams. Any entity with a project that benefits wild fish is eligible to apply. Funds can be used for design, construction, and maintenance of the project. Matching funds are not required but make an application more competitive. There is no maximum award, but the grant amount is based on available funding. Applications are accepted in summer and winter cycles, due May 15 or November 15 each year.

WaterSMART Water and Energy Efficiency Grants

This U.S. Bureau of Reclamation (USBR) grant program provides funding for states, tribes, irrigation districts, and organizations with water delivery authority. Projects must seek to conserve and use water more efficiently, mitigate conflict risk in areas at a high risk of future water conflict, and accomplish other benefits that contribute to water supply. Awards vary based on available funding. Projects are separated into funding categories based on size and length of project. Applicants must provide at least 50% match from non-Federal sources. Applications are accepted annually.

WaterSMART Small-Scale Water Efficiency Grants

This USBR grant program provides funding for states, tribes, irrigation districts, and organizations with water delivery authority. Applicable projects include canal lining or piping, metering, irrigation flow measurement, SCADA, and other projects similar in scope. Projects may be eligible for up to 50% Federal funding. Applications are accepted annually.

WaterSMART Drought Resiliency Grants

Through the Drought Response Program, USBR provides funding for drought resiliency projects that increase water supply reliability, improve water management, and provide benefits for fish, wildlife, and the environment. Projects may be eligible for up to 50% Federal funding awards are based on available funding and applications are reviewed annually.

WaterSMART Environmental Water Resources Projects

This USBR grant program awards funding to support projects focused on environmental benefits and that have been developed as part of a collaborative process to help carry out an established strategy to increase the reliability of water resources. Projects may be eligible for up to 75% Federal funding. Eligible projects include water conservation and efficiency projects that result in quantifiable and sustained water savings and benefit ecological values; water management or infrastructure improvements to mitigate drought-related impacts to ecological values: and watershed management or restoration projects benefitting ecological values that have a nexus to water resources or water resources management. States, tribes, irrigation districts, and state, regional or local authorities with water delivery authority are eligible to apply. Applications are reviewed annually.

HB 223 Grant Program

This Montana DNRC grant program provides funding for any project sponsored by a Montana conservation district under the authority of House Bill 223. Awards for on the ground projects are limited to $20,000 with a 50:50 cash match from the landowner(s) or other beneficiaries such as an irrigation district or ditch company. Applications are accepted quarterly.

Irrigation Competitive Grant Program – American Rescue Plan Act (ARPA)

This grant program provides funding for agricultural irrigation projects that aim to improve existing irrigation infrastructure and provide a water quality benefit. State and local governments, including irrigation districts, conservation districts, and water users' associations, are eligible to apply. Projects are ranked on a point-system, with the max amount of cost-share points being a 50:50 match. Application cycles and awards are based on available funds.

Environmental Quality Incentives Program (EQIP)

This Natural Resources Conservation Service (NRCS) grant program provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits such as conservation of ground and surface water. The grant may award up to 75% cost share, with historically underserved producers eligible for 90% cost share. Application cycles are on-going.

Bitterroot Conservation District Cost-Share Program

The BCD sets aside $20,000 per year to fund projects in Ravalli County. Eligible projects must enhance or benefit natural resources on private land. Awards will fund 70% of the total cost, up to $7,000. Applications are due on September 1st of each year.

Bitterroot Conservation District
Bitterroot River Irrigation Management Study

CHAPTER 2 SYSTEM INVENTORY AND ASSESSMENT

This chapter summarizes the structure inventory and condition assessment for irrigation structures within the Bitterroot River Irrigation Management Study extents. The assessment includes 20 irrigation systems along the Bitterroot River and generally includes the irrigation system headgate intake structure, diversion, and flow measurement structure. In total, approximately 60 structures at the 20 irrigation system interfaces with the Bitterroot River were assessed – see Section 2.1. Some irrigation systems lacked infrastructure such as flow measurement and/or a structure associated with a diversion. In those cases, the condition assessment noted the lack of infrastructure or the alternative means for delivering water.

A condition assessment is an inventory of irrigation structures with technical review of the condition and functionality of the structures. This condition assessment of headgates, diversions, and flow measurement devices was conducted in fall of 2021 by a team of technical staff. For most site visits, an irrigation system representative attended the condition assessment and offered input on operational and functional challenges associated with the irrigation structures. Each irrigation structure was evaluated using a standardized assessment form. The completed assessment forms are included in Appendix C. The assessment form includes the following information:

- Site Information: This information includes irrigation turnout site name and water source. Water sources include the Bitterroot River or defined locations within the Bitterroot River system such as the West Fork of the Bitterroot River, East Channel, or Mitchell Slough. Other relevant information including date of assessment, assessor, and participation by the irrigator(s) was also collected.

- Structure type: The structure type such as headgate, flow measurement and diversion are noted in this section. Additional detail was identified including specific structure type for headgates such as slide gate, stop logs, or other; flow measurement type such as flume, weir or staff gage; and diversion type such as in-stream dam, pipe/culvert, ditch or other.

- Material: Material type was identified to describe the components of the irrigation structures including wood, metal, concrete, earth, or other. In many cases, the material type was a combination of several materials. In many instances, a written description of the materials is provided to detail the considerations unique to each.

- Condition: The condition of the structure was assessed in the field as poor, fair or good. The condition assessment is based on apparent deficiencies, structure impairments, and input from the irrigators. A reconciliation meeting with the project team including all site assessors and the team lead occurred to collectively review and compare condition ratings between assessors and sites to ensure consistency with condition ratings. In addition, rating guidance was established and incorporated into the condition rating. This guidance, defined in Section 2.2 – Condition Assessment Approach, provides a framework for how condition rating was established. Ultimately, condition ratings of good, fair, or poor were assigned and the condition assessment forms were modified to reflect the reconciled ratings.

- System impairments: System impairments were noted based on evidence of a site condition that may negatively affect performance of the irrigation structure, such as the ability to convey or measure irrigation water. Examples of impairment include:

    - Erosion: Erosion in and around structural components may affect the stability of the structure. Evidence of disturbed ground or undermining of structures was noted.
    - Sediment: Sediment can impede flow and affect water delivery, flow measurement, and create disruptive operational issues.
    - Age/wear: The age and wear of a structure affects long term stability and may be a result of the structure being past its intended design life.
    - Vegetation: Vegetative growth could lead to flow impediments.
    - Debris: Debris also can impede flow or affect headgate operations. The presence of debris in and around the structures was noted.
    - Leaking: Impairment due to leaking, generally arising from headgates with a poor seal.
    - Control: Impairments to the ability to control water such as leaking (typically due to headgates with a poor seal), broken stop logs, or damaged/inadequate headgate actuators.
    - Structural: Structural impairments such as severely cracked, spalled, or eroded concrete create the potential for failure of a structure and complete loss of the ability to manage water.

- Safety considerations: The ability for an irrigator to safely access structures and manage flow was noted. Safety hazards include the necessity to enter a waterway for the placement of stop logs or diversion materials, the condition of walkways used to access the structure, and the presence of handrails, trip hazards, and other factors affecting safety and accessibility.

- Observations: Any miscellaneous observations and information from irrigators were captured in this section.

- Site and Dimensions: For most sites, a simple sketch with key dimensions was provided. Photographs of the structures were collected and organized into Appendix B.

2.1. BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY EXTENTS

The study area covers approximately 60 miles of the main stem and West Fork of the Bitterroot River, stretching from Painted Rocks Reservoir to Bell Crossing. In addition, the naturally occurring river diversion into the East Channel of the Bitterroot, which serves three irrigation systems, is also identified as a critical location impacting irrigation delivery and was included in the assessment of priority projects. Of the 20 diversion locations identified in the scope, three were not included because the owner of these sites, Daly Ditches Irrigation District (DDID), declined to participate in this Study. The three DDID intake facilities of Hedge, Rennaker, and Republican were therefore not assessed in this report and were not included in the ranking to determining priority projects. Maps of each site are available in Appendix A.

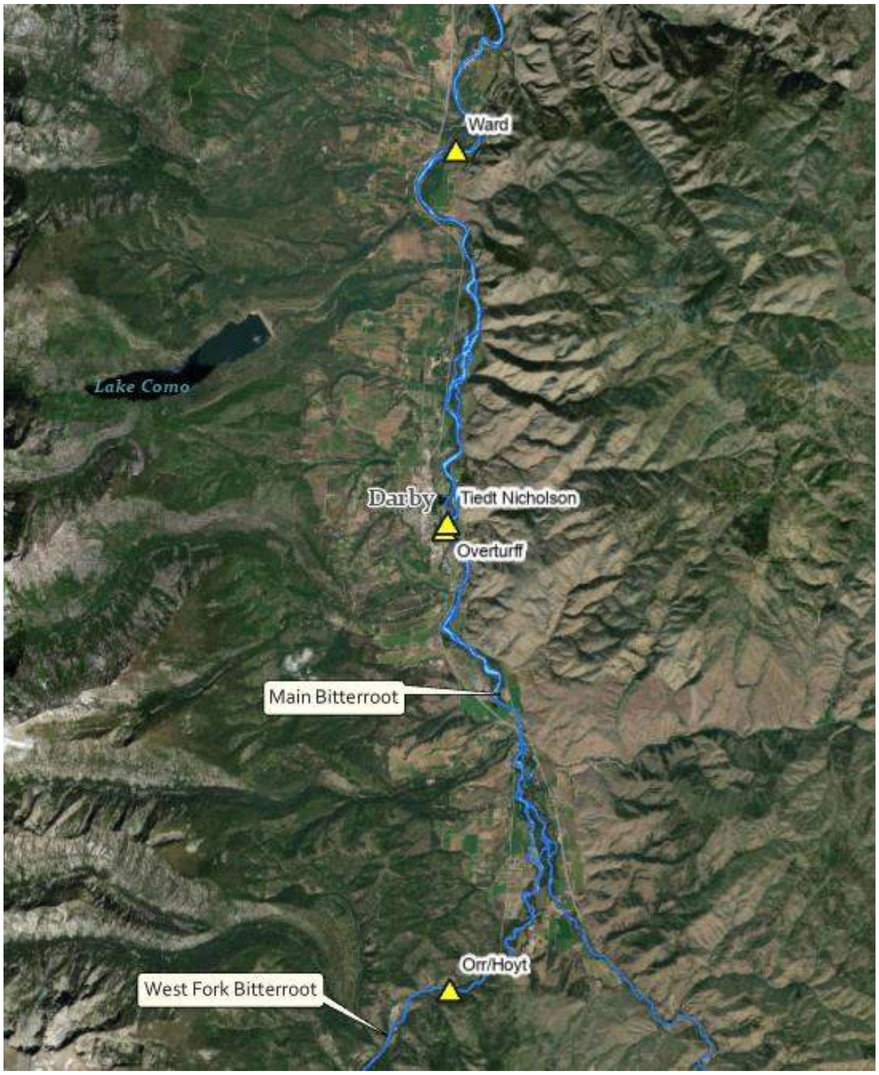


Figure 1: Intake Locations South of Hamilton

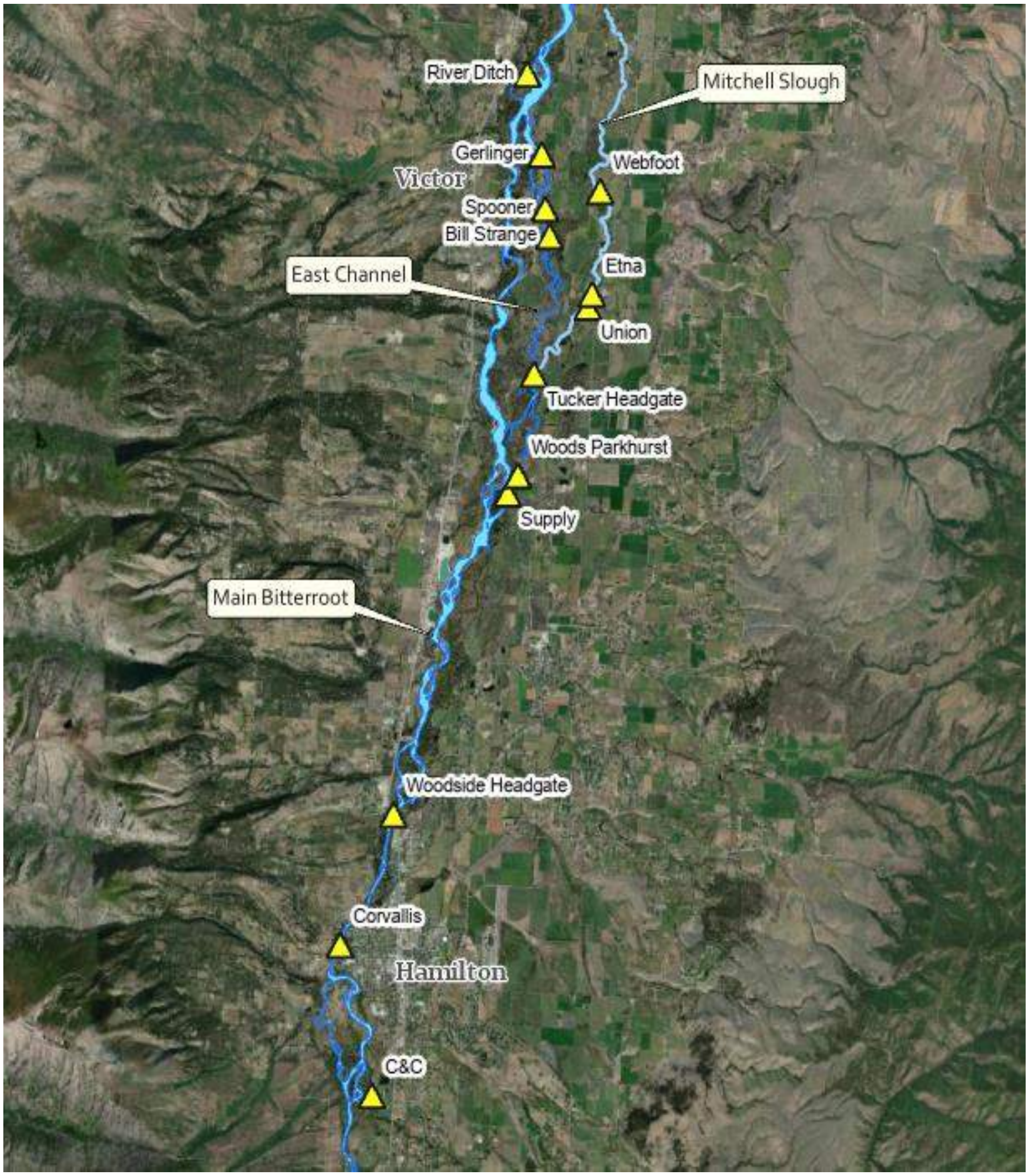


Figure 2: Intake Locations North of Hamilton

2.2. CONDITION ASSESSMENT APPROACH

Engineers from Morrison-Maierle met with stakeholders to assess structures at each intake. Field visits occurred November 9-10th, 2021 and included conversations on operability, water delivery and condition which were recorded on the field forms included in Appendix C. These forms were later reconciled by the engineering team to ensure that each rating was accurate, that guidance was consistently applied, and to include more detailed data where available.

Each diversion, headgate, and measurement device has been inspected and given a condition rating of “Poor,” “Fair” or “Good.” Guidance used in determining these categories is detailed below.

2.2.1. Diversions

Diversions analyzed in this study are the physical structures that divert water from the source to the associated headgate. It is important to note that this may differ from point of diversion for water rights, where water is first diverted from the source. Diversions were assigned a condition rating based on the following guidance:

Table 2-1: Diversion Condition Assignment Parameters

Good	Fair	Poor
Permanent structure diverting sufficient irrigation water	Concrete blocks or native material dams constructed annually	Structure decayed, lack of structural integrity
Does not require annual excavation or reconstruction	Structure requiring operator to enter water to install stop logs	Early season flows are insufficient for system
	Late season flows are insufficient for system	

2.2.2 Headgates

Headgates were assigned a condition rating based on the following guidance:

Table 2-2: Headgate Condition Assignment Parameters

Good	Fair	Poor
Constructed within past 10 years or no apparent deficiencies	Erosion, scour, or overtopping around structure	No ability to control flow
Functional gates with minimal leakage	Utilizes stop logs to control flow	Concrete structure decayed, lack of structural integrity
	Deteriorating concrete structure	Severe Leakage
	Moderate Leakage	

2.2.2. Measurement Devices

Measurement Devices were assigned a condition rating based on the following guidance:

Table 2-3: Measurement Condition Assignment Parameters

Good	Fair	Poor
Accurate measurement	mounted on or very close to a hydraulic structure	No measurement
Staff gage located in hardened channel section	Gage location upstream of headgate or too far downstream	Measurement location not isolated to source water
Functional Flume	Damaged Flume	Excessive vegetation and/or sedimentation around gage

Good	Fair	Poor
	Gage in vegetated, non-uniform channel section	

2.3. CONDITION ASSESSMENT FINDINGS

The condition assessment findings are summarized in this section. The findings are alphabetically organized by irrigation system name with subheadings for headgate, flow measurement, and diversion dam, such that each irrigation system includes three assessment subcomponents. The condition assessment rating is noted in the title of each subheading.

2.3.1. Bill Strange

The Bill Strange intake diverts water from the East Channel of the Bitterroot River near Victor, Montana. This is a private headworks that serves one water user.

Headgate - Good Condition

The Bill Strange headgate is comprised of two wood paneled slide gates that are lowered on cables by hand. The wood at the structure shows signs of weathering and could be replaced eventually but is currently in good overall condition. There are metal beams supporting the connected wood panels. The base of the structure has wood panels that show some erosion and allowed water to flow underneath. There is a wood board walkway across the ditch that presents opportunity for improvements and a handrail could be installed to improve safety.

Figure 3: Bill Strange Headgate

Flow Measurement - Fair Condition

There is a staff gage at the headgate structure. Because flow is non-uniform through the structure, the accuracy of any associated stage-discharge calibration curve is questionable. Because channel geometry near the staff gage may change over time, it is recommended that the calibration curve be periodically checked for accuracy.

Figure 4: Bill Strange Measurement Gage

Diversion - Good Condition

The Bill Strange Diversion consists of a w-weir on the East Channel of the Bitterroot built of large rocks, approximately four feet in diameter. There is only one irrigator served by the Bill Strange system and they reported these rocks settling about 2-3 feet over the lifetime of the structure, which is estimated to be nearing 25 years. The diversion works well and provides adequate flow to the ditch.

Figure 5: Bill Strange Diversion

2.3.2. C&C

The C&C Ditch Company diverts water at this headworks on Skalkaho Creek south of Hamilton, Montana. The C&C users and operators that met the Morrison-Maierle team at the site noted that there are significant structural issues with their underground pipe that passes undeveloped areas in the town of Hamilton. Their outlook for this portion of the system was that this pipe could fail imminently, resulting in complete loss of the ability to deliver water. While this portion of the infrastructure is outside the scope of this study, it is important to note given the potential urgency of the problem.

Headgate – Good Condition

The C&C headgate structure utilizes a single metal slide gate with a handwheel that opens to a 48-inch squash culvert. Operators of the site reported that the gate lifts a maximum of 3 inches which provides sufficient flow through the ditch throughout the irrigation season. There is also a secondary gate downstream of the ditch that they use to regulate flow. Some overflowing occurs over the headgate during high water events.

Figure 6: C&C Headgate

Flow Measurement - Poor Condition

There is a staff gage approximately 100 feet downstream of the headgate in the channel. There was notable buildup of vegetation and debris along this section of ditch that would lead to variability in the cross section from year to year and limit the accuracy of any stage-discharge calibration curve.

Figure 7: C&C Measurement Gage

Diversion - Fair Condition

The diversion from Skalkaho Creek consists of a 3-foot-tall concrete wall spanning the full width of the creek. The manager reports issues with high water transporting debris and clogging the creek. Areas of the bank at the edges of the wall washed out early in the life of the diversion (several decades ago) but have not eroded further and are currently stable.

Figure 8: C&C Diversion

2.3.3. Corvallis

The Corvallis intake serves members of the Corvallis Canal & Water Co. It diverts water from the Main Channel of the Bitterroot River west of Hamilton, Montana.

Headgate - Good Condition

The Corvallis headgate was updated within the past 10 years and is in good condition. The structure utilizes two metal slide gates with electrically powered hydraulic actuators. The concrete headwall and wing wall extending to the north appear to be in good condition. The northern gate is leaking when fully shut due to deterioration of the concrete floor slab which prevents the gate from making a tight seal. The system irrigator that joined the site visit, Darrell Sperry, indicated that the concrete was installed in the 1960’s and the floor could be replaced to prevent water from passing through the gates when closed. The structure has a trash rack that collects debris during high water and must be cleaned out. The site is secured with a locked chain-linked fence and signs to prevent trespassing.

Figure 9: Corvallis Headgate

Flow Measurement – Fair Condition

The primary flow measurement consists of a staff gage with a calibration curve located on a bridge approximately 1,200 feet downgradient of the headgate. This staff gage is enabled with a camera that sends pictures to managers so they can check the water level remotely. There is also a staff gage on the backside of the headgate structure. Because both staff gages are located at locations where flow is not uniform, so accuracy of any calibration curve is questionable.

Figure 10: Corvallis Measurement Gage

Diversion - Good Condition

There is an in-stream rock check on the left side of the river and a concrete slab along the right that divert water from the main Bitterroot River through the Corvallis headgate with good ability to regulate water level. The concrete slab includes recessed locations in which to place steel pipes. Stop logs can then be secured against the pipes to raise the water level as needed throughout the irrigation season. While this system provides for effective and flexible water level regulation, it requires operators work within the channel to place the diversion throughout the season, which presents a safety hazard. Additionally, the pipe recesses in the slab can gather sediment, requiring cleaning before the pipes and stop logs can be placed. The operator of the site reported that the large rocks (approximately 3-4 feet in diameter) that constitute the rock check occasionally wash downstream and equipment is required to move the rocks back to the front of the dam every 2 to 3 years.

Figure 11: Corvallis Diversion

2.3.4. East Channel

Due to the continually migrating nature of the Bitterroot River, the East Channel of the Bitterroot River typically receives insufficient water late in the irrigation season to serve its numerous irrigation water right entitlements. The Mitchell Slough receives water from the East Channel at the Tucker Diversion. The Mitchell Slough also serves the Etna, Union, and Webfoot irrigation diversions and the East Channel serves the Bill Strange, Spooner, and Gerlinger irrigation diversions downstream of the Tucker Headgate.

The East Channel Diversion does not include a headgate or measurement device but is being assessed in this Study as a potential project given its significant impact on other systems.

Diversion – Poor Condition

During low flow in the Bitterroot River, particularly late in the irrigation season, maintaining sufficient flows in the East Channel is challenging. The current strategy, as reflected in the Etna, Union, and Webfoot Ditch Company's 310 permit, is to build a temporary check structure of native cobbles and gravel on the east side of the main channel. While early season high flows are typically sufficient for irrigation needs, these flows contribute to sedimentation in the East Channel that creates challenges for maintaining sufficient flows in the late season.

Figure 12: East Channel Diversion

2.3.5. Etna

Etna Ditch Company diverts water from the Mitchell Slough near Victor, Montana. Mitchell Slough is sourced from the East Channel Bitterroot and begins at Tucker Headgate.

Headgate - Poor Condition

The Etna headgate is a concrete structure with three wood slide gates that are adjusted by hand. The concrete is deteriorating and needs to be replaced. Debris and vegetation often build up at the headgate and require maintenance to prevent blockage at the inlet. The walkway is comprised of wood boards that are weathered and could be replaced. Installing a handrail would improve safety at the headgate.

Figure 13: Etna Headgate

Flow Measurement - Fair Condition

Flow measurement consists of a staff gage approximately 50 feet downstream of the headgate structure in a natural-bottom channel with irregular cross section. Because of the potential variability in the cross section from year to year due to sedimentation, erosion, and vegetation, the accuracy of any calibration curve is questionable.

Figure 14: Etna Measurement Gage in Channel

Diversion - Poor Condition

The Etna diversion from Mitchell Slough is a concrete check-dam with wooden stop logs. The dam has four concrete gate openings and stop logs are installed manually by hand in the spring and pulled out in the winter. Once the logs are in place there are no further flow adjustments that can be made, as it becomes very difficult to move them with the pressure of flow against them. Several of the concrete walls that separate the gate openings are failing on the downstream side, with significant loss of concrete at the bottom of the downstream end of several of the walls. The middle walls are missing up to 12 to 24 inches of concrete but have been augmented with steel plates grouted to either side of the wall, as shown in Figure . There is also some evidence of erosion of the embankment on the downstream right side of the structure. Given the ongoing failure of concrete at the structure and potential for further erosion, the structure is unstable and should be replaced. Wood boards are laid across the top of the check dam to allow crossing and there is no handrail, which creates a safety hazard.

Figure 15: Etna Diversion

Figure 16: Concrete Loss at Etna Diversion

2.3.6. Gerlinger

The Gerlinger Ditch diverts water from the East Channel of the Bitterroot River. This intake is the most downstream facility on the East Channel.

Headgate - Fair Condition

The Gerlinger headgate is a corrugated steel squash culvert that utilizes wood stop logs to manage flow. The stop logs are inserted into metal channels that are welded to the face of a metal headwall. The wood planks are manually installed and removed by hand each year. The manager at the site claims this system works well.

Figure 17: Gerlinger Headgate Inlet

Flow Measurement – None

There is no flow measurement device at this site.

Diversion – Good Condition

Concrete eco-blocks are installed and removed in the East Channel of the Bitterroot each year, using an excavator, to ensure flow through the headgate. A total of 28 eco-blocks are stored at the site. The eco-blocks extend off a rock point bar into the East Channel.

Figure 18: Gerlinger Diversion

2.3.7. Hoyt

The Hoyt Ditch diverts water from the Orr/Hoyt canal, which is itself diverted from the West Fork Bitterroot River near Conner, Montana. The Orr/Hoyt diversion functionality and measurement are important to the overall system because it is the first irrigation diversion on the river after Painted Rocks Dam.

Headgate – Poor Condition

There is a wooden structure serving as the Hoyt headgate that appears to have no currently functioning mechanism for control. The wood is rotting, warped, and will need to be replaced. There is a significant amount of debris and vegetation built up at the headgate and will require maintenance to prevent blockage at the inlet.

Figure 19: Hoyt Headgate Structure

Flow Measurement - None

There is no flow measurement device at this site.

Diversion - Good Condition

There is a 2-foot concrete check and twelve eco-blocks, stacked two high and six across, diverting water from the Orr/Hoyt channel into the Hoyt headgate. There is an additional check structure to divert water into the Hoyt headgate. There is a significant amount of debris and large boulders upstream of the Hoyt check structure. This headgate is sensitive to water releases from Painted Rocks Reservoir due to measurable changes in water elevation against the headgate. This requires coordination of gate adjustments with changes in releases from the reservoir since the ditch has not purchased Painted Rocks water.

Figure 20: Hoyt Diversion

2.3.8. Orr

The Orr Ditch diverts water from the Orr/Hoyt canal, which is itself diverted from the West Fork Bitterroot River near Conner, Montana.

Headgate – Good Condition

Orr headgate is a concrete structure with two handwheel-actuated, metal slide gates that open to two 35 x 24-inch corrugated pipe arches. The concrete structure, headgates, and actuators appear to all be relatively new and in good condition. The pipes are somewhat rusted, but the corrosion appears to have only affected the surface and the pipes do not display degradation of their structural integrity. The slide gates were completely shut and, while there was ponded water on both sides of the gates, there was no flow, indicating there is minimal to no leakage of gates. There was some sediment deposited in the culverts. There is an angled trash rack constructed of round metal bars in front of the slide gates.

Figure 21: Orr Headgate

Flow Measurement – Fair Condition

The measurement gage for the Orr system consists of a staff gage in a wooden flume within a few hundred feet of the headgate.

Figure 22: Orr Measurement Gage

Diversion – Good Condition

The first diversion in the Orr/Hoyt system consists of a channel excavated from native materials on the east bank of the West Fork. System operators indicated there were no issues getting sufficient water into this channel through the irrigation season. The channel runs 500-600 feet downstream to the Orr headgate, where there is a concrete check structure that helps control how much of the diverted water enters the Orr headgate versus how much flows past to the Hoyt headgate and back to the river. The check structure consists of a 2-foot concrete wall and twelve eco-blocks, stacked two high and six across, diverting water from the West Fork to the Orr headgate and Hoyt structure. There is a significant amount of debris and large boulders past the diversion on the Hoyt side.

Figure 23: Orr/Hoyt River Diversion

Figure 24: Orr Headgate Diversion

2.3.9. Overturf

The Overturf Ditch Company diverts water from the main stem of the Bitterroot River east of Darby, Montana.

Headgate – Good Condition

The headgate structure consists of a concrete headwall and wingwalls in good condition with metal slide gate opening to a corrugated steel 58 x 36-inch pipe arch. There is evidence of sediment buildup at the outlet of the culvert. While there is standing water on the ditch side of the headgate, there appeared to be no flow, indicating minimal to no leakage.

Figure 25: Overturf Headgate

Flow Measurement - Fair Condition

There is a staff gage located at the entrance of wood box culvert a quarter mile downstream of headgate. The box culvert is approximately 3 feet deep, 5 feet wide, and 60 feet long. Because the staff gage is at the entrance of a box culvert and immediately after 90-degree bend to the west, flow is not uniform at the location and the accuracy of any calibration curve is questionable. There is also a handmade measuring device that is PVC pipe with a black line at 14 inches and a red line at 18 inches. If the water level is at or below the 14-inch mark, the last water user does not receive water. If the water level is above the 18-inch mark, portions of the ditch will overtop.

Figure 26: Overturf Measurement Gage

Diversion - Fair Condition

Four concrete dividers are placed each year, extending into the main channel of the Bitterroot River and are reinforced with many large, 4-foot diameter boulders. Getting water to flow into the Overturf ditch is a challenge every year and they have trouble getting water to the irrigator at the end of the ditch.

Figure 27: Overturf Diversion

2.3.10. River

River Ditch diverts water from the West Channel of the Bitterroot River, just upstream of Bell Crossing. This diversion is located on the downstream end of the study extents.

Headgate – Good Condition

The River Ditch headgate is a wood structure that was rebuilt within the past 10 years and remains in good condition. The structure is comprised of three wood slide gates actuated by handwheels. There is a wood walkway across the channel that is in good condition. A handrail could be installed at the headgate to improve safety.

Figure 28: River Ditch Headgate and Staff Gage

Flow Measurement - Fair Condition

Flow measurement on the River Ditch consists of a staff gage on the downstream side of the headgate structure with a calibrated stage-flow curve for the structure cross section. There is often severe vegetation growth that can inhibit accurate measurement. The River Ditch operator indicated that the calibration curve was last updated in 2018. Because the staff gage and calibration location occur at the downstream side of the headgates, flow is not uniform. Flow measurements at this location are therefore likely to be inaccurate.

Diversion - Fair Condition

The main issue at this location is getting enough water routed via the first diversion into the West Channel from the main Bitterroot River. The manager of the site said that he walks a rubber tire backhoe about a mile up the West Channel each year to rebuild the river rock bar diversion at the Main Channel to ensure adequate flow to the West Channel. A second diversion near the headgate consists of temporary dam that is built across the West Channel of the Bitterroot River with a fish passage cut out. Both diversions are considered to be in fair condition and will be ranked together as one linked system.

Figure 29: West Channel River Ditch Diversion

Figure 30: Main Bitterroot River Ditch Diversion

2.3.11. Spooner

The Spooner Ditch diverts water from the East Channel of the Bitterroot River just upstream of Victor Crossing.

Headgate - Fair Condition

The Spooner headgate is a wood structure with a concrete slab under the gates. Wood stop logs are installed by hand each year to manage flow through the ditch. The walkway consists of weathered wood planks that are secured to the rest of the structure. A handrail across the crossing would improve safety. Tires are stacked at each corner of the headgate to help prevent erosion of the embankment. Sediment and debris buildup are also concerns at this site. Water users on the Spooner Ditch indicate that the east bank that separates the East Channel from the Spooner Ditch has eroded significantly over recent years. If the erosion continues, the head gate structure could be at risk from undermining and failure.

Figure 31: Spooner Headgate

Flow Measurement – None

There is no flow measurement device at the site.

Diversion - Fair Condition

Two concrete eco-blocks, approximately two feet tall and wide by six feet long, are left extending into the East Channel of the Bitterroot River from the east bank throughout the year. Metal stands are placed across East Channel each year with a tractor and then stabilized by burying the downstream base with gravel. Stop logs are then placed in the metal stands to form a temporary check structure to increase the water level as needed throughout the irrigation season.

Figure 32: Spooner Diversion

2.3.12. Supply/Woods Parkhurst

The Supply/Woods Parkhurst Intake diverts water from the main stem of the Bitterroot River just upstream of the East Channel Diversion. The Supply Ditch is the water source for the Woods-Parkhurst intake.

Headgate – Good Condition

The Woods Parkhurst/Supply headgate is a concrete structure with hydraulically operated metal slide gates. The structure and gates were constructed in 2017. There are no reported issues with the operation of these gates. Operators have stated that they have issues with large sticks and debris getting trapped in and against the trash grate requiring someone to remove debris 5-6 times per year.

Figure 33: Supply/Woods Parkhurst Headgate

Measurement – Fair Condition

A staff gage is located approximately 100 feet downstream of the headgate in a fairly uniform channel section. The gage is mounted on a steel pipe. There was a small amount of vegetation caught against the gage when viewed during the site visit.

Figure 34: Supply/Woods Parkhurst Measurement Gage

Diversion – Good Condition

The Woods Parkhurst/Supply Diversion Dam is located on the eastern-most braid of a highly braided section of the Bitterroot River and delivers water to both Supply and Wood-Parkhurst ditches. The dam is in overall good condition and significant structural improvements were made in 2017.

Figure 35: Supply/Woods Parkhurst Diversion

2.3.13. Tiedt-Nicholsen

The Tiedt-Nicholsen Ditch diverts water on the main stem of the Bitterroot River east of Darby, Montana.

Headgate – Good Condition

The Tiedt-Nicholsen headgate is a concrete structure with a single metal slide gate that is adjusted with a handwheel. The slide gate opens to a 44 x 26-inch corrugated arch pipe. The stem on the handwheel to the slide gate is bent but still works. The manager at the site reported that they get excess water from Bunkhouse and Overturf and don’t need to open this headgate until about mid-July.

Figure 36: Tiedt-Nicholsen Headgate

Flow Measurement - Fair Condition

There is an old steel measurement flume downstream of the headgate.

Figure 37: Tiedt-Nicholsen Metal Flume

Diversion - Good Condition

Three to four-foot diameter boulders have been placed to form a small jetty that diverts water from the main Bitterroot River channel to the Tiedt-Nicholsen ditch. Operators stated that diverting water from the river is not usually an issue but there are concerns about the main channel of the river migrating to the east.

Figure 38: Tiedt-Nicholsen Diversion

2.3.14. Tucker

The Tucker intake diverts water from the East Channel of the Bitterroot into the Mitchell Slough. It is the first diversion on the East Channel.

Headgate – Good Condition

The Tucker headgate is a concrete structure with steel wrapping the concrete walls and five wood slide gates with steel guides and metal rings used to manually hook and lift the gates. The structure has a concrete slab base.

Figure 39: Tucker Headgate

Flow Measurement - Fair Condition

There is a staff gage on the downstream side of the headgate at the structure and another gage downstream of the structure in a natural-bottom, irregular cross section. Because flow is not uniform at the gates and because the downstream cross section is subject to change, the accuracy of any calibration curve at either location is questionable.

Figure 40: Tucker Measurement Gage

Diversion - Fair Condition

Concrete eco-blocks are installed each spring to divert water from the East Channel towards Tucker headgate. Gravel is then used to fill in the gaps between eco-blocks. This installation and removal process costs approximately $3,000 each year but is still limited in its effectiveness depending on the water level of the East Channel. Sediment buildup at the inlet of the gates is an issue and often requires dredging with heavy equipment to keep water flowing through the ditch. Lining the eco-blocks with a tarp and then placing the gravel could enhance the functionality.

Figure 41: Tucker Diversion

2.3.15. Union

The Union Ditch Company diverts water from the Mitchell Slough near Victor, Montana. The Mitchell Slough is sourced from the East Channel of the Bitterroot and begins at Tucker Headgate.

Headgate – Poor Condition

The Union headgate is a concrete and wood structure that is outdated. The concrete has cracks, signs of weathering and the concrete floor and footers are deteriorating. There are two wood slide gates, approximately 5 feet wide, and the gates must be adjusted by hand. The wood walkway planks and slide gates are rotting and splintered, and there is no handrail, presenting a safety risk to operators. The operator did not report any issues with headgates limiting flow.

Figure 42: Union Headgate

Flow Measurement - Fair Condition

There is a staff gage approximately 100 feet downstream of the headgate structure in a natural-bottom channel with an irregular cross section. Because of the potential variability in the cross section from year to year due to sedimentation, erosion, and vegetation, the accuracy of any calibration curve is questionable.

Figure 43: Union Measurement Gage in Channel

Diversion - Poor Condition

The Union diversion supplies the ditch with water from Michell Slough and is comprised of three concrete gate structures, 4 feet deep by 7 feet wide each, with stop logs placed in steel guides to regulate the water level. There is evidence of erosion and eddies behind the diversion walls. The bottoms of the diversion walls have lost some concrete. There are multiple, unsecured boards stacked across the diversion as a walkway and no handrail, posing a safety hazard.

Figure 44: Union Diversion

2.3.16. Ward

The Ward Irrigation District diverts water from the main stem of the Bitterroot River near Charlos Heights, Montana. This diversion is the first downstream of Lake Como, which provides supplemental flows into the Bitterroot River via Rock Creek for aquatic habitat.

Headgate – Good Condition

The Ward headgate was replaced in 2018 and is in good condition. The structure is comprised of new concrete and two metal headgates that can be adjusted with a handwheel. There is a metal grate walkway set into the headgate structure with a handrail. Debris building up at the headgate is a recurring issue.

Figure 45: Ward Headgate

Flow Measurement - Fair Condition

There is a flow measurement gage approximately 100 feet downstream of the headgate in a natural-bottom, irregular cross section of the channel. Because of the potential variability in the cross section from year to year due to sedimentation, erosion, and vegetation, the accuracy of any calibration curve is questionable. There is also a wood flume in the ditch. However, because it is located downstream of the Lost Horse Siphon, the Ward Irrigation District's headgates off Lost Horse Creek, and at least one turnout off the ditch, this flume cannot be used to accurately assess flows being diverted from the Bitterroot River.

Figure 46: Ward Measurement Gage in Channel

Figure 47: Ward Wood Flume

Diversion – Fair Condition

A rock bar comprised of river rock, logs, and imported 2-foot boulders is annually rebuilt with equipment in the main channel of the Bitterroot River to divert water flow into Ward ditch. The rock bar extends into the channel only a fraction of the overall width. River migration and down cutting is a concern that presents the potential for loss of flow delivery to the system. Debris accumulation is an issue and flows fluctuate each year at the diversion.

Figure 48: Ward Diversion

2.3.17. Webfoot

Webfoot Ditch Company is the last diversion off the Mitchell Slough near Victor Crossing. The Mitchell Slough is sourced from the East Channel Bitterroot and begins at Tucker Headgate.

Headgate - Fair Condition

The Webfoot headgate consists of a concrete check with three openings that are regulated with stop logs. The stop logs must be placed in the Webfoot ditch by hand upstream of the concrete walls. The openings have concrete slab floors. The right-most opening has filled with sediment and is no longer active, as shown in Figure . Once the logs are in place, irrigators cannot regulate flow further. The concrete pillars and floor slabs show signs erosion and spalling and could be replaced. The banks are relatively low and are susceptible to water flowing around the headgate structure during high flows.

Figure 49: Webfoot Headgate

Flow Measurement – None

There is no water measurement device at the site.

Diversion - Fair Condition

An in-stream check-dam is used to divert water from Mitchell Slough into the ditch. The check-dam is constructed of a concrete structure with stop logs that are hand placed in the spring and removed in the winter. There is some loss of the concrete at the upstream corners of the structure. There are no metal guides for stop logs and they are held into a notch in the concrete by the pressure of flowing water. There is no further control of the flow of water once the logs are in place. Water is known to overtop the diversion structure during high water.

Figure 50: Webfoot Check Dam Diversion

2.3.18. Woodside

The Woodside Ditch Company diverts water from the main stem of the Bitterroot River north of Hamilton, Montana.

Headgate – Good Condition

The Woodside Headgate consists of two 24-inch diameter corrugated metal pipes under a concrete slab, on top which sits the concrete walls that formed the previous gate structure. The old concrete gate opening is permanently blocked by wooden stop logs that are bolted to a 12-inch diameter steel pipe that is set into the concrete slab. The 24-inch pipes were installed in 2002 and lowered the inlet elevation of the headgate by approximately 30 inches. The amount of water through the double pipes is sufficient throughout the irrigation season and usually must be regulated. Regulation is accomplished by placing a steel plate with handle across all or part of one or both pipes. There is a wooden board and irregularly shaped steel beam placed across the top of the structure to allow for crossing, but safety of the walkway could be improved by a wider, more consistent walkway with handrail.

Figure 51: Woodside Headgate

Flow Measurement – Poor Condition

The flow measurement for the Woodside ditch is located approximately three-quarters of a mile down the ditch from the headgate and after the ditch water intermingles with Blodgett Creek. The placement at this site alone would merit a condition rating of Poor because the contributions of Bitterroot River/Painted Rocks water cannot be independently measured. The flow measurement consists of a staff gage placed in front of the right-hand culvert in a set of two smooth metal culverts that are both approximately 48 inches in diameter. The placement so close to a hydraulic structure means that flow will be varied, rather than uniform, resulting in an inability to generate an accurate calibration curve at this location.

Figure 52: Woodside Flow Measurement Gage

Diversion – Good Condition

There is no dedicated diversion structure at the Woodside Ditch. Water is diverted in a relatively stable reach of the main Bitterroot River channel and there have been no issues getting sufficient flow into the ditch.

Figure 53: Woodside Diversion

Bitterroot Conservation District
Bitterroot River Irrigation Management Study

CHAPTER 3 SURVEY AND HYDRAULIC ASSESSMENT

This Chapter describes survey efforts and hydraulic assumptions for the fifteen prioritized projects, as chosen in Chapter 4, Capital Improvements Plan. These assumptions were used to develop the conceptual design plans and cost estimates that are included in the next chapter. This chapter is organized by flow measurement, headgate, and diversion projects to generalize design assumptions and to document unique characteristics of each project that were considered during design.

The intent of this chapter is to document technical assumptions and provide insight on design and cost estimating decisions. Design of proposed improvements are at a conceptual level and will require further investigation before implementation.

3.1. DATA COLLECTION

The conservation and efficient use of water from the Bitterroot River is the ultimate goal of this Study. It is recognized that many of the structures diverting and regulating water use on the Bitterroot are aging, eroding, or not performing as intended. Many lack imperative safety features that would be considered standard on new structures. Conceptual design of the fifteen recommended projects begins with analyzing elevation and flow data, gathered through survey. With the completion of the existing site conditions assessment, design attention transfers to hydraulics and structural stability to complete the design of the recommended projects.

3.1.1. Survey and Flow Data Collection

A survey crew visited each prioritized site to collect topographic data and structure data such as normal water elevation, pipe diameter, structure dimensions, and elevations for the canal bottom and top of bank.

Flow measurements were collected at each site as close to the intake structure is possible using a SonTek FlowTracker. Measurements were taken between July 7 and August 1, 2022, with the intention to capture relatively high flows in the ditch. However, due to the complexity in timing of irrigation management, lower flows were captured at some sites; these cases are noted in Table 3-1. Flow Measurement Results.

These results can be used to verify the accuracy of stage-discharge rating curves where available, and, where unavailable, provide a single-point reference to assist irrigators in interpreting their staff gages. These results were also considered in combination with water right data during hydraulic calculations for developing headgate, diversion, and measurement designs. Water rights for each ditch are available in Chapter 1.

Table 3-1. Flow Measurement Results

Site	Date	Discharge (cfs)	Gage	Notes
Bill Strange	11-Jul-22	N/A	N/A	No flowing water
C and C Ditch	7-Jul-22	8.0	1.20’	
Corvallis Canal	11-Jul-22	89.3	1.72’	Improved accuracy could be attained with 2-point measurements in areas over 2’ deep. Flow table provided by irrigator associates 1.72 on gage with 108.6 cfs (122% of the measured value)
East Channel	N/A	N/A	N/A	Previously investigated
Etna	N/A	N/A	N/A	Service declined
Gerlinger	11-Jul-22	20.0	N/A	Improved accuracy could be attained with 2-point measurements in areas over 2’ deep.
Hoyt	11-Jul-22	0.8	N/A	
Orr	11-Jul-22	7.3	0.35’	
Overturf - higher water	7-Jul-22	12.2	18.25”	Irrigator reports flows are sufficient
Overturf - lower water	20-Jul-22	4.3	12.50”	Irrigator reports flows are insufficient
River Ditch	11-Jul-22	7.6	1.55’	Flow table provided by irrigator associates 1.55’ on gage with ~9.15 cfs (120% of the measured value)
Spooner	N/A	N/A	N/A	Service declined
Supply/Woods Parkhurst	N/A	N/A	N/A	Service declined
Tiedt Nicholson	20-Jul-22	4.8	0.51’	
Tucker	7-Jul-22	62.8	1.91’ (headgate) 1.81 (lower gage)	Measurement taken prior to annual maintenance on the East Channel diversion.
Union	7-Jul-22	31.1	1.37’	
Ward	1-Aug-22	14.4	2.20’	
Webfoot	20-Jul-22	11.1	N/A	Cows in the vicinity and thick vegetation on the canal bottom may have affected accuracy of the measurement
Woodside - downgradient of Blodgett Creek	20-Jul-22	15.4	0.65’	
Woodside - downgradient of Blodgett Creek	20-Jul-22	9.5	N/A	

3.2 FLOW MEASUREMENT PROJECTS

3.2.2. General Approach

Design objectives for flow measurement projects included minimizing cost, optimizing accuracy of measurement per the standards published by the United States Bureau of Reclamation (USBR), limiting maintenance, ease of operation, and accommodating existing constraints in channel geometry. Hydraulic assessment focused on ensuring the proposed flow measurement approach is accurate at the range of expected flows in the ditch and will not adversely impact water delivery.

Weirs and flumes are the primary types of measurement structures used in irrigation applications. While weirs are often less expensive than flumes, they typically require a head loss of approximately 4 times that of a flume, and the ditches assessed do not appear to have sufficient slope for the proper functioning of a weir. Accordingly, weirs were not further considered as part of this assessment. Flumes are low maintenance, provide accurate flow readings for a long lifespan, and are considered highly accurate means of flow measurement. Both prefabricated flumes (typically made of steel or fiberglass) and custom designed flumes (typically constructed from concrete) are appropriate for use in irrigation ditches.

Prefabricated flumes can be purchased and installed into an irrigation ditch, or a custom designed flume can be cast in place into the ditch with concrete. Prefabricated flumes are typically less expensive for smaller ditches with lower flow rates, whereas cast-in-place flumes (e.g., Replogle flumes) are more economical for larger sizes. Both approaches were considered and compared for cost and site suitability.

Custom-designed concrete Replogle flumes are often employed for large ditches with high flow rates. Replogle flumes were designed using USDA Agricultural Research Service’s WinFlume v2.0 for the four priority projects with design flows over 20 cfs. Design considerations during this exercise included minimizing head loss, minimizing sill height (and therefore backwater), minimizing concrete volume, simplicity of construction, and maximizing accuracy at the range of expected flows. Replogle flumes that accommodate channels with low gradients and minimize head loss are generally longer and therefore require high volumes of structural concrete. Cost estimates were compared between the Replogle flume designs and prefabricated flumes, and due to the volume of structural concrete required, Replogle flumes were consistently significantly more expensive. Therefore, while Replogle flumes would be suitable for any of the priority sites, they were not considered further for this project due to their high cost; instead, prefabricated flumes were pursued.

While there are several styles of pre-fabricated flumes suited for open channel flow, Parshall flumes are considered the standard flume style for irrigation applications. Other options include Montana flumes and Cutthroat flumes. Montana flumes require a free drop at the outlet, which would be difficult to achieve given the channel gradients of the priority locations. Cutthroat flumes are not as commonly used in irrigation ditches because they lack the self-cleaning characteristic of Parshall and Montana flumes and would likely require more maintenance.

