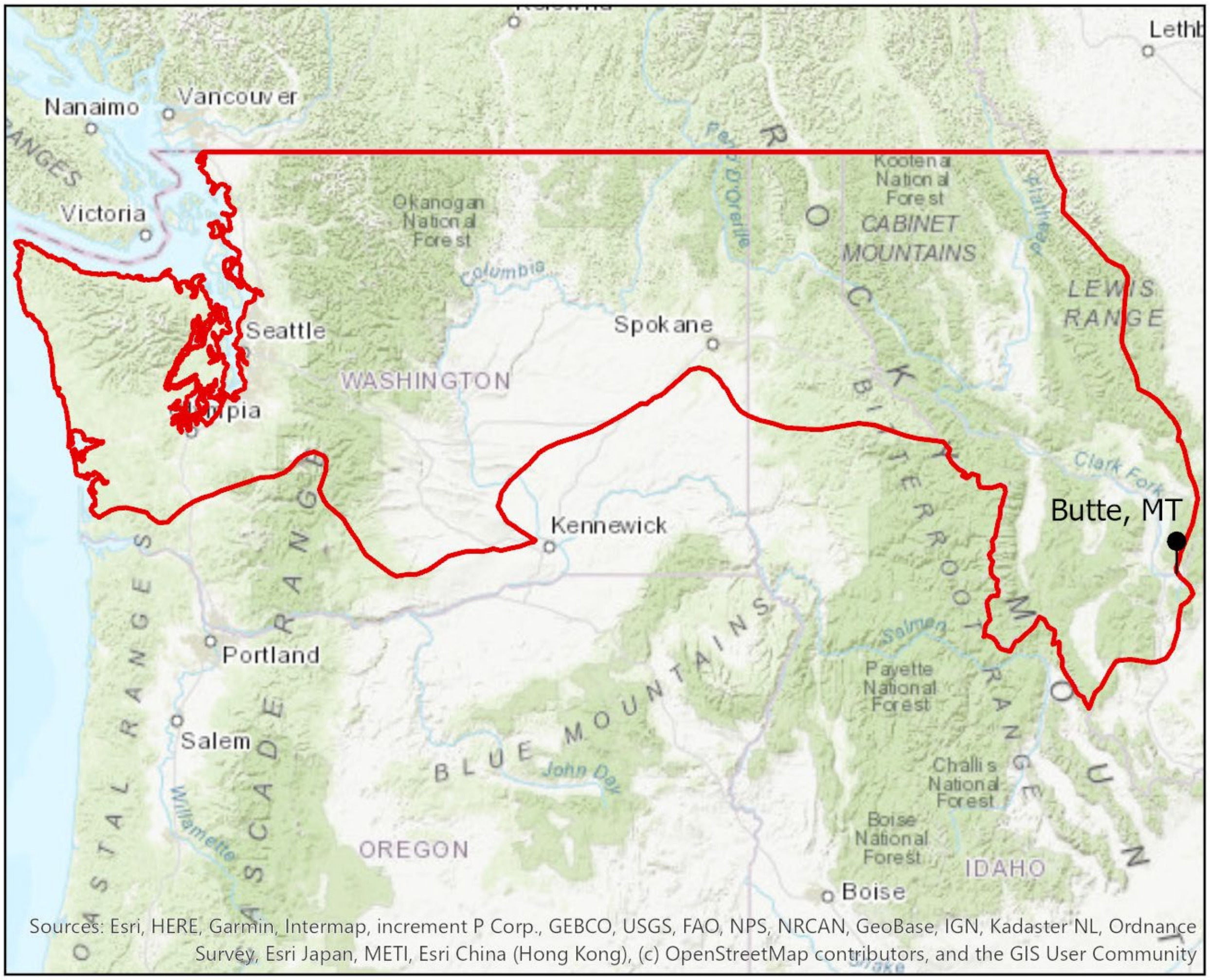
# Draft Environmental Assessment




*Location of the proposed project (black pin) within the U.S. Army Corps of Engineers Seattle District boundary (red line).*