Design flow for each site was equal to the ditch's water right or to the flow measurement collected in 2022, whichever was larger. Parshall flumes were sized to accommodate 110% of the design flow for each site. A simplified Manning's formula analysis was conducted using Bentley Flowmaster v10.03 to supplement limited on-site data collection and to confirm appropriate device sizing for each site. The smallest appropriate size of Parshall flume was selected for each site. Quotes were obtained for appropriately sized Parshall flumes from TrueNorth Steel in Missoula as well as by several out-of-state suppliers, including Intermountain, Tracom, and Open Channel Flow. TrueNorth products were determined to be the most economical both in terms of shipping and fabrication costs.

Wingwalls at a 45-degree angle are required leading to the inlet of the flume and recommended at the outlet of the flume to ensure smooth flow transitions. Because water velocities in these canals are relatively low, the wingwalls may be constructed of packed earth meeting the plasticity requirements for canal embankments set forth by the USBR. Compacted bedding, backfill on either side of the flume, and the approach to the flume should also be constructed with material meeting this specification. Concrete and prefabricated metal are also suitable wingwall materials but are less economical. Riprap should also be placed at the outlet of the flume to prevent scour.

The inlet of the flume should be placed at or above the existing channel grade, and the outlet of the flume should be placed at existing grade to minimize the risk of submergence. Accordingly, the flume should be placed sufficiently downgradient of the headgate that the inlet of the flume is below the elevation of the intake structure invert; this will prevent any interference with the hydraulic functioning of the intake structure. For flumes in which the intake is installed above existing grade, an earthen ramp should be constructed leading into the flume. The slope of this ramp can be a maximum of 4:1 H:V.

Flumes should also be installed in an area that is easy to access, as close to the intake structure as possible while complying with the grade requirements discussed above, and in a straight section of channel with steady, unobstructed flow, and minimal scour, aggradation, and interference from vegetation or structures. The channel should be straight and unobstructed for 20 throat widths upstream and downstream. Additionally, a stilling well and electronic reader are an option for all sites to optimize measurement accuracy and operation efficiency but were not recommended as part of these plans because of the additional cost.

Flow measurement structures such as flumes yield more accurate measurements and increased longevity compared to staff gages placed in the ditch. However, a staff gage located in a reinforced channel cross section with an associated stage-discharge rating curve may be the most feasible approach for certain sites. This is the case at Tucker headgate due to its high flow rates, flat and wide channel geometry, and channel instability.

3.2.3. Individual Site Design Considerations

Webfoot

In general, the Webfoot ditch in the downgradient vicinity of the intake structure exhibits low water velocity with thick aquatic vegetation on the channel bottom. There is no mechanism for flow measurement. Alternatives considered for this site included the installation of a prefabricated Parshall flume, cast-in-place Replogle flume, or staff gage with stage-discharge rating curve. Due to the high cost of a Replogle flume and the relative inaccuracy of a staff gage, a prefabricated Parshall flume is the recommended solution for this site.

The 48-inch throat width by 24-inch deep prefabricated Parshall flume with packed earth wingwalls is the smallest size of flume that accommodates the Webfoot Ditch water right of 40 cubic feet per second. However, if flows in the ditch are consistently lower than this value, a smaller flume may be chosen to reduce material costs. There is a 3-inch drop in bottom elevation over the length of this flume. Installing the flume approximately 250 feet or more from the headgate would allow for installation with the flume outlet at existing grade and the inlet at or below the elevation of the intake invert and therefore should not interfere with the hydraulic functioning of the headgate. There is thick aquatic vegetation present on the channel bottom through this area. This can cause maintenance or accuracy issues for a Parshall flume; it is therefore recommended that the channel upgradient of the structure be routinely maintain to prevent accumulation of vegetation.

Spooner

Spooner Ditch currently has no mechanism for flow measurement. Alternatives considered for this site included the installation of a prefabricated Parshall flume, cast-in-place Replogle flume, or staff gage with stage-discharge rating curve. Due to the high cost of a Replogle flume and the relative inaccuracy of a staff gage, a prefabricated Parshall flume is the recommended solution for this site.

The 12-inch throat width by 30-inch deep prefabricated Parshall flume with packed earth wingwalls is the smallest size of flume that accommodates the Spooner Ditch water right of 14 cfs. There is a three-inch drop in bottom elevation over the length of this flume. Thus, the flume should be located downstream in the ditch such that the existing bed elevation is three inches or more beneath the elevation of the existing intake invert. This criterion was not met within the area surveyed for this project. Therefore, a conceptual location for the flume was identified that likely has the required elevation. However, prior to installation, this section of channel should be investigated for grade, uniformity, and stability.

Gerlinger

Gerlinger Ditch currently has no mechanism for flow measurement. Alternatives considered for this site included the installation of a prefabricated Parshall flume, cast-in-place Replogle flume, or staff gage with stage-discharge rating curve. Due to the high cost of a Replogle flume and the relative inaccuracy of a staff gage, a prefabricated Parshall flume is the recommended solution for this site.

To accommodate the flow of 20.0 cfs measured in July 2022, a 36-inch throat width by 18-inch deep prefabricated Parshall flume with packed earth wingwalls is recommended. However, if this value does not represent the typical flow range in the ditch, a different size may be required.

There is a three-inch drop in bottom elevation over the length of this flume. Thus, the flume should be located downstream in the ditch such that the existing bed elevation is three inches or more beneath the elevation of the existing intake culvert invert. This criterion was not met within the area surveyed for this project. Therefore, a conceptual location for the flume was identified that likely has the required elevation. However, prior to installation, this section of channel should be investigated for grade, uniformity, and stability.

Tucker

For optimal accuracy of flow measurement, a flume (either a cast-in-place concrete Replogle flume or a 96” throat width prefabricated Parshall flume) could be installed. However, these alternatives were not recommended at this time due to the large quantity of concrete and/or earthmoving required for appropriate flume installation at this site.

The lower-cost, non-structural, and less invasive alternative recommended for this site is optimizing the placement and use of a staff gage for interpreting flows through the Tucker headgate. For this site, development of a stage-discharge rating curve for use with a staff gage would be significantly less expensive than installation of a flume, however, the rating curve will only be valuable for interpreting flows if the staff gage is located in a stable cross section. There are currently two staff gages near the Tucker headgate, one on the intake structure and one near the left bank of the channel immediately downstream. However, neither can be used to measure flows reliably and accurately. Because flows are non-uniform through the headgate, the staff gage on the intake structure cannot provide accurate readings. The second staff gage is in an unstable section of channel that fills with sediment each season and is then periodically dredged. Because of this, water levels at the gage do not consistently correspond with a flow rate. Further, the staff gage is in a thicket of reed canary grass which may further interfere with the accuracy of the reading and be difficult for irrigators to use. Therefore, it would be advisable to invest in the development of a rating curve for a staff gage in a location that requires less maintenance and experiences more uniform flow.

A reinforced cross section could be established to facilitate the utilization of a staff gage to interpret flows entering the Mitchell Slough. This cross section should be in a straight, unobstructed section downstream of the area that is periodically dredged. Channel banks should be excavated and reinforced with rip rap to improve stability of the cross section and limit vegetation growth. A staff gage should be installed in a location that can be easily accessed and viewed by irrigators. A stage-discharge relationship would then be developed relating readings on this staff gage to flow rates in the Mitchell Slough.

Corvallis

Staff gages currently exist on the Corvallis intake structure and on the footbridge several hundred yards downstream. The footbridge staff gage is the primary means for monitoring flows in the ditch; it has an associated stage-discharge rating curve and is fitted with a camera so that irrigators can check the water levels remotely. However, flow at both structures is non-uniform, limiting the accuracy of these staff gages.

The measured flow of 89.3 cfs on July 11, 2022 corresponded to a staff gage reading of 1.72’ at the bridge. However, the calibration curve provided by the irrigators indicates that this water level should be associated with a flow of 108.6 cfs, approximately 122% of the observed flow. Due to this discrepancy, it is recommended that additional flow measurements be taken at a variety of water levels to further assess the accuracy of the existing stage-discharge flow table and facilitate its ongoing use.

For optimal accuracy of flow measurement, a flume (either a cast-in-place concrete Replogle flume or a 96” throat width prefabricated Parshall flume) should be installed in the Corvallis canal. The 48-inch throat width by 48-inch deep prefabricated Parshall flume with packed earth wingwalls is the most cost-effective of these options that accommodates the water right of 125 cfs. There is a three-inch drop in bottom elevation over the length of this flume. Thus, the flume should be located downstream in the ditch such that the existing bed elevation is three inches or more beneath the elevation of the existing intake invert. This can be achieved by installing the flume immediately upgradient of the bridge with the existing staff gage/camera setup. Because the canal is relatively narrow through the bridge, less earthmoving would be required to backfill on either side of the flume, reducing costs. In addition, the existing camera setup may be utilized to observe flows through the flume.

3.3. HEADGATE PROJECTS

3.3.1. General Approach

Hydraulic assessment of the priority headgate structures focused on ensuring the proposed gate structures maintained adequate capacity for water users to take their full water right. Because none of the irrigators interviewed reported capacity deficiencies at their headgates, conceptual headgate designs largely matched the existing configuration, height, and width, with a few exceptions noted below. Bentley CulvertMaster v3.3 was used to complete hydraulic calculations. This approach was used because the headgates are located on feed canals with relatively flat slopes and are therefore affected by canal backwater (also described as the tailwater). The calculations built into CulvertMaster automatically include consideration of the headwater and tailwater elevations to determine whether the structure is under outlet control or, in other words, governed by tailwater elevation.

The hydraulic calculation assumptions also pulled from a mix for published design guidance and engineering judgement developed from work on several other projects in the region. The tailwater and headwater elevations were assumed from the surveyed bank elevations with 12 inches of freeboard. These freeboard assumptions are less conservative than explicitly recommended for canal banks in the USBR Design of Small Canal Structures Manual (Bureau of Reclamation, 1978), but in-line with the recommendations of USBR Design Standard No. 3, which states that “freeboard varies from 6 inches for small laterals to 2 feet or more for large canals” (Bureau of Reclamation, 1967). The 1 foot of freeboard is considered to be sufficiently conservative for the canals and ditches served by the priority headgates in this project.

Conceptual designs were developed to bring the structures up to modern design standards, as discussed further in Chapter 4. These standards include a cutoff wall at the upstream side of the foundation slab keyed into scour depth to prevent undermining of the structure. The scour depths are not calculated from hydraulic results at this stage in design but are instead assumed from other past projects in the area. Additionally, structures are assumed to be constructed from wood-formed concrete, which sets the hydraulic roughness of the structures at 0.015.

3.3.2. Individual Site Design Considerations

Union

The current Union system headgate is reported to have sufficient capacity and features two openings that are 5 feet wide by 5 feet high. The surveyed opening heights reflect the height from invert to top of abutment wall. The full height of these openings is not all conveying area because the tops of the openings remain blocked by the wooden gates. The minimum bank elevation is 3,386.78 feet NAVD88 at the cross section upstream of the gates and 3,386.49 feet NAVD88 at the cross section downstream of the gates. These elevations drive the headwater and tailwater elevation shown in Table 3-2. The inverts are determined from the average of the toe and centerline elevations at the upstream and downstream ends of the gate structure.

The new concrete gate openings will maintain the same configuration and width, but the height will be only three feet. The opening height allows for a 3-foot-tall gate, which will overlap the new walkway by 1 foot and allow space for the gate frame and handwheel. The headwall configuration is assumed to be perpendicular to channel with a square-edged inlet, resulting in an entrance loss coefficient of 0.5. The water right is used as the design flow. The capacity of gates with these parameters is confirmed using the CulvertMaster headwater elevation calculation. The calculated headwater elevation for the design flow is 3,385.69 feet NAVD88, which is below the maximum allowable headwater elevation, confirming that the conceptual gate design can meet the required hydraulic capacity. The CulvertMaster report for these calculations is shown in Appendix D.

Table 3-2. Union Headgate Input Parameters and Result

Parameter	Value
Design Flow (cfs)	71
Number of Opening(s)	2
Size of Openings	5 feet wide by 3 feet tall
Upstream Invert Elevation (feet NAVD88)	3,383.32
Downstream Invert Elevation (feet NAVD88)	3,382.74
Maximum Allowable Headwater Elevation (feet NAVD88)	3,385.80

Parameter	Value
Tailwater Elevation (feet NAVD88)	3,385.49
Headwater for Design Flow (feet NAVD88)	3,385.69

Etna

The current Etna system headgate is reported to have sufficient capacity and features two openings that are 4 feet wide by 5 feet high. The surveyed opening heights reflect the height from invert to top of abutment wall. The full height of these openings is not all conveying area because the tops of the openings remain blocked by the wooden gates. The maximum bank elevation is 3,386.30 feet NAVD88 at the cross section upstream of the gates and the minimum bank elevation is 3,385.11 feet NAVD at the cross section downstream of the gates. The maximum elevation is used upstream because the opposite bank appears to be depression between the headgate and diversion that should be re-graded and brought up to the right bank elevation during construction. The bank elevations drive the headwater and tailwater elevation shown in Table 3-3. The inverts are determined from the centerline elevation at the upstream and downstream ends of the gate structure.

The new concrete gate openings will maintain the same configuration and width, but the height will be only three feet. The opening height allows for a 3-foot-tall gate, which will overlap the new walkway by 1 foot and allow space for the gate frame and handwheel. The headwall configuration is assumed to be perpendicular to channel with a square-edged inlet, resulting in an entrance loss coefficient of 0.5. The water right is used as the design flow. The capacity of gates with these parameters is confirmed using the CulvertMaster headwater elevation calculation. The calculated headwater elevation for the design flow is 3,384.14 feet NAVD88, which is below the maximum allowable headwater elevation, confirming that the conceptual gate design can meet the required hydraulic capacity. The CulvertMaster report for these calculations is shown in Appendix D.

Table 3-3. Etna Headgate Input Parameters and Result

Parameter	Value
Design Flow (cfs)	39
Number of Opening(s)	3
Size of Openings	4 feet wide by 3 feet tall
Upstream Invert Elevation (feet NAVD88)	3,380.20
Downstream Invert Elevation (feet NAVD88)	3,380.26
Maximum Allowable Headwater Elevation (feet NAVD88)	3,385.30
Tailwater Elevation (feet NAVD88)	3,384.11
Headwater for Design Flow (feet NAVD88)	3,384.14

Hoyt

The current Hoyt system headgate is a structurally deficient wood structure with approximately 2 foot wide opening and no ability to regulate flows. There was no information available from users to understand if the system capacity is sufficient. The maximum bank elevation is 4,093.10 feet NAVD88 at the cross section upstream of the gates and the minimum bank elevation is 4,092.59 feet NAVD88 at the cross section downstream of the gates. The bank elevations drive the headwater elevation shown in Table 3-4. The inverts are determined from the centerline elevation at the upstream and downstream ends of the gate structure.

The new concrete gate opening will maintain the same configuration and width with a 2-foot-tall gate opening. The headwall configuration is assumed to be perpendicular to channel with a square-edged inlet, resulting in an entrance loss coefficient of 0.5. The water right is used as the design flow. The capacity of gates with these parameters is confirmed using the CulvertMaster headwater elevation calculation. The calculated headwater elevation for the design flow is 4,091.59 feet NAVD88, which is below the maximum allowable headwater elevation, confirming that the conceptual gate design can meet the required hydraulic capacity. The CulvertMaster report for these calculations is shown in Appendix D.

Table 3-4. Hoyt Headgate Input Parameters and Result

Parameter	**Value**
Design Flow (cfs)	3
Number of Opening(s)	1
Size of Openings	2 feet wide by 2 feet tall
Upstream Invert Elevation (feet NAVD88)	4,090.93
Downstream Invert Elevation (feet NAVD88)	4,091.59
Maximum Allowable Headwater Elevation (feet NAVD88)	4,092.10
Tailwater Elevation (feet NAVD88)	4,091.59
Headwater for Design Flow (feet NAVD88)	4,091.59

Webfoot

The current Webfoot system headgate is reported to have sufficient capacity and features three openings that are approximately 8 feet wide by 3 feet high. The surveyed opening heights reflect the height from invert to top of abutment wall. The invert elevation is 3,356.16 feet NAVD88 at the centerline of the middle gate opening. The banks rise outside the vicinity of the gates, which is why re-grading and raising the banks in the region of the headgate is a significant part of the conceptual design. Assessing the channel downstream also shows an inconsistent and, at times, adverse channel slope. It is assumed that the channel will be re-graded to have a more consistent slope and that the areas around the headgate will be raised. The furthest downstream portions of the channel (350-450 feet from the headgate) show a channel depth of 5 feet. If the banks are raised to match this, the bank elevation will be 3,362.16 based on the current invert elevation. The downstream bank elevation on the right bank (which would likely not need to be modified) is 3,361.73. These bank elevations drive the headwater elevation shown in Table 3-5. The inverts are determined from the centerline elevation at the upstream and downstream ends of the gate structure.

A new configuration and size are proposed for the Webfoot gates. The left-most opening is almost completely blocked by sediment and vegetation. Abandoning this opening would not affect capacity, as it is not currently providing meaningful conveyance, and is recommended. For the two remaining openings, 8-foot gates are relatively large, increasing the structural requirements on the gates and reducing the amount of control operators have over the headgate flows. Instead, splitting the two currently functional openings into three 4-foot-wide openings with the same abutment height is recommended. The opening height allows for a 2-foot-tall gate, which will overlap the new walkway by 1 foot and allow space for the gate frame and handwheel. The headwall configuration is assumed to be perpendicular to channel with a square-edged inlet, resulting in an entrance loss coefficient of 0.5. The water right is used as the design flow. The capacity of gates with these parameters is confirmed using the CulvertMaster headwater elevation calculation. The calculated headwater elevation for the design flow is 3,360.80 feet NAVD88, which is below the maximum allowable headwater elevation, confirming that the conceptual gate design can meet the required hydraulic capacity. The CulvertMaster report for these calculations is shown in Appendix D.

Table 3-5. Webfoot Headgate Input Parameters and Result

Parameter	**Value**
Design Flow (cfs)	40
Number of Opening(s)	3
Size of Openings	4 feet wide by 2 feet tall
Upstream Invert Elevation (feet NAVD88)	3,357.18
Downstream Invert Elevation (feet NAVD88)	3,357.51
Maximum Allowable Headwater Elevation (feet NAVD88)	3,361.16
Tailwater Elevation (feet NAVD88)	3,360.73
Headwater for Design Flow (feet NAVD88)	3,360.80

3.4. DIVERSION PROJECTS

3.4.1. General Approach

The morphology of the Bitterroot River lends to design challenges associated with in-channel diversion dams. These challenges include sediment bed loads, lateral migration, low gradient channels, and sensitive aquatic species. It should be acknowledged that while hydraulic solutions are presented here, other elements worth consideration are permitting requirements, as well as on-going operation and maintenance of the proposed solutions. Final design will require extensive modeling to refine performance of the diversions and to achieve permitting compliance.

Modeling requirements for new diversions includes several types that serve different aspects of the design. Two-dimensional (2D) hydraulic modeling will be required for to complete detailed structure design, to determine velocity and shear stress for scour depth calculation and rock sizing, and to evaluate if structures allow for fish passage. One-dimensional hydraulic models will be needed for floodplain permitting of any new structure. Additionally, sediment transport models and geomorphology assessments would also be appropriate for new diversions off the Bitterroot River main channel, including the East Channel, Ward, and Overturf Diversions.

New river diversions or in-river structures will require several permits to proceed. Many of the permits required, including the floodplain permit mentioned above, are obtained through the Joint Application Form along with appropriate technical documentation. Some of the major permits required are briefly described below:

Table 3-6. Abridged Stream Permitting Requirements

Permit Name	**Permit Objective**	**Permitting Agency**
310 Permit	Minimize erosion and sediment; Protect streams and rivers	Bitterroot Conservation District
124 Permit	Protect and preserve fish and wildlife resources	MT Fish, Wildlife, and Parks
318 Permit	Protect water quality and minimize sedimentation from construction activities	MT Department of Environmental Quality
Floodplain Permit	Promote public safety from flood conditions in Regulated Flood Hazard Areas	Ravalli County Floodplain Administrator
404 Permit	Restore and maintain the chemical, physical, and biological integrity of nation's water	US Army Corps of Engineers

This information was adapted from the following website, where additional information is available:
http://dnrc.mt.gov/divisions/cardd/conservation-districts/the-310-law

Two important simplifying assumptions were made to support development of conceptual diversion designs. The first is that the conceptual designs' primary objective was to resolve existing issues with insufficient stage to provide necessary flows. Put another way, the conceptual designs mainly sought to meet the hydraulic grade line (HGL) needed to drive necessary flows into each diversion. At the conceptual design stage, no detailed consideration of more in-depth hydraulics is done, although some general consideration is given to issues of scour and long-term river morphology. The second is that adjustable diversions are strongly preferred over permanent diversions. Adjustable diversions allow for operators to adopt different configurations at high water, when high sediment loads can damage structural components or drive sedimentation that impairs structure function, and at low water, when the diversion may need to be raised to have a high enough stage to drive irrigation flows.

3.4.2. Individual Site Design Considerations

Etna

There are no reported problems with sufficient capacity at the Etna diversion structure. The major concerns at this site are related to structural stability, with some added O&M benefits possible. Given that there are no reported issues with hydraulic capacity at this site, the conceptual design is essentially a replacement of the existing structure with a modification to the existing configuration. The current structure has four openings, but the left-most opening provides little to no conveyance because it is approximately 85% blocked by sediment and vegetation. The conceptual design recommendation is a three-opening configuration with the left abutment wall starting at the right edge of the fourth, partially blocked opening. The three-opening configuration is expected to meet the existing hydraulic capacity because the fourth opening currently does not provide significant conveyance.

The use of stop logs for level control at this site does limit the ability of operators to regulate flow to a few discrete settings. The number and spacing of these settings are determined by the width of the board used. Typically, 2x6 dimensional lumber is used for stop logs. Using the sharp-crested weir equation shown below and the existing opening width of 6-feet, the removal of one 6-inch board in one opening at a constant headwater elevation will result in a flow change of about 7 cfs.

$$Q = CBH^{3/2}$$

$$where:$$

$$C = weir\ coefficient = 3.33$$

$$B = width\ of\ opening = 6\ feet$$

$$H = water\ depth\ above\ weir\ crest = 0.5\ feet$$

$$Q = 3.33\ \times 6\ feet\ \times\ 0.5\ feet^{3/2} = 7.1\ cfs$$

The calculation above simplifies the flow change when a board is removed. In reality, the level will drop and the change in flow is less than 7 cfs. It does illustrate that the changes in flow are restricted to set levels that can be relatively large.

More sophisticated level control could be provided by an overshot weir. An overshot gate includes a metal plate that is positioned by a cable hoist and actuator (typically powered), allowing for setting a weir height at a level between the open and closed positions. The overshot gate provides control and safety benefits, as operators do not have to manually place or remove any equipment into the flowing stream or canal. These benefits come at a cost increase over a stop-log based system.

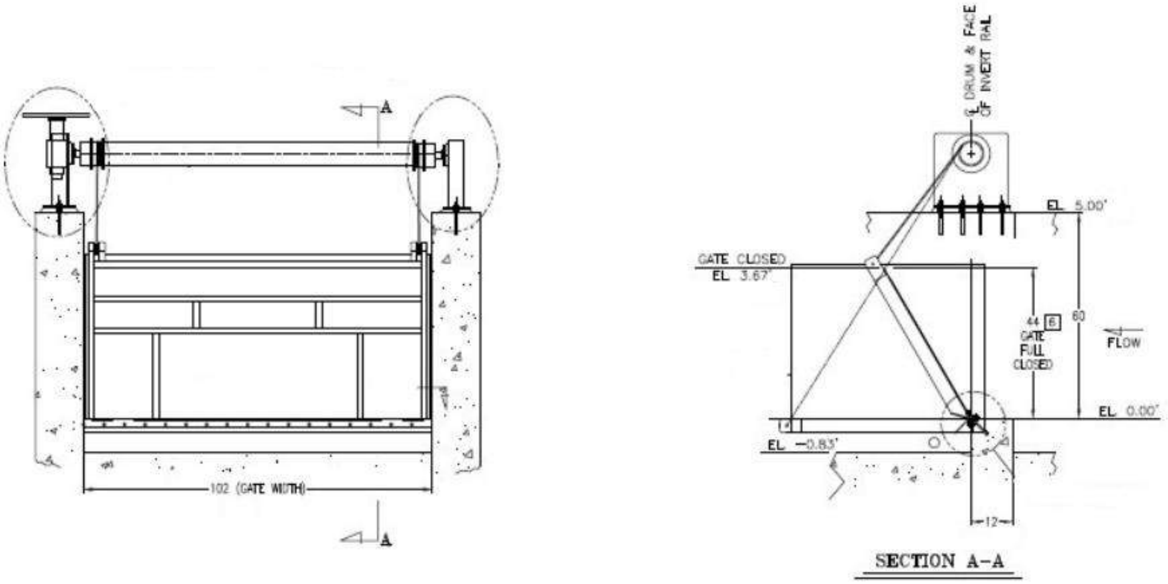


Figure 3-1. Example Overshot Gate Drawing

Union

There are no reported problems with sufficient capacity at the Union diversion structure. The major concerns are this site are related to structural stability, with some added O&M benefits possible. Given that there are no reported issues with hydraulic capacity at this site, the conceptual design is a replacement of the existing structure. With the same opening sizes, same elevations, and a reduction in the surface roughness of the diversion openings from new concrete, it is expected that a new structure will meet the existing hydraulic capacity of the Union diversion. Union uses a similar stop log system as Etna, which carries the same limitations. Overshot gates would offer similar benefits for the Union system in terms of greater fidelity of level control and improved safety.

Tucker

The Tucker Diversion provides sufficient stage to drive flows in its current configuration when there is enough flow in the East Channel. The East Channel Diversion is also a priority project and is addressed elsewhere. Many of the concerns about the current Tucker Diversion surround operability and safety. The major hydraulic concerns on this project are the diversion crest elevation and preventing sedimentation at the Tucker headgate entrance. The height of the breakaway jacks that will support new stop logs will be set such that the top elevation of the stop logs, once placed, equals or exceeds the elevation of the current eco-block diversion. The breakaway jacks will allow for sediment to be flushed during high flows. Detailed hydraulic modeling may reveal that lower slab elevation with higher breakaway jacks will provide even better sediment transport away from the gate.

East Channel

The recommendation for the East Channel Diversion consists of a modified O&M strategy will use temporary barriers to help address the grade control and sedimentation problems. Bed load transport often can peak during spring and early summer high runoff, during which sedimentation in the East Channel can be substantial but irrigation water is readily available. The modified O&M alternative will use temporary barriers, potentially super sacks filled with native channel materials and covered or concrete blocks, to build a temporary weir across the East Channel during high flows. This may help reduce bed load deposition in the East Channel, while irrigation flows will be sufficient due to high water in the Bitterroot River. Then, as the river stage drops, the temporary barriers will be relocated across the Main Channel to provide grade control, raising the main river water level and increasing ability to divert flow into the East Channel and increasing irrigation flows.

Ward

The Ward diversion performance has suffered in recent years due to channel migration to the opposite bank. Mitigating this primarily requires stabilizing the opposite bank and providing vertical grade control at key points along the channel in the vicinity of the Ward diversion. These grade control elements will be keyed into scour depth and have a top elevation that is flush with the existing riverbed. Installing these grade control elements will allow the Ward diversion to maintain historic performance.

Overturf

The Overturf system receives enough water during high water and the diversion provides sufficient stage once it is placed, but there is an intermediate period during which it cannot be placed, and flows are insufficient. As such, the conceptual design mainly offers operational and safety benefits. The new adjustable diversion will have a very similar, if not identical, height as the existing concrete block structure. While the hydraulics of the current temporary diversion seem to be effective, there was concern that the inlet culvert has an adverse slope that further limits flows into the ditch. Survey data did reveal this to be the case, with the inlet invert elevation at 3,874.93 feet NAVD88 and the outlet invert elevation at 3,875.05 feet NAVD88.

A CulvertMaster analysis was done on the headgate to confirm that the culvert performance is not sensitive to the slope. The culvert is corrugated metal arch pipe measuring 58 inches wide by 36 inches tall. The corrugated metal has a hydraulic roughness of 0.028. The perpendicular headwall configuration has an entrance loss coefficient of 0.5. The existing culvert parameters were entered and the headwater elevation required for the design flow was calculated to be 3,880.84 feet NAVD 88, as shown in Table 3-7. The culvert inverts were modified by dropping the outlet to the current inlet elevation and raising the inlet to give an overall slope of 0.5%. The required headwater elevation for the design flow was unchanged at 3,380.84, as shown in Table 3-8. The CulvertMaster reports for these calculations are shown in Appendix D.

Table 3-7. Existing Overturf Headgate Input Parameters and Result

Parameter	**Value**
Design Flow (cfs)	10.5
Number and Type of Opening(s)	1 arch culvert
Size of Opening	58 inches wide by 36 inches tall
Upstream Invert Elevation (feet NAVD88)	3,874.93
Downstream Invert Elevation (feet NAVD88)	3,875.05
Maximum Allowable Headwater Elevation (feet NAVD88)	3,883.93
Tailwater Elevation (feet NAVD88)	3,880.81
Headwater for Design Flow (feet NAVD88)	3,880.84

Table 3-8. Conceptual Overturf Headgate Input Parameters and Result

Parameter	**Value**
Design Flow (cfs)	10.5
Number and Type of Opening(s)	1 arch culvert
Size of Opening	58 inches wide by 36 inches tall
Upstream Invert Elevation (feet NAVD88)	3,875.03
Downstream Invert Elevation (feet NAVD88)	3,874.93
Maximum Allowable Headwater Elevation (feet NAVD88)	3,883.93
Tailwater Elevation (feet NAVD88)	3,880.81
Headwater for Design Flow (feet NAVD88)	3,880.84

Bitterroot Conservation District
Bitterroot River Irrigation Management Study

CHAPTER 4 CAPITAL IMPROVEMENTS PLAN

This Capital Improvements Plan (CIP) is a resource and tool that documents the irrigation needs within the Bitterroot River system and identifies the highest priority projects with associated costs, prioritization, and funding sources. The irrigation water users may use this plan to facilitate implementation of projects for infrastructure improvement. The potential projects from this study include improvements to select headgates, diversions, or flow measurement sites at 18 irrigation system intakes along the Bitterroot River.

Each site underwent comprehensive scoring using standard criteria, which results in a ranking score. By using weighted criteria, each project will be carefully considered during ranking so that the highest priority sites will have the most beneficial impact on the objectives of this Study. The ten highest ranking sites have been deemed “priority projects” and will proceed into hydraulic assessment and concept design. The concept design, cost estimating, and hydraulic information is assessable to irrigators to support implementation of projects.

The intent of this CIP is to provide a tool for irrigators to plan financially and methodically to improve water measurement and efficient diversion from the Bitterroot River. This document also provides justification to funding agencies for the relative importance of the recommended improvements at the watershed scale of this Study.

4.1. OBJECTIVES

In accordance with the requirements set forth by the Montana DNRC as the funding agency for this planning effort and in alignment with conservation goals set forth by the BCD, the following objectives are identified to develop recommendations within this Study:

- Conserve surface water through the implementation of accurate flow measurement and functional intake structures that reduce water losses and water waste.
- Manage surface water through improvements to headgates and diversions that offer irrigators the ability to better manage water deliveries and improvements to flow measurement for ease and accuracy of flow uses.
- Preserve delivery of surface water for the purpose of irrigation by repairing or replacing irrigation infrastructure that is currently in disrepair.
- Preserve aquatic and wildlife habitat. Effective water management and conservation achieved through efficient headgates and accurate flow measurement will minimize wasted flows in the irrigation system, allow for these surface water flows to remain in the Bitterroot River, will prevent excess water from being diverted, and will thereby benefit fish and riparian habitats.

Additionally, the designs sought to ensure that water control structures and water measurement devices meet legal requirements as presented in Montana Code Annotated (MCA) 85-5-302.

4.2. RANKING CRITERIA

The systematic ranking process used to prioritize the identified projects assigns a numeric score to each of the eight criteria which are weighted based on significance and impact aligned with the study objectives. The ranking criteria were selected in collaboration with the BCD. The score received for each criterion will be multiplied by the weighting factor and summed to reach a final priority score. The sixteen highest-scoring projects will proceed to hydraulic analysis and concept design.

Table 4-1: Ranking Criteria

Criteria	**Weighting Factor**
Renewable Resource Conservation	0-4
Renewable Resource Management	4
Renewable Resource Preservation	4
Regulatory Compliance	3
Stakeholder Engagement	3
Influence	3
Operator Safety	2
Cost	2

Each project is evaluated per each criterion and given a score of 1-5 based on how well the project outcomes will meet the criterion. Scoring guidelines are outlined for each of the criteria below.

It should be noted that the project ranking and scoring within this CIP are inherently open to differences of opinion. Input from the consultant and BCD have been considered in the scoring of projects. Some projects may become more feasible or practical in the future due to currently unforeseen or changing circumstances. This CIP is intended to help guide near-term decision-making regarding construction projects, beneficial impacts, and funding. Future refinements may be needed based on updated regulations, failure of infrastructure (resulting in increased priority), or availability of funding opportunities that advance a project.

4.3. CRITERIA AND SCORING

4.3.1. Renewable Resource Conservation

Weight = 0-4

Renewable resources of surface water and arable land may be conserved with implementation of this project. Conservation methods may include diverting only the needed water from the river, preventing seepage, or eliminating in-canal flows during off-season.

Conservation of renewable resources on the Bitterroot River is a priority of the BCD. Projects that provide water conservation will rank highest in this category. Weighting for both headgate and diversion structures was held constant at the maximum weighting of 4. The conservation score for these types of structures is based on the current condition or the amount of water that is currently lost to valuable riverine or agriculture uses, which is not bounded by the size of structure. Put another way, if a small diversion were to fail, the amount of water lost to conservation would not be controlled by the size the of structure. Conversely, the amount of water conserved by proper measurement is bounded by the amount of water diverted, which is quantified in this study by the water right flow. Assuming the diversion and headgate structure are properly functioning, the amount of water that can be conserved by eliminating measurement errors is limited by the total amount of water diverted. Therefore, the weighting for measurement scores is equal to the influence score (described in Section 0) scaled by 80% such that the maximum weighting is 4.

Table 4-2 Conservation Weighting Parameters

	Measurement	**Headgate**	**Diversion**
Weight	0.8 x influence score	4	4

Table 4-3: Conservation Scoring Parameters

Score	**Description**		
	Measurement	**Headgate**	**Diversion**
5	No measurement	Overflows, significant leakage through headgate	High risk of failure
4	Highly inaccurate measurement, e.g. due to multiple sources of water at measurement location	N/A	N/A
3	Isolated source water with least accurate measurement equipment	Slide Gate with leakage or stop logs	All other diversions are given a 3 unless special conditions exist.
2	Isolated source water moderately accurate measurement equipment	N/A	N/A

1	Isolated source water with most accurate measurement equipment	Functioning headgate, no conservation issues	

4.3.2. Renewable Resource Management

Weight = 4

Renewable Resources such as surface water and arable land will benefit from improved management. Management methods may include improved measurement, increased operability, and ease of maintenance.

Effective management of renewable resources on the Bitterroot River is an additional priority of the BCD. Accurate methods of water management can ensure that surface water resources are being used as efficiently as possible. All projects in this study are intended to improve management of water for irrigation and surface water benefits.

Table 4-2: Management Scoring Parameters

Score	**Description**		
	Diversion	**Measurement**	**Headgate**
5	Significant effort required routinely. Complete loss of ability to divert water	No Measurement	Inoperable Headgate
4	River Migration occurring. Loss of water anticipated due to channel migration	Measurement in Place, On Structure	Leaking, old stop logs
3	Diversion functional. Minimal maintenance	Gage in non-uniform channel, vegetation	Good Condition, able to access Stop logs
2	In-River maintenance required	Gage in uniform channel section	Functioning Headgate – Minimal improvements recommended. Generally works, potential for enhanced operation and maintenance (O&M)
1	Permanent Structure, No annual maintenance	Accurate Measurement	Functioning Headgate – No improvements needed. Gate Seals, actuator is functional

4.3.3. Renewable Resource Preservation

Weight = 4

Surface water, arable land, and aquatic and riparian habitat are some renewable resources that may be preserved with the implementation of this project. Preservation methods may include repair or replacement of structures that are close to failure or non-existent to allow continued supply of surface water to arable land.

Preservation of renewable resources on the Bitterroot River is a priority of the BCD. Projects that have the largest potential to benefit resource preservation will be scored highest in this category. Scores were determined based on the condition assessment completed and summarized in Chapter 2. Guidance used in assigning scores is below.

Table 4-3: Preservation Scoring Parameters

Score	**Description**	
	Preservation	**Structure Condition**
5	Opportunity to Preserve	Poor
3	Minimal Preservation	Fair
1	No Opportunity to Increase Preservation	Good

4.3.4. Regulatory Compliance

Weight = 3

This project will aid the intake and user in compliance with MCA 85-5-302, requiring suitable headgates and flow measurement.

The State of Montana requires maintenance of headgates and measuring devices under Title 85, Water Use. The code MCA 85-5-302 is as follows:

> *"All persons using water from any stream or ditch for which a water commissioner is appointed are required to have suitable headgates at the point where a ditch taps a stream and shall also, at some suitable place on the ditch and as near the head as practicable, place and maintain a proper measuring box, weir, or other appliance for the measurement of the waters flowing in the ditch. If a person fails to place or maintain a proper measuring appliance, it is the duty of the water commissioner not to apportion or distribute any water through the ditch. The commissioner shall notify all parties interested by certified mail or in person 1 week before making the annual repair or cleaning of a stream or ditch or performing necessary labor or expenses to divert water to a ditch. The sending of a certified letter to the last-known post-office address of any interested party is prima facie evidence of the fact that the party was duly notified. Any work in the way of repairing a ditch made necessary by an emergency may be done without notice when injury would result from a delay."*

Many of the intake facilities in this Study do not have accurate measurement, and a few have no means of measurement. Headgates throughout the study vary in effectiveness and age. Projects that will bring irrigators into compliance with State law will rank highest in this category. Because diversions do not have impact on compliance, they will be assigned a score of 1 for this criterion.

Table 4-4: Compliance Scoring Parameters

Score	**Description**		
	Measurement	**Headgate**	**Diversion**
5	No Measurement	Inoperable headgate	N/A
4	Highly inaccurate measurement, e.g. due to multiple sources of water at measurement location	N/A	N/A
3	Inaccurate Measurement	Headgate needs improvement	N/A
1	Good Measurement	Functioning headgate	Diversions have no impact on compliance.

4.3.5. Stakeholder Engagement

Weight = 3

All stakeholders, including landowners, ditch riders, irrigators, and the District are in support of this project and willing to participate in funding procurement, design and construction of future implementation.

This Study identifies projects that will take priority as BCD continues to sponsor irrigators in obtaining grant funding. Grant funding is more likely to be awarded to projects that have a conceptual design completed and have been explored and documented in reports, such as this Study. Because only 15 projects proceed into concept design, stakeholder engagement is a key factor in deciding which irrigators are interested in collaboration with BCD to secure funding for their project. Stakeholders provided input on their assigned stakeholder score at an irrigator meeting in April 2022. Assignment of an engagement score does not commit or prohibit an irrigator to a project but does allow for a higher or lower ranking based on irrigator-provided input on level of interest for proceeding with a collaboration.

Table 4-5: Engagement Scoring Parameters

Score	**Description**
5	Very interested in collaborating to implement recommended improvements.
3	May be willing to participate in implementation of project
1	Does not want to participate with implementation of project.

4.3.6. Influence

Weight = 3

This project will benefit multiple water users, many wetted acres, and supports a significant water right.

It is important that the projects prioritized for design and funding have the largest impact on benefitting the Bitterroot River and water users. Projects that have a higher diverted flow and serve many water users will rank higher than projects that will impact only a few. Scores were based on the flow rate of the water right as a proportion of the largest diversion studied on a scale from 0-5. The largest water right in the study was Supply/Woods/Parkhurst at 202 cubic feet per second (cfs) (8080 miner's inches).

Equation 4-1: Influence Score Calculation

*Influence Score = 5 * (water right in CFS / 202)*

4.3.7. Operator Safety

Weight = 2

This project will improve conditions and increase safety during operations and maintenance for operators.

Operation and maintenance of irrigation structures often requires an operator working above moving water. To support operator safety, structures should have safety features like signage, guardrails, fencing, ladders, or safety cables incorporated and regularly maintained. Projects that will improve operator safety will score the highest in this category. Temporary diversions that require in-river construction each year will receive a higher score than diversions which require less effort and risk to prepare for summer. Measurement projects will receive a 1, as they have no safety impacts.

Table 4-6: Safety Scoring Parameters

Score	**Description**	
	Headgates	**Diversions**
5	No safety features in place, not structurally sound	Temporary, requires annual in-river construction
3	Some safety features, improvements recommended	Requires operator-placed stop logs
1	No additional safety features needed	Permanent, little maintenance needed

4.3.8. Funding Potential

Weight = 2

The cost for this project is reasonable and foreseen benefits outweigh costs over the useful life. The project meets requirements for at least one funding source.

The project cost will consider size and complexity, available funds from water users, and compatibility with funding source requirements.

Table 4-7: Funding Scoring Parameters

Score	Description
5	Compatible with multiple funding source requirements
3	Compatible with one funding source
1	Excessive cost, not compatible with funding source requirements

4.4. PROPOSED PRIORITY PROJECTS

Site visits, preliminary assessments, and standardized ranking according to the criteria described in section 4.3 were conducted at a total of 52 potential projects on 18 irrigation system intakes off the Bitterroot River. The maximum possible score was 125 and the minimum possible score was 25 (21 for flow measurements). This Study identifies and provides additional concept design for the fifteen highest-scoring projects. Table 4-8 lists the fifteen top-priority projects, their rankings, and the corresponding sections within this Chapter. Conceptual design drawings and additional engineering details for each of the top-priority projects are provided in Appendix C.

Table 4-8. Priority Projects

Rank	Ditch Name	Structure	Overall Score	Section
1	Union	Headgate	97.1	4.4.1
2	Etna	Headgate	92.8	4.4.2
3	Hoyt	Headgate	88.2	4.4.3
4	Union	Diversion	85.1	4.4.4
5	Etna	Diversion	82.8	4.4.5
6	Webfoot	Measurement	82.7	4.4.6
7	East Channel	Diversion	79.0	4.4.7
8	Spooner	Measurement	78.3	4.4.8
9	Gerlinger	Measurement	78.1	4.4.9
10	Tucker	Diversion	76.6	4.4.10
11	Tucker	Measurement	74.7	4.4.11
12	Webfoot	Headgate	72.9	4.4.12
13	Ward	Diversion	72.2	4.4.13
14	Corvallis Canal	Measurement	71.8	4.4.14
15	Overturf	Diversion	70.7	4.4.15

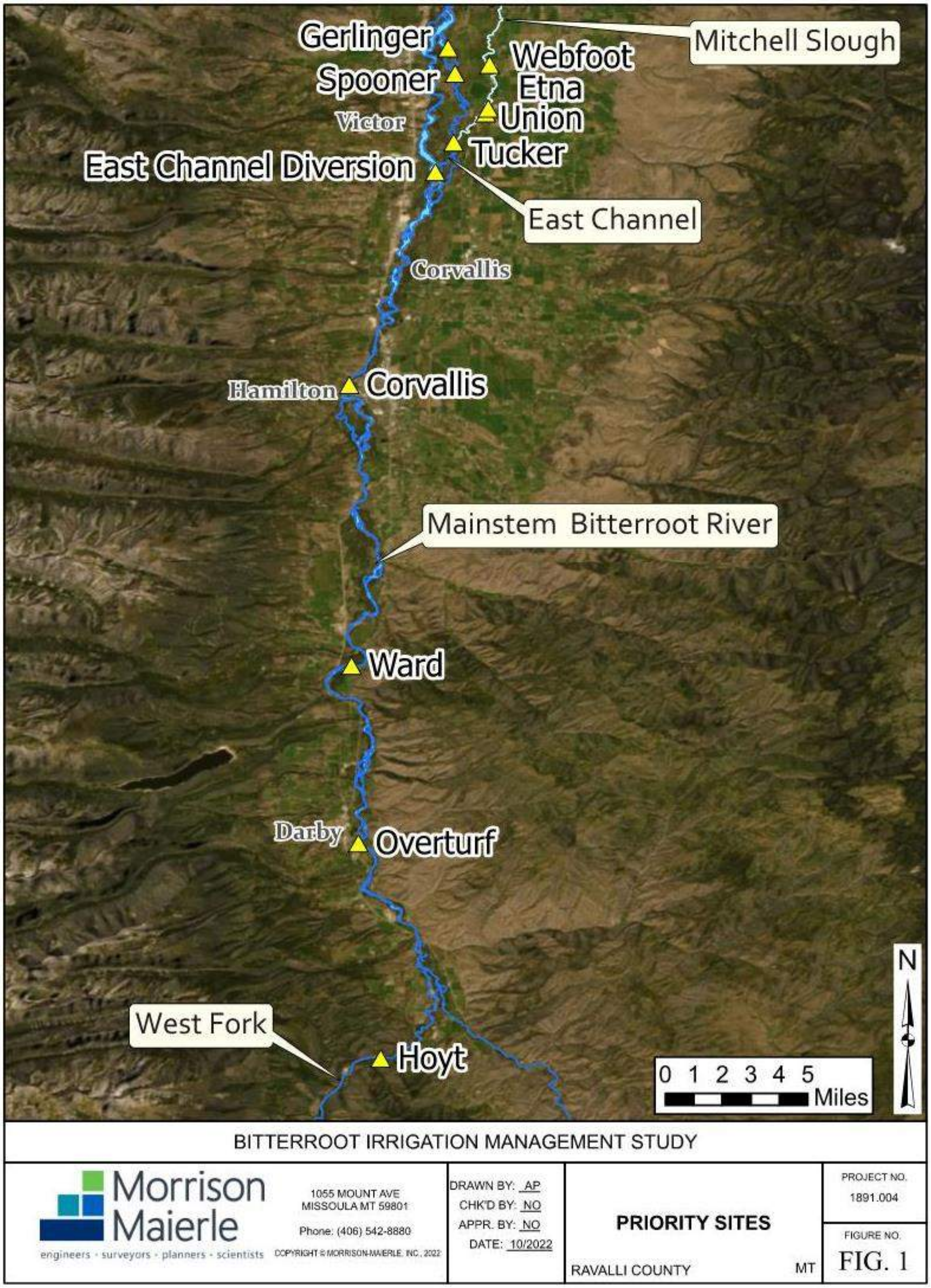


Figure 1: Map of Priority Project Locations

In developing the conceptual designs for each priority structure, the following design objectives were pursued:

- Meet or exceed the ability to convey flow compared to the existing configuration.
- Comply with Federal, State, and local laws and regulations. State regulations include Montana Code Annotated (MCA) 85-5-302 which requires that irrigators have a “suitable headgate” and “suitable…appliance for measurement”.
- Recommend structures that withstand large peak flow events. Structures would likely be designed to withstand a 100-year peak flow event.
- Provide operator safety features.
- Minimize required maintenance activities.
- Allow for operability of the structure throughout the seasons when irrigation and/or stockwater are needed.
- Develop designs that will be permittable, constructable, and cost effective.

The designs discussed in this report and the accompanying drawings are conceptual in nature and are therefore not developed enough to be considered construction ready. At all sites, detailed hydraulic modeling, scour analysis, and structural engineering are needed to finalize the designs. Several of the sites will also need sediment transport and geomorphic analyses as part of a successful design. Given that level of additional design development, the engineer’s opinions of probable cost included in Appendix C are subject to change during final design and a relatively large contingency factor of 30% is appropriate. Rather than providing a fixed cost in the following narratives, a range of potential costs are provided. More detailed estimates of probable cost of each project can only be developed through a detailed design process when the project extents and specific components are better defined.

Permit requirements for the proposed projects at the priority structures remains another uncertainty. Several larger structures will require significant permitting effort and extensive consultation with resource agencies. Even smaller projects will face some permit requirements. The Bitterroot River system supports a vibrant fishery and, therefore, many new structures or modifications to existing structures may face requirements to provide fish passage and/or entrainment mitigation measures. These potential mitigation improvements are not included in the conceptual opinions of project cost.

4.4.1. Union Headgate

Rank	Score	Estimated Project Cost
1	97.1	$126,000-$154,000

Background

The Union headgate diverts water from Mitchell Slough near Victor, Montana. The headgate is an outdated wood and concrete structure in poor condition, as discussed in Chapter 2. The concrete wingwalls, floor, and footers show signs of deterioration, including cracks and weathering. Record drawings and notes from structure installation were not available, however, the erosion of concrete at the base of the structure indicates that the concrete structure does not extend down to the scour depth, as modern design requirements would recommend. As such, the headgate is not stable and will continue to deteriorate. The headgate requires improvement and modernization in order to comply with MCA 85-5-302 standards. The structure’s life has been prolonged by retrofitting steel plates on areas of significant wear and targeted repairs. While such repairs are likely to continue as a stop-gap measure, they will not solve the underlying problems of the overall structure age and deficient design. Fixing the design deficiency would require excavating the structure foundations to allow for installation of a cutoff wall at the upstream end of the structure that extends to the expected scour depth. This level of effort would be similar for installation of a new structure and would be a large portion of the cost for any such project. Therefore, rehabilitating the structure would likely be as expensive, if not more, than installing a new structure. For this reason, the proposed project recommendation includes a full structure replacement.

Proposed Project Recommendation

A complete structure replacement is recommended because the existing structure does not meet modern design standards, is well past its reasonable service life, and would require such extensive rehabilitation that it likely would offer little to no cost savings. The new structure will consist of a concrete headwall and wingwalls keyed into the banks on both sides, a new foundation slab with a cutoff wall at the upstream end, and new internal wall that allow for mounting of new slide gates. The headwall and cutoff wall must be keyed into the ground to scour depth or frost depth, whichever is greater, to prevent future instabilities of the structure. These features are critical to prevent the erosive forces of water of cutting around or under the structure.

Because the Union system operator did not report issues with the headgates limiting flow, the existing configuration of two gate openings will be kept and sized to match the existing openings. Two new rectangular slide gates will be installed to regulate the headgates. Slide gates will be actuated by manual handwheels that will be accessible from a new metal walkway over the structure. The new metal walkway will greatly improve operator safety. Additional safety features that should be incorporated should also include toe kicks, handrails, and safety clips for harnessing during O&M activities.

1 EXISTING UNION HEADGATE

2 EXISTING UNION DIVERSION

GENERAL NOTES

1. FINAL DESIGN IS NECESSARY PRIOR TO INSTALLATION.
2. PERMITS WILL BE NECESSARY PRIOR TO INSTALLATION. REGULATORY AGENCIES MAY REQUIRE ADDITIONAL ELEMENTS NOT CURRENTLY SHOWN.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\UNION HEADGATE.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

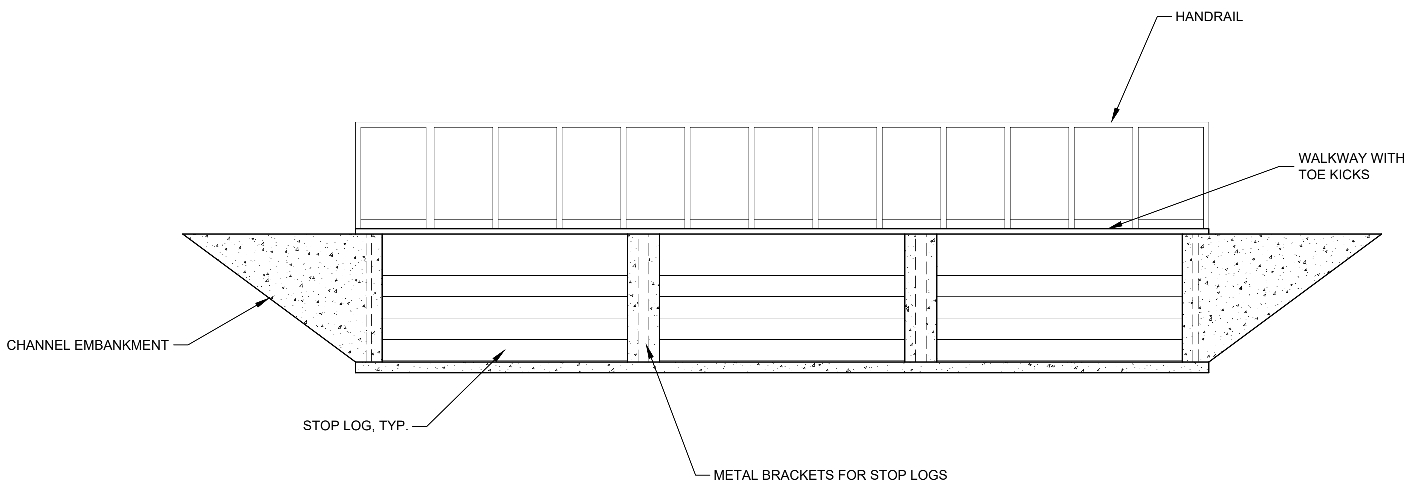
Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

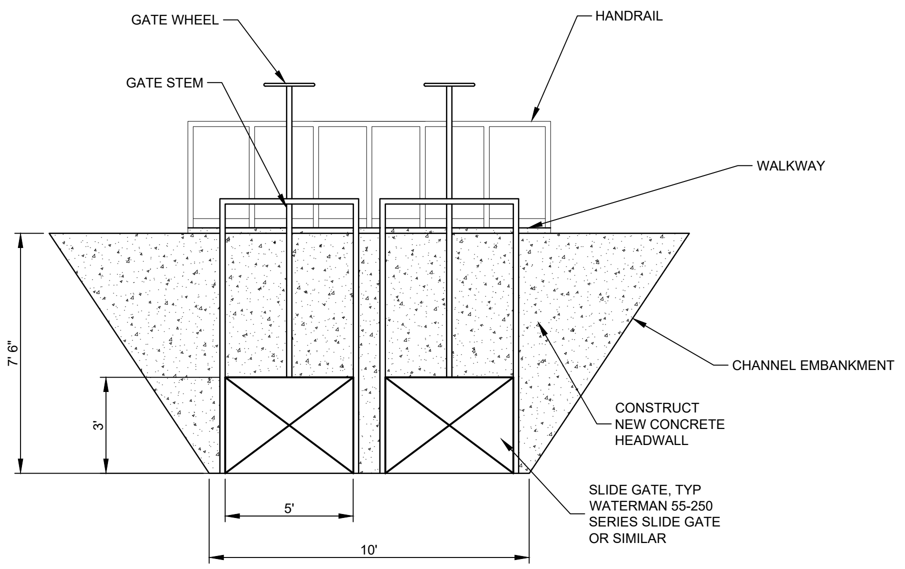
UNION HEADGATE & DIVERSION CONCEPT PLAN

PROJECT NUMBER
1891.004

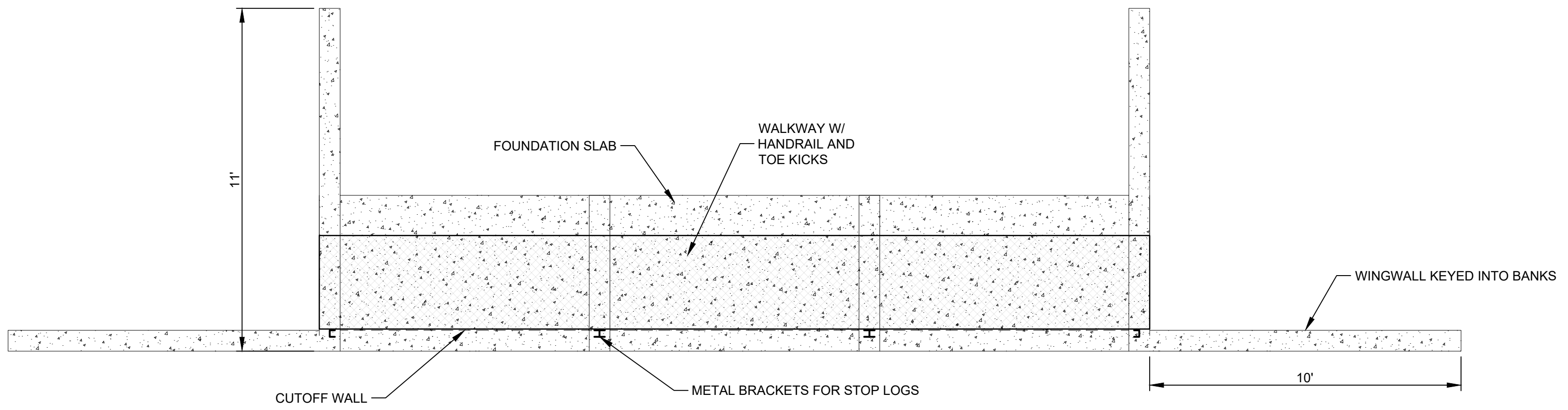
DRAWING NUMBER
11



PROFILE VIEW



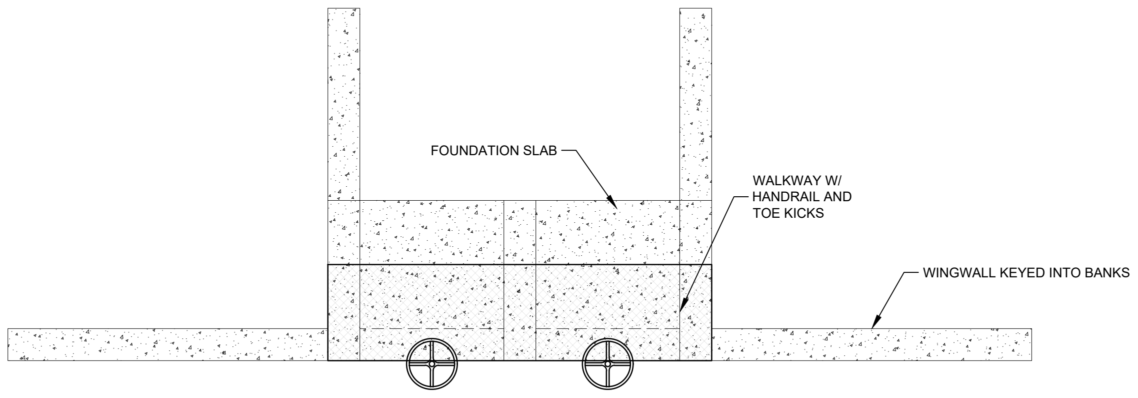
PROFILE VIEW



PLAN VIEW

1 PROPOSED UNION DIVERSION STRUCTURE
12

SCALE: 1" = 3'



PLAN VIEW

2 PROPOSED UNION HEADGATE STRUCTURE
12

SCALE: 1" = 3'

GENERAL NOTES

1. WALKWAYS TO INCLUDE HANDRAILS AND TOE KICKS.
2. OPTIONAL DENIL FISHWAY OR SIMILAR TO FACILITATE FISH PASSAGE MAY BE CONSTRUCTED ALONGSIDE DIVERSION.
3. WINGWALLS MUST TIE INTO CHANNEL BANKS AT LEAST 5' UNLESS FINAL DESIGN INDICATES OTHERWISE.
4. KEY STRUCTURE TO EXTEND DOWN TO SCOUR DEPTH OR FROST LINE WHICHEVER IS LOWER.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\UNION DIVERSION.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

UNION CONCEPT DETAILS

PROJECT NUMBER
1891.004

DRAWING NUMBER
12

4.4.2. Etna Headgate

Rank	Score	Estimated Project Cost
2	92.8	$170,000-$208,000

Description

The Etna ditch diverts water from Mitchell Slough near Victor, Montana. The Etna headgate is a concrete structure with three wooden slide gates. The structure is in poor condition with the concrete showing signs of significant deterioration, as discussed in Chapter 2. Record drawings and notes from structure installation were not available. However, the erosion of concrete at the base of the structure indicates that the concrete structure does not extend down to the scour depth, as modern design requirements would recommend. As such, the headgate is not stable and will continue to deteriorate. The structure has been maintained by retrofitting steel plates on areas of significant wear and targeted repairs. While such repairs are likely to continue as a stop-gap measure, they will not solve the underlying problems of the overall structure age and deficient design. Rehabilitating the structure to resolve the design deficiency would likely be as expensive, if not more, than installing a new structure. For this reason, the proposed project recommendation includes a full structure replacement. Any new design must allow operators to access the gate regularly, as the slide gates are adjusted by hand and debris and vegetation blockages often need to be cleared from the inlet. The wooden walkway boards are weathered and there is no handrail.

Proposed Project Recommendation

A complete structure replacement is recommended because the existing Etna headgate structure does not meet modern design standards, is well past its reasonable service life, and would require such extensive rehabilitation that it likely would offer little to no cost savings. The new structure will consist of a concrete headwall and wingwalls keyed into the banks on both sides, a new foundation slab with a cutoff wall at the upstream end, and a new internal wall that allows for mounting of new slide gates. The headwall and cutoff wall must be keyed into the ground to scour depth or frost depth, whichever is greater, to prevent future instabilities of the structure. These features are critical to prevent the erosive forces of water of cutting around or under the structure. It may be necessary to clear some vegetation that grows between the Etna headgate and diversion to complete construction, which could improve the problem of vegetation getting swept into the ditch. If this will not be sufficient, screening of the ditch inlet can be added to the design.

Because the Etna system operator did not report issues with the headgates limiting flow, the existing configuration of three gate openings will be kept and sized to match the existing openings. Three new rectangular slide gates will be installed to regulate flow through the headgate. Slide gates will be actuated by manual handwheels that will be accessible from a new metal walkway over the structure. The new metal walkway will greatly improve operator safety. Additional safety features that should be incorporated include toe kicks, handrails, and safety clips for harnessing during operations and maintenance (O&M) activities.

① EXISTING ETNA HEADGATE

② EXISTING ETNA DIVERSION

GENERAL NOTES

1. FINAL DESIGN IS NECESSARY PRIOR TO INSTALLATION.
2. PERMITS WILL BE NECESSARY PRIOR TO INSTALLATION. REGULATORY AGENCIES MAY REQUIRE ADDITIONAL ELEMENTS NOT CURRENTLY SHOWN.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\ETNA HEADGATE.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

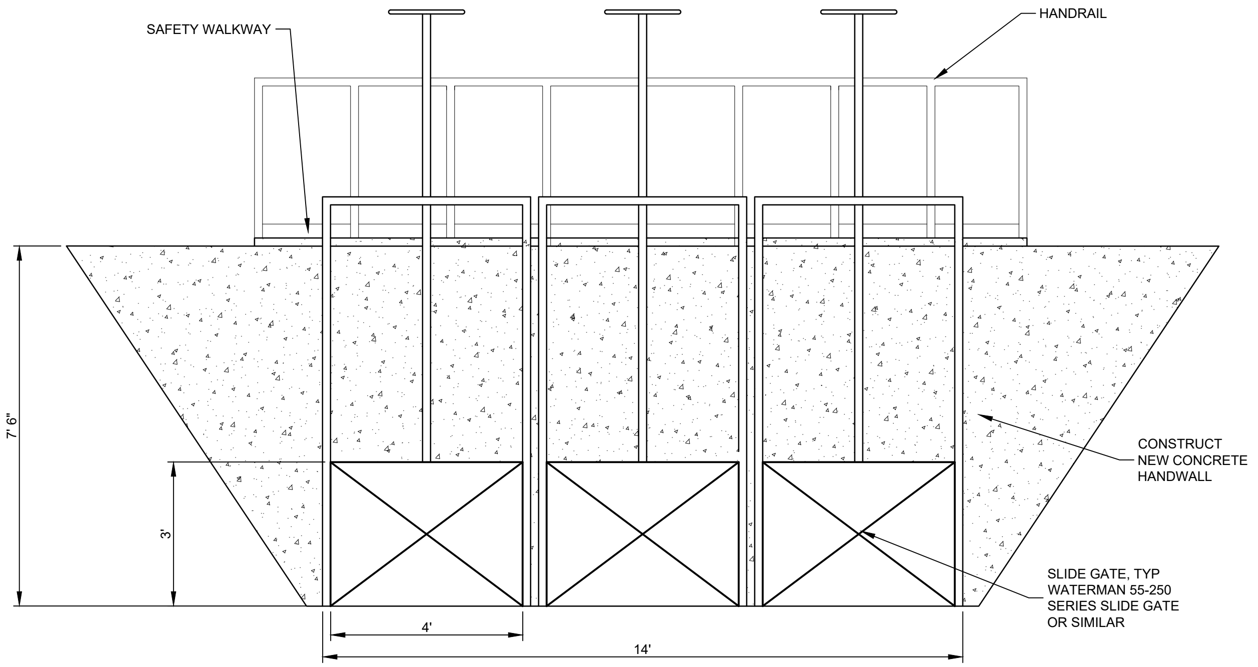
Morrison Maierle
engineers ▪ surveyors ▪ planners ▪ scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

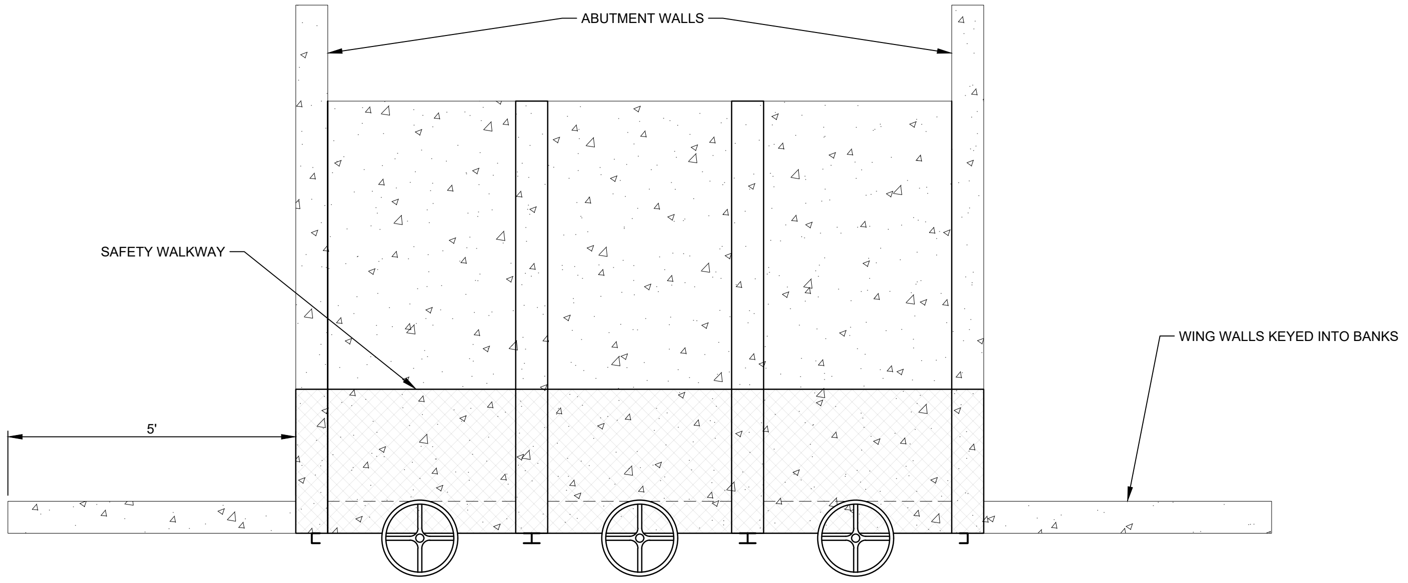
ETNA HEADGATE & DIVERSION CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
3



PROFILE VIEW

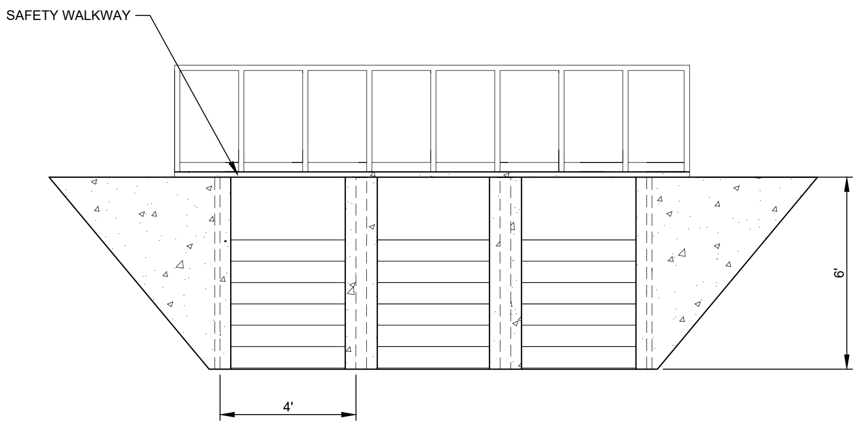


PLAN VIEW

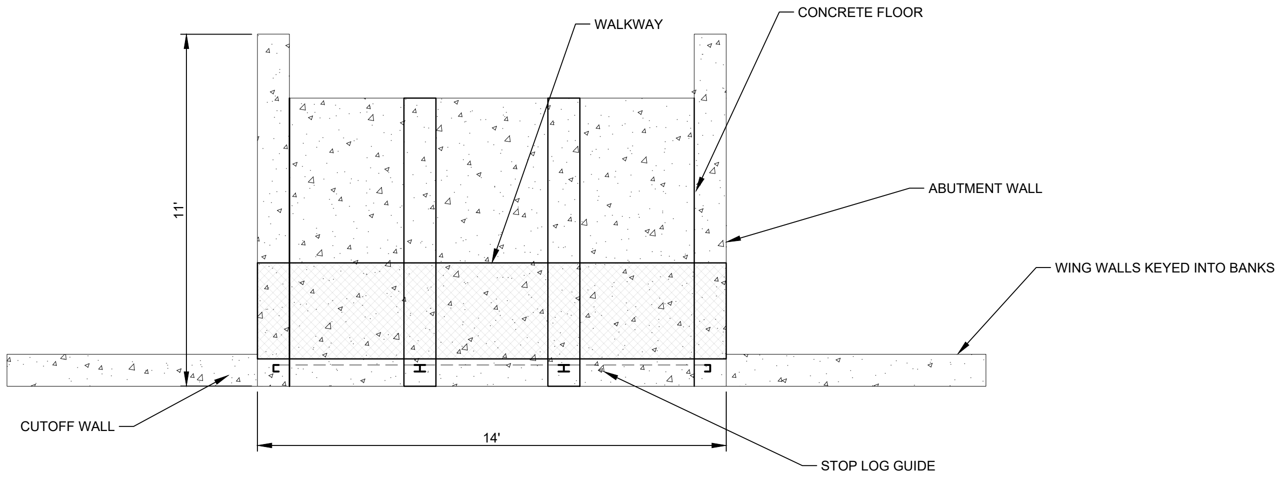
1 NEW ETNA HEADGATE

GENERAL NOTES

1. WINGWALLS MUST TIE INTO CHANNEL BANKS AT LEAST 5' UNLESS FINAL DESIGN INDICATES OTHERWISE.
2. KEY STRUCTURE MUST EXTEND TO SCOUR DEPTH OR FROST LINE, WHICHEVER IS LOWER.
3. WALKWAYS TO INCLUDE HANDRAILS AND TOE KICKS.



PROFILE VIEW



PLAN VIEW

2 NEW ETNA DIVERSION

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\ETNA DIVERSION.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

Morrison Maierle

engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

ETNA DIVERSION & HEADGATE CONCEPT DETAILS

PROJECT NUMBER
1891.004

DRAWING NUMBER
4

4.4.3. Hoyt Headgate

Rank	Score	Estimated Project Cost
3	88.2	$59,000-$72,000

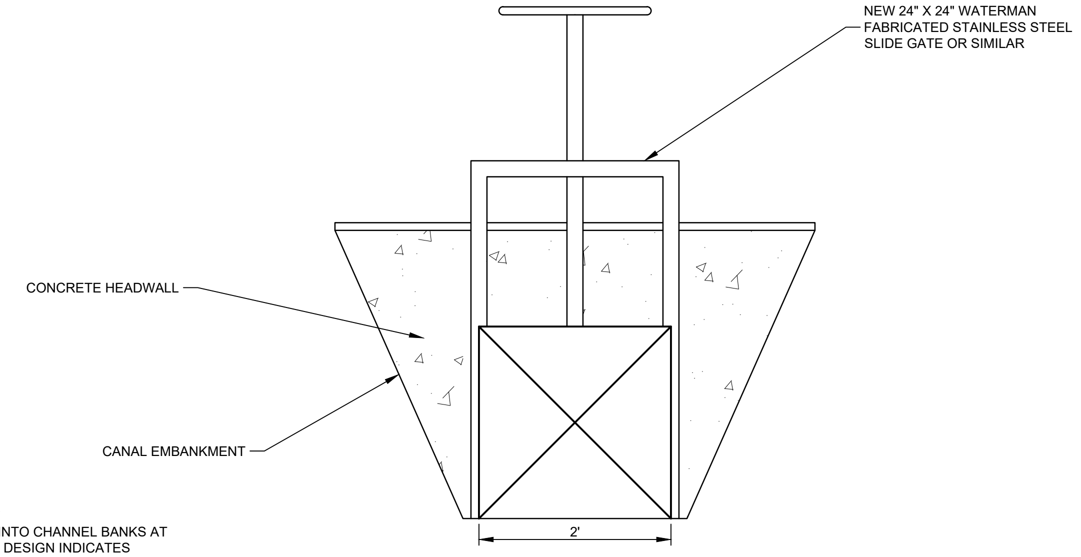
Description

The Hoyt ditch diverts water from the Orr/Hoyt canal, which is diverted from the West Fork Bitterroot River near Conner, Montana. The Hoyt headgate is a non-functional wooden structure that has no mechanism for controlling flows. The wood is rotting, warped, and there is a significant amount of debris and vegetation built up at the inlet, indicating a high risk of blockage and maintenance burden.

Proposed Project Recommendation

The wooden Hoyt headgate structure should be completely replaced with a new concrete headwall and wingwalls keyed into the banks on both sides, a new foundation slab with a cutoff wall at the upstream end, and a new handwheel operated slide gate. The headwall and cutoff wall must be keyed into the ground to scour depth or frost depth, whichever is greater, to prevent future instabilities of the structure. The structure should include a new metal walkway spanning the ditch with toe kicks, handrails, and safety clips for harnessing during operations and maintenance (O&M) activities. Although vegetation and debris has built up at the entrance the Hoyt ditch, coordination with the operators should be further pursued to understand the level of maintenance required to clear these potential blockages before pursuing a structural solution.

1 EXISTING HOYT HEADGATE



1 PROPOSED HOYT HEADGATE

GENERAL NOTES

1. WINGWALLS MUST TIE INTO CHANNEL BANKS AT LEAST 5' UNLESS FINAL DESIGN INDICATES OTHERWISE.
2. CUTOFF WALL MUST EXTEND TO SCOUR DEPTH OR FROST LINE, WHICHEVER IS LOWER.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\HOYT HEADGATE.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

HOYT HEADGATE CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
6

4.4.4. Union Diversion

Rank	Score	Estimated Project Cost
4	85.1	$83,000-$101,000

Description

The Union ditch diverts water from Mitchell Slough near Victor, Montana. The diversion consists of three concrete gate structures with stop logs placed in steel guides to regulate the water level. The structure poses a failure risk, as the bottoms of the concrete walls are deteriorating, and there is evidence of erosion due to flow eddies behind the abutment walls. The walkway consists of multiple, unsecured boards stacked across the diversion and no handrail. In particular, the erosion of concrete at the base of the structure indicates that the concrete structure does not extend down to the scour depth, as modern design requirements would recommend. As such, the headgate is not stable and will continue to deteriorate. Record drawings and notes from structure installation were not available; however, it appears that the concrete may be greater than 75 years old, which would be past its intended design life. Fixing the existing diversion would require excavating the structure foundations to allow for installation of a cutoff wall at the upstream end of the structure that extends to the expected scour depth. This level of effort would be similar for installation of a new structure and would be a large portion of the cost for any such project. Therefore, rehabilitating the structure would likely be as expensive, if not more, than installing a new structure.

Proposed Project Recommendation

A new concrete structure is proposed to replace the original, dated Union diversion. The proposed structure may be configured with similar dimensions as the original, including the same number of bays, span of bay openings, and elevation. The proposed bay openings are four-feet high and eight-feet wide for each of the three bays. However, it is critical that the new structure walls be keyed into the ground to scour depth or frost depth, whichever is greater, to prevent future instabilities of the structure. Other key features include wing walls and subsurface cutoff walls, both of which will prevent the erosive forces of water from cutting around or under the structure. The proposed abutments walls should include channel stabilization to prevent erosion and to stabilize the bank and structure. The concrete mix design, wall thickness, and structural reinforcement should consider water forces presented on the structure. Safety features that should be incorporated include a stable walkway with toe kicks, handrails, and safety clips for harnessing during installation and removal of stop logs. For elevation control, stoplogs with slide rails can be used or, alternatively, slide gates with operators may be considered as an alternate to stop logs. If fish passage is sought in the future or is required for permitting, the design could consider provisions to accommodate a Denil fish ladder.

4.4.5. Etna Diversion

Rank	Score	Estimated Project Cost
5	82.8	$127,000-$156,000

Description

The Etna ditch diverts water from Mitchell Slough near Victor, MT. The diversion is comprised of a concrete check-dam with wooden stop logs. The stop logs are installed manually each irrigation season into four concrete openings in the check-dam. Early session elevation adjustments using stoplogs is difficult due to the pressure of flowing water against them. The walkway that accesses the stoplogs consists of wooden planks and lacks a handrail. The concrete structure itself is unstable; several of the walls that separate the gate openings are deteriorating on the downstream side, with the lower portions of the walls missing 1-2’ of concrete and augmented with steel plates. Further erosion and concrete failure are likely. The walkway is made of wooden boards laid across the check-dam and has no handrail. In particular, the erosion of concrete at the base of the structure indicates that it was incorrectly installed above scour depth; as such, the headgate is not hydraulically stable and will continue to deteriorate. Record drawings and notes from structure installation were not available; however, it is anticipated that the structure is greater than 75 years old and exceeds the expected design life for concrete. Regardless, rehabilitating the structure and installing it at sufficient depth would likely be more expensive than installing a new structure.

Proposed Project Recommendation

A new concrete structure is proposed to replace the original, dated Etna diversion. The proposed structure may be configured with similar dimensions as the original, including the same number of bays, span of bay openings, and elevation. However, it is critical that the new structure walls be keyed into the ground to scour depth or frost depth, whichever is greater, to prevent future instabilities of the structure. Other key features include wing walls and subsurface cutoff walls, both of which will prevent the erosive forces of water cutting around or under the structure. The concrete mix design, wall thickness, and structural reinforcement should consider water forces presented on the structure. Safety features that should be incorporated include a stable walkway with toe kicks, handrails, and safety clips for harnessing during installation and removal of stop logs. For elevation control, stoplogs with slide rails can be used or, alternatively, slide gates actuated by manual handwheels may be considered as an alternative to stop logs. If fish passage is sought in the future or required for permitting, the design could consider provisions to accommodate a Denil fish ladder.

4.4.6. Webfoot Flow Measurement

Rank	Score	Estimated Project Cost
6	82.7	$20,000 - $25,000

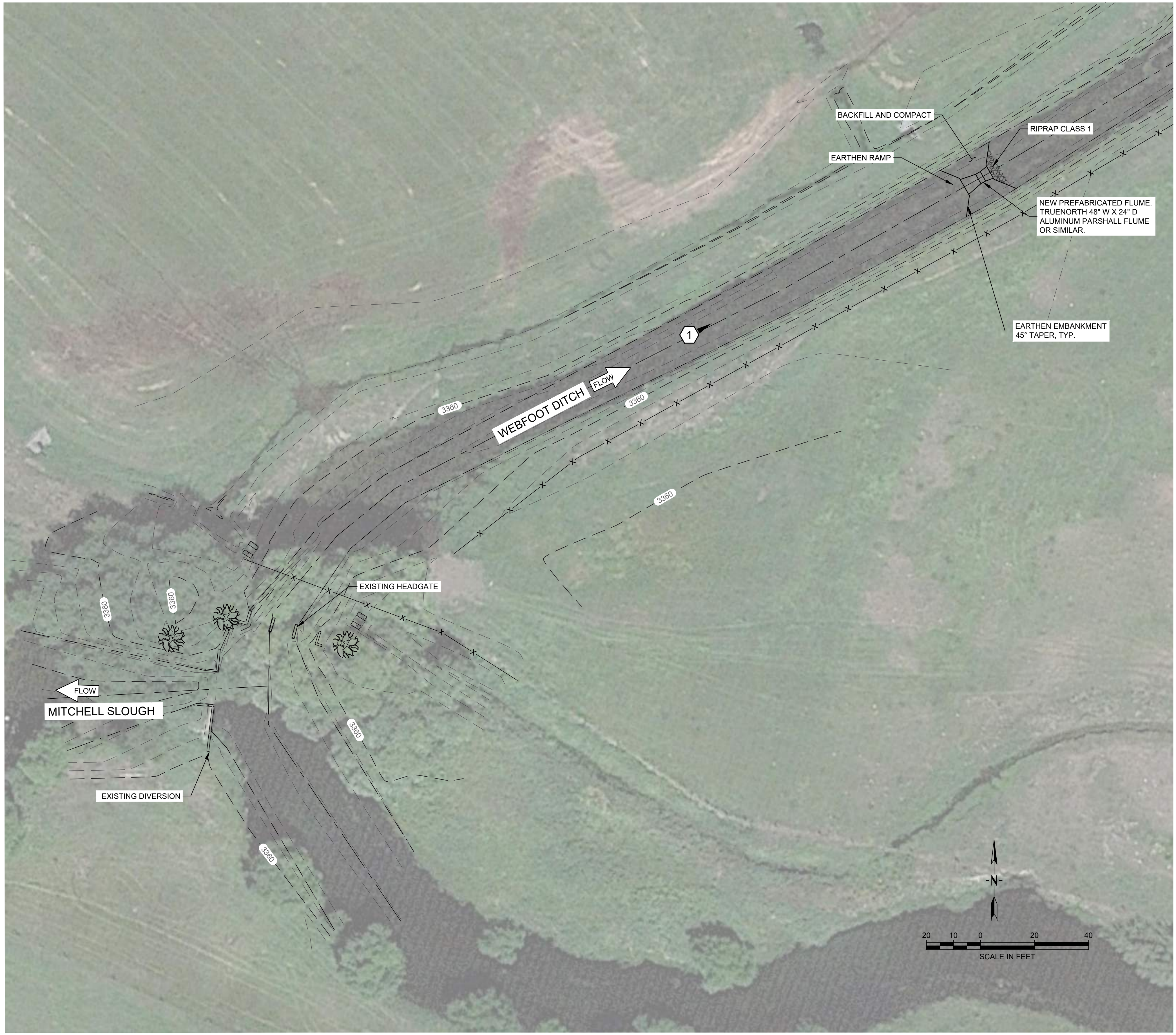
Description

Webfoot Ditch Company is the last irrigation diversion off Mitchell Slough near Victor Crossing; it currently has no flow measurement device. The ditch is relatively wide with minimal grade drop and exhibits excessive vegetation in the ditch during late summer flows. The ditch has a water right of 40 cfs, and discharge was measured at 11.1 cfs in July 2022.

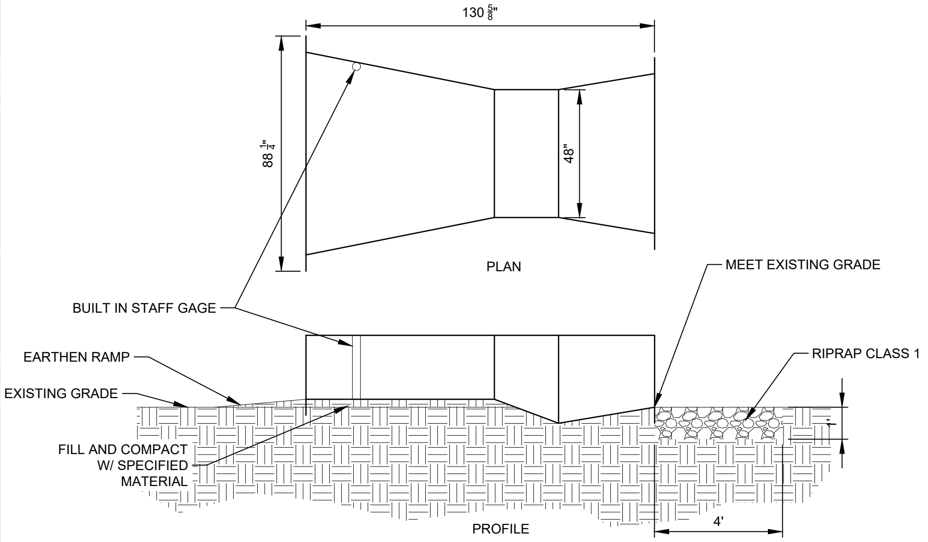
Proposed Project Recommendation

The recommended approach for providing long-term, accurate, and compliant flow measurement at Webfoot ditch is installing a prefabricated Parshall flume. A 48-inch throat width by 24-inch depth Parshall flume is available from TrueNorth Steel for a significantly lower cost than out-of-state suppliers. This size flume accommodates the provided water right of 40 cfs; however, if flows in Webfoot ditch are consistently lower, a smaller flume may be chosen to reduce material costs. The flume comes with a staff gage and a stage-discharge rating curve; this is necessary to facilitate interpretation of water levels in the flume as flow rates in cfs or miner's inches. The flume should be installed in an accessible, stable, straight and uniform section as close to the headgate as achievable in the Webfoot ditch. For this site, it is recommended that the flume be located approximately 300 feet downgradient of the headgate. The flume must also be carefully installed to ensure proper functioning, which includes grade control and sufficient subgrade compaction.

In lieu of a flume, irrigators may install a staff gage in a stable, uniform section of channel and develop the associated stage-discharge relationship necessary for interpreting the staff gage. However, this method is less accurate than a flume, and if technical services are required to develop the stage-discharge relationship, this alternative may still require significant effort. Because the channel cross section at the staff gage may change over time, it would be recommended that the stage-discharge curve be occasionally checked for accuracy using a handheld flow meter.



⟨1⟩ WEBFOOT FLOW MEASUREMENT



PROPOSED PARSHALL FLUME

GENERAL NOTES

1. BEDDING BENEATH THE FLUME MUST BE COMPACTED AND LEVELED PRIOR TO INSTALLATION.
2. WING WALLS MUST TIE INTO CHANNEL BANKS AT 45° ANGLES AND MAY BE PREFABRICATED W/ FLUME OR CONSTRUCTED FROM CONCRETE OR EARTH.
3. INSTALL OUTLET OF FLUME AT EXISTING GRADE. RAMP BEDDING MATERIAL UP TO ELEVATION OF FLUME INLET.
4. CENTER FLUME IN CHANNEL AND ENSURE LATERALLY LEVEL.
5. BACKFILL MATERIAL SHALL INCLUDE A MINIMUM 20% FINES COMPONENT WITH A PLASTICITY INDEX OF GREATER THAN 7 PER USBR EMBANKMENT RECOMMENDATIONS OR BY RECOMMENDATION OF ENGINEER.
6. EXCAVATE AND PLACE CLASS 1 RIP RAP 1' DEEP TO REINFORCE CHANNEL BED AT FLUME OUTLET.
7. CLEAR AQUATIC VEGETATION FROM FLUME INLET/OUTLET AS REQUIRED.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED.
LINE BELOW MEASURES ONE INCH
ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\WEBFOOT MEASUREMENT.DWG PLOTTED BY:STEPHEN MURPHY ON

Bitterroot Conservation District

Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

WEBFOOT FLOW MEASUREMENT CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
15

4.4.7. East Channel Diversion

Rank	Score	Estimated project cost
7	79.0	$3,800/year

Description

There are numerous water rights entitlements served by the East Channel diversion, both on the East Channel of the Bitterroot River (Bill Strange, Spooner, and Gerlinger Ditches) and on Mitchell Slough (Etna, Union, and Webfoot Ditches) near Victor, MT. However, due to the dynamic nature of the Bitterroot River, the East Channel and Mitchell Slough typically receive insufficient water to satisfy water right claims late in the irrigation season. The purpose of the East Channel diversion is to augment flows in the East Channel with water from the western (main) channel of the Bitterroot; in turn, the East Channel delivers water to Mitchell Slough at the Tucker headgate. Though this diversion does not include a headgate or measurement device, it has been considered as a potential project given its significant impact on other systems.

Currently, the diversion is in poor condition, making it an ongoing challenging to maintain sufficient flows in the East Channel and Mitchell Slough. The current strategy, as reflected in the Etna, Union, and Webfoot Ditch Company’s 310 maintenance permit, is to build a temporary check structure of native cobbles and gravel on the right (east) side of the main channel. While early season high flows are typically sufficient for irrigation needs, these flows contribute to sedimentation in the East Channel near the diversion, which creates challenges for maintaining sufficient flows. Irrigators report that while their maintenance permit allows for 1,500 cubic yards of excavation per year, more is needed.

As can be seen in the Figure 2, the main channel in the vicinity of the East Channel diversion is also highly dynamic, as evidenced by the high depositional rates, depositional features, side channels, braiding, and high bank erosion rates, and prompt failure of a diversion structure installed in 1998. Because the main channel is prone to migration, any diversion structures should span the active channel zone as well as the channel migration zone to reduce the risk of failure.

Proposed Project Recommendation

The East Channel Diversion was analyzed and design alternatives were proposed by Morrison-Maierle in early 2022, as well as by Wildland Hydrology in 2008. Wildland Hydrology recommended the construction of a new diversion in the upgradient vicinity of the existing diversion location. This approach was later determined to be infeasible due to land ownership in the vicinity. The following feasible alternatives identified in the 2022 study were:

- Enhanced O&M: This approach involves placement of a temporary weir constructed of native channel materials at the mouth of the East Channel directing water (and therefore sediment) away from the East Channel during high water. Later in the season, the weir material should be moved and used to build a diversion to direct water towards the East Channel as additional flows become necessary. This option has the lowest risk of failure and has a much lower up-front cost than any structural solution. The current permits should be modified to allow for moving up 3,100 CY of material each season. This volume corresponds to several feet of sedimentation in the first thousand feet of the East Channel.

- W-rock weir: A new W-rock weir could be constructed to direct flows in conjunction with a new downstream weir for grade control. This structure should be sized to cross the entire channel migration zone and should use larger rocks; this should make it more successful than the previously constructed rock weir. However, the system is sufficiently dynamic that this solution is unlikely to be dependable in the long term; this approach is also high cost (~$3.5 million).
- Adjustable weir: An adjustable permanent weir could be installed at the location of the existing diversion for approximately $2.7 million. A solid foundation, such as a concrete slab, would be installed at grade. Adjustable stop logs or an inflatable air bladder dam would allow for sediment to pass at high flows and for the diversion of water during low flows. However, this structure would need to span beyond the channel migration zone, leading to high costs and potential permitting challenges.

Regardless, additional study would be required for any structural solution proposed at this site.

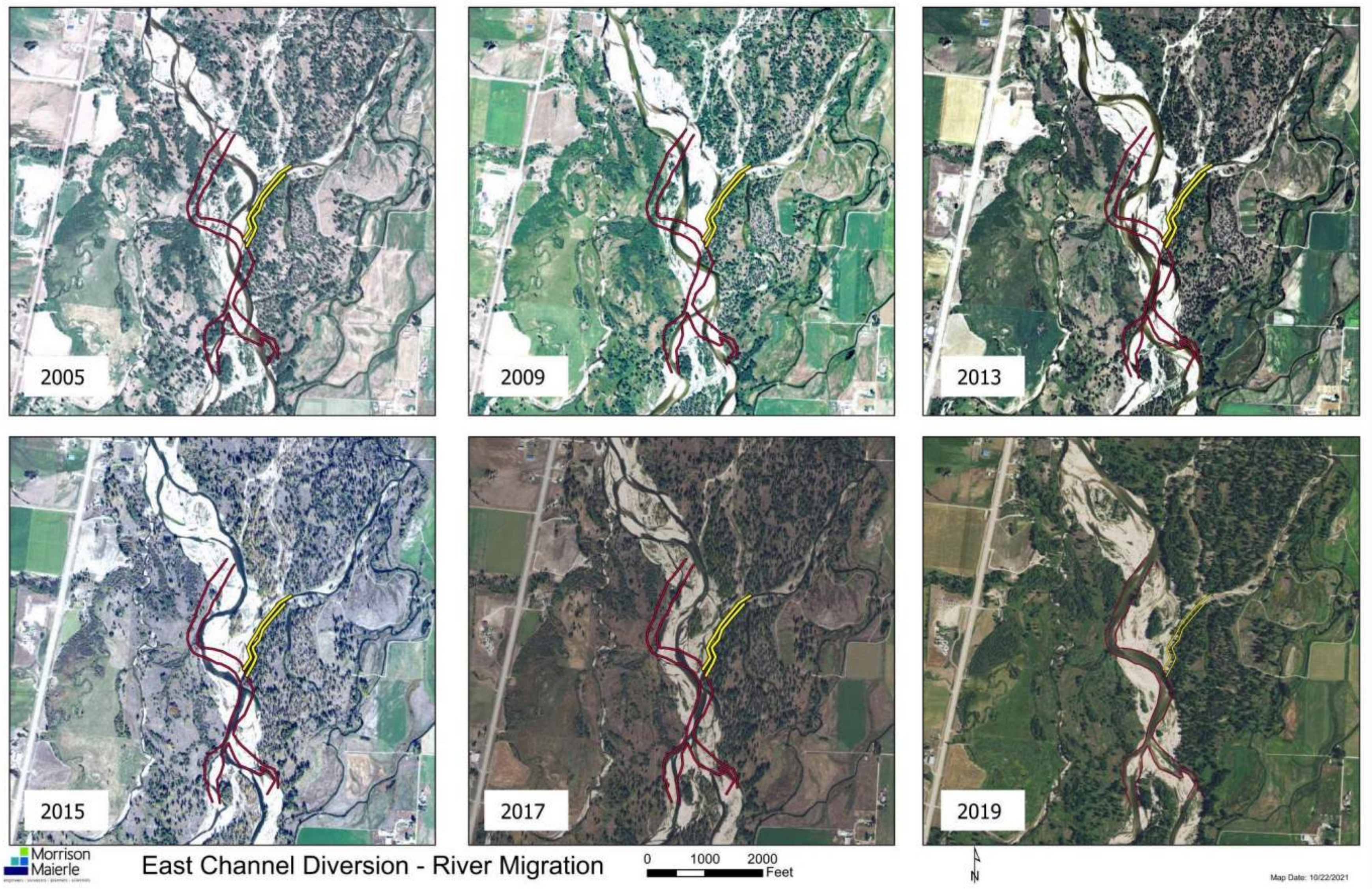


Figure 2: Channel Migration at East Channel Diversion.

Yellow lines show the location of the East Channel and the red lines show the location of the main channel in 2019.

1 EAST CHANNEL DIVERSION

2 PREVIOUS ROCK DIVERSION

GENERAL NOTES

1. PERMITS WILL BE NECESSARY TO ADOPT NEW MAINTENANCE STRATEGY. REGULATORY AGENCIES MAY REQUIRE ADDITIONAL ELEMENTS NOT CURRENTLY SHOWN.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED.
LINE BELOW MEASURES ONE INCH
ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\EAST-CHANNEL-DIVERSION.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/03/2022

Bitterroot
Conservation
District

Morrison
Maierle
engineers ▪ surveyors ▪ planners ▪ scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

EAST CHANNEL DIVERSION CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
2

4.4.8. Spooner Flow Measurement

Rank	Score	Estimated Project Cost
8	78.3	$15,000 - $19,000

Description

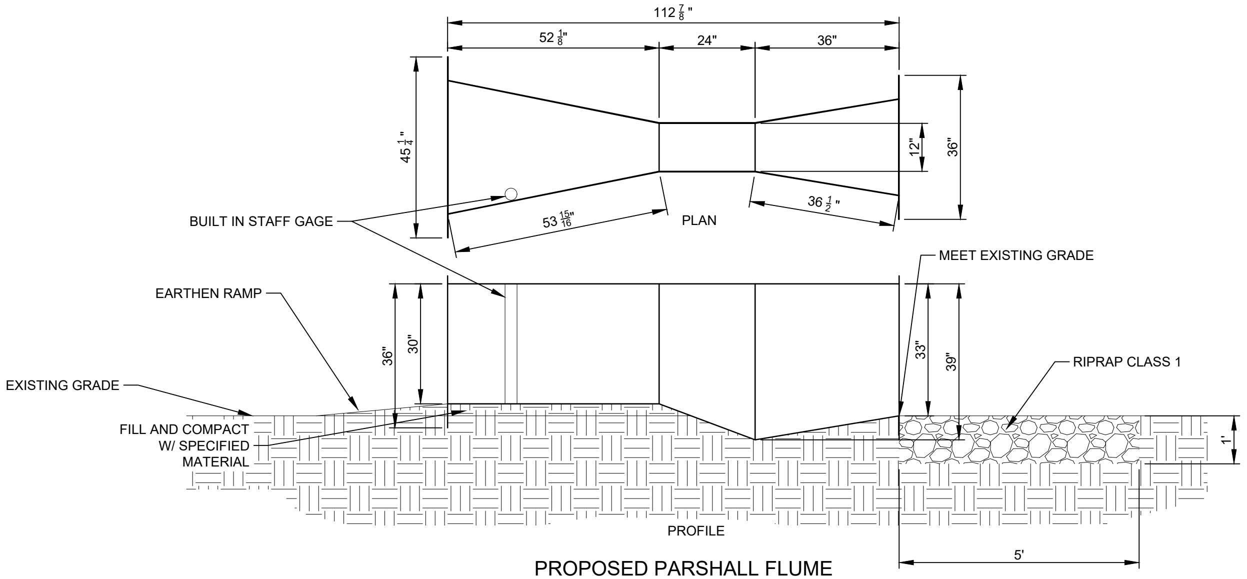
Spooner ditch diverts water from the East Channel of the Bitterroot River just upstream of Victor Crossing; it currently has no flow measurement device. The ditch has a water right of 14 cfs.