**Title**: Moulton Dam #1 Spillway and Embankment Improvements Project

**Prepared by the Non-Federal Sponsor**: City and County of Butte-Silver Bow

**January 2024**

# Contents

# ACRONYMS

| | |
|---|---|
| BSB | Butte-Silver Bow |
| cy | Cubic yard |
| DNRC | Department of Natural Resources and Conservation |
| EA | Environmental Assessment |
| EPA | Environmental Protection Agency |
| HDPE | High Density Polyethylene |
| IDF | Inflow Design Flood |
| NAAQS | National Ambient Air Quality Standards |
| NEPA | National Environmental Policy Act |
| NFS | Non-Federal sponsor |
| NRHP | National Register of Historic Places |
| PER | Preliminary Engineering Report |
| SHPO | Montana State Historic Preservation Office |
| USACE | U.S. Army Corps of Engineers |
| U.S.C. | United States Code |
| USFWS | U.S. Fish and Wildlife Service |

# 1. INTRODUCTION

The purpose of an Environmental Assessment (EA), as reflected in 40 Code of Federal Regulations (CFR) Sections 1500.1(a) and 1501.5(c)(1) of the Council on Environmental Quality regulations implementing the National Environmental Policy Act of 1969 (NEPA) as amended, is to "*provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement [EIS] or a finding of no significant impact [FONSI]*" on actions authorized, funded, or carried out by the Federal Government, and "*ensure Federal agencies consider the environmental impacts of their actions in the decision-making process.*" Pursuant to Section 102(C) of the NEPA, this assessment evaluates environmental consequences of the proposed rehabilitation actions to be implemented by City and County of Butte-Silver Bow (BSB) to improve Moulton Dam #1 near Butte, Montana. This EA was prepared by BSB in cooperation with the Seattle District, U.S. Army Corps of Engineers (USACE).

# 2. AUTHORITY

USACE participation in this project is authorized under Section 595 of the Water Resources Development Act of 1999 [Public Law (PL) 106-53], as amended. Under Section 595, the USACE provides design and construction assistance to non-Federal sponsor (NFS) interests to carry out water-related environmental infrastructure, and resource protection and development projects in rural areas of certain states, including Montana. Projects may include wastewater treatment and related facilities, water supply and related facilities, environmental restoration, and surface water resource protection and development. Section 595 is a cost-share program where 75 percent of the project cost is provided by the Federal government and 25 percent by the NFS. The USACE can engage in design, construction, or both for projects under this program. The City and County of Butte-Silver Bow is the project's NFS.

# 3. LOCATION

Moulton Dam is an earthen dam with a concrete core wall constructed in 1907. The dam is a critical source of municipal water supply to the city of Butte, Montana and surrounding areas because groundwater in the area has been permanently damaged by historic mining. Moulton Dam is owned and operated by BSB Public Works Department and is in Silver Bow County approximately seven miles north of the city of Butte in Section 19, Township 4 North, Range 7 West (Figure 1). The dam is located on Yankee Doodle Creek and accessed via Moulton Reservoir Road leading from Main Street in the city of Butte.


Figure 1. Location of the BSB Moulton Dam, north of Butte, Montana.

# 4. BACKGROUND

## 4.1 Aging Infrastructure

Moulton Dam has historically had seepage issues on the downstream slope near the left groin and attempts were made to cut off leakage by grouting during the early operating years of the dam. A drainage tunnel was later constructed to collect seepage. The tunnel was rebuilt over the years and then a drainage collection pipe (toe drain) was added in the mid-1990s, and the tunnel was collapsed and backfilled. Other modifications were also made in the mid-1990s which included removing the wet-well tower on the upstream side of the dam, slip lining and grouting the original 24-inch cast iron outlet with 16-inch-high density polyethylene (HDPE), and placing geomembrane liner and riprap on the upstream slope. Recent engineering inspections identified problems with aging infrastructure associated with the dam's spillway, upstream embankment slope, and toe drain.