Proposed Project Recommendation

The recommended approach for providing long-term, accurate, and compliant flow measurement at Spooner ditch is installing a prefabricated Parshall flume. A 12-inch throat width by 30-inch depth Parshall flume will accommodate flows in Spooner ditch and is available from TrueNorth Steel for a significantly lower cost than out-of-state suppliers. The flume comes with a staff gage and a stage-discharge rating curve; this is necessary to facilitate interpretation of water levels in the flume as flow rates in cfs or miner's inches. The flume should be installed in an accessible, stable, straight, and uniform section as close to the headgate as achievable. To avoid interfering with the hydraulic functioning of the headgate, it is recommended that the flume be installed where the existing bed elevation is at least three inches lower than the elevation of the intake structure invert. This criterion was not met within the area surveyed for this project. Therefore, a conceptual location for the flume was identified that likely has an acceptable elevation. However, prior to installation, this section of channel should be surveyed for grade, uniformity, and stability. The flume must also be carefully installed to ensure proper functioning, which includes grade control and sufficient subgrade compaction.

In lieu of a flume, irrigators may install a staff gage in a stable, uniform section of channel and develop the associated stage-discharge relationship necessary for interpreting the staff gage. However, this method is less accurate than a flume, and if technical services are required to develop the stage-discharge relationship, this alternative may still require significant effort. Because the channel cross section at the staff gage may change over time, it is also recommended that the stage-discharge curve be occasionally checked for accuracy using a handheld flow meter.

1 SPOONER HEADGATE



PROPOSED PARSHALL FLUME

GENERAL NOTES

1. BEDDING BENEATH THE FLUME MUST BE COMPACTED AND LEVELED PRIOR TO INSTALLATION.
2. WING WALLS MUST TIE INTO CHANNEL BANKS AT 45° ANGLES AND MAY BE PREFABRICATED W/ FLUME OR CONSTRUCTED FROM CONCRETE OR EARTH.
3. INSTALL OUTLET OF FLUME AT EXISTING GRADE. RAMP BEDDING MATERIAL UP TO ELEVATION OF FLUME INLET.
4. CENTER FLUME IN CHANNEL AND ENSURE LATERALLY LEVEL.
5. BACKFILL MATERIAL SHALL INCLUDE A MINIMUM 20% FINES COMPONENT WITH A PLASTICITY INDEX OF GREATER THAN 7 PER USBR EMBANKMENT RECOMMENDATIONS OR BY RECOMMENDATION OF ENGINEER.
6. EXCAVATE AND PLACE CLASS 1 RIP RAP 1' DEEP TO REINFORCE CHANNEL BED AT FLUME OUTLET.
7. PROPOSED FLUME LOCATION IS CONCEPTUAL. VERIFY WITH ADDITIONAL SURVEY AND FINAL DESIGN.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\SPOONER MEASUREMENT.DWG PLOTTED BY:STEPHEN MURPHY ON

Bitterroot Conservation District

Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

SPOONER FLOW MEASUREMENT CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
8

4.4.9. Gerlinger Flow Measurement

Rank	Score	Estimated Project Cost
9	78.1	$14,000 - $17,000

Description

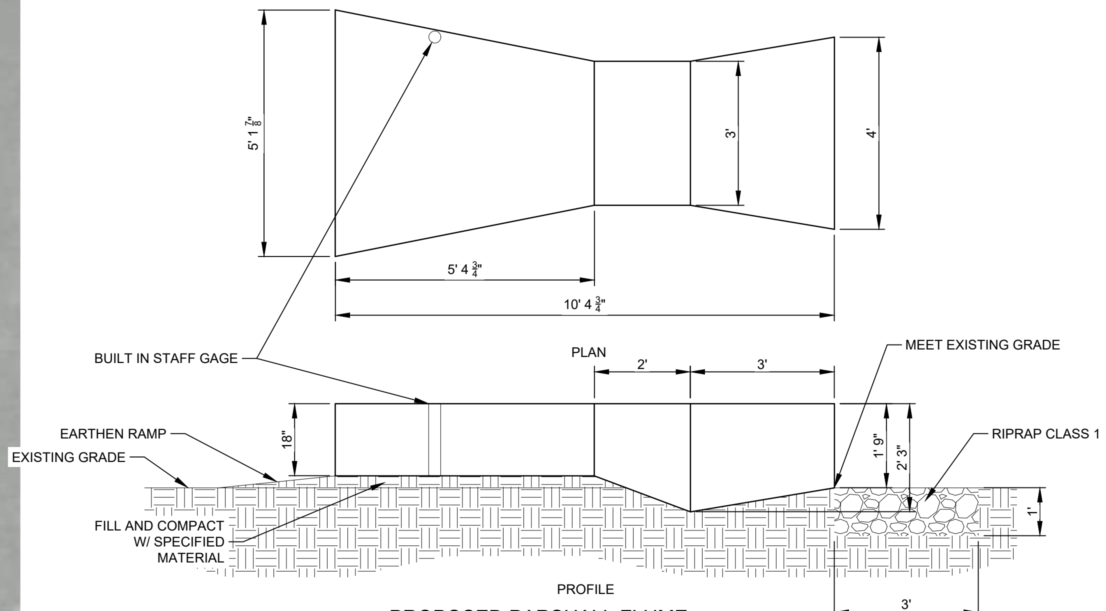
The Gerlinger ditch is the furthest downstream diversion on the East Channel. The ditch has a water right of 12.5 cfs, and flow was measured at 20.0 cfs in July 2022. There is currently no flow measurement device.

Proposed Project Recommendation

The recommended approach for providing long-term, accurate, and compliant flow measurement at Gerlinger ditch is installing a prefabricated Parshall flume. A 36-inch throat width by 18-inch depth Parshall flume available from TrueNorth Steel will accommodate the observed flow of 20.0 cfs; however, if typical flows are less than this value, a smaller flume may be used to save on costs. The flume comes with a staff gage and a stage-discharge rating curve; this is necessary to facilitate interpretation of water levels in the flume as flow rates in cfs or miner's inches. The flume should be installed in an accessible, stable, straight, and uniform section as close to the headgate as achievable. To avoid interfering with the hydraulic functioning of the headgate, it is recommended that the flume be installed where the existing bed elevation is at least three inches lower than the elevation of the intake structure invert. This criterion was not met within the area surveyed for this project. Therefore, a conceptual location for the flume was identified that likely an acceptable elevation. However, prior to installation, this section of channel should be investigated for grade, uniformity, and stability. The flume must also be carefully installed to ensure proper functioning, which includes grade control and sufficient subgrade compaction. Detailed installation notes, as well as a proposed location for the flume, are provided in the drawing. Cost estimate details are available in Appendix B.

In lieu of a flume, irrigators may install a staff gage in a stable, uniform section of channel and develop the associated stage-discharge relationship necessary for interpreting the staff gage. However, this method is less accurate than a flume, and if technical services are required to develop the stage-discharge relationship, this alternative may still require significant effort. It should be noted that 2-point velocity measurements may be required to calibrate the stage-discharge curve, as water levels in the ditch are over 2 feet at some flows. Because the channel cross section at the staff gage may change over time, it is also recommended that the stage-discharge curve be occasionally checked for accuracy using a handheld flow meter.

1 PROPOSED FLUME LOCATION



PROPOSED PARSHALL FLUME

GENERAL NOTES

1. BEDDING BENEATH THE FLUME MUST BE COMPACTED AND LEVELED PRIOR TO INSTALLATION.
2. WING WALLS MUST TIE INTO CHANNEL BANKS AT 45° ANGLES AND MAY BE PREFABRICATED W/ FLUME OR CONSTRUCTED FROM CONCRETE OR EARTH.
3. INSTALL OUTLET OF FLUME AT EXISTING GRADE. RAMP BEDDING MATERIAL UP TO ELEVATION OF FLUME INLET.
4. CENTER FLUME IN CHANNEL AND ENSURE LATERALLY LEVEL.
5. BACKFILL MATERIAL SHALL INCLUDE A MINIMUM 20% FINES COMPONENT WITH A PLASTICITY INDEX OF GREATER THAN 7 PER USBR EMBANKMENT RECOMMENDATIONS OR BY RECOMMENDATION OF ENGINEER.
6. EXCAVATE AND PLACE CLASS 1 RIP RAP 1' DEEP TO REINFORCE CHANNEL BED AT FLUME OUTLET.
7. PROPOSED FLUME LOCATION OS CONCEPTUAL. VERIFY WITH ADDITIONAL SURVEY AND FINAL DESIGN.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED.
LINE BELOW MEASURES ONE INCH
ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\GERLINGE MEASURMENT.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/03/2022

Bitterroot Conservation District

Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

GERLINGER FLOW MEASUREMENT

PROJECT NUMBER
1891.004

DRAWING NUMBER
5

4.4.10. Tucker Diversion

Rank	Score	Estimated Project Cost
10	76.6	$374,000 - $457,000

Description

The Tucker intake is the first diversion from the East Channel and delivers water into Mitchell Slough, which serves numerous irrigation systems including Union, Etna, Webfoot, and other large ranches. The diversion structure is in fair condition; concrete eco-blocks are installed each spring to direct water towards the Tucker headgate, and gravel is used to fill the gaps between the eco-blocks. The annual installation and removal costs approximately $3,000 associated with primarily labor and equipment to remove and install the concrete blocks, but low water levels in the East Channel can still limit the effectiveness of the diversion. The existing diversion presents challenges due to aggradation (sediment deposition) upgradient of the concrete eco-block diversion, which can impede flow through the Tucker headgate. It is necessary to remove the structure post season to prevent continued aggradation. The eco-blocks are installed after spring runoff as sufficient water surface elevations are present without the use of the concrete blocks during high water. In addition, the stability of the eco-blocks is at risk during the higher flows of spring runoff. This diversion has one of the largest cumulative water rights of those surveyed, and therefore improvements to this structure will be relatively impactful for users and in terms of water management.

Proposed Project Recommendation

The proposed recommendation for the Tucker diversion is an adjustable diversion. An adjustable diversion is necessary to allow passage of high water associated with sediment transport by removing the diversion structure and allows for grade control during mid- and late-irrigation season flows through installation of the diversion structure. The existing eco-block concrete diversion is classified as an adjustable diversion; however, the challenges associated with the functionality of the structure include lack of incremental grade control through the ability to set only one elevation that is associated with the top of block, seepage between the concrete eco-blocks and stability of the eco-blocks during higher flow conditions. While aggradation and sediment issues will exist regardless of a permanent or adjustable diversion, the ability to adjust (lower) the diversion during portions of the year will allow for some natural flushing processes to mobilize some sediment and reduce the potential for additional sediment accumulations. Options for adjustable diversions include a stop log system as a lower cost solution or an inflatable rubber bladder diversion as a higher cost solution. These options present unique considerations, and for the purposes of this report, the lower cost stop log diversion is discussed.

An adjustable diversion using stop logs requires a concrete slab to control grade, create a level plane for the stop logs, and prevent scour from spill-over from the diversion. The concrete slab should include structural reinforcement and be keyed to scour depth with a cut off wall to prevent undercutting of the structure. The slab should be bound by concrete abutment walls to contain flow. Stop logs are installed using break-over jacks to support the stop logs when erect and fold down to reduce obstacles in the waterway when not in use. The stop log length should be set at increments to be maneuverable, and the height of the stop logs will allow for variability in water surface level control compared to the single height concrete blocks. An operation plan should be developed to outline safety procedures during installation and removal.

An inflatable bladder diversion dam, similar to the Obermeyer hydro dam, is also a desirable option, as it would allow for deployment during the relatively high water at midseason and eliminate the need to enter the channel to operate the diversion, which is a safety enhancement. The inflatable diversion dam would require a power source to operate the pneumatic system. Design of the bladder would consider protection against scour and damage from bedload. Selection between stop log and inflatable diversion should be based on detailed hydraulic and sediment transport analysis, cost optimization, and consultation with permit agencies.

Due to the width and relatively low gradient of the channel, a permanent diversion structure with sluice gate options for sediment removal is not recommended.

4.4.11. Tucker Flow Measurement

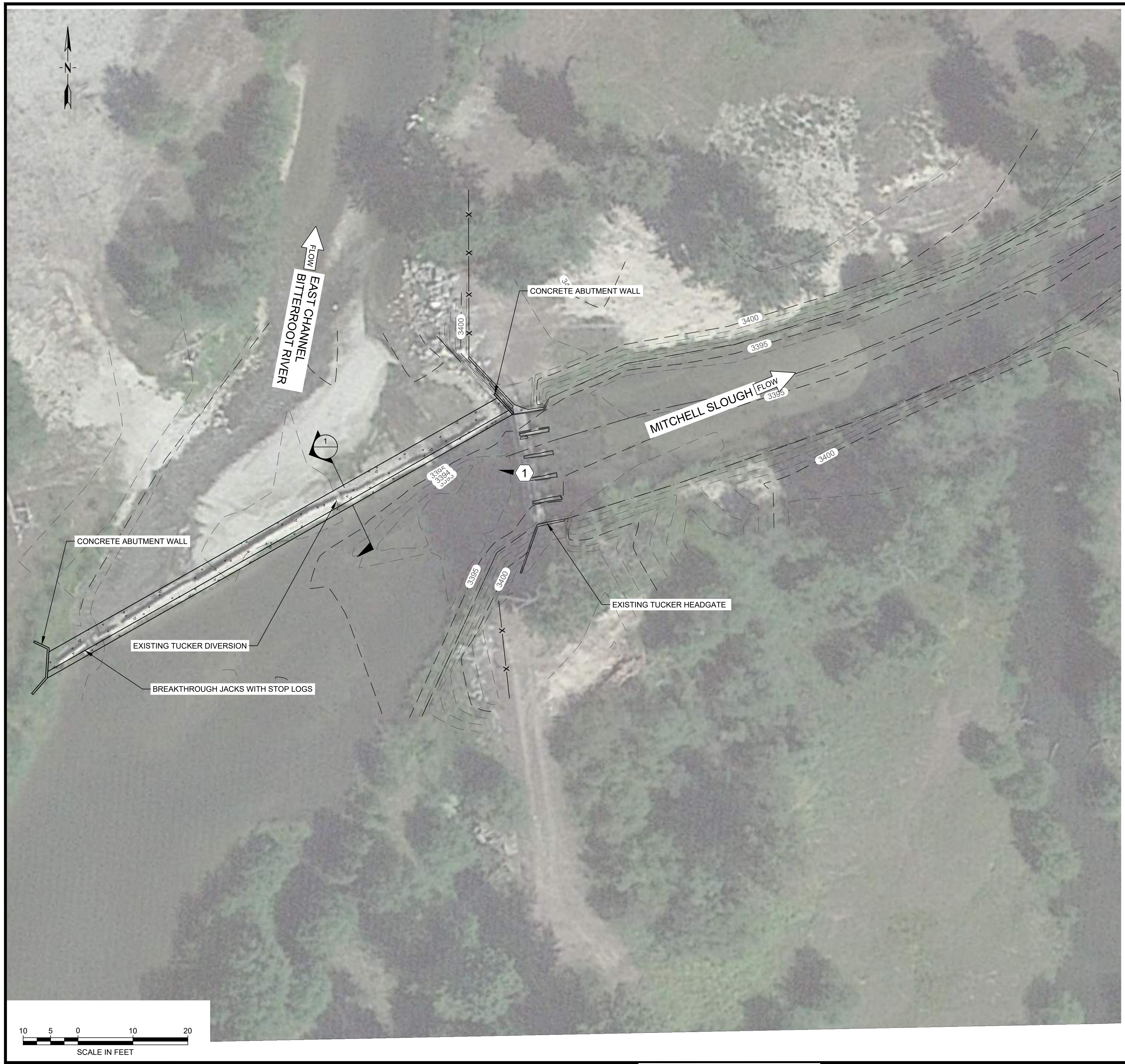
Rank	Score	Estimated Project Cost
11	74.7	$12,000-$15,000

Description

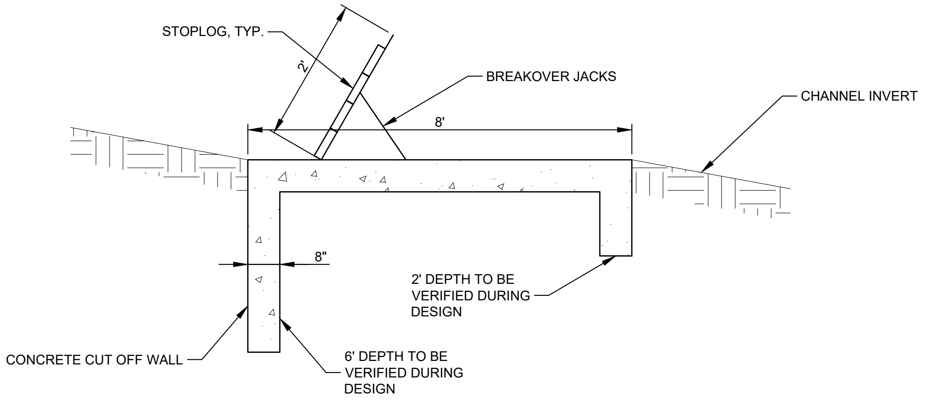
The Tucker headgate is the first diversion from the East Channel and delivers water into Mitchell Slough. The other systems included in this study that take water from Mitchell Slough have combined water rights of 156 cfs, and flow was measured at 62.8 cfs in July 2022. One staff gage is presently installed on the downstream side of the headgate, and another is located approximately 30 feet further down the ditch in a natural-bottom, irregular cross section. The accuracy of both gages is compromised: flows are not uniform at the first gage on the headgate, and the cross-section at the lower gage is subject to change due to annual sediment buildup, periodic dredging, and vegetation growth. Because the Tucker water right is among the largest in this Study, accurate flow measurement has important implications for water conservation, management, and effective irrigation delivery.

Proposed Project Recommendation

The most cost-effective option for improving flow measurement at the Tucker headgate, given the large size of the channel and relatively flat slope of the channel, is to create a standard, semi-hardened section as the location for flow measurements that will be used to develop a rating curve the staff gage on downstream side of the headgate. The semi-hardened section will include rip-rap or other revetment on the banks but keep a natural channel invert. A hard bottom in this section is not recommended, as it is likely to fill with sediment and create an unnecessary maintenance need. The hardened banks will prevent the section from changing due to vegetation or bank erosion across the years. This section should be located near the fence line that crosses the channel several hundred yards downstream of the headgate, out of the way of the periodic dredging needed near the headgate. The section will be marked by fence posts on both banks and a staff gage. The section will be surveyed, flow will be measured at this standard location at a range of flows, and these flows will be correlated back to the stage measurement on the downstream side of the gate to develop a rating curve. The accuracy of this method depends on the accuracy of the rating curve. Therefore, the rating curve should be checked on a regular interval of 2-3 years and updated as needed. While this method is less accurate and requires more upkeep, development of a rating curve will certainly be significantly less expensive than installation of a flume at this site.



1 TUCKER DIVERSION



1 PROPOSED TUCKER DIVERSION CONCRETE PAD W/ BREAKOVER JACK

GENERAL NOTES

1. CUTOFF WALL MUST EXTEND TO SCOUR DEPTH OR FROST LINE, WHICHEVER IS LOWER.
2. BACKFILL STRUCTURE WITH NATIVE STREAMBED MATERIALS TO CREATE CONSISTENT SLOPE.
3. ALL DIMENSIONS TBD W/ FINAL DESIGN
4. INSTALL STOP LOGS ANNUALLY DURING LOW FLOWS FOR SAFETY

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED.
LINE BELOW MEASURES ONE INCH
ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\TUCKER DIVERSION.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot
Conservation
District

Morrison
Maierle
engineers • surveyors • planners • scientists

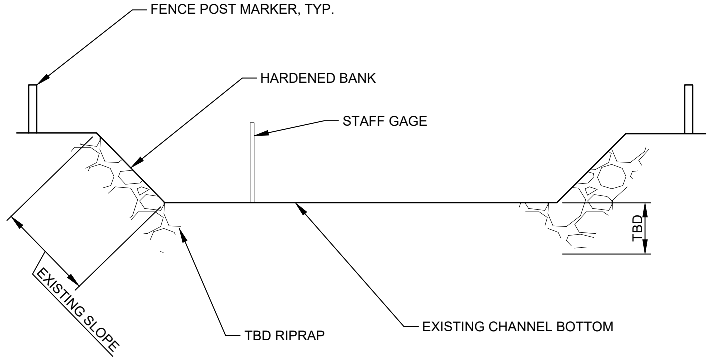
BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

TUCKER DIVERSION CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
9

1 TUCKER FLOW MEASUREMENT



1 PROPOSED FLOW MEASUREMENT SECTION DETAIL

N.T.S.

GENERAL NOTES

1. HARDEN CANAL BANKS AT EXISTING SLOPE WITH RIPRAP SIZE TBD.
2. INSTALL STAFF GAGE IN ACCESSIBLE AND VISIBLE LOCATION.
3. GRADE INSTRUCTIONS.
4. CENTER FLUME IN CHANNEL AND ENSURE LATERALLY LEVEL.
5. LOCATE HARDENED CROSS SECTION DOWNSTREAM OF DREDGING/ HEAVY SILTATION REACH.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\TUCKER MEASUREMENT.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

TUCKER FLOW MEASUREMENT CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
10

4.4.12. Webfoot Headgate

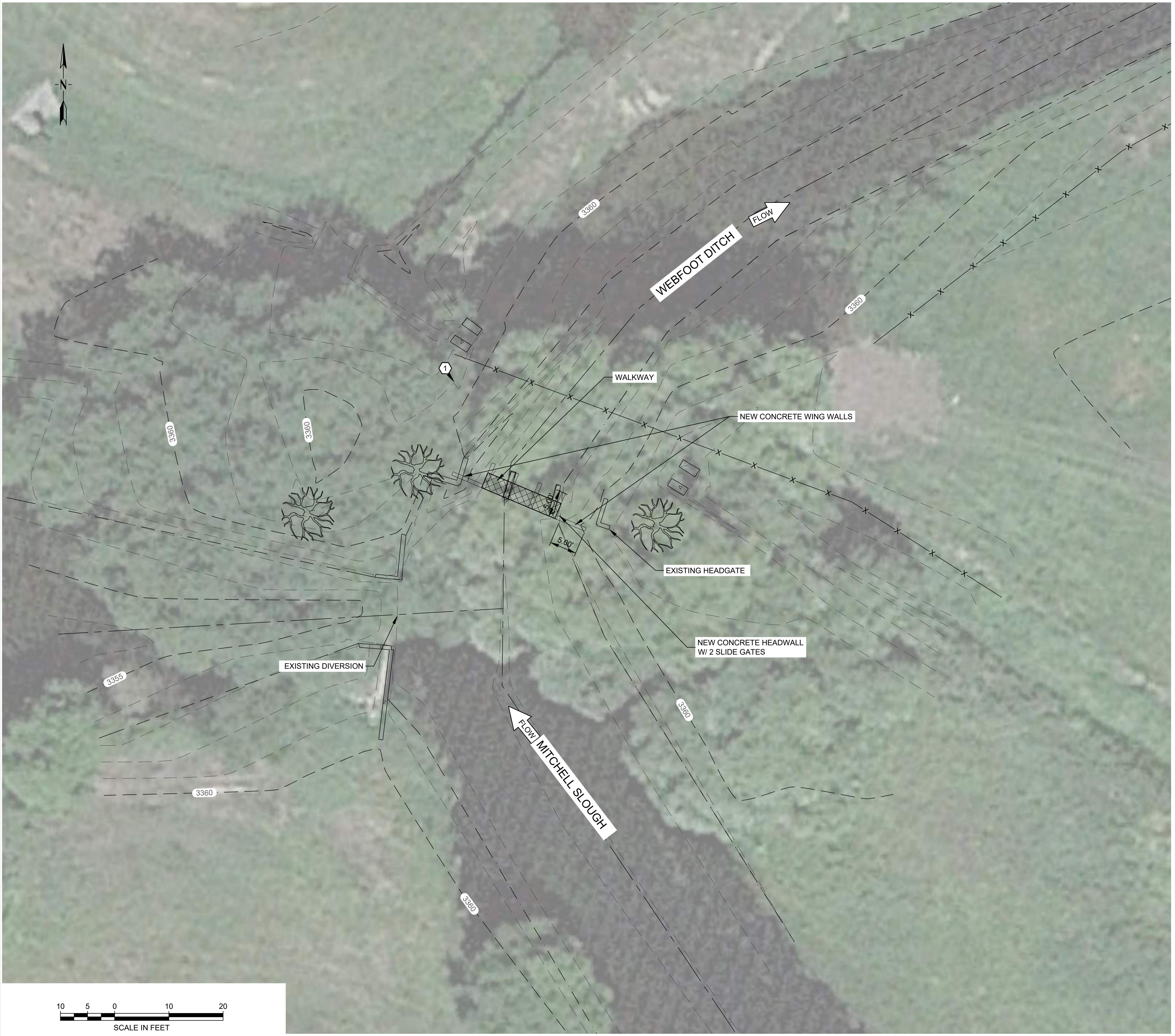
Rank	Score	Estimated Project Cost
12	72.9	$169,000-$207,000

Description

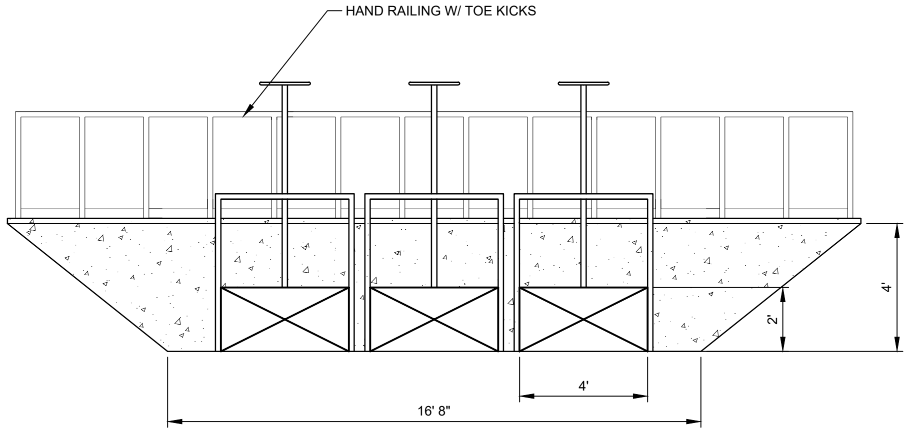
The Webfoot Headgate is located at the last diversion off Mitchell Slough, near Victor Crossing. It consists of a concrete check with three openings with stop logs. While the headgate is in fair condition, the stop logs must be placed manually, and the right-most opening is filled with sediment and is no longer active. Once the logs have been placed, there is no way to adjust flows. The concrete floor slabs and pillars show signs of spalling and erosion. The banks surrounding the headgate are relatively low, and high waters may overtop the banks and compromise the structure.

Proposed Project Recommendation

The existing Webfoot headgate should be replaced with a new concrete structure, coupled with re-grading of the banks to constrain flows to the headgate openings and fencing off the structure to prevent erosion due to livestock. The new structure would consist of a concrete headwall and wingwalls keyed into the banks on both sides, a new foundation slab with a cutoff wall at the upstream end, and three new handwheel-operated slide gates. The operators report that the existing headgate does not prevent them from getting the needed flows, even though the left opening is almost entirely filled in with sediment and has been that way for long enough that vegetation is actively growing. Therefore, the new openings should be constrained to the right and middle bays. The left bank, where overtopping is reported, should be built up, starting from the current divider wall between the middle and left openings, to prevent overtopping and subsequent erosion of the bank. The right-hand portion of the headgate should be re-configured into three openings, as slide gates that span the existing eight-foot-wide openings would be difficult to actuate. They should be equipped with metal slide gates with handwheels that can be operated from a new metal walkway. The walkway should include toe kicks, a railing, and attachment points to harness into for O&M activities.



① EXISTING WEBFOOT HEADGATE



1 NEW HEADGATE STRUCTURE

GENERAL NOTES

1. WINGWALLS MUST TIE INTO CHANNEL BANKS AT LEAST 5' UNLESS FINAL DESIGN INDICATES OTHERWISE.
2. KEY STRUCTURE MUST EXTEND TO SCOUR DEPTH OR FROST LINE, WHICHEVER IS LOWER.
3. WALKWAYS TO INCLUDE HANDRAILS AND TOE KICKS.
4. PERMITS WILL BE NECESSARY PRIOR TO INSTALLATION. REGULATORY AGENCIES MAY REQUIRE ADDITIONAL ELEMENTS NOT CURRENTLY SHOWN.
5. FINAL DESIGN IS NECESSARY PRIOR TO INSTALLATION

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED.
LINE BELOW MEASURES ONE INCH
ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\WEBFOOT HEADGATE.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

Morrison Maierle
engineers ▪ surveyors ▪ planners ▪ scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

WEBFOOT HEADGATE CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
14

4.4.13. Ward Diversion

Rank	Score	Estimated Project Cost
13	72.2	$420,000 - $513,000

Description

The Ward diversion is located on the main stem of the of the Bitterroot River near Charlos Heights, Montana. The diversion is a very short and partially spanning structure comprised of river rock, log, and debris. While the diversion is currently in fair condition, it must be rebuilt annually and only spans a small portion of the channel. Accordingly, river migration, downcutting, debris, and fluctuating flows may all pose long-term risks to the ability of the Ward Irrigation District to deliver sufficient and regular flows. High potential for obtaining funding and high stakeholder engagement were also noted with regards to this site. Topographic survey data from the Ward diversion location was collected in 2018 and August 2022. No identifiable change in streambed elevation was observed between these two dates.

Water delivery into the Ward ditch has been increasingly difficult to achieve because of river migration patterns, which seem to have accelerated since 2005. Figure 3 shows local migration patterns in proximity to the headgate. Over time, the channel width has increased due to migration of the south bank. In addition, a sandbar has emerged resulting in braided flow conditions. It is suspected that fire events in the tributary drainages upgradient to this site have resulted in increased bed load, which may have aggraded near the Ward intake structure.

Proposed Project Recommendation

A full spanning grade control structure is necessary to grade and control the extents of this segment of the river. A grade control structure would be comprised of large diameter rock keyed into the bed of the channel. The rock would not need to protrude into the channel but keyed in at grade to maintain consistent elevations. The rock would need to be sized to withstand tractive forces from large runoff events such as the 100-year flood. Abutment walls would be necessary to key the grade control to the adjacent banks. Permitting challenges with this type of diversion would be very significant and might require mitigation requirements set forth by the United States Army Corps of Engineers and the United States Fish and Wildlife Service.

Designing a structure to establish grade control or otherwise address the challenges created by river migration will require significant additional study. Hydraulic modeling would be needed to determine required elevations, erosive potential of the river at peak flows, rock sizing, and scour depth in this reach. Additional study of sediment transport in the reach could inform alternative designs that encourage aggradation on the south bank and help to reverse the recent migration trends. The possibility of using a partially spanning grade control structure should also be given serious consideration.

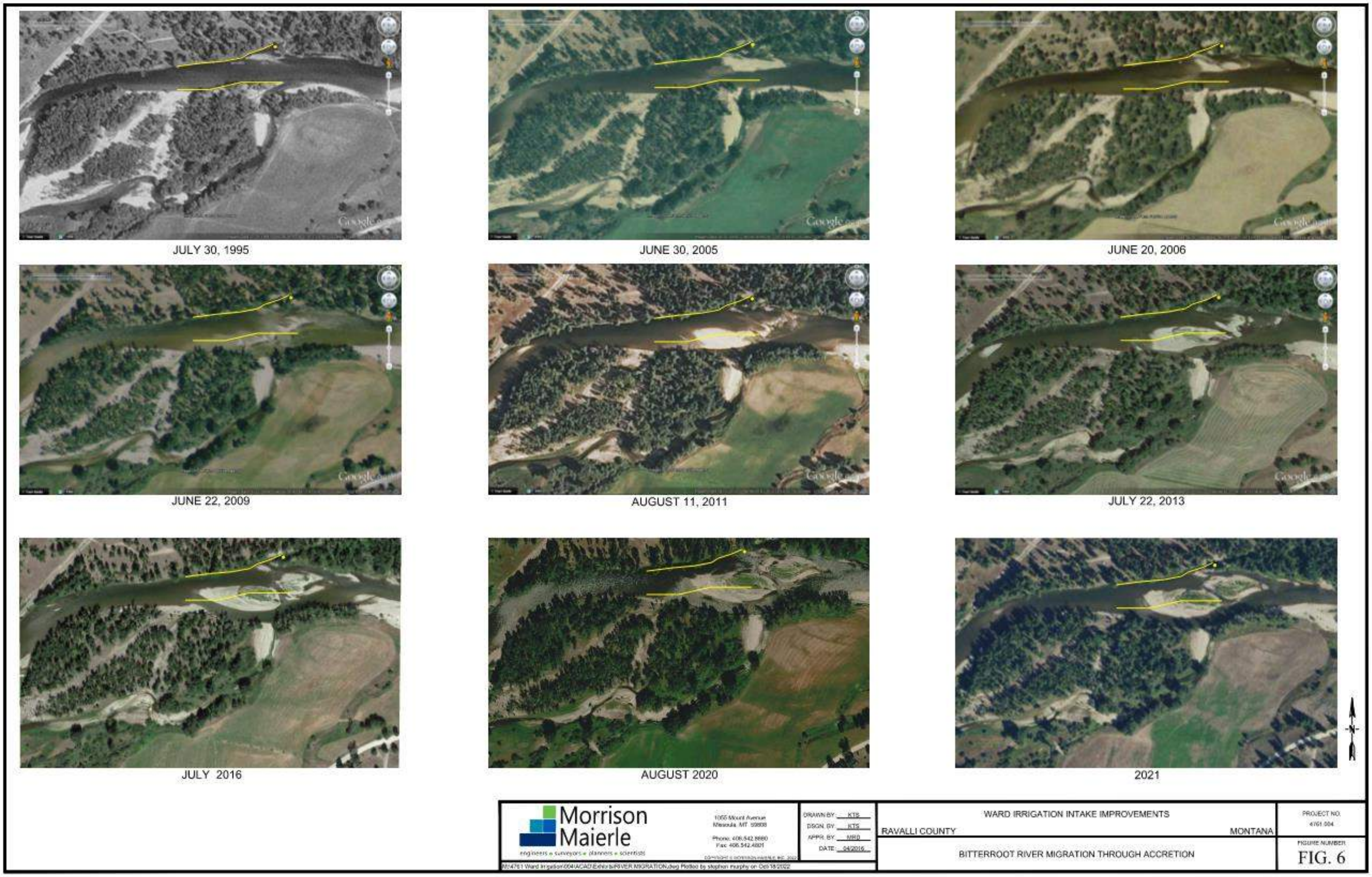
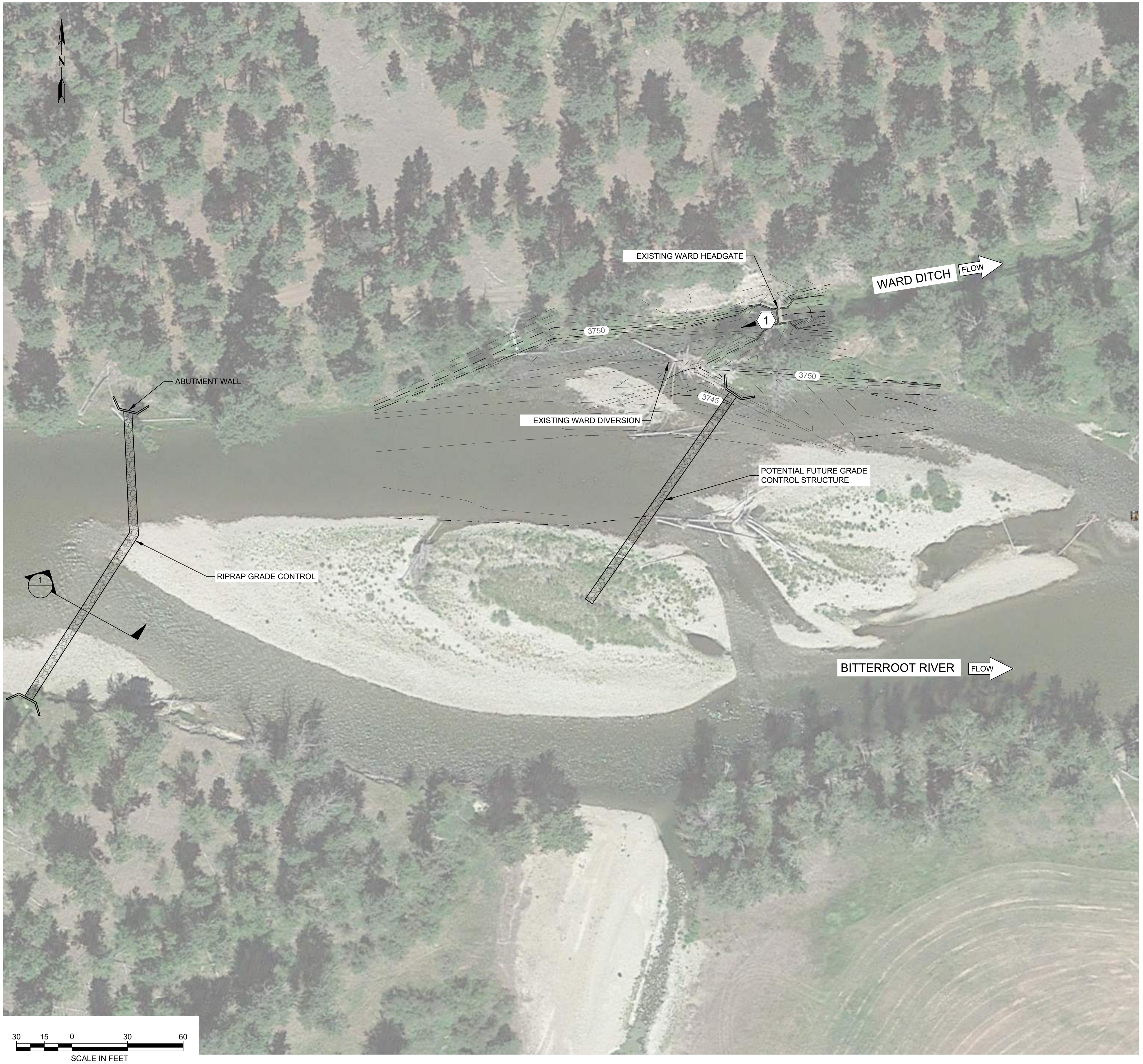
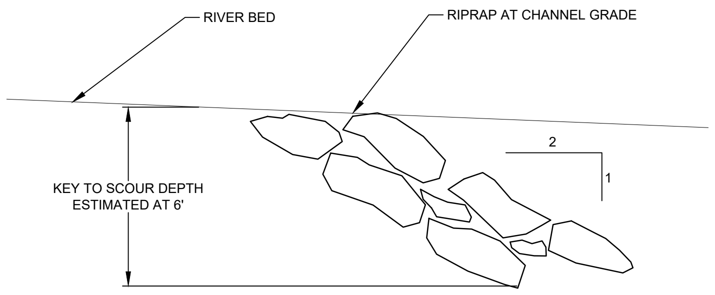


Figure 3: Channel Migration at Ward Diversion. Yellow lines show the main channel and diversion boundaries in July 1995.



1 EXISTING WARD DIVERSION



1 PROPOSED WARD DIVERSION

SCALE: N.T.S.

GENERAL NOTES

1. GENERAL NOTE 1.
2. GENERAL NOTE 2.
3. GENERAL NOTE 3.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED.
LINE BELOW MEASURES ONE INCH
ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\WARD DIVERSION.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot
Conservation
District

Morrison
Maierle
engineers ▪ surveyors ▪ planners ▪ scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

WARD DIVERSION CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
13

4.4.14. Corvallis Canal Measurement

Rank	Score	Estimated Project Cost
14	71.8	$26,000-$32,000

Description

The Corvallis Canal & Water Company diverts water from the Mainstem Bitterroot River near Hamilton, MT. The Corvallis canal has a water right of 125 cfs, and a flow of 89.3 cfs was measured in July 2022. Because the Corvallis canal is among the largest ditches studied, accurate flow measurement is relatively impactful

The primary means of measuring flows is currently a staff gage located on the bridge near the Hamilton wastewater treatment plant, with a camera that sends pictures to managers so irrigators can check the water level remotely. This staff gage also has a stage-discharge calibration curve. There is an additional staff gage located on the downstream side of the headgate structure.

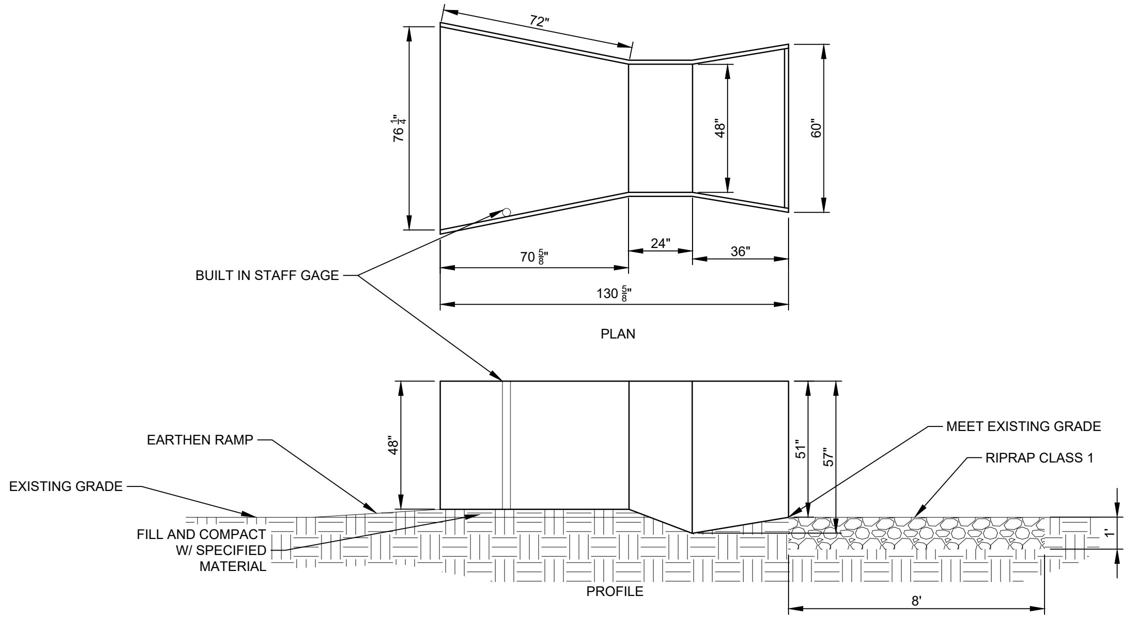
Proposed Project Recommendation

Because Corvallis canal has already invested in and has established management routines surrounding the staff gage on the footbridge, updating and/or developing a stage-discharge relationship for an existing or relocated staff gage may be a more attractive option than investing in a new flow measurement device. However, since both existing staff gages are attached to structures where flows are non-uniform, the accuracy of these staff gages for interpreting flows is likely compromised. For example, the measured flow of 89.3 cfs on July 11, 2022 corresponded to a staff gage reading of 1.72 feet. However, the calibration curve provided by the irrigators indicates that a stage of 1.72 feet should be associated with a flow of 108.6 cfs, approximately 122% of the observed flow. Due to this discrepancy, it is recommended that additional flow measurements be taken at a variety of water levels to further assess the accuracy of the existing stage-discharge flow table and facilitate its ongoing use.

Regardless, the staff gage and flow table method will always be less accurate than a flow measurement device, such as a flume. Further, if technical services are required to develop or revise the stage-discharge relationship, it may still require significant effort. This effort would also need to be repeated periodically because the channel cross section surrounding the staff gage may change over time.

The optimal approach for providing long-term, accurate, and compliant flow measurement in Corvallis canal is installing a prefabricated Parshall flume. A 48-inch throat width by 48-inch depth Parshall flume is available from TrueNorth Steel for significantly less than out-of-state suppliers. The flume comes with a staff gage and a stage-discharge rating curve; this is necessary to facilitate interpretation of water levels in the flume as flow rates in cfs or miner's inches. The flume should be installed in an accessible, stable, straight, and uniform section as close to the headgate as achievable. Locating the flume just upstream of the bridge with the staff gage and camera may reduce installation costs and allow the Corvallis canal to continue using their existing camera setup to monitor flows. The flume must also be carefully installed to ensure proper functioning, which includes grade control and sufficient subgrade compaction.

1 EXISTING CORVALLIS CANAL



PROPOSED FLUME DETAIL

GENERAL NOTES

1. BEDDING BENEATH THE FLUME MUST BE COMPACTED AND LEVELED PRIOR TO INSTALLATION.
2. WING WALLS MUST TIE INTO CHANNEL BANKS AT 45° ANGLES AND MAY BE PREFABRICATED W/ FLUME OR CONSTRUCTED FROM CONCRETE OR EARTH.
3. INSTALL OUTLET OF FLUME AT EXISTING GRADE. RAMP BEDDING MATERIAL UP TO ELEVATION OF FLUME INLET.
4. CENTER FLUME IN CHANNEL AND ENSURE LATERALLY LEVEL.
5. BACKFILL MATERIAL SHALL INCLUDE A MINIMUM 20% FINES COMPONENT WITH A PLASTICITY INDEX OF GREATER THAN 7 PER USBR EMBANKMENT RECOMMENDATIONS OR BY RECOMMENDATION OF ENGINEER.
6. EXCAVATE AND PLACE CLASS 1 RIP RAP 1' DEEP TO REINFORCE CHANNEL BED AT FLUME OUTLET.

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\CORVALLIS MEASUREMENT.DWG PLOTTED BY:STEPHEN MURPHY ON

Bitterroot Conservation District

Morrison Maierle
engineers • surveyors • planners • scientists

BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

CORVALLIS FLOW MEASUREMENT CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
1

4.4.15. Overturf Diversion

Rank	Score	Estimated project cost
15	70.7	$602,000 - $736,000

Description

The Overturf Ditch Company diverts water from the main stem of the Bitterroot River east of Darby, Montana. Four concrete dividers are placed each year, extending into the main channel of the Bitterroot River and are reinforced with large, 4-foot diameter boulders. Getting water to flow into the ditch is a recurring problem, particularly delivering flows to users at the far end of the ditch. River migration appears to be less dramatic in this stretch than in other priority diversion locations. However, there is no prior nor current bathymetric data to reveal how the channel bed has changed across its width at this location. Therefore, for example, it is possible that the channel may have deepened on the bank opposite the Overturf diversion and headgate. Flows are sufficient at the beginning of the season when the river stage is high enough. Once in place in late season, the temporary diversion also typically raises river stage enough to supply sufficient flow. However, Operators report that during mid-season the river levels are not high enough to provide sufficient flows but are too high to safely place the temporary diversion. Operators also expressed concern that headgate culvert inlet could be too high. Survey results indicated that the culvert currently does have an adverse grade (that is, the inlet is at a higher elevation than the outlet), but hydraulic results show that the headwater elevation is the flow-controlling parameter. Stakeholders expressed a high level of engagement in this project, and potential for securing funding is high.

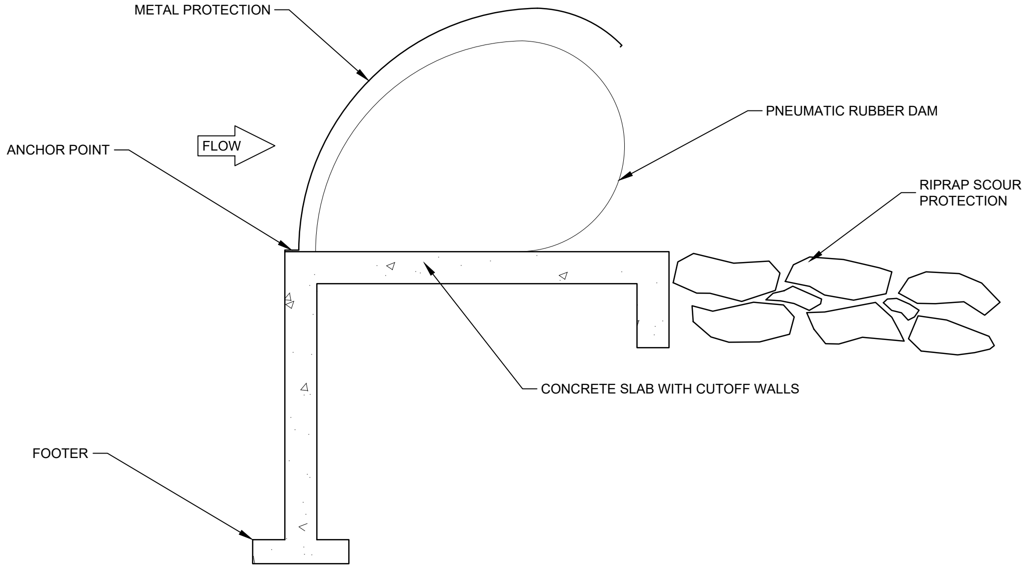
Proposed Project Recommendation

Given the reported success of the Overturf diversion once in place, the recommended structure at this site is an adjustable diversion that spans the left side of the channel. Given the width of the channel at this site and the difficulties in permitting, a channel-spanning structure is not recommended at this site. The adjustable diversion will feature a concrete pad that is keyed into scour depth at the upstream face and mid-channel end, as well as protected with sufficiently sized riprap at the mid-channel end. Additional j-hook vanes are recommended on the right bank to promote aggradation on the right bank, prevent additional migration in that direction, maintain the historic channel, and create aquatic habitat.

An adjustable diversion is necessary to allow passage of high water associated with sediment transport by removing the diversion structure and allows for grade control during mid and late irrigation season flows through installation of the diversion structure. The existing concrete block and rock diversion is classified as an adjustable diversion; however, the challenges associated with this approach include the difficulty of placing the diversion as early as is needed, lack of incremental grade control through the ability to set only one elevation that is associated with the top of block, and stability of the structure during higher flow conditions. While aggradation and sediment issues will exist regardless of whether a permanent or adjustable diversion is used, the ability to lower the diversion during portions of the year will allow for natural flushing processes to mobilize some sediment and reduce the potential for additional sediment accumulations. Because of the desirability of being able to adjust the diversion height without entering the channel, an inflatable rubber bladder diversion is recommended.

An inflatable rubber bladder diversion includes a concrete foundation slab to control grade, create an anchorage point for the bladder, and to prevent scour at the diversion point. The concrete slab should include structural reinforcement and be keyed into the channel bed with a cut off wall to prevent undercutting of the structure. The slab should also be keyed into the scour depth on the mid-channel right end. On the left bank, the slab should have an abutment wall that ties into the headgate structure. On the upstream side, there should be metal plate to protect the rubber bladder from damaging bedload. On the downstream side, there should be rip-rap to prevent scour from the flow over the diversion. On the bank side, there will have to be a powered air compressor and power source to inflate the diversion. Design of the bladder would have to include detailed hydraulic and sediment transport analysis, cost optimization, and consultation with permit agencies.

1 OVERTURF DIVERSION



1 PROPOSED OVERTURF DIVERSION PROFILE

GENERAL NOTES

1. POWER SUPPLY IS NECESSARY TO OPERATE PNEUMATIC COMPRESSOR.
2. CUTOFF WALL MUST BE KEYED IN TO SCOUR DEPTH..
3. KEY IN LEFT BANK ABUTMENT TO BANK AND EXISTING STRUCTURE..

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED.
LINE BELOW MEASURES ONE INCH
ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK
1				
2				
3				

M:\1891_BITTERROOT CONSERVATION DISTRICT\004-00_BITTERROOT RIVER IRRIGATION MGMNT. STUDY\ACAD\SHEETS\CIVIL\OVERTURF DIVERSION.DWG PLOTTED BY:STEPHEN MURPHY ON Nov/09/2022

Bitterroot Conservation District

Morrison Maierle
engineers ▪ surveyors ▪ planners ▪ scientists

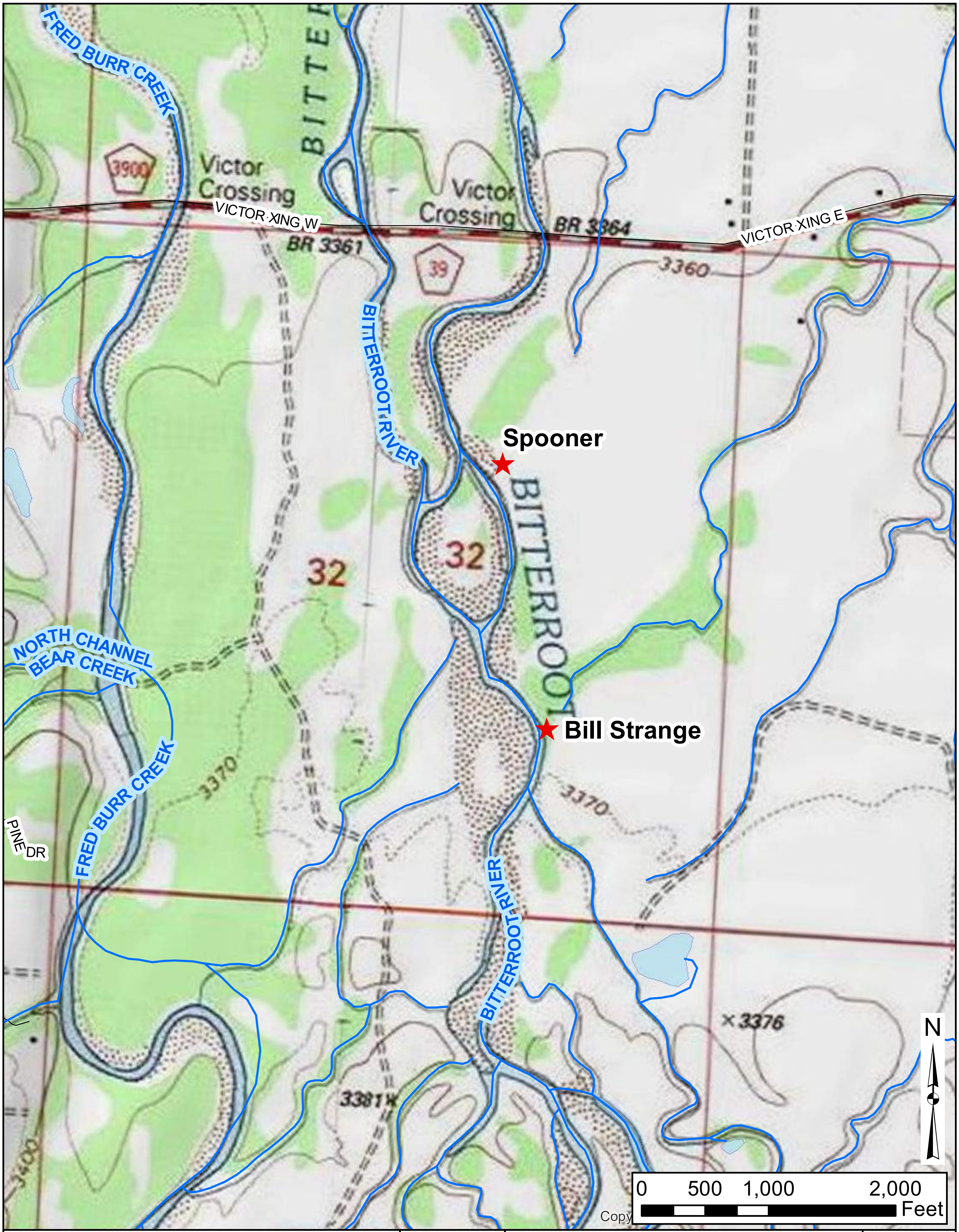
BITTERROOT CONSERVATION DISTRICT
IRRIGATION MANAGEMENT STUDY

OVERTURF DIVERSION CONCEPT PLAN

PROJECT NUMBER
1891.004

DRAWING NUMBER
7

Bitterroot River Irrigation Management Study
Appendix A: Maps



Morrison Maierle

engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

MISSOULA

VICINITY MAP

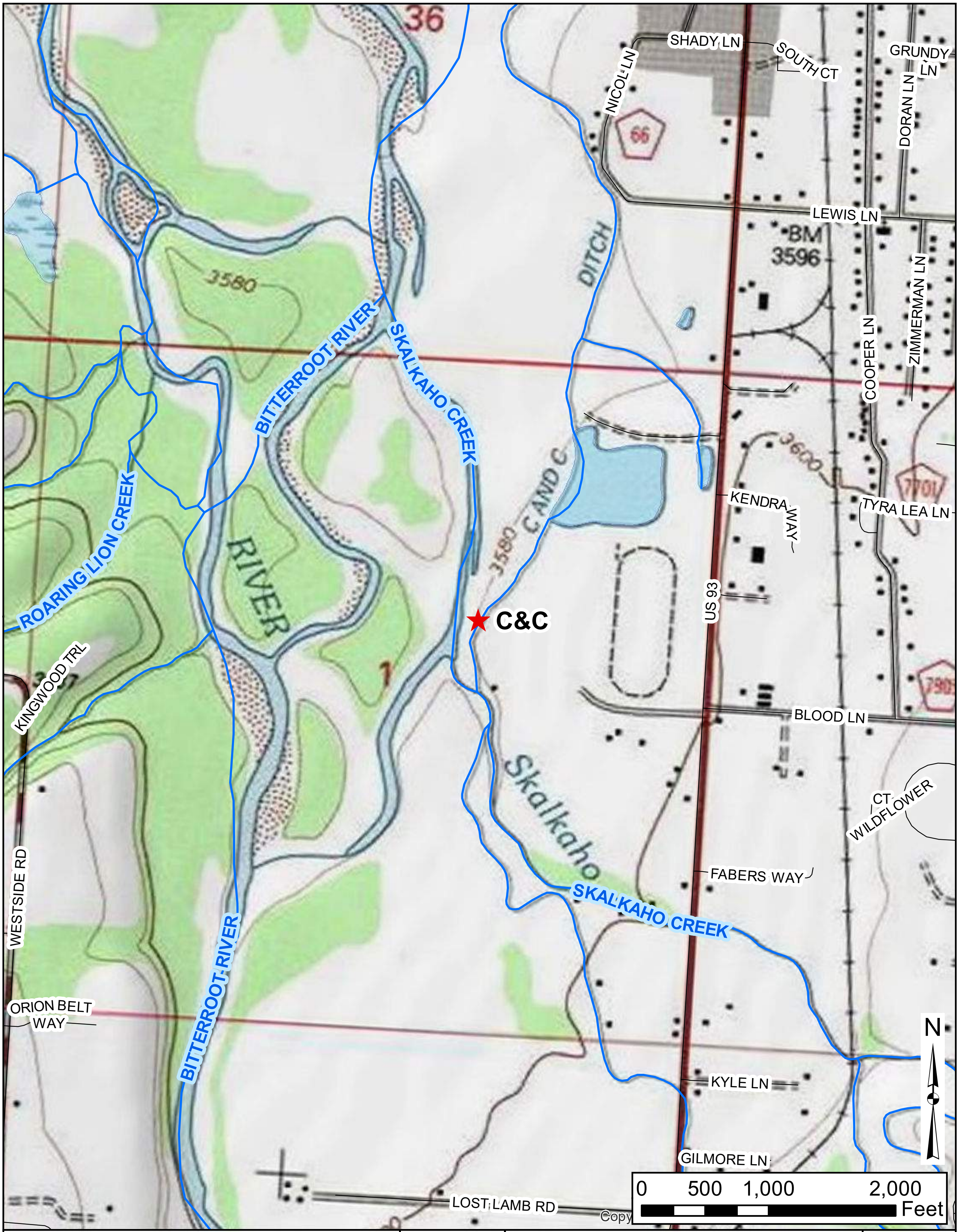
MT

Bill Strange, Spooner

PROJECT NO.
1891.004

FIGURE NO.
FIG. 1

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

MISSOULA MT

C&C

PROJECT NO.
1891.004

FIGURE NO.
FIG. 2

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022

Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

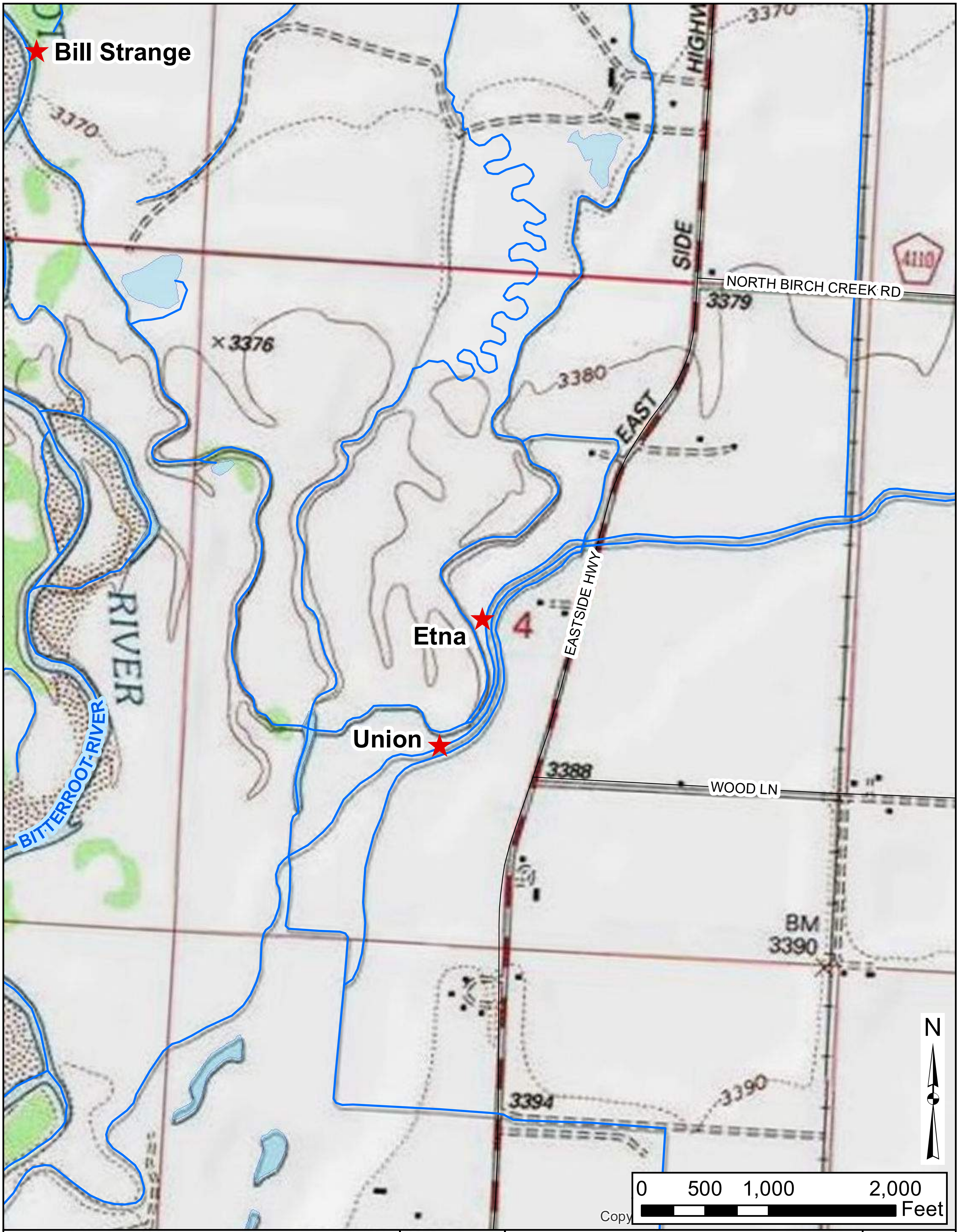
MISSOULA
MT

Corvallis

PROJECT NO.
1891.004

FIGURE NO.
FIG. 3

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

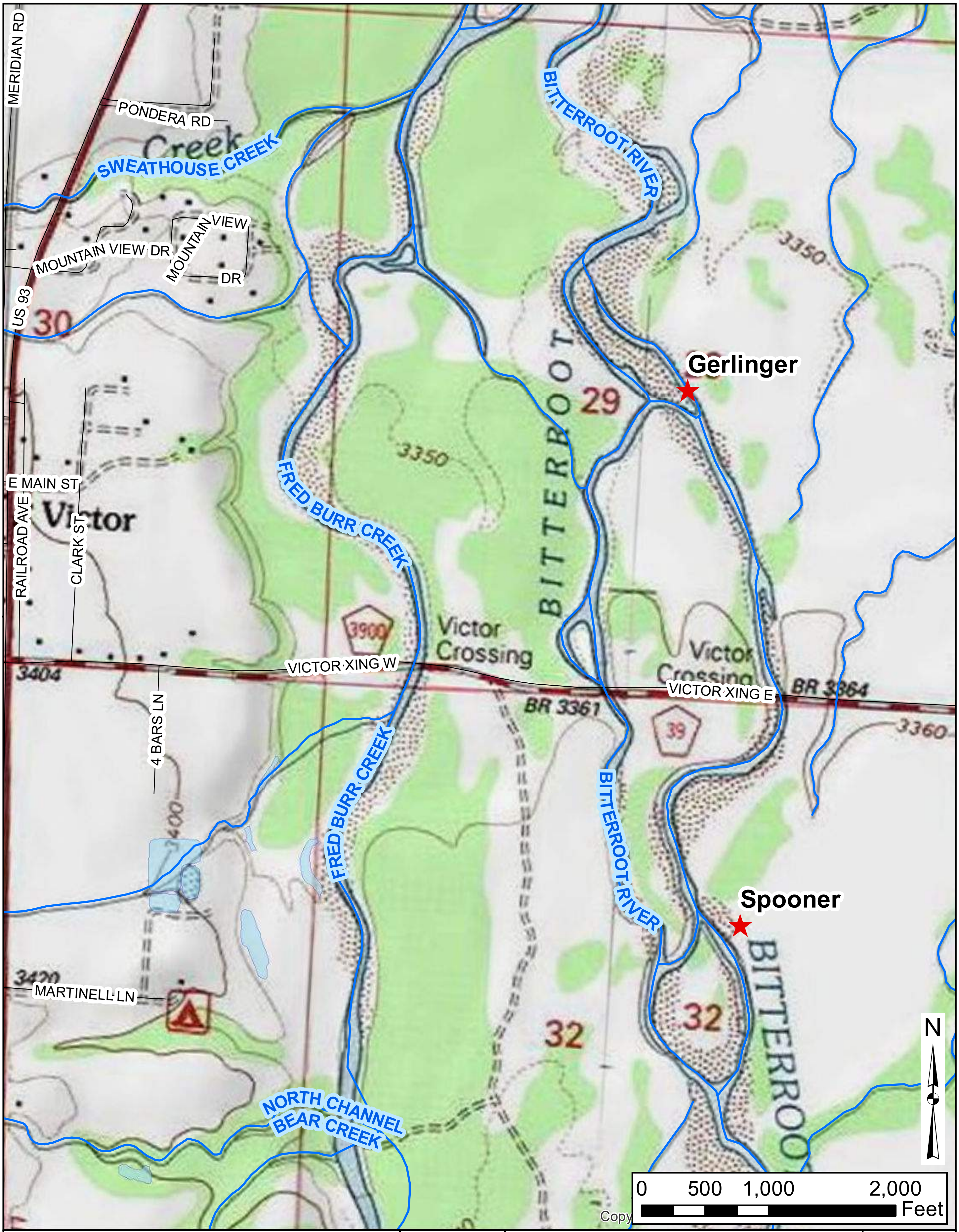
MISSOULA MT

Etna, Union

PROJECT NO.
1891.004

FIGURE NO.
FIG. 4

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

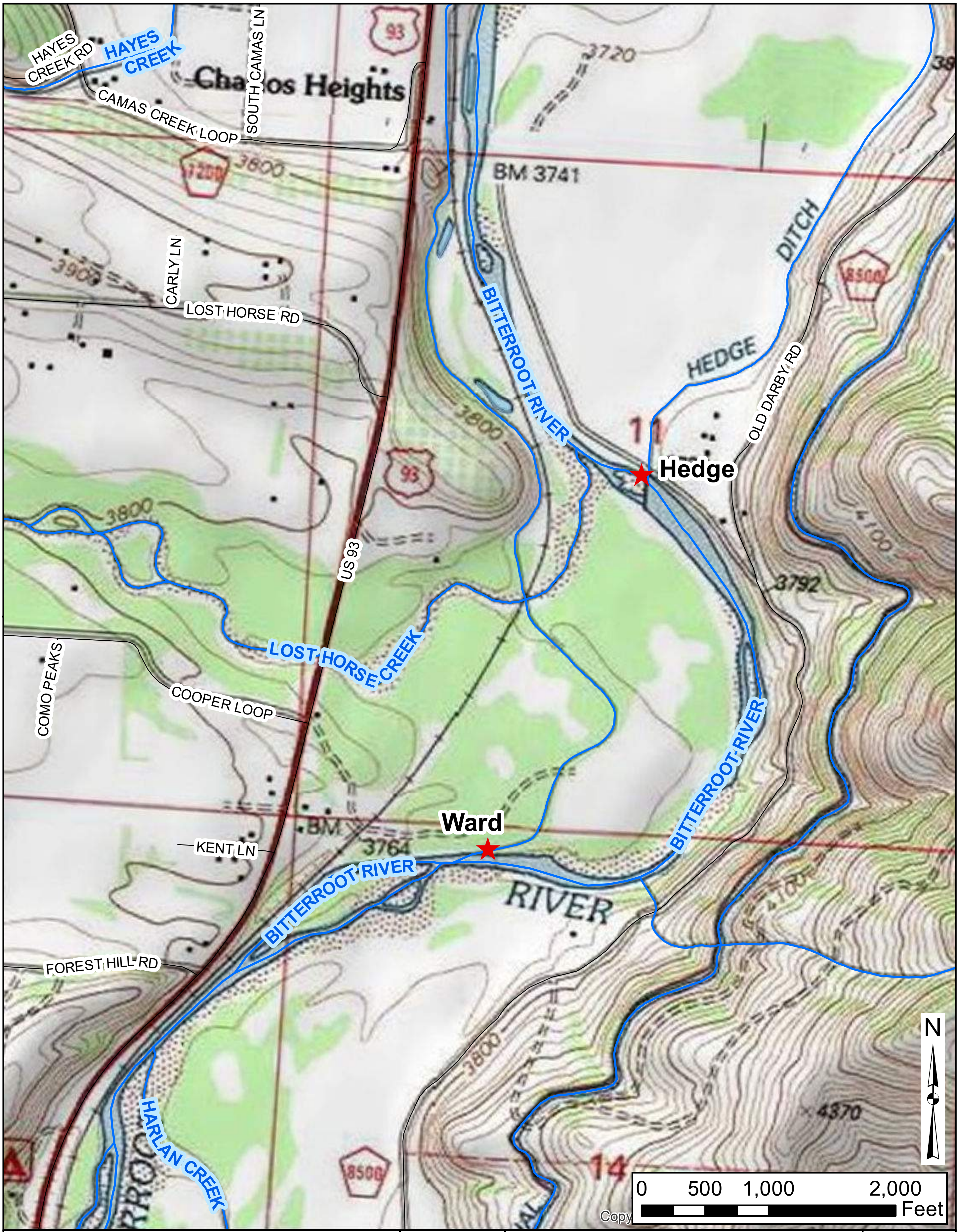
MISSOULA MT

Gerlinger

PROJECT NO.
1891.004

FIGURE NO.
FIG. 5

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison
Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

MISSOULA MT

Hedge, Ward

PROJECT NO.
1891.004

FIGURE NO.
FIG. 6

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022

Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

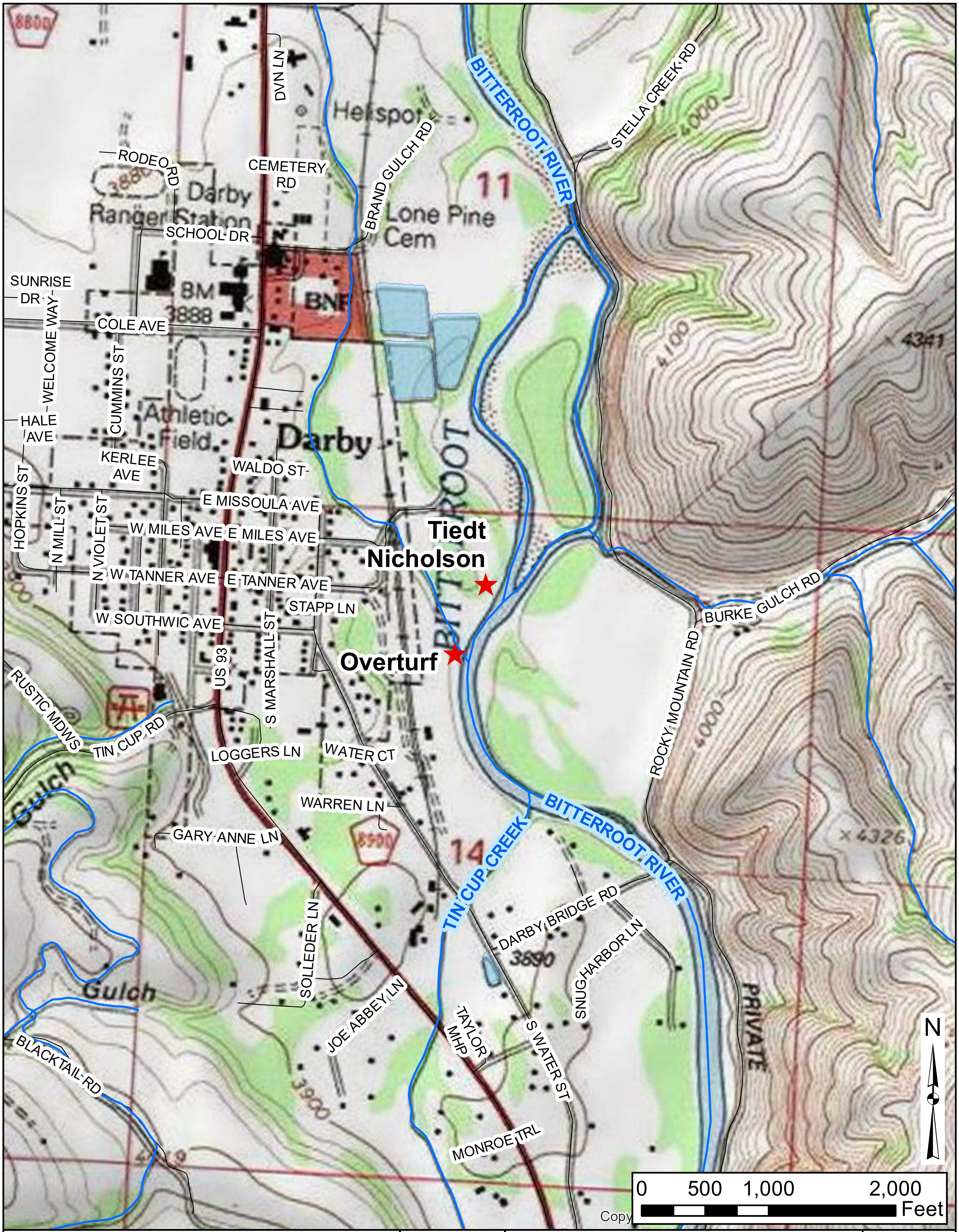
MISSOULA
MT

PROJECT NO.
1891.004

Orr, Hoyt

FIGURE NO.
FIG. 7

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

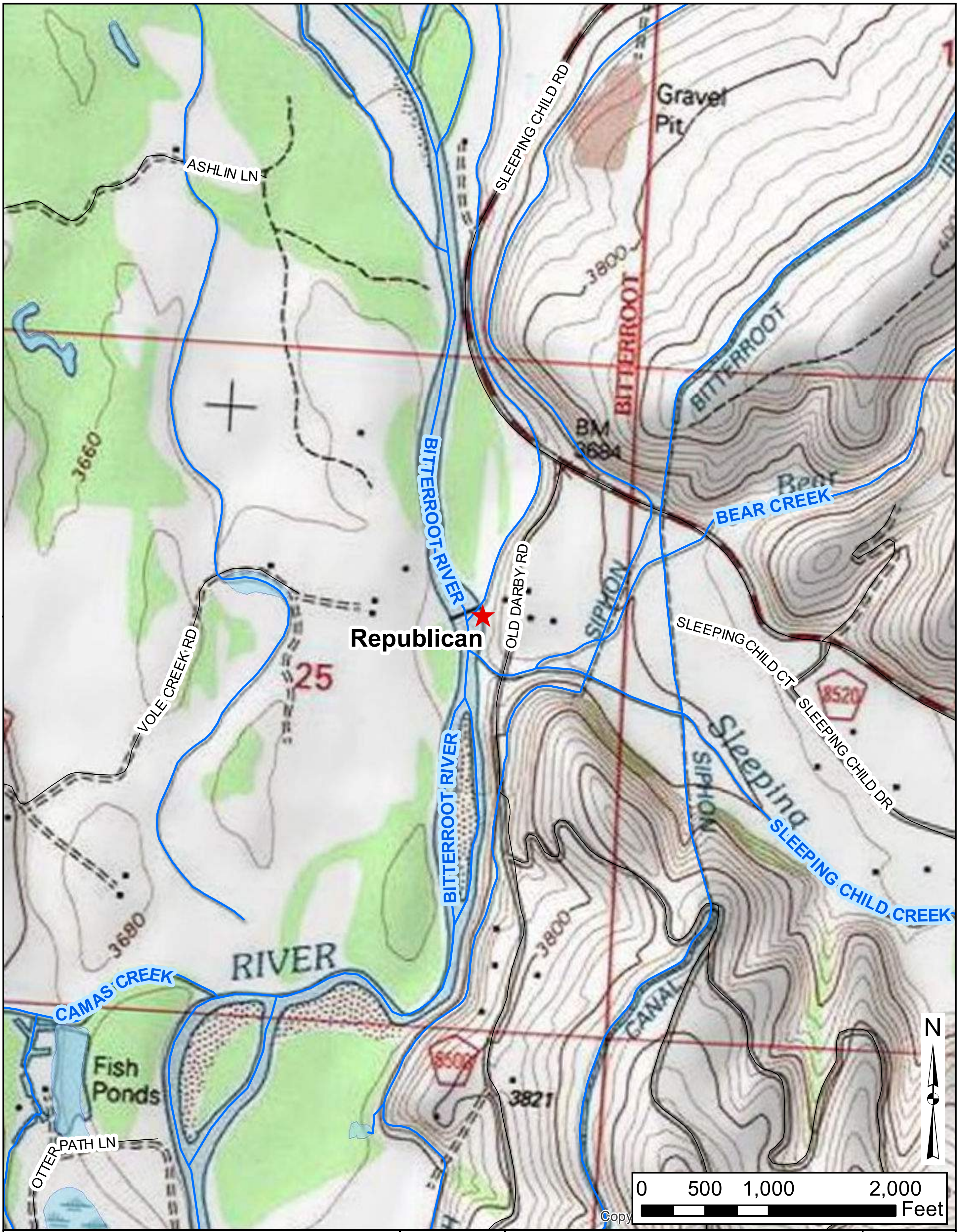
MISSOULA MT

Overturf, Tiedt Nicholson

PROJECT NO.
1891.004

FIGURE NO.
FIG. 8

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle

engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

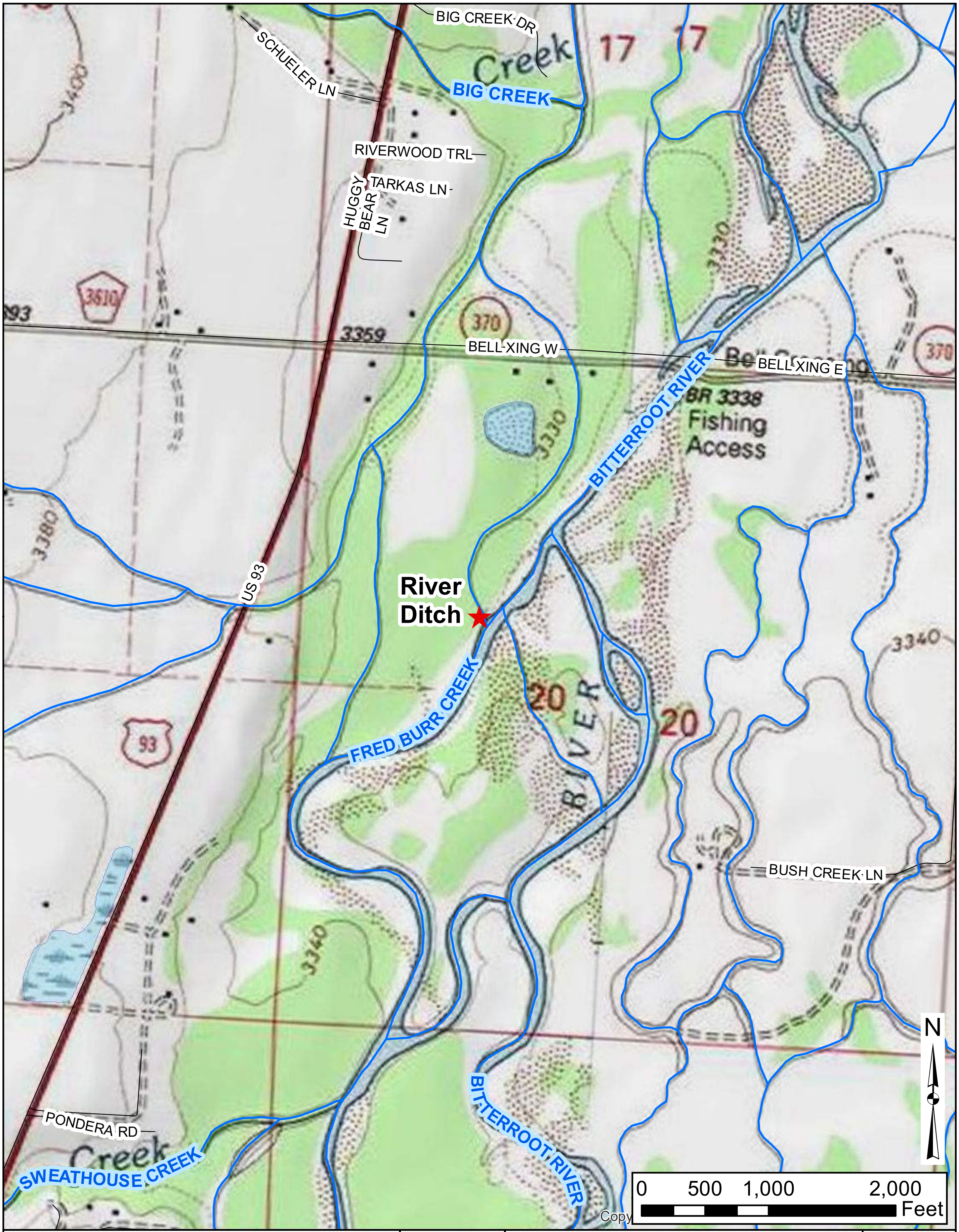
MISSOULA MT

PROJECT NO.
1891.004

FIGURE NO.
FIG. 9

Republican

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle

engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

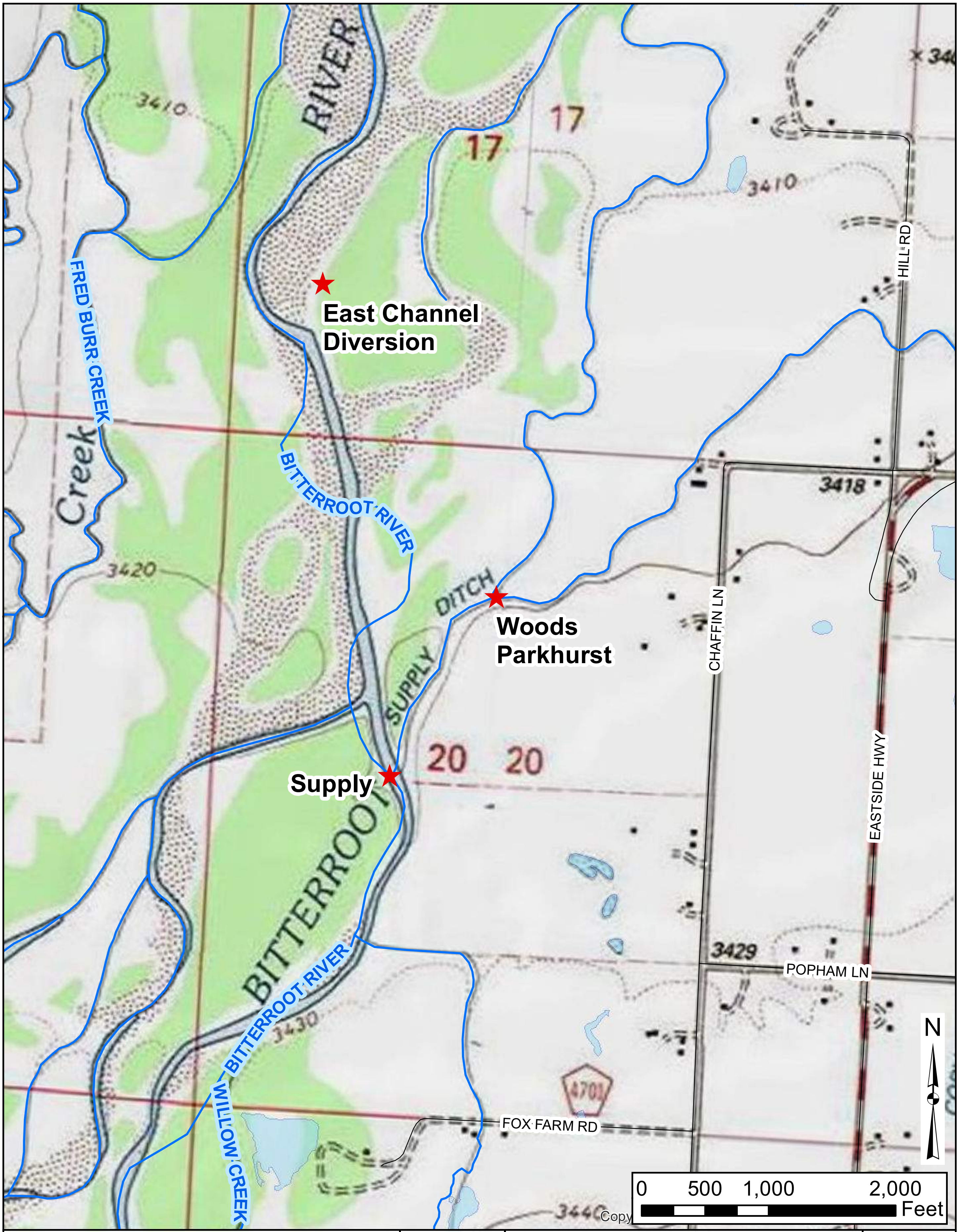
MISSOULA MT

River Ditch

PROJECT NO. 1891.004

FIGURE NO. FIG. 10

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison
Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

MISSOULA

VICINITY MAP

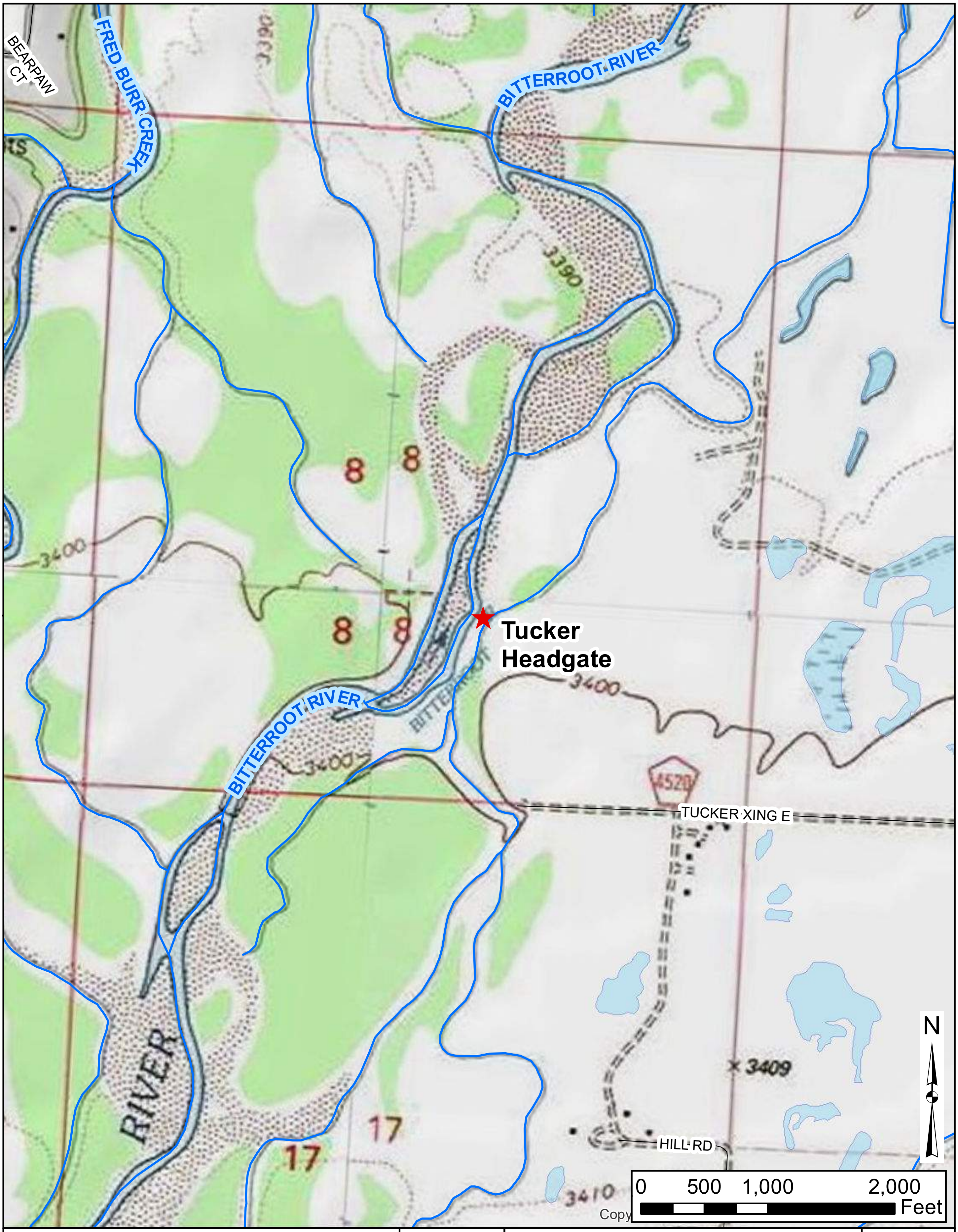
MT

Supply, Woods Parkhurst,
East Channel Diversion

PROJECT NO.
1891.004

FIGURE NO.
FIG. 11

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

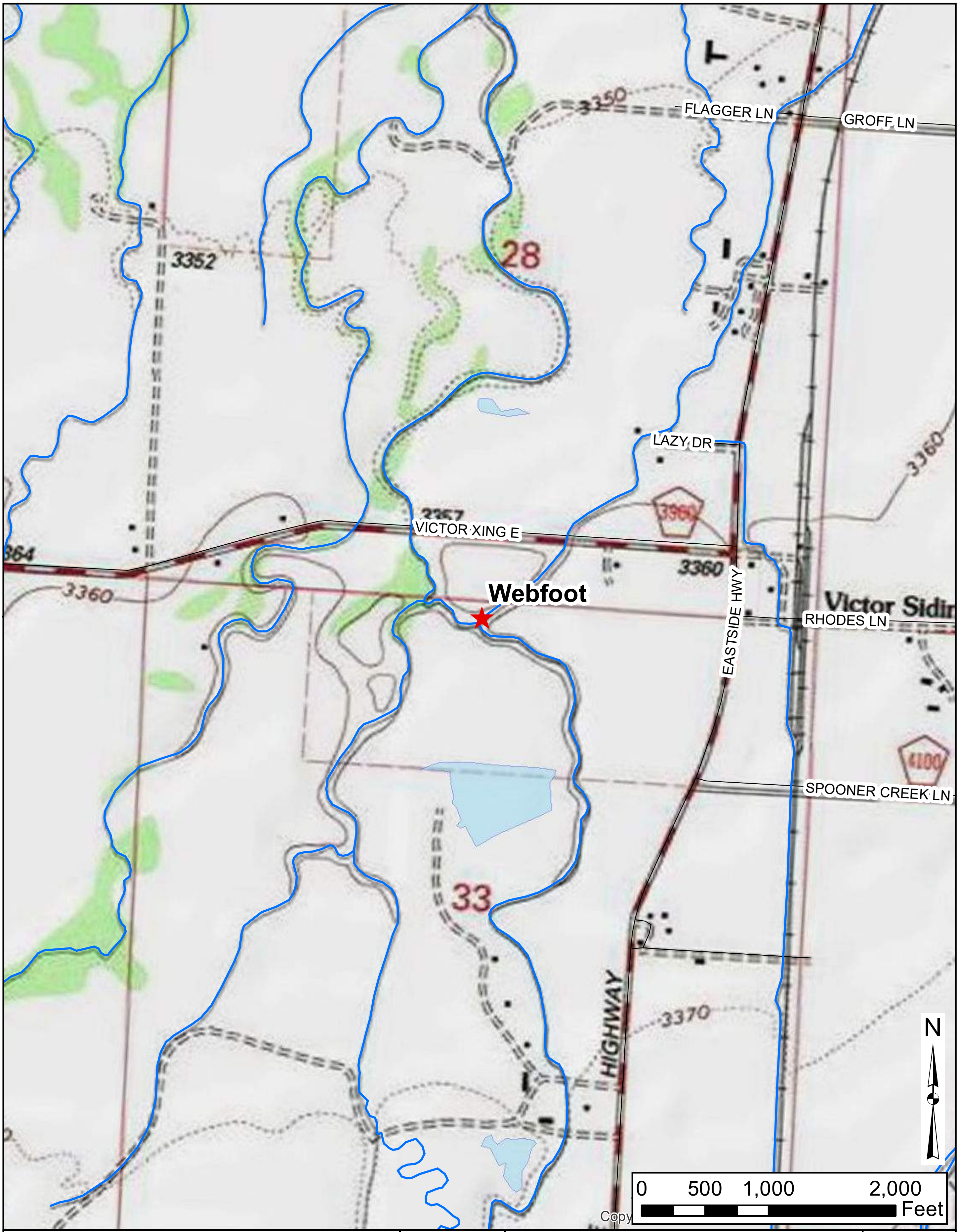
MISSOULA MT

Tucker Headgate

PROJECT NO.
1891.004

FIGURE NO.
FIG. 12

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

MISSOULA

VICINITY MAP

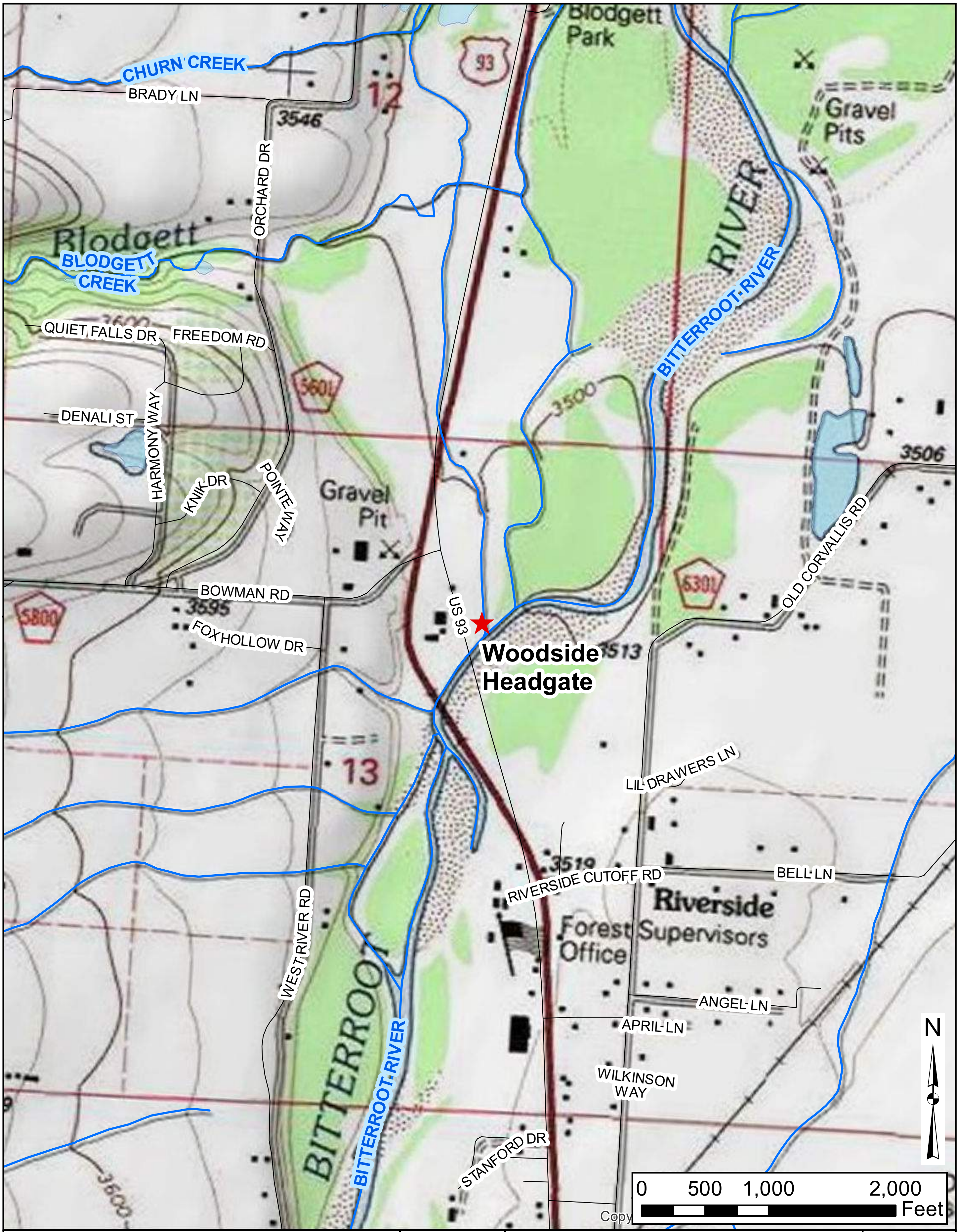
MT

PROJECT NO.
1891.004

Webfoot

FIGURE NO.
FIG. 13

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022



Morrison Maierle
engineers · surveyors · planners · scientists

1055 Mount Ave
Missoula, MT 59801

Phone: (406) 542-8880

DRAWN BY: SKL
CHK'D BY: AP
APPR. BY: MRD
DATE: 10/2022

VICINITY MAP

MISSOULA MT

PROJECT NO.
1891.004

Woodside Headgate

FIGURE NO.
FIG. 14

M:\1891_Bitterroot Conservation District\004-00_Bitterroot River Irrigation Mgmnt. Study\GIS\MapBook.mxd; Plotted: 10/14/2022

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: Grlinger

WATER SOURCE: East Channel

Date: 11/9/21

Assessor: TM

Irrigator on Site? John Lewis Sr.