### Spillway

The dam's spillway has significant structural issues including concrete degradation, truss failure, erosion, and wall movement/buckling/cracking. These issues adversely affect spillway performance and decrease conveyance capacity. Considerable head cutting, erosion, seepage, piping of fine-grained soils, woody debris and trees are present in the downstream earthen channel portion of the spillway. The earthen spillway channel has been described as a U-shaped spillway in past inspection reports; however, the channel now more closely resembles a V-shape because of erosion. Furthermore, the spillway may not be able to structurally withstand a design flood event. The Moulton Dam #1 concrete portion of spillway is in poor condition and there is considerable erosion in the earthen conveyance channel portions. Additionally, when the spillway discharges, seepage appears to leak from the unlined portion of the spillway and expresses near the left downstream toe area of the embankment. The concrete portion of the spillway structure is badly deteriorated and there are aspen trees growing at the bottom of the structure. Metal trusses meant to hold the top of the spillway walls apart have failed, causing significant movement of the spillway walls. Engineering inspections (HDR 2021, Pioneer 2020, and HDR 2018) have determined that rehabilitation of the spillway is not realistic, and replacement is necessary.

### Upstream Embankment Slope

The upstream embankment slope is lined with a geomembrane liner that is covered with a non-woven geotextile. Riprap and tires cover a portion of the liner, typically at locations above the high-water mark. It is unknown if the riprap initially covered the entire slope, and if it did, has slipped on the liner. The riprap is rounded to sub-rounded and likely undersized. The geotextile liner is in poor to fair condition and has some rips and wear. Engineering inspections have recommended that the upstream slope be protected with adequately sized riprap or other armor.

### Toe Drain

The downstream embankment has had seepage issues near the left downstream groin and toe. Historically grouting was performed to cutoff seepage. Later, a seepage collection tunnel was constructed and then later abandoned. A perforated pipe (toe drain) was placed in the tunnel in the mid-1990's and backfilled. Slumps and depressions are present in the area of the former seepage tunnel. The toe drain is collecting water and discharging it into a concrete box junction at the downstream toe. An expanded toe drain system and filter system needed to expand and improve seepage collection.

### 4.2 Dam Safety Concerns

Due to the dam's condition, the Moulton Dam was listed as a high hazard dam in 1979. The dam was reclassified to not high hazard in 1996 subsequent to removing the dam tender's house located immediately downstream of the dam. On August 28, 2019, the Montana Department of Natural Resources and Conservation (DNRC) reclassified the dam as high hazard due to new development downstream of the dam. Because of the high hazard determination, the facility must be operated under the provisions of an Operating Permit issued by the Dam Safety Section of the Montana DNRC. As outlined by the Dam Safety Section, the first step in obtaining a permit requires a professional engineer to inspect the dam for the initial 5-Year Periodic Engineer's Inspection. The initial inspections were conducted in November of 2019 and May of 2020 and summarized in a report. The failing spillway, upstream embankment condition, and downstream seepage issues with the toe drain described above were among the most concerning identified in the initial Periodic Inspection Report. The report recommended the completion of a hydrology and hydraulics analysis and a feasibility level geotechnical design study. In July of 2020, BSB contracted with Pioneer Technical Services to complete a hydraulic analysis for the Moulton Reservoir Dam # 1. The Moulton Reservoir Dam #1 Hydraulic Analysis Report was completed in December of 2020 and revised in September 2021 to determine the required capacity of the replacement spillway based on the Inflow Design Flood. This hydraulic analysis, performed using Montana DNRC and industry standard methods and procedures, determined that one residential structure was located within the dam breach inundation area. Additionally, approximately 1.5 miles of Moulton Dam Road would be inundated in the event of a dam failure, which would endanger lives by eliminating access and emergency services to dozens of homes and cabins in the area.