~~STRUCTURE TYPE~~:

[✓ HEADGATE:]	☐ Slide gate	☐ Stop logs	☒ Culvert	
~~FLOW MEASUREMENT:~~	☐ Flume	☐ Weir	☐ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☐ Concrete	☐ Earth	☐

Culvert
use wood boards - works well

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

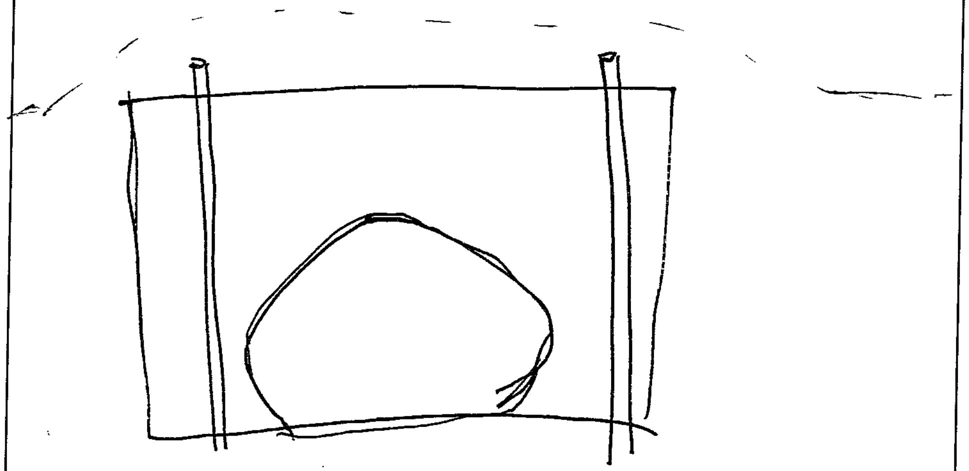
SAFETY CONCERNS:

Manual input of wood boards

OBSERVATIONS:

Corrugated steel pipe. No holes apparent

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

JOHN LEWIS: 406 531 1765

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: GERLINGER

WATER SOURCE: EAST CH.

Date: 11/7

Assessor: CA

Irrigator on Site? Johnny Lewis

STRUCTURE TYPE:

~~HEADGATE:~~	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☐ Gauge	☒ NONE
DIVERSION:	☒ In-stream dam TEMP	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☒ Concrete	☐ Earth	☐

Concrete ecoblocks and gravel berm

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

CONCRETE BLOCKS PLACED BY ~~[illegible]~~ EXCAVATOR ~ 28 ON SITE

IMPAIRMENTS:

☑ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

BANK IS GRAVEL. RAMP FOR EXCAVATOR

SAFETY CONCERNS:

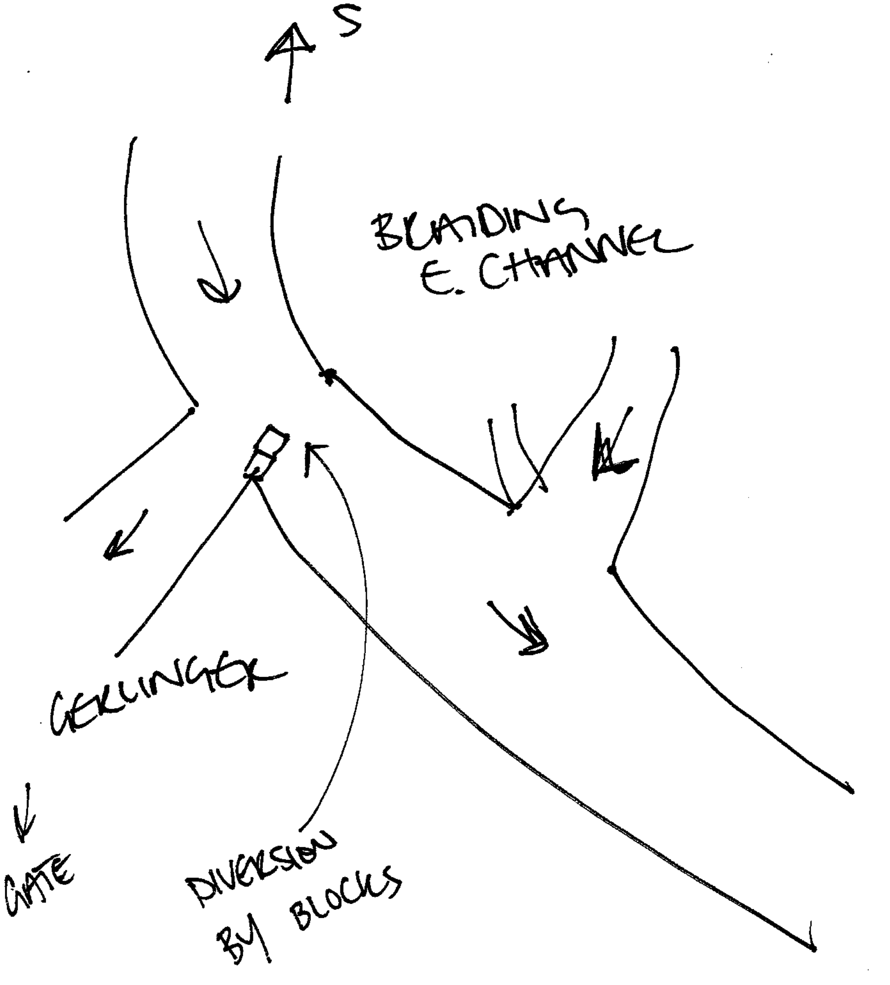
OBSERVATIONS:

JOHN LEWIS
HIRED BY GERLINGER
TO CONSTRUCT DIVERSION

WASTES BACK INTO
CHANNEL NEAR BELL CROSSING

MAIN ISSUE IS GETTING WATER
@ TUCKER (ACRE + SPOONER)

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: Bill Strange

WATER SOURCE: East Channel

Date: 11/9/2021

Assessor: TM

Irrigator on Site? Ted Jolly

STRUCTURE TYPE:

[✓ HEADGATE:]	☒ Slide gate	☐ Stop logs	☐	
~~FLOW MEASUREMENT:~~	☐ Flume	☐ Weir	☒ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☒ Wood	☒ Metal	☐ Concrete	☐ Earth	☐

The walkway consists of a single wooden board plank.

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☐ Good	☐ New

There is opportunity for walkway improvements - such as a handrail

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☒ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

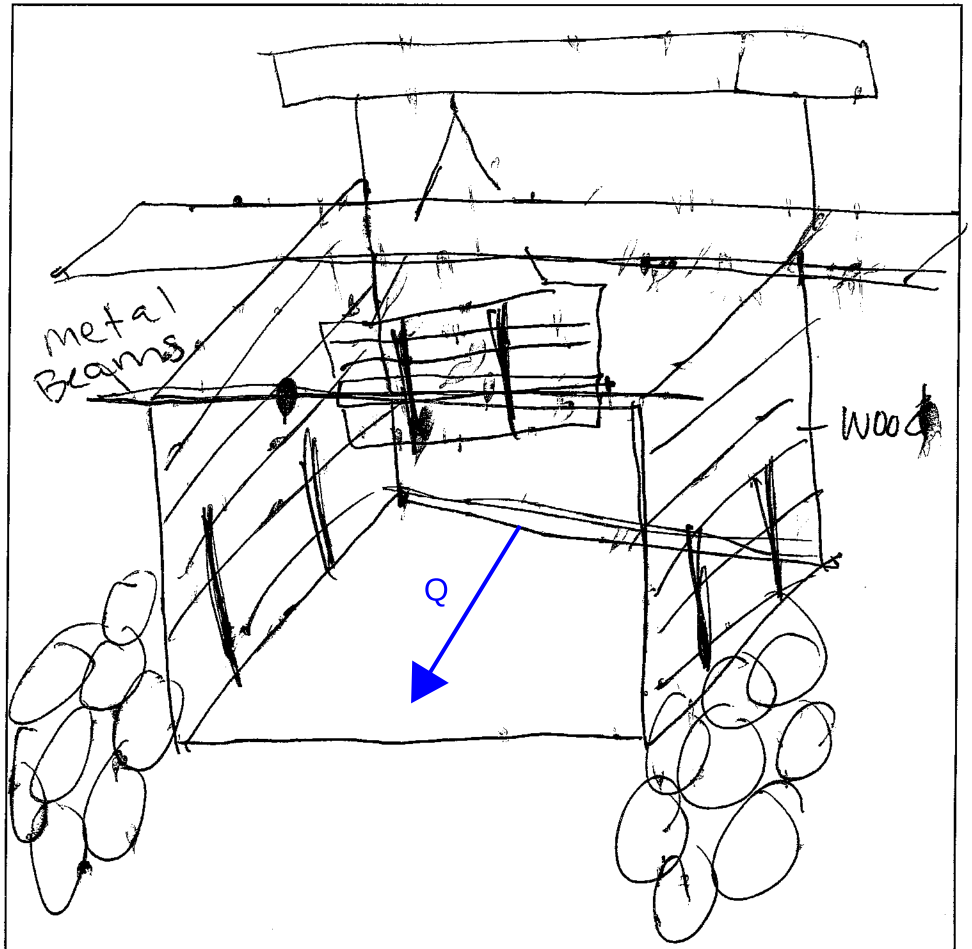
Boards need replaced (gates)

SAFETY CONCERNS:

No railing

OBSERVATIONS:

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY	Date: 11/9
	TURNOUT SITE: BILL STRANGE	WATER SOURCE: E. CHANNEL
		Assessor: CA
		Irrigator on Site? TED JOLLY

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
[✓ FLOW MEASUREMENT:]	☐ Flume	☒ Weir	☒ Gauge	☐ W-WEIR
[✓ DIVERSION]	☒ In-stream dam /WEIR	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☐ Concrete	☒ Earth	☐

LARGE ROCK ~ 4' DIAMETER BOULDERS FOR W-WEIR

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

GAUGE IN GATE CHANNEL

Staff gauge = FAIR - location could be improved

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

ROCKS SUNKEN SLIGHTLY ~2-3 feet

NO CONCERNS ON FUNCTION

SAFETY CONCERNS:

OBSERVATIONS:

DOUBLE ROCK ASSISTED
IN CONSTRUCTION.

DIVERSION WORKS WELL
WITH GOOD FLOWS IN RIVER

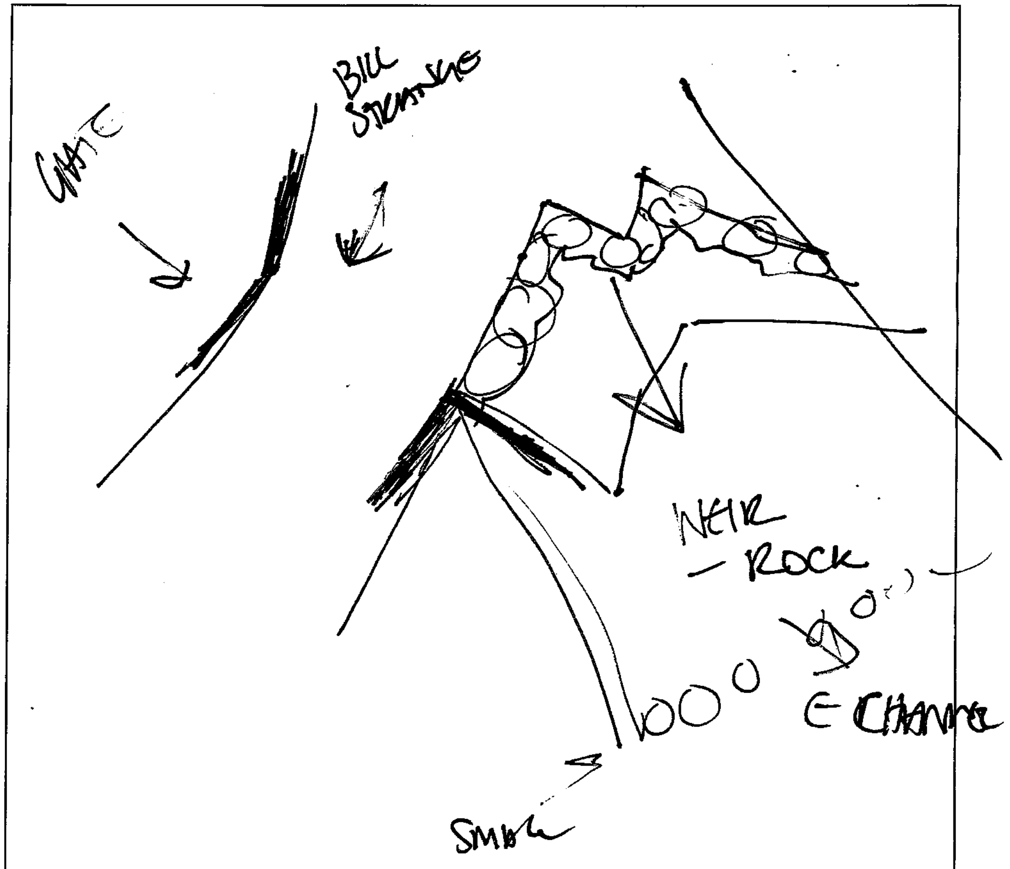
MAYBE ANOTHER ROCK LAYER
IN FUTURE

NO FLOOD 1YR
↳ DWATS – NO ISSUES

1 FARM SERVED

↑ S

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: River Ditch

WATER SOURCE: West Channel

Date: 8|9|21

Assessor: TM

Irrigator on Site? Ryan Esch

STRUCTURE TYPE:

HEADGATE:	☒ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☒ Gauge	☐
DIVERSION:	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☒ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☐ Good	☒ New

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

Getting H_2O into West channel

SAFETY CONCERNS:

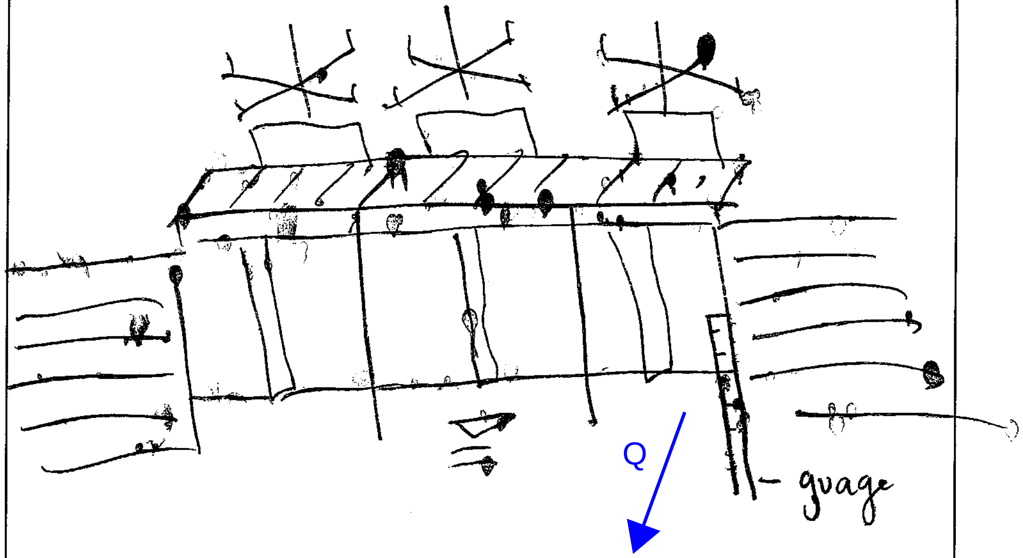
No railing

OBSERVATIONS:

3 Slide gate w/ hand wheele to lift/lower

Excellent Condition

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**		Date: 11/9
	TURNOUT SITE: RIVER DITCH	WATER SOURCE: ~~SDC~~ CH WEST	Assessor: CA Irrigator on Site? RYAN

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
[✓ FLOW MEASUREMENT:]	☐ Flume	☐ Weir	☒ Gauge	☐
[✓ DIVERSION:]	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☐ Concrete	☒ Earth	☐

Native RIVER ROCK DAM ACROSS CH. W/ FISH PASSAGE CUT OUT

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	~~☒ Good~~	☐ New

Flow measurement = Fair Condition - location of staff guage could be improved.
Diversion = Fair Condition

IMPAIRMENTS:

☐ Erosion	☒ Sediment	☐ Age/Wear	☒ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

VEGETATION BEFORE GATE + SEDIMENT

SAFETY CONCERNS:

OBSERVATIONS:

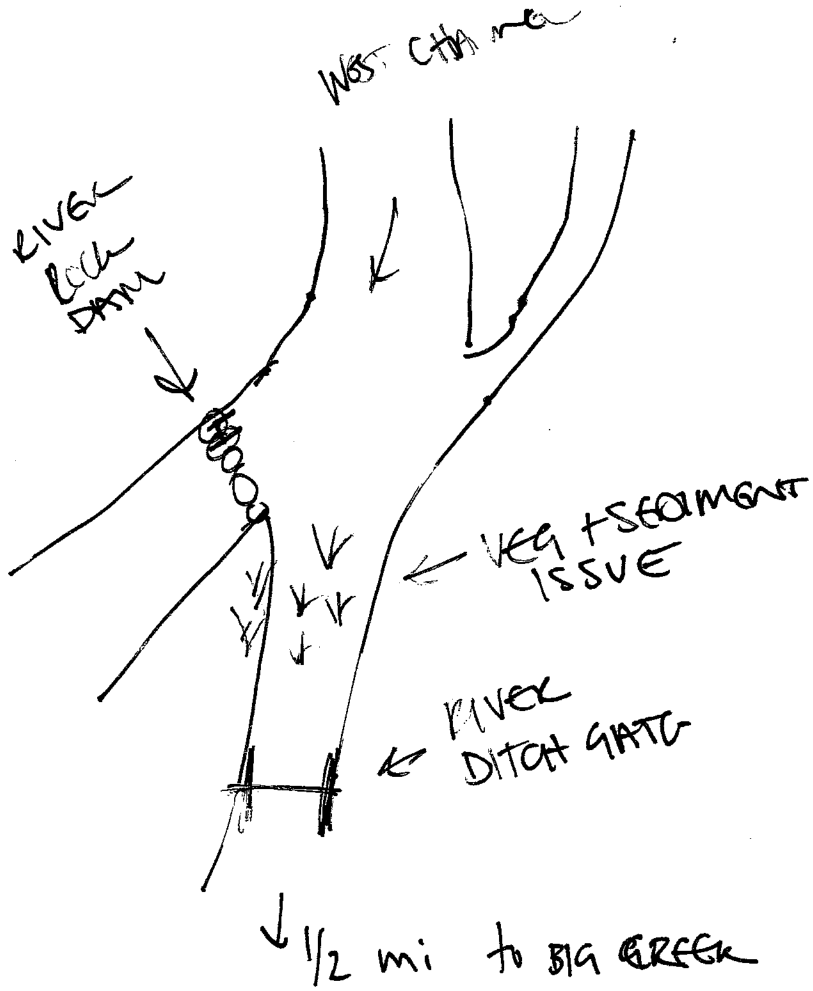
NO ISSUES W/ DIVERSION
TAKE OUT NEXT WEEK
+ REBUILD IN SPRING

MAIN ISSUE IS GETTING
WATER TO WEST CHANNEL

@ MAIN RIVER DIVERSION
→ REBUILD DIVERSION EARTH
BERM EACH YEAR — RUBBER TIRE BACKHOE

BIG CREEK CONVEYS TO ANOTHER DITCH

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Concerns:
Maintenance
Has to walk equipment 1 mile each year to rebuild diversion in west channel of Bitterroot

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: Corvalis Ditch

WATER SOURCE: Main Channel

Date: 11/9/21

Assessor: TM

Irrigator on Site? Darrell Sparry

STRUCTURE TYPE:

[✓ HEADGATE:]	☒ Slide gate	☐ Stop logs	☐	
~~FLOW MEASUREMENT:~~	☐ Flume	☐ Weir	☒ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

Concrete is older (60's)

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☐ Good	☒ New

Ideally would like a new floor since gates leak water when completely shut.

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☒ Leaking	☐ Structural	☐		

High water sometimes causes debris to go over barrier (trash rack) and they have to try at pull out. Gates completely shut now & water still going under

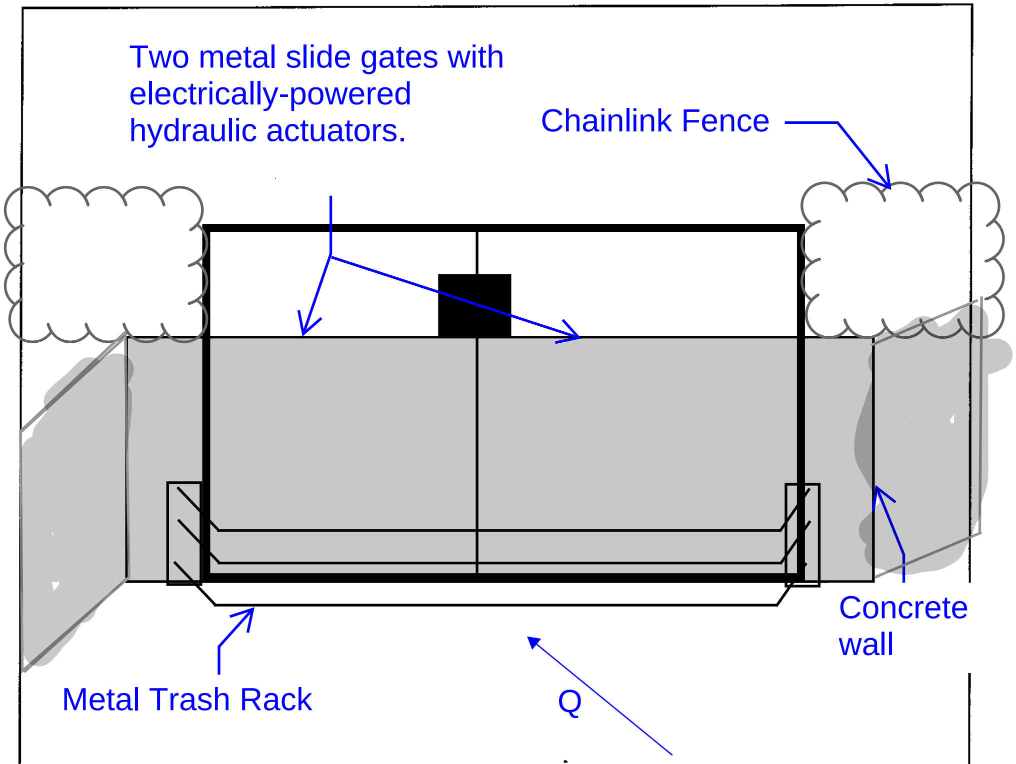
SAFETY CONCERNS:

OBSERVATIONS:

Good fenced Security System

Handrail

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**	Date: 11/7
	TURNOUT SITE: CORVALLIS / WATER SOURCE: MAIN BR CHANNEL	Assessor: CA Irrigator on Site? DARYL SPERRY

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☒ Gauge	☐
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☑ Wood	☐ Metal	☐ Concrete	☒ Earth	☐

IN STREAM ROCK DAM ~ 2-3 ft ROCKS BOARD STIPS FOR CON WATER

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☐ Good	☒ New

4-5 YR CYCLE → EQUIPMENT NEEDED TO MOVE ROCKS BACK TO FRONT OF DAM

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☒ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

4-5 YR MAINTENANCE

SAFETY CONCERNS:

NA

OBSERVATIONS:

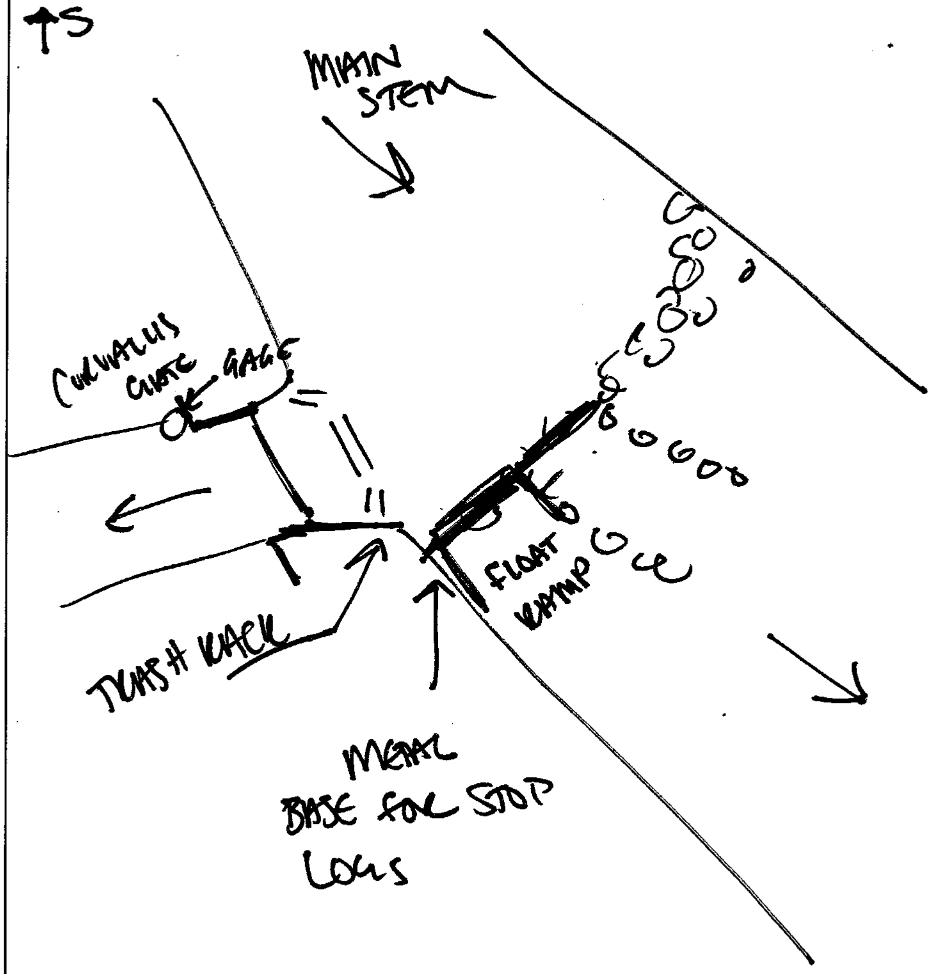
WOULD LIKE LONGER BASE FOR STOP LOGS MOVE TOWARDS MIDDLE OF CHANNEL

GATES LEAK - NEW FLOOR NEEDED

GAGE ON BACK OF TURNOUT 2ND GAGE ON BRIDGE DOWNSTREAM

CAMERA @ 2ND GAGE

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

~~Need more info!~~

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY	Date: 11|9|2021
	TURNOUT SITE: Woodside Ditch	WATER SOURCE: Main Channel
		Assessor: TM
		Irrigator on Site? None

STRUCTURE TYPE:

[✓ HEADGATE:]	☐ Slide gate	☐ Stop logs	☒ Culverts	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☐ Gauge	☐
DIVERSION:	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☒ Concrete	☐ Earth	☐

Crack in concrete wingwall

Corrugated metal pipes

24" diameter

Low flow Culverts (2)

CONDITION:

☐ Not Used	☐ Broken	~~☒ Poor~~	☒ Good	☐ New

IMPAIRMENTS:

☒ Erosion	☐ Sediment	☒ Age/Wear	☐ Vegetation	☒ Debris
☒ Leaking	☒ Structural	☐		

SAFETY CONCERNS:

Walkway is not secure, no railing

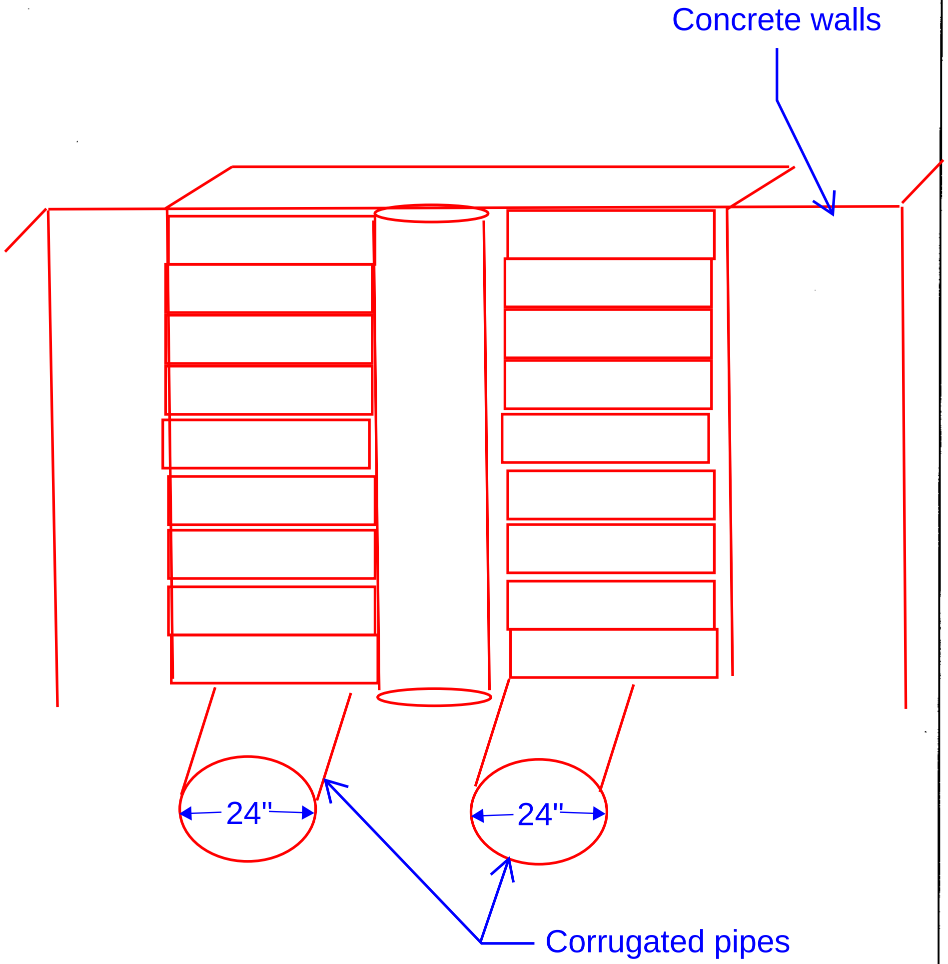
OBSERVATIONS:

Two 24-inch diameter corrugated metal pipes under concrete slab which sits beneath old concrete walls that served the previous gate structure.

The old concrete gate opening is permanently blocked by wooden stop logs that are bolted to a 12-inch diameter steel pipe that is set into the concrete slab.

24-inch pipes were installed in 2002 and lowered in the inlet elevation of the headgate by approx. 30 inches.

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: WOODSIDE

WATER SOURCE: ~~[illegible]~~ MAIN CH

Date: 11/9

Assessor: CA

Irrigator on Site? NONE

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
[✓ FLOW MEASUREMENT:]	☐ Flume	☐ Weir	☐ Gauge	~~X NONE~~
[✓ DIVERSION:]	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	~~☐ X NONE~~

MATERIAL:

☐ Wood	☐ Metal	☐ Concrete	☒ Earth	☐

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☐ Good	☐ New

Diversion = Good condition, no issues getting adequate water, located in stable reach of the river
Flow Measurement = Poor Condition; Located at the entrance of culvert, resulting in varied flow condition and inaccurate measurements.

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

SAFETY CONCERNS:

Notes in green added by Nik Ortman based on 16-Nov-2021 site visit with JR Iman

OBSERVATIONS:

LARGE GRADE CHANGE
UNDER WATER CULVERT

GATE INVERT ~ 4 ft HIGHER
THAN CURRENT WATER LEVEL

STABLE BANK ON BOTH SIDES

DEBRIS STACKED ON BANK

Underflow culverts embedded in concrete slab were installed in early 2000s; there is 6-8" of concrete above the culverts

Operator usually keeps ~1 culvert blocked until water drops to 4" below top of culverts, then opens the second culvert halfway

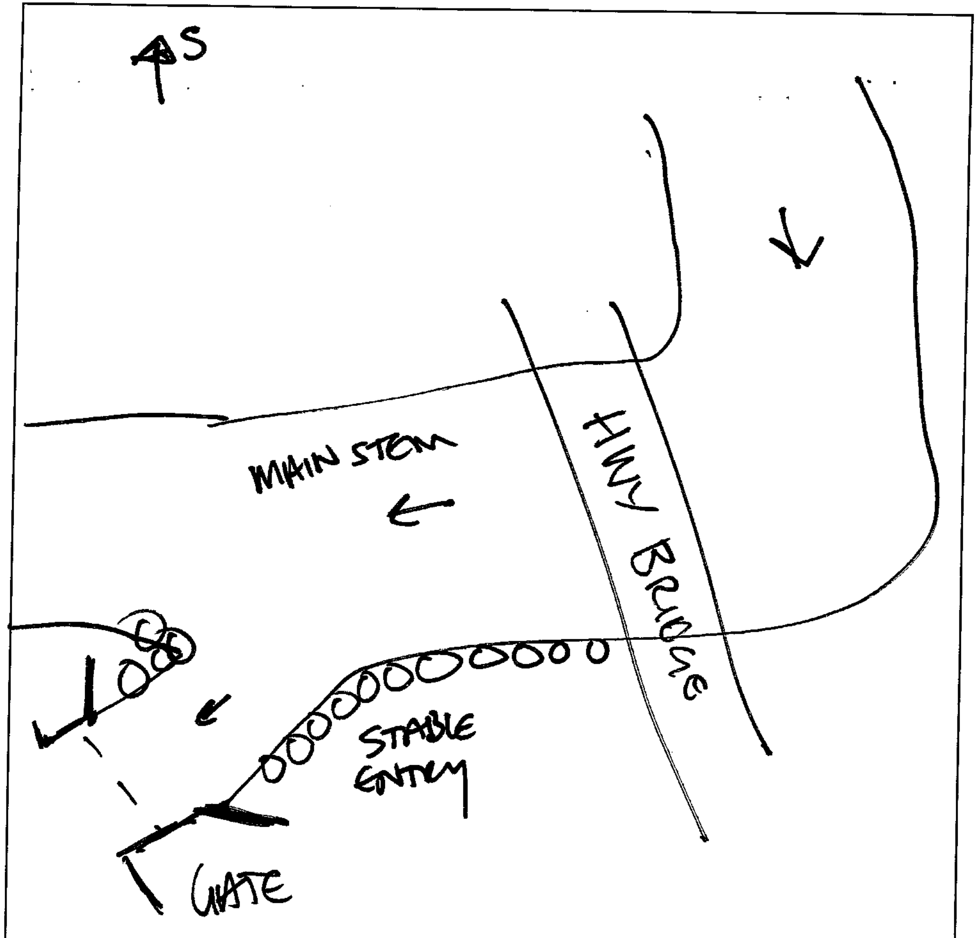
Operator sprays ditch with Clearcast Aquatic Herbicide to combat vegetation

Ditch crosses Blodgett Creek; operator only opens culvert once Blodgett check structure is in place

Ditch collects lots of local runoff

Operator estimates that ditch spills 20-40" to Mill Creek; operator estimates that there 1000 irrigated acres served between the Blodgett culvert and Sheafman creek

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Notes in green added by Nik Ortman based on 16-Nov-2021 site visit with JR Iman

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY		Date: 11/9/2021
	TURNOUT SITE: SPOONER	WATER SOURCE: East Channel	Assessor: TM Irrigator on Site? John Lewis Sr.

~~STRUCTURE~~ TYPE:

[✓ HEADGATE:]	☐ Slide gate	☐ Stop logs	☒ Wood Boards	
~~FLOW MEASUREMENT:~~	☐ Flume	☐ Weir	☐ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☒ Wood	☐ Metal	☒ Concrete	☐ Earth	☐

Wood Planks, Concrete deteriorating

↳ left on bank over the winter - weathering/rotting

CONDITION:

☐ Not Used	☐ Broken	~~☒ Poor~~	☒ Good	☐ New

Headate = Fair condition

IMPAIRMENTS:

☒ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

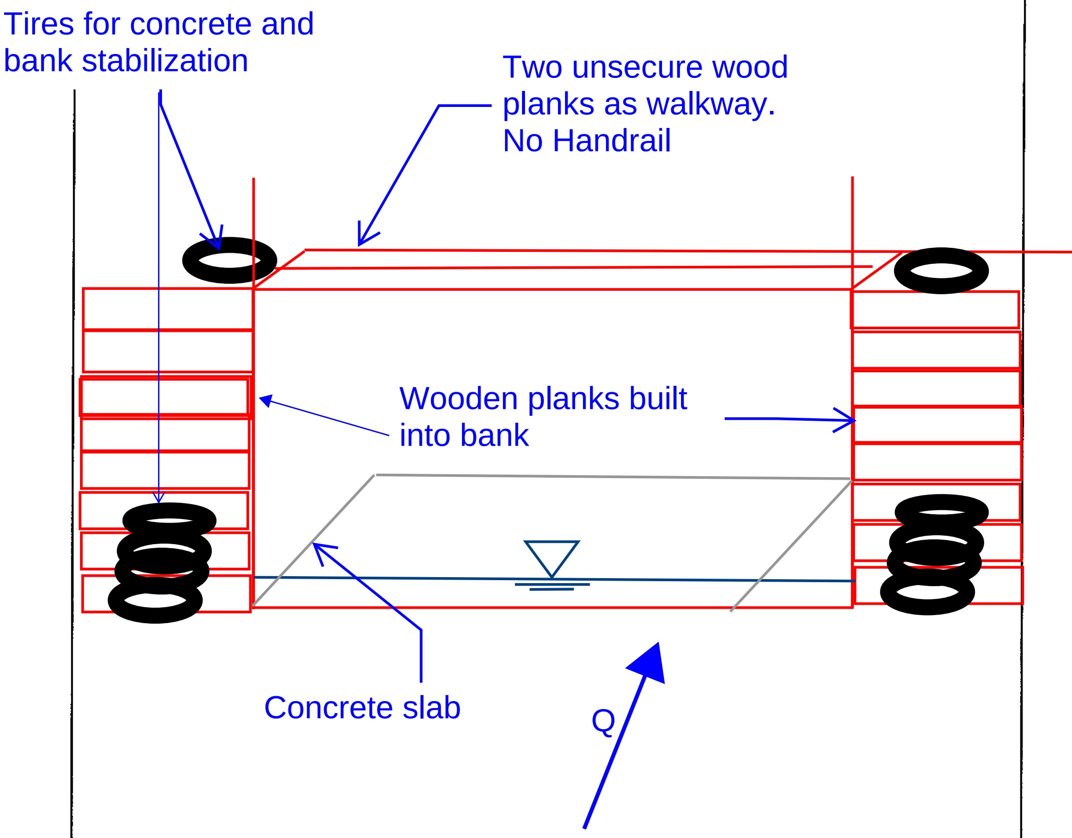
River eroding bank between ditch & river

SAFETY CONCERNS:

Needs more boards for walkway - large gaps between boards. Loose (Not bolted

OBSERVATIONS:

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: SPOONER

WATER SOURCE: E CHANNEL

Date: 11/9

Assessor: CA

Irrigator on Site? Johnny Lewis

STRUCTURE TYPE:

~~HEADGATE:~~	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☐ Gauge	☒ NONE
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☒ Concrete	☒ Earth	☐

RIVER ROCK PIER w/ CONCRETE BLOCKS, METAL STANDS WITH LOGS & METAL PANELS

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ ~~Good~~	☐ New

Diversion = Fair Condition

ADD METAL STANDS/LOGS WITH TRACTOR FLAT
STABILIZE WITH GRAVEL

IMPAIRMENTS:

☒ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

WASHOUT DOWNSTREAM OF HEAD GATE

SAFETY CONCERNS:

OBSERVATIONS:

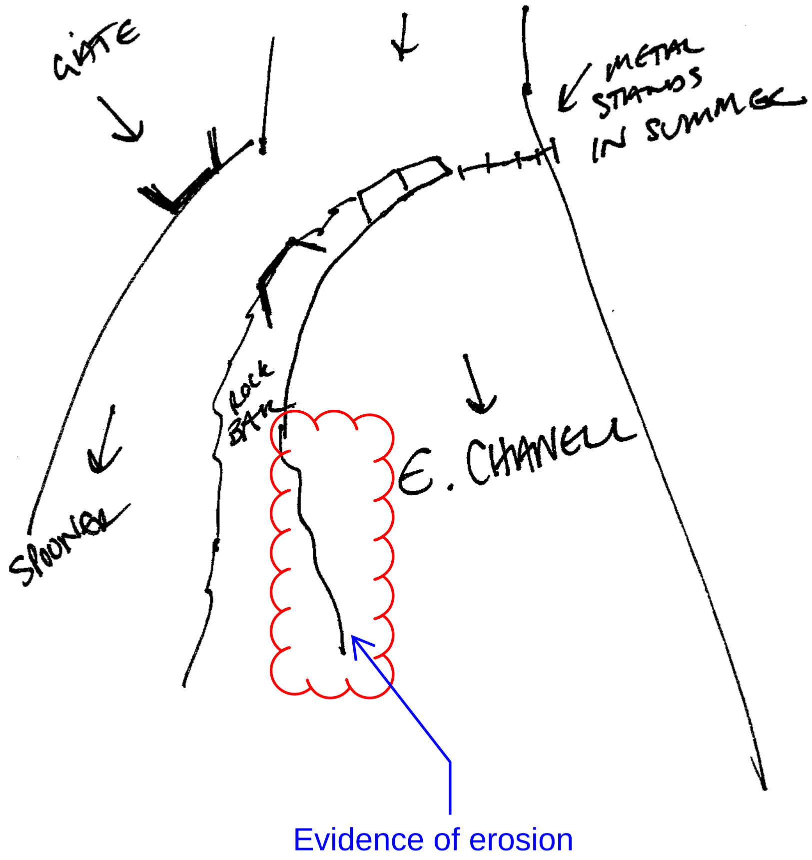
DIVERSION GOOD

NO WASHOUT ISSUES

INSTALL WITH TRACTOR EVERY YEAR

S ↑

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

Date: 11/9/2021

Assessor: TM

Irrigator on Site? Bob Sutherland

TURNOUT SITE: WEBFOOT

WATER SOURCE: Michel Slough

STRUCTURE TYPE:

[✓ HEADGATE:]	☐ Slide gate	☒ Stop logs	☐	
~~FLOW MEASUREMENT:~~	☐ Flume	☐ Weir	☐ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☒ Concrete	☒ Earth Logs	☐

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	~~☒ Good~~	☐ New

Not much adjustments necessary

Headgate = Fair condition

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☒ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

SAFETY CONCERNS:

Compromised concrete

Missing walkway

electric fence

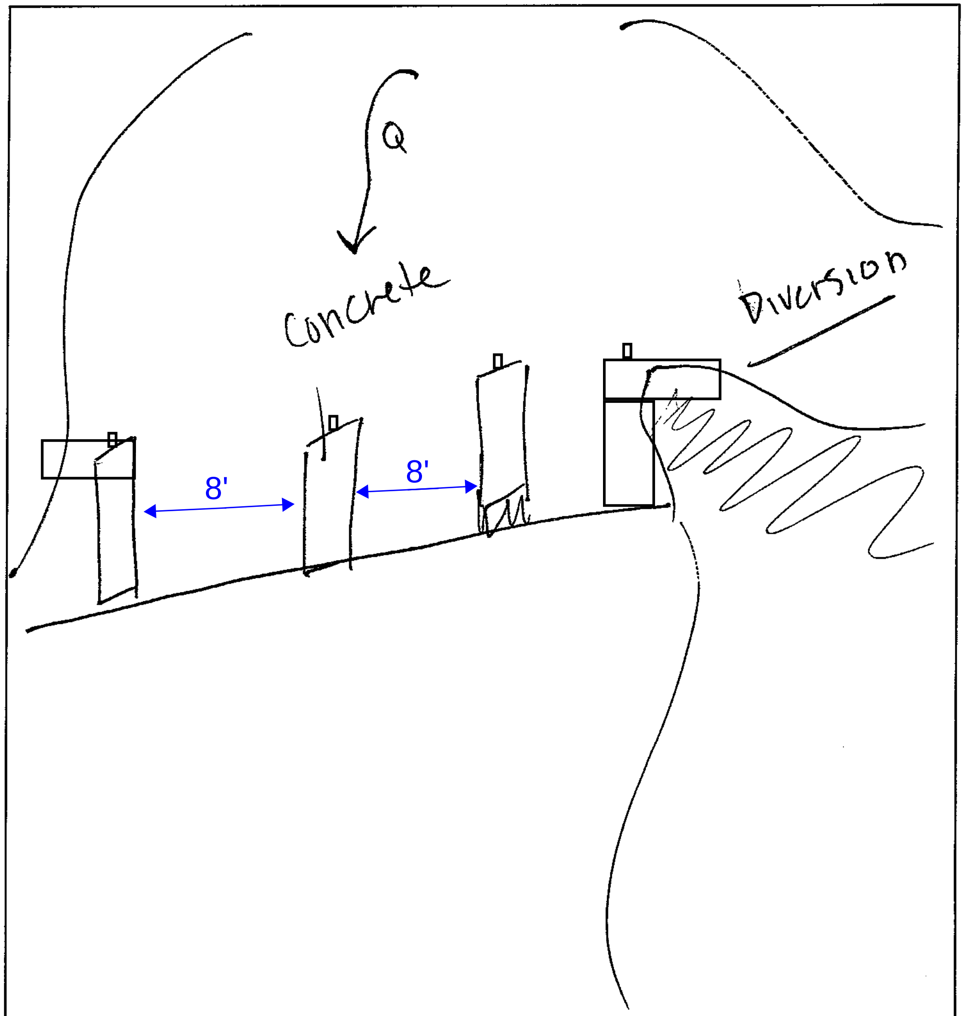
People drag logs into place in Spring

OBSERVATIONS:

Logs against 3 concrete pillars
put them in in the spring
take them out in the winter

missing water measurment

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**		Date: 11/9 Assessor: CA Irrigator on Site? BOB
	TURNOUT SITE: WEBFOOT	WATER SOURCE: MITCHELL	

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☐ Gauge	☒ NONE
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☒ Wood	☐ Metal	☒ Concrete	☐ Earth	☐

CHECK DAM - WOOD STOP LOGS

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	~~☒ Good~~	☐ New

Diversion = Fair Condition

Plank for walkway.
Diversion Concrete shows evidence of wearing

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☒ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

CONCRETE EROSION ON SIDE

SAFETY CONCERNS:

ONLY ONE BOARD FOR WALK, IN-WATER EFFORT TO ADD LOGS

OBSERVATIONS:

LOGS OUT IN SPRING-GATE

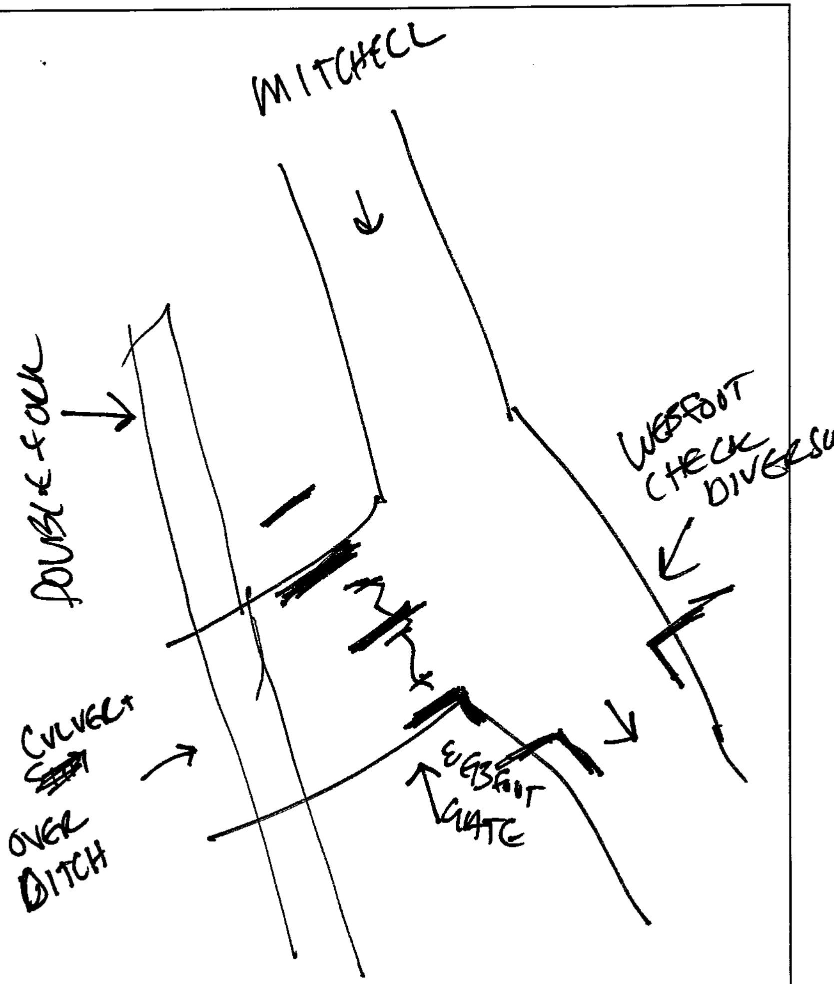
NOT MUCH CONTROL NEEDED

SOME OVERTOPPING DURING HIGH WATER

QUESTION:

Are these 12' boards that span the entire diversion structure?