## 5. PURPOSE AND NEED FOR THE PROPOSED PROJECT

The purpose of this project is to repair the Moulton Dam #1. The project is needed because of dam safety concerns related to aging dam infrastructure. Repairs are needed to prevent loss of life and property damage related to a failure event.

## 6. ALTERNATIVES

Alternatives considered under NEPA must include a reasonable range of alternatives, including the proposed action (Preferred Alternative) and the No Action Alternative. The NFS evaluated various alternatives to rehabilitate the dam's spillway, upstream embankment slope, and seepage collection system (e.g., toe drain). These alternatives are described in a 2021 Feasibility Report and are hereby incorporated by reference (HDR 2021). The alternatives considered included various construction methods and materials, and the alternative for each that was best suited for the dam's spillway, upstream embankment slope, and seepage collection system was selected as the preferred alternative. Therefore, this EA evaluates the No Action Alternative and the NFS's Preferred Alternative. The 2021 feasibility report is available in Appendix A.

### 6.1 No Action Alternative

Under the No Action Alternative, no construction or repair activities would occur. The dam's aging infrastructure and associated dam safety concerns would persist. While the No Action Alternative has the lowest short term cost this option carries the highest risk due to the severely deteriorated condition of the dam. These known issues would persist and worsen over time, increasing the chance of dam failure. Seepage would continue, which can lead to stability issues that would expose BSB to undue risk as the owners of the facility as well the inability to use the Moulton Reservoir as a water source. This option also has the highest risk of catastrophic failure, which would ultimately result in the highest long-term cost and loss of one of the only sources of municipal water to the region.

## 6.2 Preferred Alternative

Under the Preferred Alternative, the NFS would construct repairs to the dam's spillway, upstream embankment slope, and seepage collection system. Each component of the preferred alternative is described below and shown in Figure 2.

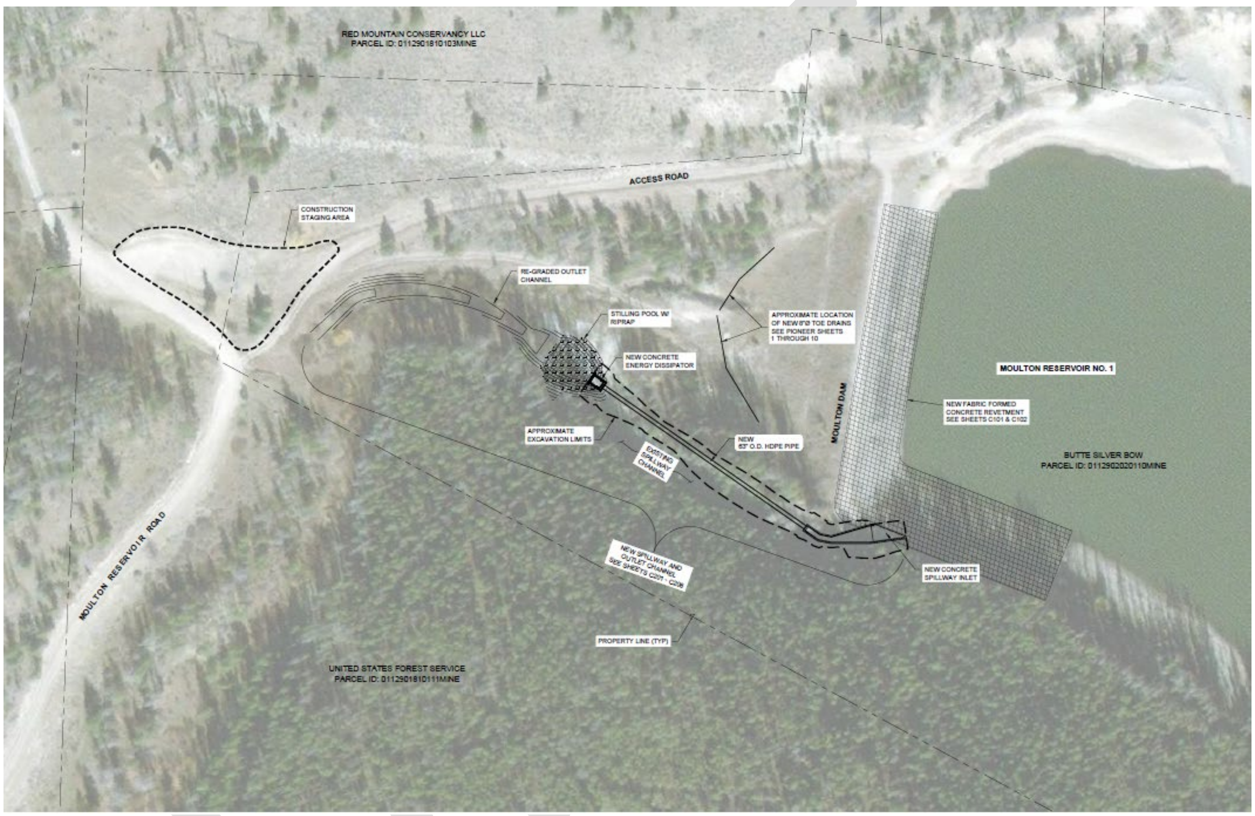



Figure 2. Overview of the project area and components.

***Spillway:*** The proposed spillway would be constructed at the current spillway location at the left abutment of the dam. The existing earthen spillway would be incorporated into the proposed design. A portion of the existing spillway is concrete; the concrete portion of the existing spillway is to be removed and replaced with an ogee crest that transitions to a concrete channel. The concrete channel would lead to a 55" I.D. (63" O.D.) HDPE pipe, which acts as the primary spillway. This HDPE is not susceptible to freeze/thaw damage and eliminates seepage concerns. There would also be a rectangular weir cut into the left wall of the concrete channel, which would direct discharge not conveyed through the pipe to the existing spillway. The HDPE pipe would safely convey the Inflow Design Flood (IDF) flow prior to flow overtopping the rectangular weir. The rectangular weir has been designed to convey an additional IDF. A baffled outlet is included as an energy dissipator at the outlet of the HDPE pipe. The baffled outlet then discharges into a rock-lined channel which ties into the natural channel further downstream.

***Upstream Embankment Armor:*** Based on the alternatives evaluated in the 2021 Feasibility report (HDR 2021), a fabric formed concrete revetment was selected as the preferred alternative for armoring the embankment. This design has the following benefits (HDR 2021):

- Provides a stable system without requiring extending to the toe of the embankment (reduces materials).
- Requires minimal subgrade preparation.
- Is a flexible system which conforms to the subgrade.
- Can be installed in the wet (reservoir does not need to draw down completely).
- Entire system is cabled together for longitudinal and lateral stability.
- Is easier to place and ship, and less susceptible to damage during shipping and installation, since fabric forms are filled onsite.
- Provides complete coverage of the existing liner and is less susceptible to ice damage (all revetment cables are concrete encased and are not exposed).
- Life expectancy of the system is ultimately the life expectancy of concrete.

The fabric formed concrete revetment consists of an articulating concrete block mat with continuous revetment cables provided in both the longitudinal (along the slope) and lateral (transverse to the slope) direction for binding of the finished articulating block mattress. Revetment cables are encased in the concrete blocks to prevent degradation and damage to the cables. Articulating concrete block type mats provide protection against heavy hydraulic loading including wave action and ice formation, conform to the subgrade, and provide relief of hydrostatic uplift pressure through perimeter fabric between blocks.