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**		Date: 11/9/2021 Assessor: TM Irrigator on Site? yes - Bob Sutherland
	TURNOUT SITE: ETNA	WATER SOURCE: East Channel	

STRUCTURE TYPE:

[✓ HEADGATE:]	☒ Slide gate	☐ Stop logs	☐	
~~FLOW MEASUREMENT~~:	☐ Flume	☐ Weir	☐ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☒ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

CONDITION:

☐ Not Used	☐ Broken	☒ Poor	~~☒ Good~~	☐ New

Concrete piers have cracking

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☒ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

SAFETY CONCERNS:

walkway could be improved
manual lifting gates, Gate(locked)

OBSERVATIONS:

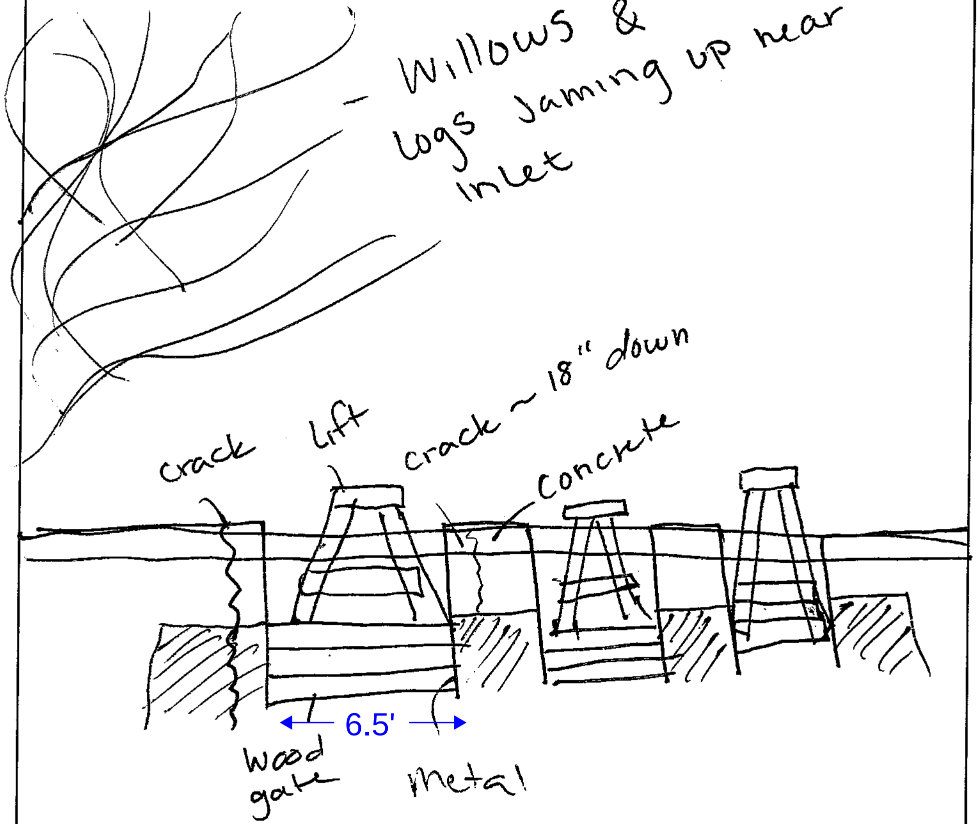
concrete keyed in to bank
to prevent spillover

metal slides in good condition
Wood gates - manually lifted

Drive through private property
(2276 E. Side Hwy)

walkway could be improved

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: ~~UNION ET~~ ETNA

WATER SOURCE: ~~EAST CH~~/MITCHELL

Date: 11/9

Assessor: GA

Irrigator on Site? BOB

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT: ☆	☐ Flume	☐ Weir	☒ Gauge DOWNSTREAM	☐ OF BRIDGE + GATES
DIVERSION: ☆	☒ In-stream ~~dam~~ CHECK	☐ Pipe/Culvert	☐ Ditch	☒ CHECK ON MITCHELL

MATERIAL:

☒ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

CHECK ON MITCHELL TO ~~BTNE~~ ETNA. 4 GATES - STOP LOGS

CONDITION:

☐ Not Used	☐ Broken	☒ Poor	☐ Good	☐ New

CHECK - EITHER ALL OPEN OR OFF

DOUBLE FORK TO PUT MEASUREMENT DEVICE IN.
↳ PARSHALL NEAR GAGE

IMPAIRMENTS:

☒ Erosion	☐ Sediment	☒ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☒ Structural	☐		

SEDIMENT OK - SAFETY

STRUCTURE CONCRETE EROSION

SAFETY CONCERNS:

BRIDGE -/ CATWALK,

OBSERVATIONS:

STOP LOGS AT CHCK

NEW WALK

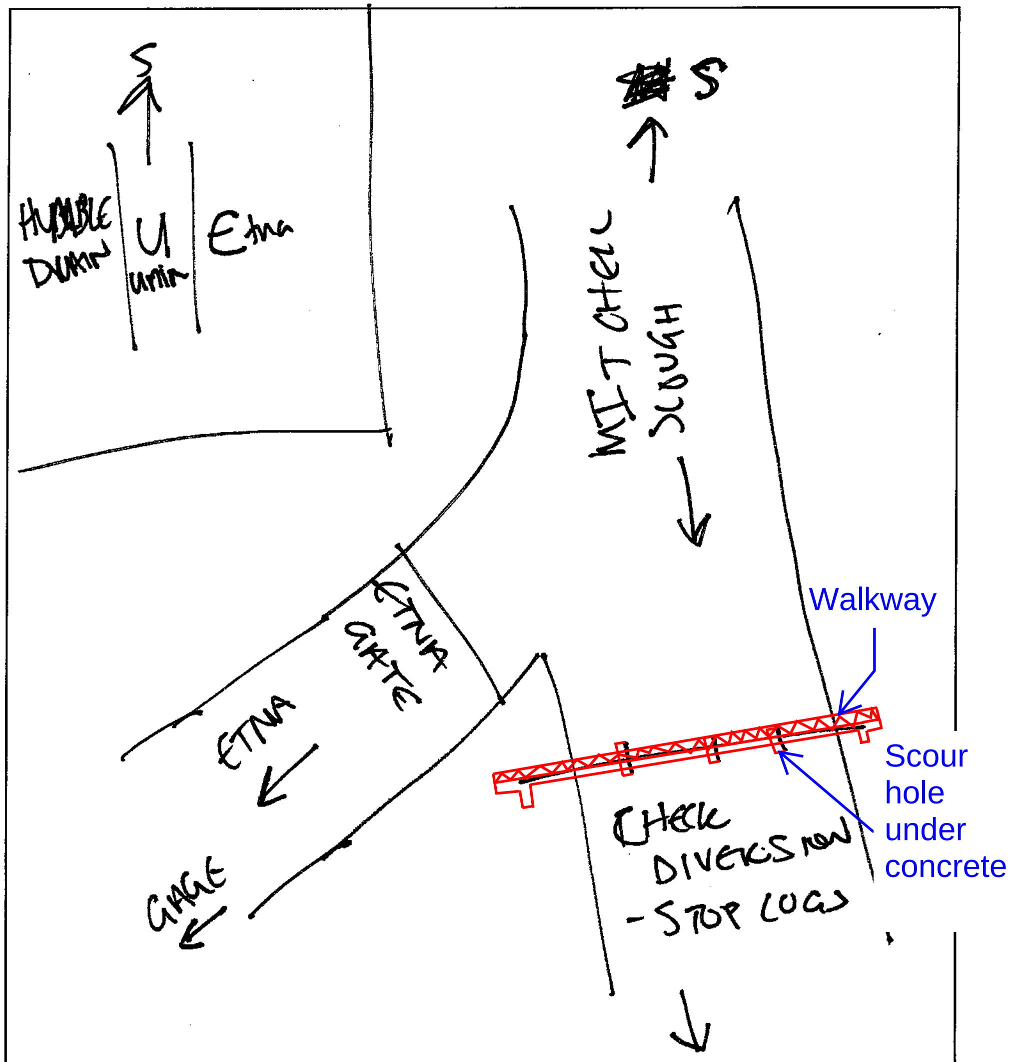
GAGE DOWNSTREAM

MITCHELL SLOUGH COMES
OUT OF TUCKER

SURVEY TO GRAB GRADE
NEAR GAGE

BUZZ - UNION

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

DOUBLE FORK

BIG SKY RANCH · ETNA + SUPPLY

PARSHALL

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**		Date: 11/9/2021 Assessor: TM Others On-Site: Bob Sutherland
	TURNOUT SITE: Tucker Headgate	WATER SOURCE: East Channel	

STRUCTURE TYPE:

HEADGATE:	☒ Gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☒ Gauge	☐
DIVERSION:	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐ Eco Blocks to direct channel

MATERIAL:

☐ Wood	☐ Metal	☐ Concrete	☐ Earth	☐

Concrete structure with steel wrapping the concrete walls and five wood slide gates with steel guides and metal rings used to manually lift the gates.

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

Works fine

IMPAIRMENTS:

☐ Erosion	☒ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

SAFETY OBSERVATIONS:

Locked gates / fence (chain link), Signs to keep out

OBSERVATIONS:

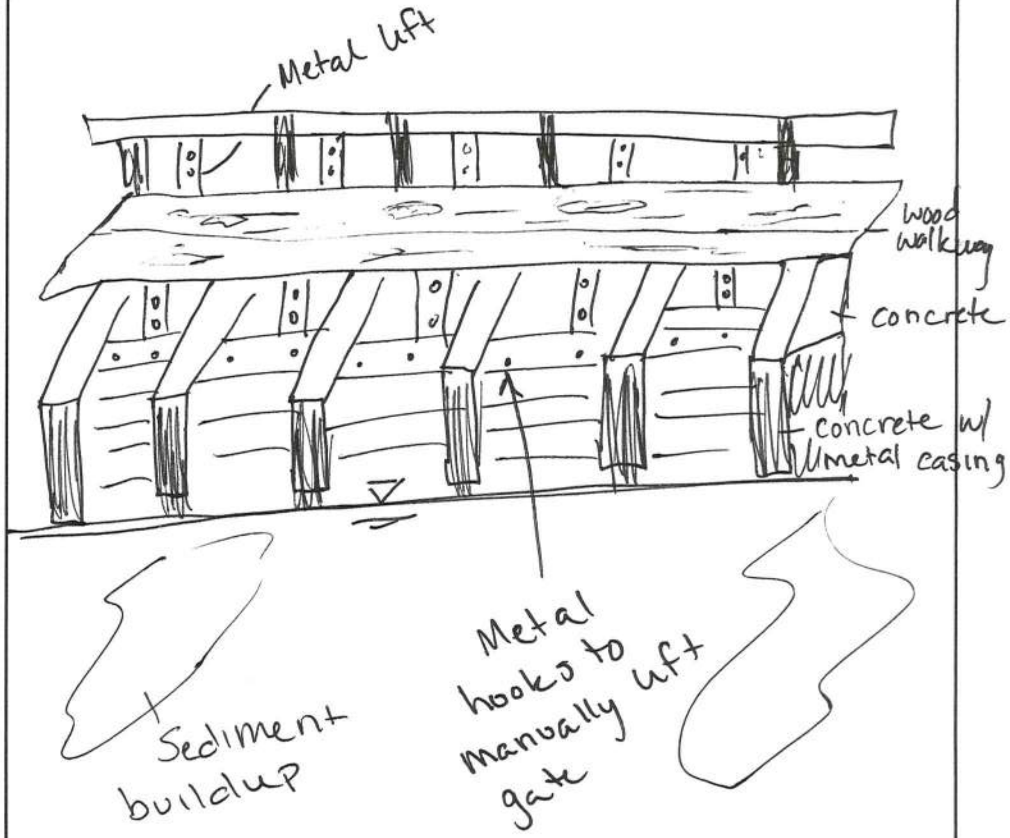
Eco blocks w/ gravel - not very efficient
cost ~ $3,000/year to install Eco blocks

Improve gate system or concrete apron
So we could stop using Eco blocks

Old wood beams Could be replaced - Hand
Crank gates
- Sediment is an issue and has to be
removed because ~~rain~~water wont flow -
→ Maybe line Ecoblocks w/ tarp then place gravel
5 gates ~ 12' each.

No safety rail on downstream site of
walkway

SKETCH AND DIMENSIONS:



No of Photos Taken: Nik & Carly Phones

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: TUCKER

WATER SOURCE: EAST FK

Date: 11/9

Assessor: CA

Irrigator on Site? BOB

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☒ Gauge	☐
DIVERSION:	☒ In-stream dam TEMP.	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☒ Concrete	☐ Earth	☐

CONCRETE BLOCKS PLACED IN EACH YEAR

CONDITION:

☐ Not Used	☐ Broken	~~☒ Poor~~	☐ Good	☐ New

NEEDS TO BE PLACED EACH YEAR, ~$3K

Diversion = Fair Condition
Flow Measurement = Fair Condition

IMPAIRMENTS:

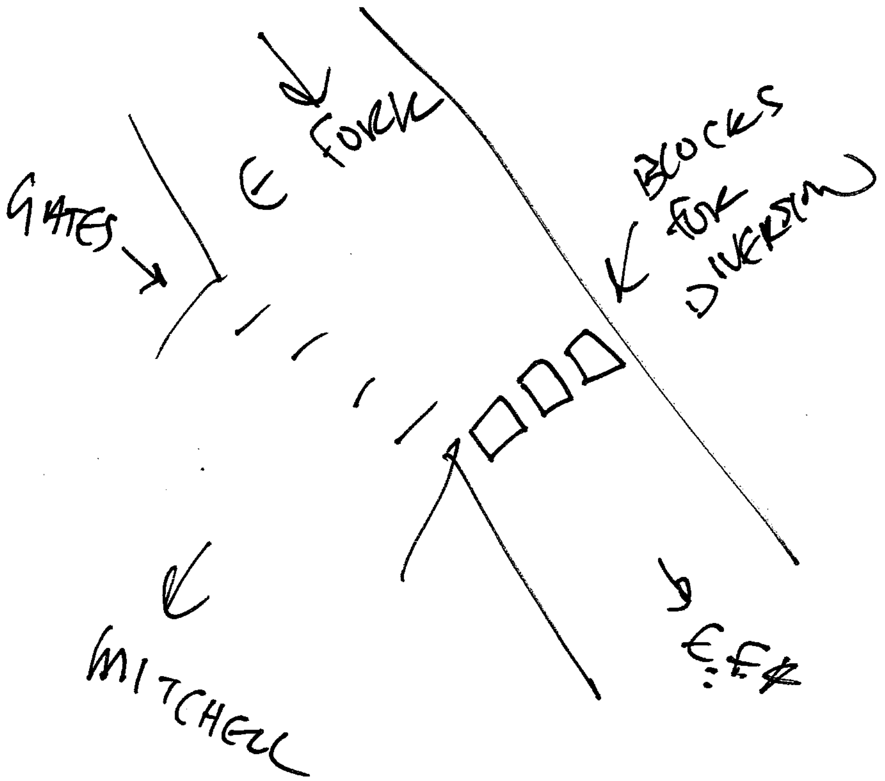
☐ Erosion	☒ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☒ Structural	☐		

RIVER SEDIMENT BUILDS UP FROM BLOCKS + PAST GATES

SAFETY CONCERNS:

OBSERVATIONS:

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**		Date: 11/10/2021 Assessor: TM Irrigator on Site? Joe, Dave, Rob
	TURNOUT SITE: C & C	WATER SOURCE: Skalkaho	

STRUCTURE TYPE:

[✓ HEADGATE:]	☒ Slide gate	☐ Stop logs	☐	
~~FLOW MEASUREMENT:~~	☐ Flume	☐ Weir	☒ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

Single metal slide gate that opens to a 48-inch squash culvert.

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

Gate only lifts 3" and they get enough flow - there is a secondary gate down stream that they adjust.

IMPAIRMENTS:

☐ Erosion	☒ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

Some inlet & outlet debris (Leaves / logs)

Some overflowing ~~[illegible]~~ over headgate in High Water

SAFETY CONCERNS:

OBSERVATIONS:

Concrete in good condition

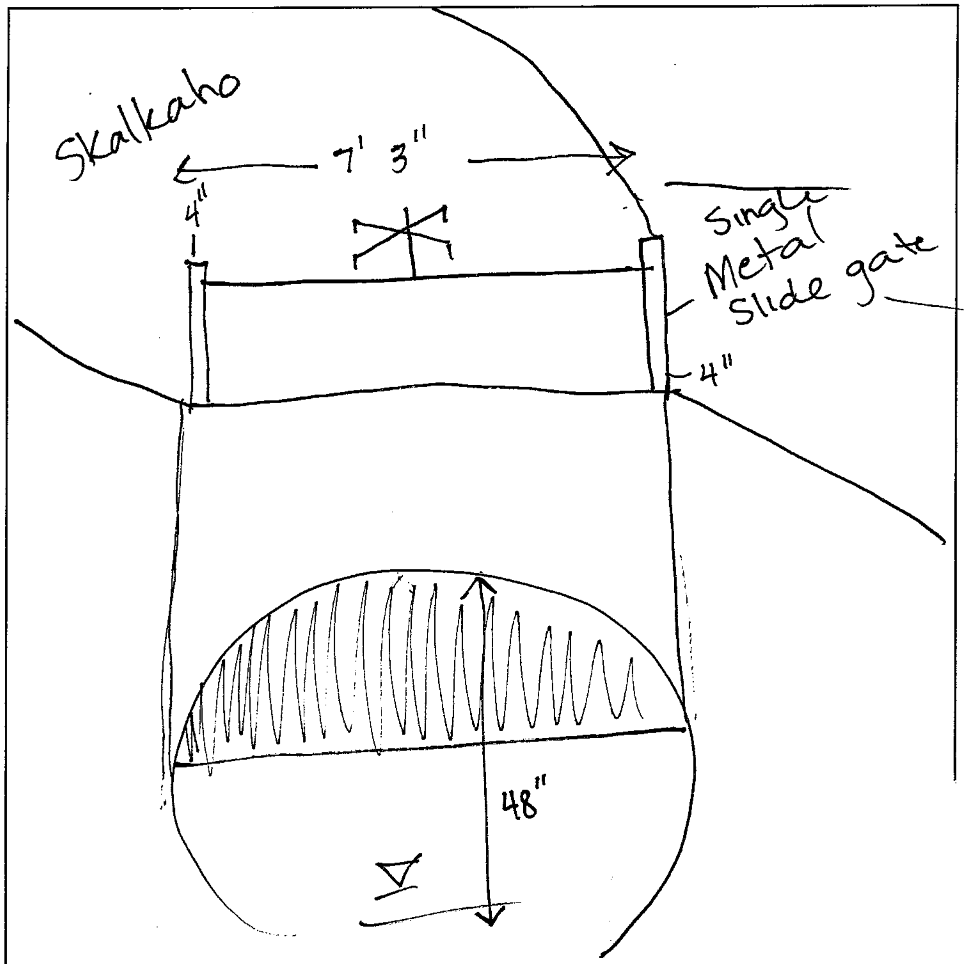
Single metal slidegate that

opens through to culvert.

Some sediment & debris build

up at inlet.

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY		Date: 11/10 Assessor: CA Irrigator on Site? JOE, ROBERT DAVE
	TURNOUT SITE: C & C	WATER SOURCE: SKALKAHO CREEK	

STRUCTURE TYPE:

~~HEADGATE:~~	☐ Slide gate	☐ Stop logs	☐	
[✓ FLOW MEASUREMENT:]	☐ Flume	☐ Weir	☒ Gauge	☐
[✓ DIVERSION:]	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☒ Concrete	☐ Earth	☐

~ 3 ft TALL CONCRETE WALL IN STREAM

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	~~☒ Good~~	☐ New

Diversion = Fair Condition NO ISSUES GETTING WATER UNLESS STREAM CHANGES

Flow Measurement = Poor Condition due to staff gauge located in heavy sediment and vegetation

IMPAIRMENTS:

☒ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		↳ HIGH WATER

ISSUES WITH HIGH WATER BRINGING DEBRIS AND CLOGGING CREEK

SAFETY CONCERNS:

OBSERVATIONS:

JOE,

PIPING IS FAILING NORTH OF TOWN

↳ UNGALVANIZED PIPE RUSTING

⇒ SAME PIPE EXPOSED (3/4 mile) BURIED N OF MAIN ST

6"-3ft deep

CHANGES EACH SEASON

↳ FLOWS, CHANNEL

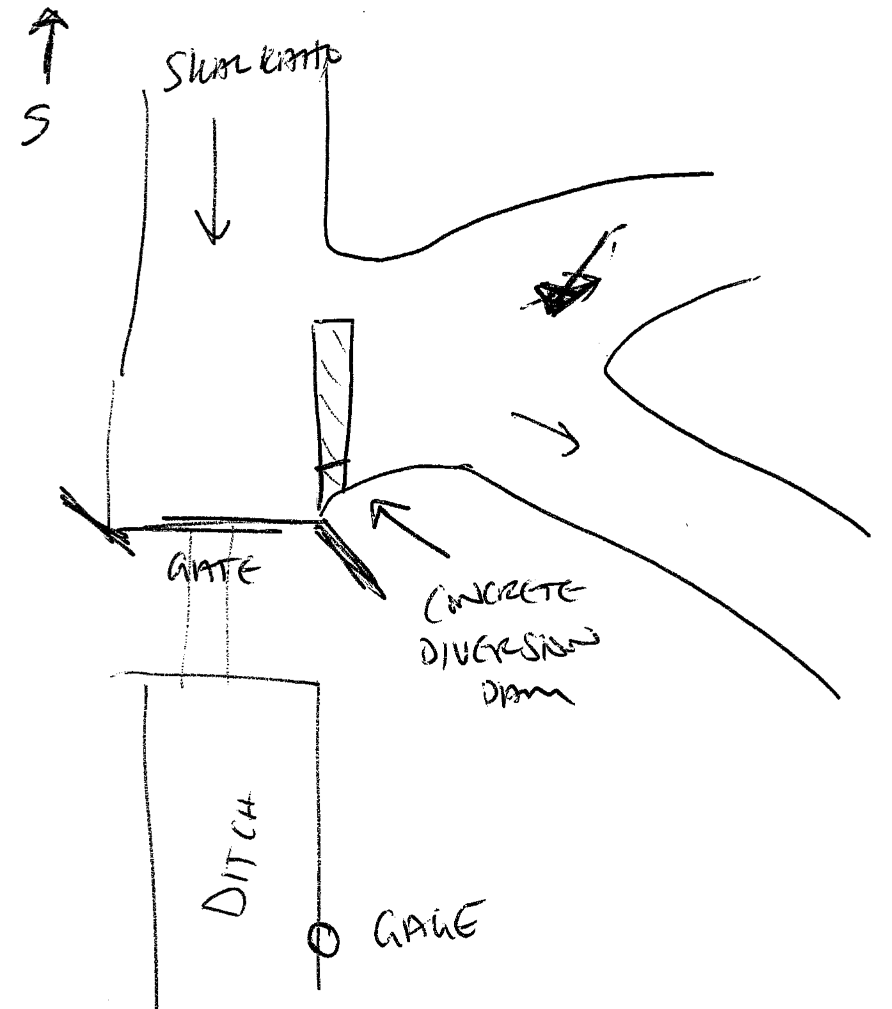
3-INCH OPENING GETS PLENTY OF WATER

→ $9-10 K BUDGET EACH YEAR

COST $3500 TO MAINTAIN

NORTH OF MAIN USERS AT RISK OF ~~USING~~ LOSING WATER

SKETCH AND DIMENSIONS:



No of Photos Taken: ______

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**		Date: 11/10/21
	TURNOUT SITE: ORR ~~[illegible]~~	WATER SOURCE: West Fork	Assessor: TM Irrigator on Site? None

STRUCTURE TYPE:

[✓ HEADGATE:]	[✓ ☑ Slide gate]	☐ Stop logs	☐	
~~FLOW MEASUREMENT:~~	☐ Flume	☐ Weir	☐ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

Metal gates w/ metal ^ trash collection rack

Rectangle

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

Concrete structure with two handwheels that lift two metal slide gates that open to two 35" x 24" corrugated pipe arches. The pipes are old and showing evidence of rusting. The slide gates were completely shut and water was still passing into the ditch.

IMPAIRMENTS:

☐ Erosion	☒ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

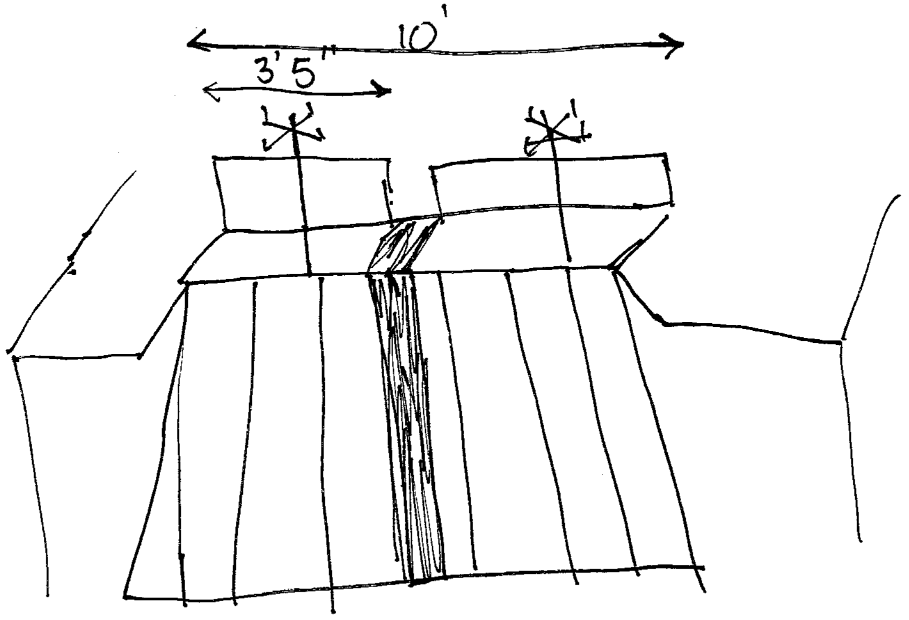
SAFETY CONCERNS:

Locked headgate wheels

OBSERVATIONS:

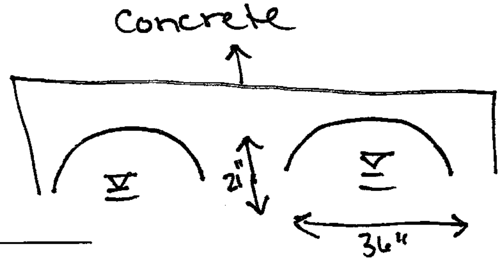
SKETCH AND DIMENSIONS:

2 Headgates



OUTLET:

* lots of sediment buildup at outlet



No of Photos Taken: ____________

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY		Date: 11/10 Assessor: CA Irrigator on Site? NA
	TURNOUT SITE: ORR + HUNT	WATER SOURCE: WEST FORK	

STRUCTURE TYPE:

~~HEADGATE~~	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☐ Gauge	☒ NONE
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☒ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☒ Concrete	☒ Earth	☐

~2ft CONCRETE WALL + 2 LAYERS OF BLOCKS (6 across)

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

Flow Measurement = Fair Condition
*Orr staff gauge or flume - Check in Spring

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

LEAVES + TWIGS AGAINST DIVERSION LOGS IN DITCH

SAFETY CONCERNS:

OBSERVATIONS:

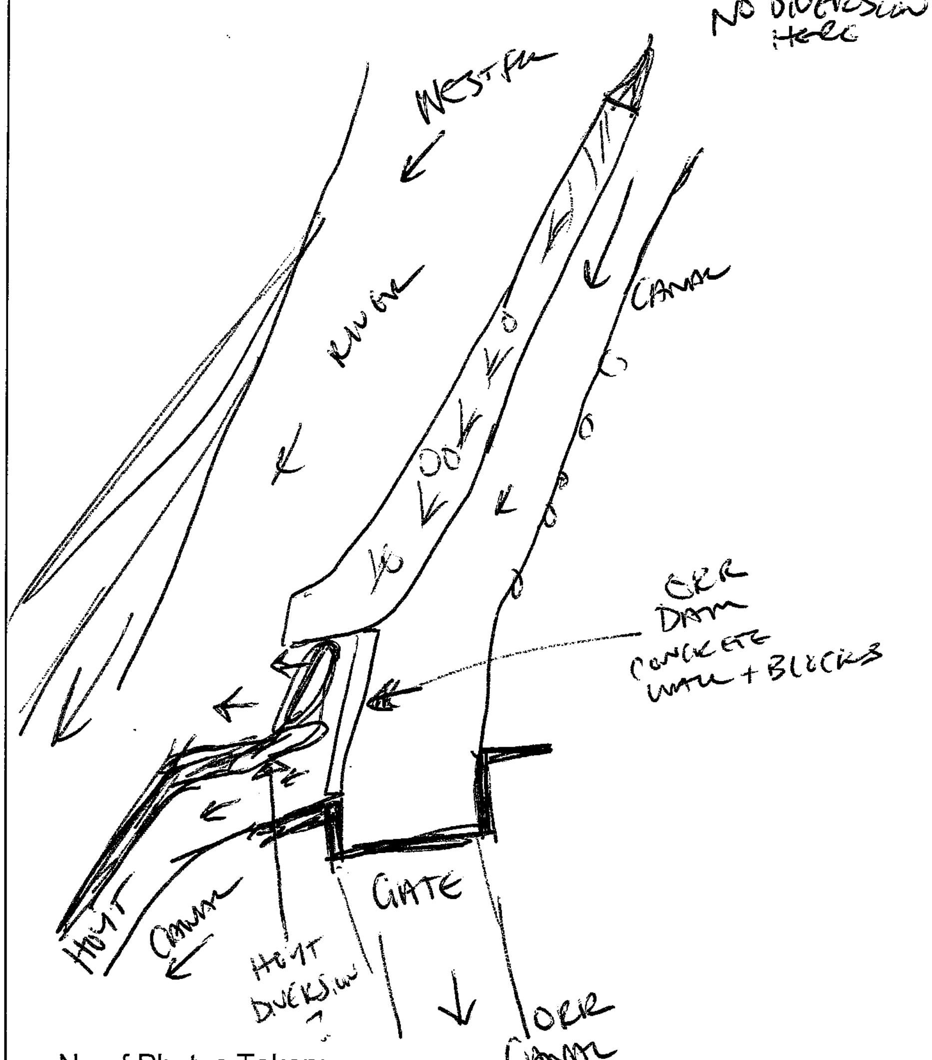
SERVICE CANAL LEADS TO HEADGATES + DIVERSION DAM

PAST DIVERSION, ~~[illegible]~~ ROCK + CONCRETE BERM DIRECT BYPASS FLOWS INTO SMALL CANAL

CANAL SEEMS STABLE, MANY LOGS/DEBRIS

NO WOOD FLUME FOUND

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: Ward

WATER SOURCE: Main Channel

Date: 11/10/2021

Assessor: TM

Irrigator on Site? Ron Porter

STRUCTURE TYPE:

[✓ HEADGATE:]	☒ Slide gate	☐ Stop logs	☐	
~~FLOW MEASUREMENT~~:	☐ Flume	☐ Weir	☐ Gauge	☐
~~DIVERSION~~:	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

Two metal headgates

New concrete, metal grate walkway with handrail

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☐ Good	☒ New

Ward headgate was replaced in 2018 and is in excellent condition

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

Debris building up at the headgate is a recurring issue

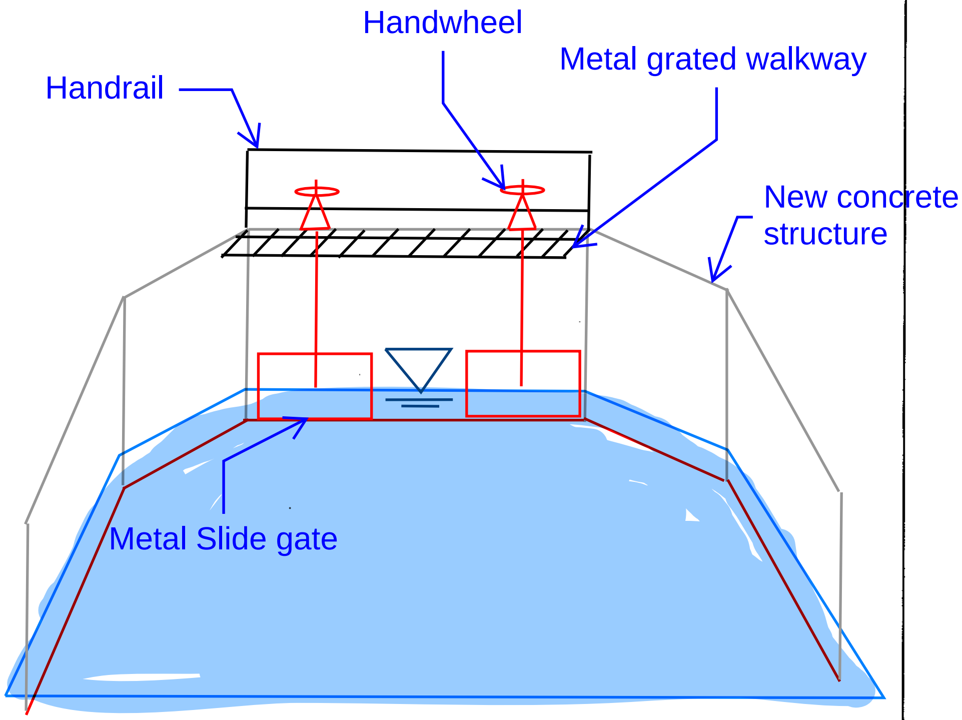
SAFETY CONCERNS:

Nine

OBSERVATIONS:

Flume has board bottom

SKETCH AND DIMENSIONS:



No of Photos Taken: ___________

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY	Date: 11/10
	TURNOUT SITE: WARD	WATER SOURCE: BITTERROOT
		Assessor: GT
		Irrigator on Site? Ron

STRUCTURE TYPE:

HEADGATE:	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☒ Flume	☐ Weir	☒ Gauge	☐
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☒ EARTH

MATERIAL:

☐ Wood	☐ Metal	☐ Concrete	☒ Earth	☐

REDONE EACH YEAR DEPENDING ON RIVER, RIVER ROCKS, LOGS, 2FT BOULDERS

CONDITION:

☐ Not Used	☐ Broken	☒ Poor	☒ Good	☐ New

Flow Measurement = Fair Condition
Diversion = Fair Condition

DEPENDING ON WATER

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

YEARLY CLEANING OF DEBRIS/LOGS IN ENTRY DITCH

SAFETY CONCERNS:

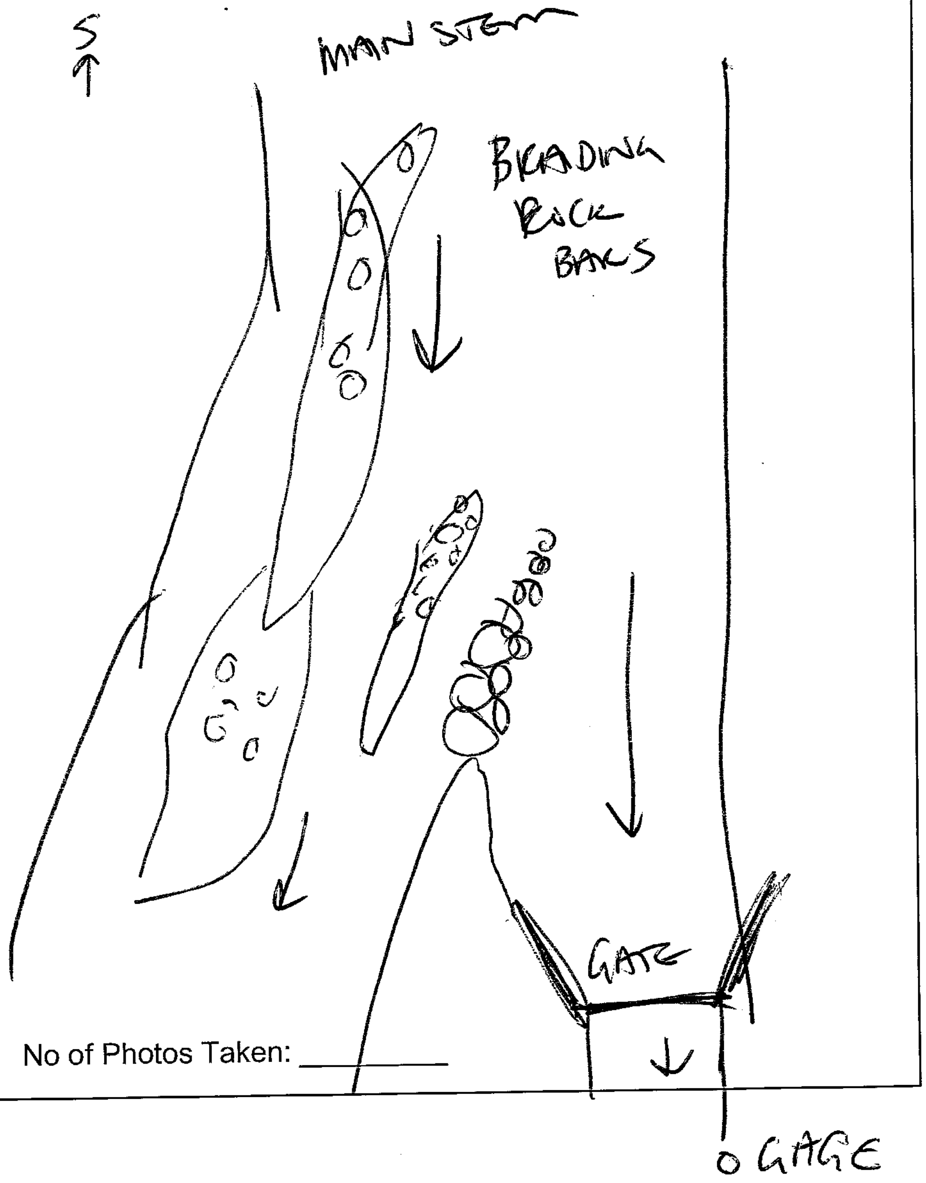
OBSERVATIONS:

GETS ENOUGH WATER

DIVERSION REBUILT EACH YEAR WITH LOGS, RIVER ROCK, AND IMPORTED 2' BOULDERS

Theere is a flow measurement gauge ~100 ft downstream of the headgate in a natural bottom, irregular cross-section of channel. There is also an old wood flume in the ditch located downstream of the Lost Horse Siphon

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: Tiedt Nicholson

WATER SOURCE: Bitterroot Main CH.

Date: 11/10/21

Assessor: TM

Irrigator on Site? Randy Maxwell

STRUCTURE TYPE:

HEADGATE:	☒ Slide gate	☐ Stop logs	☐	
~~FLOW MEASUREMENT~~:	☐ Flume	☐ Weir	☒ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

Concrete seems to be in good condition
wheel twist for lifting headgate is bent but still works

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☐ Leaking	☐ Structural	☐		

SAFETY CONCERNS:

Located in embankment so access is good

OBSERVATIONS:

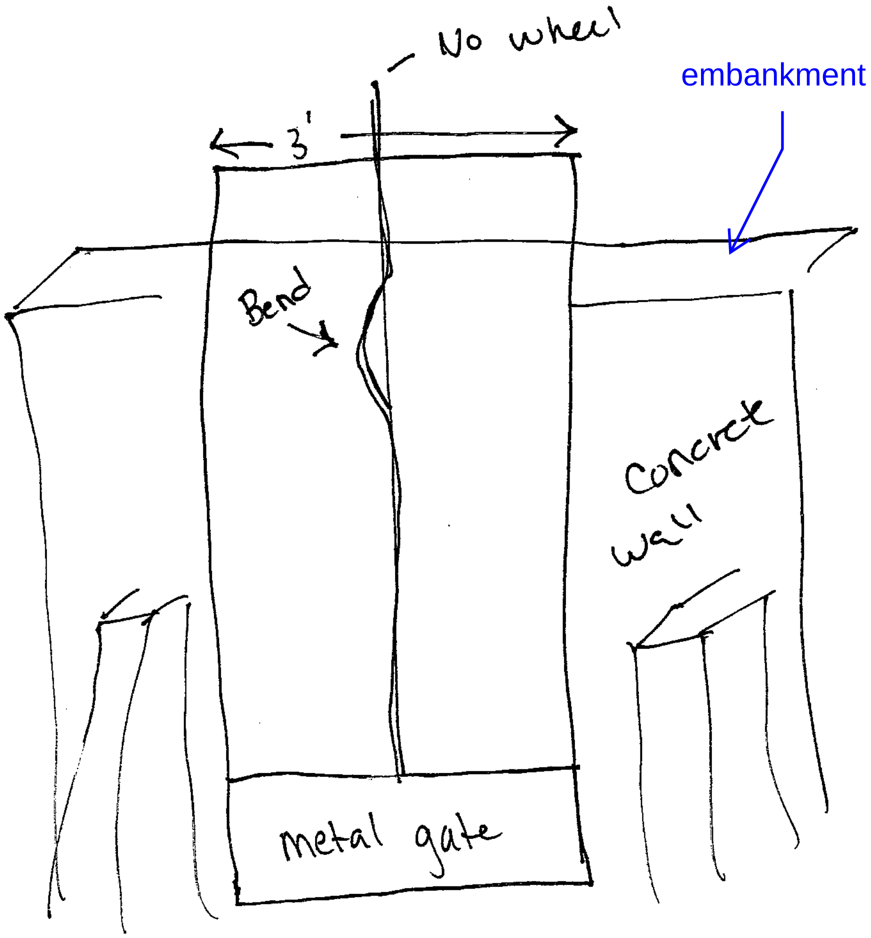
4 users downstream

Plenty of water

Culvert outlet (44 x 30)

gets excess H_2O from bunkhouse & overturf so they dont use/open this until mid July.

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY		Date: 11/10 Assessor: CA Irrigator on Site? RANDY
	TURNOUT SITE: TEDDY NICHOLSON	WATER SOURCE: BITTERROOT	

STRUCTURE TYPE:

~~HEADGATE:~~	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☒ Weir	☒ Gauge	☐
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☐ Concrete	☒ Earth	☐

3-4 ft BOULDERS FOR SMALL JETTY DIVERSION
WEIR - METAL PROBABLY 5' X 3' BOX

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

WOULD LIKE SOME THING MORE PERMANENT
ADDS ROCKS IN SPRING

Flow Measurement = Fair Condition

~~WEIR - POOR~~

IMPAIRMENTS:

☐ Erosion	☒ Sediment	WEIR [✓ ☐ Age/Wear]	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

SOME SEDIMENT IN FRONT OF DIVERSION

AGED WEIR

SAFETY CONCERNS:

4 TOTAL USERS

OBSERVATIONS:

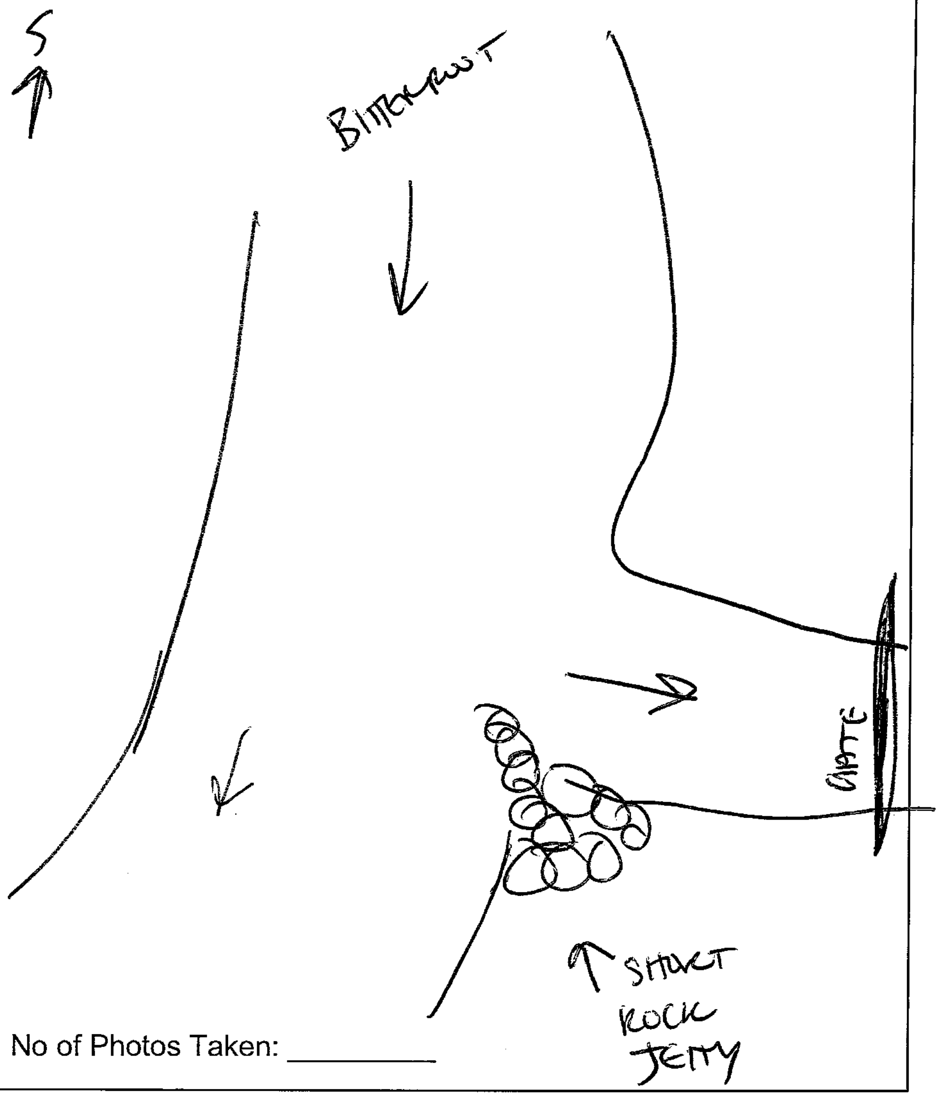
RIVER IS STABLE IN THIS AREA.