The fabric formed concrete revetment would extend a minimum of 10 feet laterally beyond the ends of the existing liner for protection and to allow for tying into the embankment. Longitudinally, the fabric formed concrete revetment would extend from a bottom elevation of 6,736 feet to a top elevation of 6,769 feet. The top elevation is above the existing liner for protection, but below the crest of the dam to facilitate anchorage. The bottom elevation is 10 feet below the reservoir minimum design operating level of 6,746 feet provided by BSB (HDR 2022 and HDR 2021). This design elevation provides protection for the existing liner below the minimum anticipated reservoir water level. Along the top of the fabric formed concrete revetment, the top termination anchor trench is a standard design with the fabric formed concrete revetment keyed into the slope. The design includes a 2-foot depth turn down trench and 2-foot horizontal bench at the bottom of the turn down trench which would be backfilled with fine aggregate concrete.

***Seepage Collection System:*** The seepage collection system includes a new toe drain system and a filter diaphragm. The proposed new toe drain system consists of a left and right toe drain intended to collect seepage expressing from embankment/foundation soils and route the discharge into the existing outlet channel. The toe drain system would be composed of an 8-inch-diameter dual wall HDPE drainpipe (slotted wall and solid wall) with a 2-stage granular filter composed of drain stone and filter sand. The proposed dual wall HDPE pipe, placed with a 1 percent grade, has an approximate capacity of 590 gallons per minute. The 8-inch diameter drains are anticipated to have enough capacity to collect existing seepage in addition to any new seepage collected in the system.

The proposed north toe drain is approximately 109 feet in length and runs along the right downstream groin and discharges into Yankee Doodle Creek. The proposed south toe drain is approximately 151 feet in length and runs along the left downstream groin and downstream toe toward a new manhole. The manhole provides a collection point which can then route the seepage water through a solid wall pipe to an existing concrete vault located approximately 40 feet downstream of the toe. An existing water pipe that tees off the outlet conduit and discharges into a concrete vault transects the proposed south toe drain. The new south toe drain would be positioned such that it is approximately 2 feet above the existing pipe. Seepage from the collapsed tunnel is currently being collected and discharged into the concrete vault. This system would remain independent of new toe drain system.

The filter diaphragm is composed of filter sand constructed around the existing 2-foot diameter outlet conduit within the existing embankment. The filter diaphragm functions to intercept and filter seepage flow through the embankment and along the interface between the conduit and the earth fill. Any internal erosion fines within the seepage water would be filtered by the diaphragm and over time create a 'filter cake' on the upstream side of the diaphragm which prevents further erosion. The filter extends 4 feet above the top of the conduit, 3 feet below the bottom of the conduit, and 6 feet on each side of the conduit. The thickness of the filter diaphragm is 3 feet.

# 7. ENVIRONMENTAL CONSEQUENCES

## 7.1 Geology and Soils

Geologically, the dam is located over alluvial deposits underlain by rhyolitic bedrock of the Lowland Creek Volcanic Field. The dam embankment is comprised of fill classified as silty sand. Soil Maps indicate the anticipated project area soils consist of the following: Kilgore-Danielvil complex (28C), 2 to 8 percent slopes (43.1% of anticipated project area); Evaro-Vitroff-Germangulch, very stony complex (543F), 20 to 50 percent slopes (16.7% of anticipated project area); Savenac-Pappascreek-Mooseflat complex (557D), 4 to 25 percent slopes, very stony (0.5% of anticipated project area); Euell-Bigbutte complex (561F), 20 to 50 percent slopes, stony (28.7% of anticipated project area); and water (11.0% of anticipated project area). Soils data was obtained from the United States Department of Agriculture's Natural Resources Conservation Services Web Soils Survey (NRCS 2022).

### 7.1.1 Alternative 1—No action

The No Action Alternative could result in continued deterioration of the dam that may lead to potential failure. Dam failure would negatively impact life and property downstream of the dam. Failure could also negatively impact municipal water supply to the region. If conditions require it, emergency repairs would likely be undertaken to prevent dam failure. The degree of dam failure would determine the magnitude of impacts to geology and soils. If the dam does not fail, there would be no effects to geology and soils.

### 7.1.2 Alternative 2—Preferred Alternative

The proposed dam infrastructure improvements, described in section 6.2, are designed to withstand a 5,000-year design level earthquake. The preferred alternative construction footprint occurs in previously disturbed soils from construction of the original dam. The preferred alternative would largely maintain these soils and any changes are necessary to maintain the structural integrity of the dam. Effects on geology and soils would be negligible.

## 7.2 Water Resources

Work would occur on the upstream face, downstream toe, and spillway of Moulton Dam #1 which impounds a raw water supply for the City of Butte's potable water system. Currently, any water released from the reservoir that is not used at the downstream Moulton Water Treatment Plant, flows down Yankee Doodle Creek to the Yankee Doodle Tailings Pond.

### 7.2.1 Alternative 1—No action

The No Action Alternative could result in continued deterioration of the dam that may lead to potential failure. Dam failure could negatively impact municipal water supply to the region. If conditions require it, emergency repairs would likely be undertaken to prevent dam failure. The degree of dam failure would determine the magnitude of impacts to water resources. Without rehabilitation BSB would be unable to obtain an Operating Permit from the Dam Safety Section of the Montana DNRC for the dam as it is currently operated, and deficiencies would be left unaddressed. This would require Moulton Reservoir operate at less than maximum capacity to prevent spillway flows.

### 7.2.2 Alternative 2—Preferred Alternative

BSB intends to work with the selected contractor to coordinate the proposed improvements so that as much of the work as possible can be implemented during periods of low reservoir levels. Due to the type of anticipated rehabilitation, dewatering utilizing cofferdams or other means is not anticipated. Emphasis would be placed completing any in-water work in the shortest amount of time possible. Limited temporary adverse effects on water quality may occur during construction of the upstream armor and new spillway concrete section construction. Debris containment measures are required to prevent construction debris/materials from entering the waterway. No refueling of equipment would take place within 100 feet of the ordinary highwater mark of the reservoir or any wetland boundary. The selected contractor would be required to always have spill kits (minimum 5-gallon capacity) on board each piece of equipment when working near water. The selected contractor would be required to inspect all equipment for oil, gas, diesel, antifreeze, hydraulic fluid, or other petroleum leaks prior to the equipment being allowed to work on the project site. No construction equipment would operate within the lake unless it is specifically permitted to do so. All work is anticipated to disturb less than one acre of existing ground. As a result, a Storm Water Permit is not anticipated to be required at this time. Given the nature of the construction activities, the proposed project is not anticipated to have any impact on groundwater resources and aquifers. Effects on water resources would be negligible.

## 7.3 Vegetation

The drainage area above Moulton Creek Dam #1 is a 2.64 square mile area that is roughly circular in area (Figure 1). It is bordered on the east by mountains that are part of the Continental Divide. Elevation in the watershed range from the reservoir elevation at 6,762 feet to about 7,780 feet. The drainage area is characterized by pine and aspen forests with shrubs and small ground cover. The Montana Natural Heritage Map Viewer Land Cover Summary for the area lists Recently Disturbed or Modified Forest (56%), Forest and Woodland Systems (28%), Wetland and Riparian Systems (8%), Grassland Systems (4%), Human Land Use (3%), and Shrubland/Steppe/Savana Systems (1%). The lodgepole pine forest in the area has been severely impacted by a beetle infestation that began in the early 2000's.

The vegetation associated with the project's spillway replacement component consists of largely of lodgepole pine that has been severely impacted by a mountain pine beetle infestation that began in the early 2000's. At the base of Moulton Dam downstream embankment, Yankee Doodle Creek emerges from the outlet and flows down gradient in a man-made channel at first and then in the historic creek channel. The narrow floodplain adjacent to the creek is dominated by willow in the overstory and a variety of upland grasses and forbs in the understory. Vegetation downstream of the dam consists predominately of montane grasslands, montane riparian woodland and shrubland, Douglas-fir forest, and living and insect killed Lodgepole pine forest.

### 7.3.1 Alternative 1—No Action

The No Action Alternative could result in continued deterioration of the dam that may lead to potential failure. Dam failure could negatively impact municipal water supply to the region, including agriculture. If conditions require it, emergency repairs would likely be undertaken to prevent dam failure. The degree of dam failure would determine the magnitude of impacts to vegetation downstream of the dam.