IMPORTED ROCK DIVERSION ADJUSTED SLIGHTLY EACH YEAR AS NEEDED

SEDIMENT BUILT UP IN ENTRY, NOT NEGATIVELY AFFECTING DELIVERY

LATE SUMMER - BOARD PANELS INSERTED IN CHANNEL FOR DIVERSION (PLY WOOD ON METAL POST)

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

EARLY SEASON WATER FROM BUNKHOUSE [illegible]

NOT TAKING FROM RIVER EARLY SEASON UNTIL LATE JULY

Morrison Maierle

BITTERROOT CONSERVATION DISTRICT
BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY

TURNOUT SITE: Overturf

WATER SOURCE:

Date: 11/10/2021

Assessor:

Irrigator on Site? Jake, Wayne & Randy

STRUCTURE TYPE:

[✓ HEADGATE:]	☒ Slide gate - single	☐ Stop logs	☐	
~~FLOW MEASUREMENT~~:	☐ Flume	☐ Weir	☐ Gauge	☐
~~DIVERSION:~~	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☒ Metal	☒ Concrete	☐ Earth	☐

Concrete structure in good condition with metal slide gate inletting to a corrugated steel 58" x 36" pipe.

CONDITION:

☐ Not Used	☐ Broken	☐ Poor	☒ Good	☐ New

Headgate = good condition

IMPAIRMENTS:

☐ Erosion	☒ Sediment	☐ Age/Wear	☐ Vegetation	☒ Debris
☒ Leaking	☐ Structural	☐		

gate closed

There is evidence of sediment buildup at the outlet of the culvert and water leaks under the gate when in closed position.

SAFETY CONCERNS:

None - located in embankment so access is good

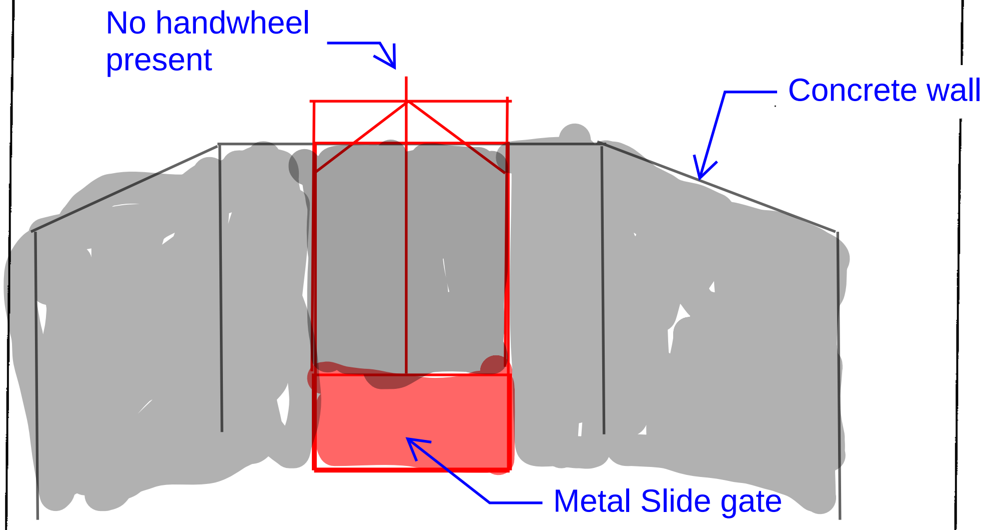
OBSERVATIONS:

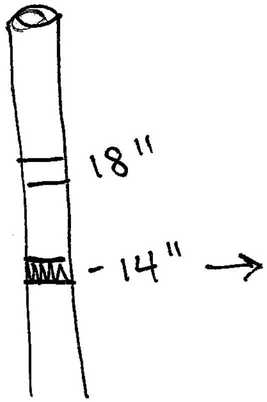
Concrete Structure in good condition w/ metal headgate working Inletting to Culvert (57"x 3') Sedimentation buildup at outlet.

- Car parts along riverbank for support / prevent erosion

~ 23 users (less people actually 'use' because EPA cleanup etc. are considered users but not using.

SKETCH AND DIMENSIONS:





8" down at measuring spot - if at this elevation last water user - wayne doesnt get water
↓
uses ~ 90 sprinkler heads

No of Photos Taken: ________

Morrison Maierle	**BITTERROOT CONSERVATION DISTRICT** **BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY**	Date: 11/10
	TURNOUT SITE: OVERTURF	WATER SOURCE: BITTERROOT
		Assessor: CA
		Irrigator on Site? WAYNE + JACE

STRUCTURE TYPE:

~~HEADGATE:~~	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☒ Gauge	☐
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☐ Wood	☐ Metal	☐ Concrete	☒ Earth	☐

MEASUREMENT – GAGE IN WOOD BOX CROSSING SECTION UNDER RAIL ROAD

ROCK

CONDITION:

☐ Not Used	☐ Broken	~~☒ Poor~~	~~☒ Good~~	☐ New

Flow Measurement = Fair condition

Diversion = Fair condition

~~MEASUREMENT – POOR – GOOD~~

DIVERSION – ADD CONCRETE EACH YEAR IN JULY (BLOCKS)

$1600 TO PUT DIVERSION IN

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☐ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

NO SEDIMENT

MEASUREMENT AT CULVERT

SAFETY CONCERNS:

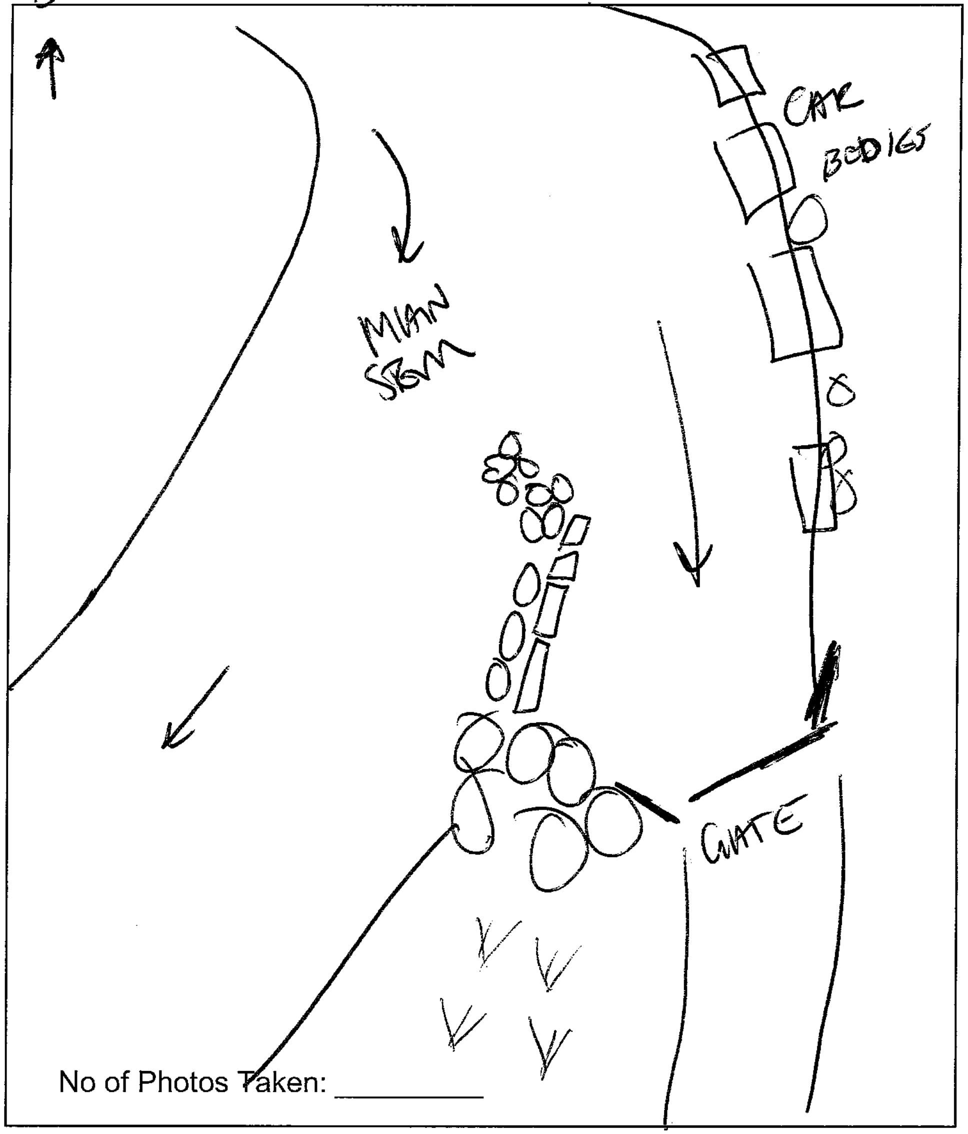
OBSERVATIONS:

DIVERSION 4 ft BOULDERS
+ CONCRETE DIVIDERS (4)

FLAT STRETCH OF RIVER.
SLOW MOVING BEFORE + AFTER
GATES

S

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY	Date: 11/10/2021 Assessor: TM Irrigator on Site? None
	TURNOUT SITE: Union WATER SOURCE: Mitchell Sleough	

STRUCTURE TYPE:

[✓ HEADGATE:]	☐ Slide gate	☐ Stop logs	☐	
~~FLOW MEASUREMENT~~:	☐ Flume	☐ Weir	☒Gauge	☐
DIVERSION:	☐ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☒Wood	☐ Metal	☒ Concrete	☐ Earth	☐

Two wood Slide gates

Concrete has cracks & weathering - footer is broken

CONDITION:

☐ Not Used	☐ Broken	☒Poor	☐ Good	☐ New

Concrete aging and undermining

IMPAIRMENTS:

☐ Erosion	☐ Sediment	☒Age/Wear	☐ Vegetation	☒Debris
☒Leaking	☐ Structural	☐		

Outdated wood and concrete structure with sidns of weathering and deteriorating

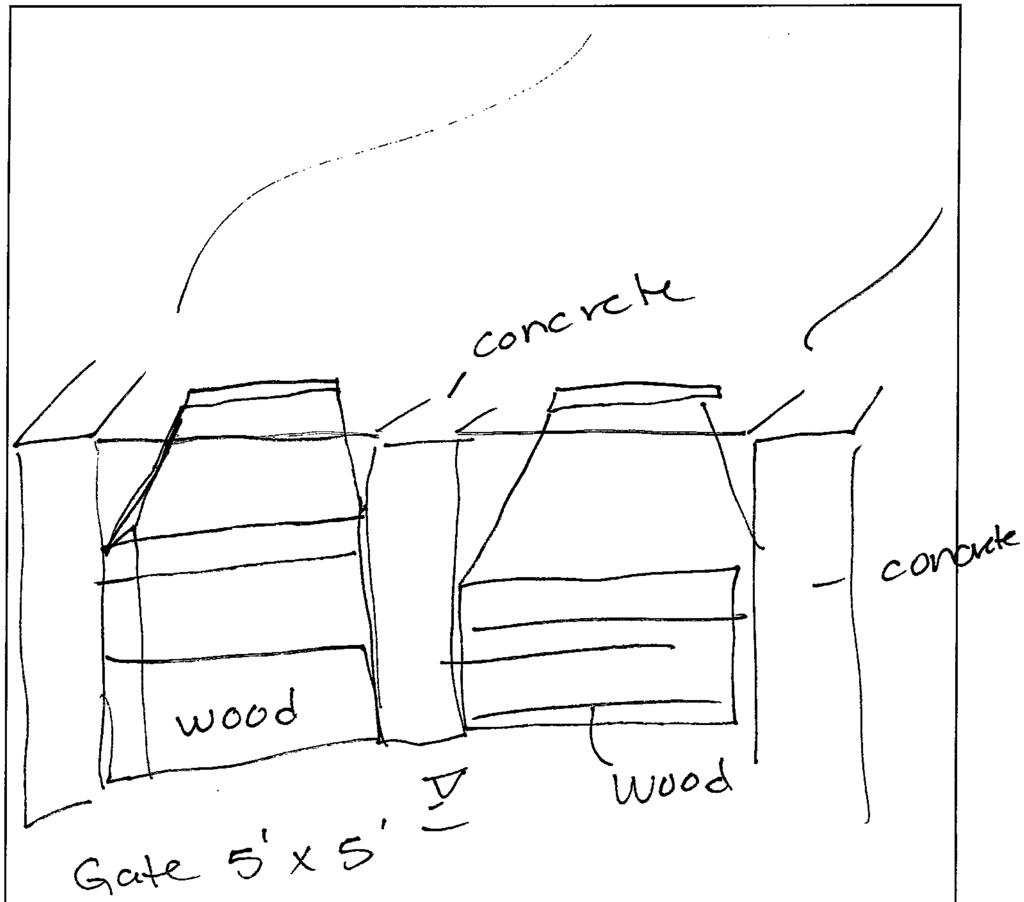
SAFETY CONCERNS:

No handrail, old wood boards for walk Planks

OBSERVATIONS:

Abutment wingwall migrating.
* need to verify which wingwall.

SKETCH AND DIMENSIONS:



No of Photos Taken: ________

Morrison Maierle	BITTERROOT CONSERVATION DISTRICT BITTERROOT RIVER IRRIGATION MANAGEMENT STUDY		Date: 11/10 Assessor: CA Irrigator on Site? NA
	TURNOUT SITE: UNION	WATER SOURCE: MITCHELL SLOUGH	

STRUCTURE TYPE:

~~HEADGATE:~~	☐ Slide gate	☐ Stop logs	☐	
FLOW MEASUREMENT:	☐ Flume	☐ Weir	☒ Gauge	☐
DIVERSION:	☒ In-stream dam	☐ Pipe/Culvert	☐ Ditch	☐

MATERIAL:

☒ Wood	☐ Metal	☒ Concrete	☐ Earth	☐

CONCRETE ~~[illegible]~~ 3 - GATE STRUCTURE W/ STOP LOGS
GATES 4' X 7'

CONDITION:

☐ Not Used	☐ Broken	☒ Poor	☐ Good	☐ New

DIVERSION - POOR; OLD CONCRETE, ~~[illegible]~~

~~POOR MEASUREMENT SECTION~~ Flow measurement = Fair Condition

IMPAIRMENTS:

☒ Erosion	☐ Sediment	☒ Age/Wear	☐ Vegetation	☐ Debris
☐ Leaking	☐ Structural	☐		

POOR CONDITION OF WALK WAY
EROSION BEHIND DIVERSION WALLS

SAFETY CONCERNS:

WALK WAYS UNSAFE. LOGS MUST BE PUT IN ~~[illegible]~~ IN-STREAM

OBSERVATIONS:

WALK WAYS UNSAFE

CONCRETE OK CONDITION

NO EROSION

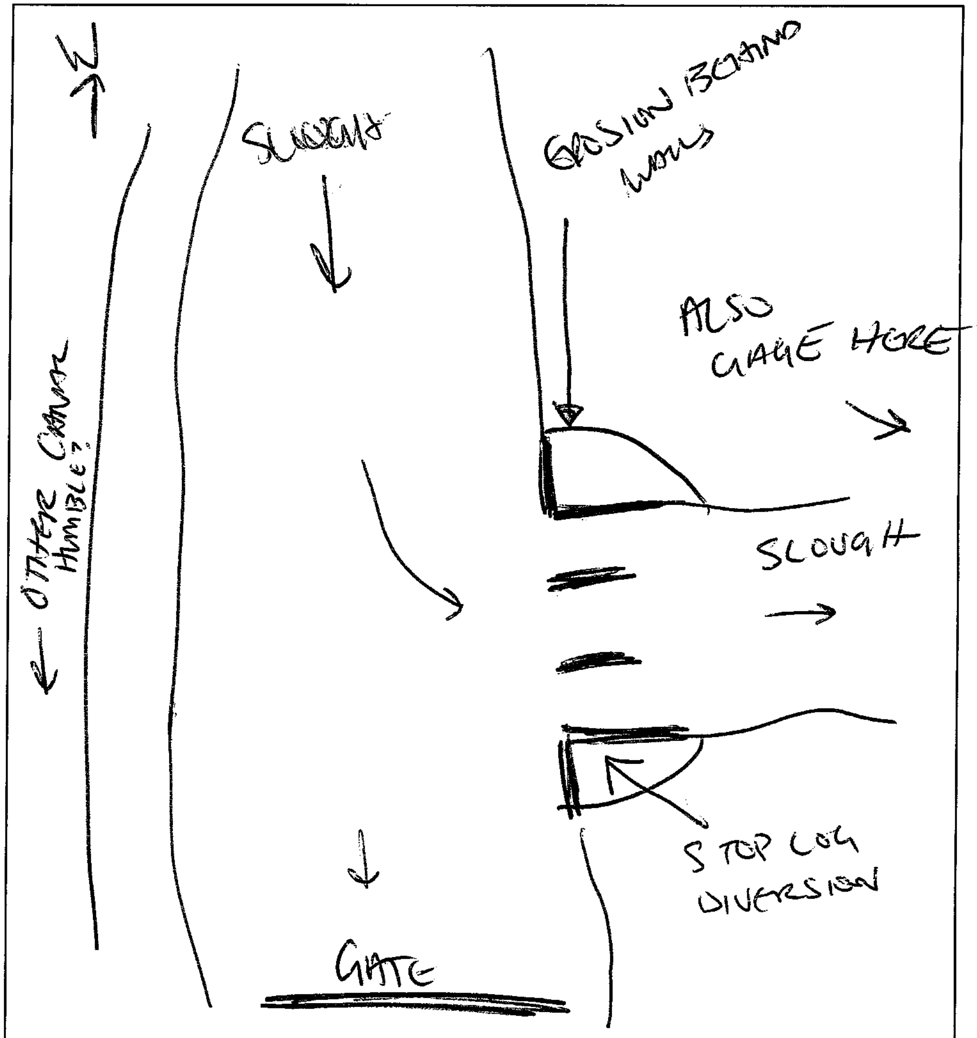
- NOT CURRENTLY BLOCKING ANY WATER.

EROSION ~~BO~~ EDDIES BEHIND DIVERSION

Pontential concrete stability issues

Leaking gates

SKETCH AND DIMENSIONS:



No of Photos Taken: __________

↓ GAGE

BILL STRANGE

Figure 1: Bill Strange Headgate

Figure 2: Bill Strange Diversion

C&C

Figure 3: C&C Headgate

Figure 4: C&C Diversion

CORVALLIS

Figure 5: Corvallis Headgate

Figure 6: Corvallis Diversion

EAST CHANNEL

Figure 7: East Channel Diversion

ETNA

Figure 8: Etna Headgate

Figure 9: Etna Diversion

GERLINGER

Figure 10: Gerlinger Headgate

Figure 11: Gerlinger Diversion

HOYT

Figure 12: Hoyt Headgate

Figure 13: Hoyt Diversion

ORR

Figure 14: Orr Headgate

Figure 15: Orr Diversion

Figure 16: Orr Wooden Flume

OVERTURF

Figure 17: Overturf Headgate

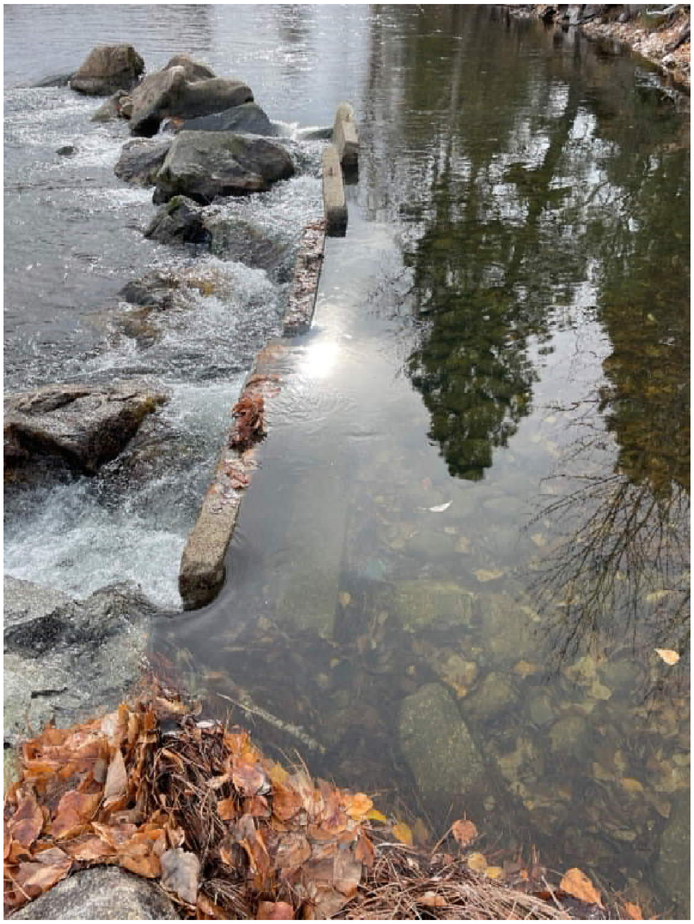


Figure 18: Overturf Diversion

RIVER DITCH

Figure 19: River Ditch Headgate

Figure 20: River Ditch Diversion

SPOONER

Figure 21: Spooner Headgate

Figure 22: Spooner Diversion

TIEDT NICHOLSON

Figure 23:Tiedt Nicholson Diversion

Figure 24:Tiedt Nicholson Metal Flume

Figure 25: Tiedt Nicholson Headgate

TUCKER

Figure 26: Tucker Headgate

Figure 27: Tucker Diversion Location

UNION

Figure 28: Union Headgate

Figure 29:Union Diversion

WARD

Figure 31: Ward Headgate

Figure 30: Ward Wooden Flume

Figure 32: Ward Diversion

WEBFOOT

Figure 33: Webfoot Headgate

Figure 34: Webfoot Diversion

WOODSIDE

Figure 35: Woodside Diversion

Figure 36: Woodside Headgate

Culvert Calculator Report
Union_HG

Comments: Current opening size is 5' wide X 5' tall.
Maximum allowable headwater/tailwater is minimum bank elevation minus 1 foot.
For invert values, used average of centerline and toe values.

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	3,385.80	ft	Headwater Depth/Height	0.79	
Computed Headwater Eleva	3,385.69	ft	Discharge	71.00	cfs
Inlet Control HW Elev.	3,385.49	ft	Tailwater Elevation	3,385.49	ft
Outlet Control HW Elev.	3,385.69	ft	Control Type	Outlet Control	

Grades

Upstream Invert	3,383.32	ft	Downstream Invert	3,382.74	ft
Length	13.12	ft	Constructed Slope	0.044055	ft/ft

Hydraulic Profile

Profile	S1		Depth, Downstream	2.75	ft
Slope Type	Steep		Normal Depth	0.52	ft
Flow Regime	Subcritical		Critical Depth	1.16	ft
Velocity Downstream	2.58	ft/s	Critical Slope	0.003897	ft/ft

Section

Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	5.00	ft
Section Size	5 x 3 ft		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	3,385.69	ft	Upstream Velocity Head	0.18	ft
Ke	0.50		Entrance Loss	0.09	ft

Inlet Control Properties

Inlet Control HW Elev.	3,385.49	ft	Flow Control	Unsubmerged	
Inlet Type	90 and 15° wingwall flares		Area Full	30.0	ft²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	2	
C	0.04000		Equation Form	1	
Y	0.80000				

Culvert Calculator Report
Etna_HG

Comments: Size is actually 4' wide X 5' tall
Maximum allowable headwater is bank elevation
For invert values, used centerline points near headgate
Tailwater elevation??

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	3,385.30	ft	Headwater Depth/Height	1.31	
Computed Headwater Eleva	3,384.14	ft	Discharge	39.00	cfs
Inlet Control HW Elev.	3,384.11	ft	Tailwater Elevation	3,384.11	ft
Outlet Control HW Elev.	3,384.14	ft	Control Type	Outlet Control	

Grades

Upstream Invert	3,380.20	ft	Downstream Invert	3,380.26	ft
Length	16.16	ft	Constructed Slope	-0.003714	ft/ft

Hydraulic Profile

Profile	PressureProfile		Depth, Downstream	3.85	ft
Slope Type	N/A		Normal Depth	0.00	ft
Flow Regime	N/A		Critical Depth	0.69	ft
Velocity Downstream	1.08	ft/s	Critical Slope	0.005509	ft/ft

Section

Section Shape	Box		Mannings Coefficient	0.015	
Section Material	Concrete		Span	4.00	ft
Section Size	4 x 3 ft		Rise	3.00	ft
Number Sections	3				

Outlet Control Properties

Outlet Control HW Elev.	3,384.14	ft	Upstream Velocity Head	0.02	ft
Ke	0.50		Entrance Loss	0.01	ft

Inlet Control Properties

Inlet Control HW Elev.	3,384.11	ft	Flow Control	Unsubmerged	
Inlet Type	90 and 15° wingwall flares		Area Full	36.0	ft²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	2	
C	0.04000		Equation Form	1	
Y	0.80000				

Culvert Calculator Report
Hoyt_HG

Comments: Maximum allowable headwater is bank elevation
For invert values, used centerline points near headgate
Tailwater elevation??

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	4,092.10	ft	Headwater Depth/Height	0.33	
Computed Headwater Eleva	4,091.59	ft	Discharge	3.00	cfs
Inlet Control HW Elev.	4,091.59	ft	Tailwater Elevation	4,091.59	ft
Outlet Control HW Elev.	4,091.59	ft	Control Type	Inlet Control	

Grades

Upstream Invert	4,090.93	ft	Downstream Invert	4,090.87	ft
Length	14.09	ft	Constructed Slope	0.056000	ft/ft

Hydraulic Profile

Profile	CompositeS1S2		Depth, Downstream	0.22	ft
Slope Type	Steep		Normal Depth	0.21	ft
Flow Regime	N/A		Critical Depth	0.41	ft
Velocity Downstream	6.86	ft/s	Critical Slope	0.006980	ft/ft

Section

Section Shape	Box		Mannings Coefficient	0.015	
Section Material	Concrete		Span	2.00	ft
Section Size	2 x 2 ft		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	4,091.59	ft	Upstream Velocity Head	0.21	ft
Ke	0.20		Entrance Loss	0.04	ft

Inlet Control Properties

Inlet Control HW Elev.	4,091.59	ft	Flow Control	Unsubmerged	
Inlet Type	90° headwall w 45° bevels		Area Full	4.0	ft²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Culvert Calculator Report
Webfoot_HG

Comments: Size is actually 8' wide X 3' tall
Maximum allowable headwater is bank elevation
For invert values, used centerline points near headgate
Tailwater elevation??
Test 2 vs 3 openings

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	3,361.16	ft	Headwater Depth/Height	1.81	
Computed Headwater Eleva	3,360.80	ft	Discharge	40.00	cfs
Inlet Control HW Elev.	3,360.73	ft	Tailwater Elevation	3,360.73	ft
Outlet Control HW Elev.	3,360.80	ft	Control Type	Outlet Control	

Grades

Upstream Invert	3,357.18	ft	Downstream Invert	3,357.51	ft
Length	7.83	ft	Constructed Slope	-0.042545	ft/ft

Hydraulic Profile

Profile	PressureProfile		Depth, Downstream	3.22	ft
Slope Type	N/A		Normal Depth	0.00	ft
Flow Regime	N/A		Critical Depth	0.70	ft
Velocity Downstream	1.67	ft/s	Critical Slope	0.005510	ft/ft

Section

Section Shape	Box		Mannings Coefficient	0.015	
Section Material	Concrete		Span	4.00	ft
Section Size	4 x 2 ft		Rise	2.00	ft
Number Sections	3				

Outlet Control Properties

Outlet Control HW Elev.	3,360.80	ft	Upstream Velocity Head	0.04	ft
Ke	0.50		Entrance Loss	0.02	ft

Inlet Control Properties

Inlet Control HW Elev.	3,360.73	ft	Flow Control	Unsubmerged	
Inlet Type	90 and 15° wingwall flares		Area Full	24.0	ft²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	2	
C	0.04000		Equation Form	1	
Y	0.80000				

Culvert Calculator Report
Overturf - Exist

Comments: Pipe is actually 58 X 36"
actual invert downstream = 3875.05
allowable headwater is top of bank from survey minus 1 foot.

Upstream: 3874.929

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	3,883.93	ft	Headwater Depth/Height	1.97	
Computed Headwater Eleva	3,880.84	ft	Discharge	10.40	cfs
Inlet Control HW Elev.	3,880.81	ft	Tailwater Elevation	3,880.81	ft
Outlet Control HW Elev.	3,880.84	ft	Control Type	Outlet Control	

Grades

Upstream Invert	3,874.93	ft	Downstream Invert	3,875.05	ft
Length	20.00	ft	Constructed Slope	-0.006000	ft/ft

Hydraulic Profile

Profile	PressureProfile		Depth, Downstream	5.76	ft
Slope Type	N/A		Normal Depth	0.00	ft
Flow Regime	N/A		Critical Depth	0.69	ft
Velocity Downstream	0.92	ft/s	Critical Slope	0.015886	ft/ft

Section

Section Shape	Arch		Mannings Coefficient	0.028	
Section Material	luminum 18 inch CR 3x1 Corrugations Historic		Span	4.83	ft
Section Size	58 x 36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	3,880.84	ft	Upstream Velocity Head	0.01	ft
Ke	0.50		Entrance Loss	0.01	ft

Inlet Control Properties

Inlet Control HW Elev.	3,880.81	ft	Flow Control	Unsubmerged	
Inlet Type	18 inch CR structural plate, No bevels		Area Full	11.4	ft²
K	0.00880		HDS 5 Chart	35	
M	2.00000		HDS 5 Scale	2	
C	0.03680		Equation Form	1	
Y	0.68000				

Culvert Calculator Report
Overturf - New

Comments: Pipe is actually 58 X 36"
actual invert downstream = 3875.05
allowable headwater is top of bank from survey
Changing slope has no impact on discharge???
Q when both ends = current upstream elevation: 193.32
Q when both ends = current downstream elevation: 193.32
Q at current configuration: 193.32
Downstream: 3875.052
Upstream: 3874.929

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	3,883.93	ft	Headwater Depth/Height	1.94	
Computed Headwater Eleva	3,880.84	ft	Discharge	10.40	cfs
Inlet Control HW Elev.	3,880.81	ft	Tailwater Elevation	3,880.81	ft
Outlet Control HW Elev.	3,880.84	ft	Control Type	Outlet Control	

Grades

Upstream Invert	3,875.03	ft	Downstream Invert	3,874.93	ft
Length	20.00	ft	Constructed Slope	0.005000	ft/ft

Hydraulic Profile

Profile	PressureProfile		Depth, Downstream	5.88	ft
Slope Type	N/A		Normal Depth	0.94	ft
Flow Regime	N/A		Critical Depth	0.69	ft
Velocity Downstream	0.92	ft/s	Critical Slope	0.015886	ft/ft

Section

Section Shape	Arch		Mannings Coefficient	0.028	
Section Material	luminum 18 inch CR 3x1 Corrugations Historic		Span	4.83	ft
Section Size	58 x 36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	3,880.84	ft	Upstream Velocity Head	0.01	ft
Ke	0.50		Entrance Loss	0.01	ft

Inlet Control Properties

Inlet Control HW Elev.	3,880.81	ft	Flow Control	Unsubmerged	
Inlet Type	18 inch CR structural plate, No bevels		Area Full	11.4	ft²
K	0.00880		HDS 5 Chart	35	
M	2.00000		HDS 5 Scale	2	
C	0.03680		Equation Form	1	
Y	0.68000				

Priority Project Rankings

				RENEWABLE RESOURCE CONSERVATION WEIGHT = 0-4		RENEWABLE RESOURCE MANAGEMENT WEIGHT = 4		RENEWABLE RESOURCE PRESERVATION WEIGHT = 4		COMPLIANCE WEIGHT = 3		ENGAGEMENT WEIGHT = 2	INFLUENCE WEIGHT = 3		FUNDING POTENTIAL WEIGHT = 2		SAFETY WEIGHT = 2	
Rank	Ditch Name	Structure	Overall Score	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	SCORE	WATER RIGHT (CFS / MINERS INCHES)	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION
1	Union	Headgate	97.1	5	Poor - significant leakage	3	Wood slide gates must be adjusted by hand	5	Poor	3	Needs improvement	5	1.7	71 / 2840	3	25K-125K	5	Not structurally sound - must be adjusted by hand
2	Etna	Headgate	92.8	5	Poor - significant leakage	4	Leaking, Requires routine maintenance to prevent blockage at inlet	5	Poor	3	Needs improvement	3	0.9	39 / 1560	3	25K-125K	5	Not structurally sound, no handrail
3	Hoyt	Headgate	88.2	5	Poor - not functional	5	Inoperable Headgate	5	Poor	5	Inoperable	1	0.1	3 / 120	3	25K-125K	2	Not structurally sound
4	Union	Diversion	85.1	5	High risk of failure	3	Stop logs placed in steel guides	5	Poor	1	No impact on compliance	3	1.7	71 / 2840	3	25K-125K	5	Deteriorating concrete walls, unsecured boards as walkway, no handrail
5	Etna	Diversion	82.8	5	High risk of failure	4	Stop logs installed manually by hand each season- difficult to remove due to pressure of flowing water	5	Poor	1	No impact on compliance	3	0.9	39 / 1560	1	<125K	5	Structure is unstable. Requires manually placing/removing stop logs which proves difficult due to high flows. No handrail.
6	Webfoot	Measurement	82.7	5	No measurement	5	No measurement	5	Poor	5	No measurement	3	1.0	40 / 1600	5	<25K	1	No safety impacts
7	East Channel	Diversion	79.0	3	All diversions given a 3, unless special conditions exist	4	River migration occurring	5	Poor	1	No impact on compliance	3	5.0	208.9 / 8356	1	High upfront cost or recurring cost	1	Permanant structure
8	Spooner	Measurement	78.3	5	No measurement	5	No measurement	5	Poor	5	No measurement	3	0.3	14 / 560	5	<25K	1	No Safety Impacts
9	Gerlinger	Measurement	78.1	5	No measurement	5	No measurement	5	Poor	5	No measurement	3	0.3	12.5 / 500	5	<25K	1	No safety impacts
10	Tucker	Diversion	76.6	3	All diversions given a 3, unless special conditions exist	4	Eco-blocks installed and gravel is placed to fill gaps - limited in effectiveness depending on water level of east channel. Sediment has to be dredged with heavy equipment to keep water flowing through the ditch	3	Fair	1	No impact on compliance	3	4.2	176 / 7040	1	>125K	5	Concrete eco-blocks installed/removed in East Channel each year.
11	Tucker	Measurement	74.7	3	Isolated source water with least accurate measurement equipment	4	Measurement on headgate structure	3	Fair	1	Inaccurate	3	4.2	176 / 7040	5	<25K	1	No safety impacts
12	Webfoot	Headgate	72.9	3	Fair - Water is known to flow around headgate, stop logs do not further regulate	4	Concrete check with three openings regulated with stop logs. Water is known to flow around headgate	3	Fair	3	Stop logs - difficult to control	3	1.0	40 / 1600	3	25K-125K	3	A dedicated walkway with handrail would improve safety at this site
13	Ward	Diversion	72.2	3	All diversions given a 3, unless special conditions exist	4	Rock bar annually rebuilt with heavy equipment in the main channel of the Bitterroot - Concerns of river migration	3	Fair	1	No impact on compliance	5	0.7	30 / 1200	1	>125K	5	Rock bar annually rebuilt in main channel of Bitterroot with heavy equipment
14	Corvallis Canal	Measurement	71.8	2	Not accurate	4	Measurement on headgate structure	3	Fair	3	Inaccurate	3	3.0	125 / 5000	5	<25K	1	No safety impacts
15	Overturf	Diversion	70.7	3	All diversions given a 3, unless special conditions exist	4	Managers report having trouble getting water to irrigators at the end of the ditch each year	3	Fair	1	No impact on compliance	5	0.2	10.4 / 416	1	>125K	5	Concrete dividers placed in the main Bitterroot Channel and reinforced with large boulders.
16	Hoyt	Measurement	70.5	5	No measurement	5	No measurement	5	Poor	5	No Measurement	1	0.1	3 / 120	5	Non-priority measurements given a default score of 5	1	No safety impacts

Priority Project Rankings

				RENEWABLE RESOURCE CONSERVATION WEIGHT = 0-4		RENEWABLE RESOURCE MANAGEMENT WEIGHT = 4		RENEWABLE RESOURCE PRESERVATION WEIGHT = 4		COMPLIANCE WEIGHT = 3		ENGAGEMENT WEIGHT = 2	INFLUENCE WEIGHT = 3		FUNDING POTENTIAL WEIGHT = 2		SAFETY WEIGHT = 2	
Rank	Ditch Name	Structure	Overall Score	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	SCORE	WATER RIGHT (CFS / MINERS INCHES)	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION
17	Bill Strange	Measurement	70.5	3	Isolated source water with least accurate measurement equipment	4	Measurement on headgate structure	3	Fair	3	Inaccurate	3	0.2	6.4 / 256	5	Non-priority measurements given a default score of 5	1	No safety impacts
18	Woodside	Measurement	70.4	4	Highly inaccurate	4	Measurement on headgate structure	5	Poor	4	Highly inaccurate	1	1.2	50 / 2000	5	Non-priority measurements given a default score of 5	1	No safety impacts
19	Supply/ Woods-Parkhurst	Measurement	69.2	2	Less accurate measurement	2	Fair condition - Measurement Gauge in channel downstream of headgate	3	Fair	2	Less accurate measurement	3	4.8	202 / 8080	5	<25K	1	No Safety Impacts
20	Spooner	Headgate	67.0	3	Fair - Wood planks manage flow	3	Wood planks installed by hand each year to manage flow	3	Fair	3	Wood planks - needs improvement	3	0.3	14 / 560	3	Non-priority headgates given a default score of 3	3	Wood boards need to be replaced for walkway, handrail would improve safety
21	Overturf	Measurement	65.3	3	Isolated source water with least accurate measurement equipment	4	Measurement on headgate structure	3	Fair	3	Inaccurate	5	0.2	10.4 / 416	5	Non-priority measurements given a default score of 5	1	No safety impacts
22	River Ditch	Diversion	65.3	3	All diversions given a 3, unless special conditions exist	4	River migration occurring - has to rebuild river rock bar in main Bitterroot each year	3	Fair	1	No impact on compliance	3	0.4	18 / 720	1	Non-priority diversions given a default score of 1	5	River rock bar annually reconstructed in the main Bitterroot River with heavy equipment
23	Spooner	Diversion	65.0	3	All diversions given a 3, unless special conditions exist	4	Metal stands placed across East Channel with tractor and stabilized by burying with gravel then stop logs are placed as needed throughout the season	3	Fair	1	No impact on compliance	3	0.3	14 / 560	1	Non-priority diversions given a default score of 1	5	Metal stands placed/removed across East Channel annually with tractor, then stop logs are placed in the metal stands to increase water levels throughout irrigation season
24	C and C Ditch	Measurement	63.0	3	Isolated source water with least accurate measurement equipment	3	Gauge in non-uniform channel, excessive vegetation	5	Poor	3	Inaccurate	3	0.2	8 / 320	5	Non-priority measurements given a default score of 5	1	No safety impacts
25	Tiedt Nicholson	Measurement	62.6	3	Not accurate	2	Flume downstream of headgate	3	Fair	3	Inaccurate	3	0.2	7.8 / 312	5	Non-priority measurements given a default score of 5	1	No safety impacts
26	River Ditch	Measurement	60.3	3	Isolated source water with least accurate measurement equipment	4	Measurement on headgate structure	3	Fair	3	Inaccurate	3	0.4	18 / 720	5	Non-priority measurements given a default score of 5	1	No safety impacts
27	Ward	Measurement	60.3	2	Isolated source water moderately accurate measurement equipment	3	Measurement Gauge and flume in non-uniform section of channel	3	Fair	2	Less accurate measurement	5	0.7	30 / 1200	5	Non-priority measurements given a default score of 5	1	No safety impacts
28	Orr	Measurement	58.9	2	Isolated source water moderately accurate measurement equipment	2	Fair condition - Measurement Gauge in channel downstream of headgate	3	Fair	3	Inaccurate	3	0.3	12.6 / 504	5	Non-priority measurements given a default score of 5	1	No safety impacts
29	Webfoot	Diversion	58.9	3	All diversions given a 3, unless special conditions exist	3	Stop logs held into place by the pressure of flowing water. Overtopping during high flows	3	Fair	1	No impact on compliance	3	1.0	40 / 1600	1	Non-priority diversions given a default score of 1	3	Stop logs placed/removed seasonally
30	Tucker	Headgate	58.6	1	Good - Functioning slide gates	2	Functioning Headgate	1	Good	1	Functional	5	4.2	176 / 7040	3	Non-priority headgates given a default score of 3	3	Handrail would improve safety, implementing a wheel instead of having to hook and manually lift slide gates

Priority Project Rankings

				RENEWABLE RESOURCE CONSERVATION WEIGHT = 0-4		RENEWABLE RESOURCE MANAGEMENT WEIGHT = 4		RENEWABLE RESOURCE PRESERVATION WEIGHT = 4		COMPLIANCE WEIGHT = 3		ENGAGEMENT WEIGHT = 2	INFLUENCE WEIGHT = 3		FUNDING POTENTIAL WEIGHT = 2		SAFETY WEIGHT = 2	
Rank	Ditch Name	Structure	Overall Score	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	SCORE	WATER RIGHT (CFS / MINERS INCHES)	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION
31	Etna	Measurement	57.8	1	Isolated source water with most accurate measurement equipment	3	1/4 mile downstream in non-uniform channel section	3	Fair	2	Less accurate measurement	3	0.9	39 / 1560	5	Non-priority measurements given a default score of 5	1	No safety impacts
32	Union	Measurement	57.5	1	Isolated source water with most accurate measurement equipment	3	100 feet downstream in non-uniform channel section	3	Fair	2	Less accurate measurement	3	1.7	71 / 2840	5	Non-priority measurements given a default score of 5	1	No safety impacts
33	Corvallis Canal	Diversion	57.0	3	All diversions given a 3, unless special conditions exist	2	Minimal maintenance required	1	Good	1	No impact on compliance	3	3.0	125 / 5000	1	Non-priority diversions given a default score of 1	5	Operators required to work within the main Bitterroot Channel to place the diversion throughout the season
34	C and C Ditch	Diversion	52.6	3	All diversions given a 3, unless special conditions exist	2	Permanent structure - issues with high water transporting debris and blocking diversion	3	Fair	1	No impact on compliance	3	0.2	8 / 320	1	Non-priority diversions given a default score of 1	3	Permanent concrete wall - debris must be routinely cleaned out
35	Overturf	Headgate	50.7	3	Functional Slide gate with some leakage	2	Functional Headgate	1	Good	1	New	5	0.2	10.4 / 416	3	Non-priority headgates given a default score of 3	1	No additional safety features recommended
36	Supply/Woods-Parkhurst	Diversion	50.5	1	Diversions that are new or remain effective are given a	2	Functional Diversion	1	Good	1	No impact on compliance	3	4.8	202 / 8080	1	Non-priority diversions given a default score of 1	3	
37	Supply/Woods - Parkhurst	Headgate	50.5	1	Good - Functioning metal slide gates with hydraulic actuators	1	Functional headgate; minimal improvements recommended	1	Good	1	New	3	4.8	202 / 8080	3	Non-priority headgates given a default score of 3	3	Permanent concrete wall - debris must be routinely cleaned out
38	Gerlinger	Diversion	48.9	3	All diversions given a 3, unless special conditions exist	2	Eco-blocks extend off rock point bar into East Channel	1	Good	1	No impact on compliance	3	0.3	12.5 / 500	1	Non-priority diversions given a default score of 1	5	Requires annual in-river construction
39	Gerlinger	Headgate	46.9	1	Fair - Wood planks manage flow	3	Wood planks manually installed - reported to work well	1	Good	3	Stop logs	3	0.3	12.5 / 500	3	Non-priority headgates given a default score of 3	1	No additional safety features recommended
40	Corvallis Canal	Headgate	45.0	1	Good - Functioning metal slide gates with hydraulic actuators	2	Functional headgate; minimal improvements recommended	1	Good	1	New	3	3.0	125 / 5000	3	Non-priority headgates given a default score of 3	1	No additional safety features recommended
41	Orr	Headgate	44.9	3	Functional Slide gate with some leakage	2	Functional Headgate	1	Good	1	New	3	0.3	12.6 / 504	3	Non-priority headgates given a default score of 3	1	No additional safety features recommended
42	Woodside	Headgate	43.6	1	Good - Functioning metal pipes with metal plate to regulate flow	2	Functioning Headgate	1	Good	1	Functional	3	1.2	50 / 2000	3	Non-priority headgates given a default score of 3	3	Wider walkway with handrail would improve safety at this site
43	River Ditch	Headgate	43.3	1	Good - Functioning slide gates	1	Functional Headgate	1	Good	3	wood gates	3	0.4	18 / 720	3	Non-priority headgates given a default score of 3	3	Handrail could be installed to improve safety
44	Orr	Diversion	40.9	3	All diversions given a 3, unless special conditions exist	2	Functional Diversion	1	Good	1	No impact on compliance	3	0.3	12.6 / 504	1	Non-priority diversions given a default score of 1	1	Minimal maintenance required
45	Bill Strange	Headgate	40.5	1	Good - Functional wood panel slide gates	2	Functional headgate minimal improvements recommended	1	Good	1	New	3	0.2	6.4 / 256	3	Non-priority headgates given a default score of 3	3	Handrail could be installed to improve safety
46	Hoyt	Diversion	40.2	3	All diversions given a 3, unless special conditions exist	2	Functional Diversion	1	Good	1	No impact on compliance	3	0.1	3 / 120	1	Non-priority diversions given a default score of 1	1	Minimal maintenance required
47	Ward	Headgate	40.2	1	Good- functional metal slide gates	1	Headgate installed in 2018 - No improvements recommended	1	Good	1	New	5	0.7	30 / 1200	3	Non-priority headgates given a default score of 3	1	No additional safety features recommended

Priority Project Rankings

				RENEWABLE RESOURCE CONSERVATION WEIGHT = 0-4		RENEWABLE RESOURCE MANAGEMENT WEIGHT = 4		RENEWABLE RESOURCE PRESERVATION WEIGHT = 4		COMPLIANCE WEIGHT = 3		ENGAGEMENT WEIGHT = 2	INFLUENCE WEIGHT = 3		FUNDING POTENTIAL WEIGHT = 2		SAFETY WEIGHT = 2	
Rank	Ditch Name	Structure	Overall Score	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION	SCORE	SCORE	WATER RIGHT (CFS / MINERS INCHES)	SCORE	JUSTIFICATION	SCORE	JUSTIFICATION
48	Woodside	Diversion	39.6	3	All diversions given a 3, unless special conditions exist	1	No dedicated diversion - located in relatively stable reach of main Bitterroot river and has no issues of getting sufficient flows	1	Good	1	No impact on compliance	3	1.2	50 / 2000	1	Non-priority diversions given a default score of 1	1	No dedicated diversion - minimal maintenance required
49	C and C Ditch	Headgate	36.6	1	Good - Functional metal slide gate	2	Minimal maintenance required	1	Good	1	Functional	3	0.2	8 / 320	3	Non-priority headgates given a default score of 3	1	No additional safety features recommended
50	Tiedt Nicholson	Diversion	36.6	3	All diversions given a 3, unless special conditions exist	1	No maintenance required - Permanent Structure	1	Good	1	No impact on compliance	3	0.2	7.8 / 312	1	Non-priority diversions given a default score of 1	1	Minimal maintenance required
51	Tiedt Nicholson	Headgate	36.6	1	Good - Functioning slide gate	2	Functioning Headgate	1	Good	1	Functional	3	0.2	7.8 / 312	3	Non-priority headgates given a default score of 3	1	No additional safety features recommended
52	Bill Strange	Diversion	28.5	1	Diversions that are new or remain effective are given a score of 1	1	W-weir in place no annual maintenance	1	Good	1	No impact on compliance	3	0.2	6.4 / 256	1	Non-priority diversions given a default score of 1	1	Permanent, little maintenance needed

Morrison
Maierle

engineers ▪ surveyors ▪ planners ▪ scientists

Morrison-Maierle | 1055 Mount Ave. Missoula, MT 59801 | 406-542-8880 | www.m-m.net