### 7.3.2 Alternative 2—Preferred Alternative

Under this alternative, vegetation within the project footprint would be disturbed. Excavated areas would be restored and seeded with native species to promote revegetation and reduce erosion. Overall, the effect of the preferred alternative on vegetation would be less than significant given the limited vegetation present and the proposed revegetation. The proposed project is not anticipated to have any negative impact on vegetation.

## 7.4 Fish and Wildlife

Habitat around Moulton Reservoir and Yankee Doodle Creek consists largely of pine and aspen forests with shrubs and small ground cover. The project area has been highly disturbed by human activity. Species observed in the area include a variety of birds, fish, rodents, foxes, elk, deer, and other small mammals.

### 7.4.1 Alternative 1—No action

The No Action Alternative could result in continued deterioration of the dam that may lead to potential failure. Dam failure would negatively impact fish and wildlife. If conditions require it, emergency repairs would likely be undertaken to prevent dam failure. The degree of dam failure would determine the magnitude of impacts to fish and wildlife. Without rehabilitation BSB would be unable to obtain an Operating Permit from the Dam Safety Section of the Montana DNRC for the dam as it is currently operated, and deficiencies would be left unaddressed. This would require Moulton Reservoir operate at less than maximum capacity to prevent spillway flows, reducing available habitat for fish populations in the reservoir.

### 7.4.2 Alternative 2—Preferred Alternative

Under this alternative, there would be short-term impacts to fish and wildlife from construction activities. The primary impacts would be a temporary increase in turbidity and an increase in noise, vibration, and human activity caused by heavy equipment use. These impacts may temporarily displace fish and wildlife during construction, but species would be expected to return as soon as construction is complete. No significant migratory bird nesting areas are anticipated to be disturbed by the proposed project, as tree removal is anticipated to be limited and disturbance generally limited to pre-disturbed areas on the dam face/downstream toe and spillway area.

Silt fences, straw wattles, straw bales, and/or other best management practices along the banks and slopes would be utilized to reduce direct erosion into the water during construction and to prevent silt and construction debris from entering the reservoir or downstream channel. Care would be taken when removing the existing infrastructure to minimize any adverse effects to reservoir as well as the downstream channel bed and banks. To mitigate impacts to the reservoir during concrete pumping, a turbidity curtain would be utilized to help contain concrete milk. Potential environmental impacts associated with fabric formed concrete revetment construction are primarily those associated with cement from the grout mixture being lost through the fabric forms during pumping operations. Cement lost through the fabric forms could raise the pH of the receiving water in the reservoir. To ensure that that rise in pH does not exceed 1.0 in stagnant water, the manufacturer recommends the total volume of water must be at least 50 times the volume of grout pumped. Based on 49 to 50 square feet of coverage per cubic yard (cy) of grout, the total volume of in-place concrete for the fabric formed concrete revetment is approximately 1,315 cy. Based on a recent bathymetric survey, the volume of the water with the reservoir drawn down to an elevation of 6,736.00 is approximately 267,813 cy. This would leave approximately 203 cy of water per cy of grout which is well above the minimum 50 cy of water per cy of grout recommended by the manufacturer and is not expected to impact fish and wildlife. All disturbed areas would be seeded to prevent erosion and promote vegetation. Any effects to fish and wildlife due to this alternative are expected to be temporary and localized.

## 7.5 Threatened and Endangered Species

A data base search conducted using the Montana Natural Heritage Program website found four species occurrences of species of concern in the area: Westslope Cutthroat Trout, Wolverine, Grizzly Bear, Golden Eagle (MNHP 2022). Data from the U.S. Fish and Wildlife Service (USFWS) identified three species potentially affected by activities in the area: Canada Lynx, Grizzly Bear, and Monarch Butterfly (USFWS 2022). Of these species, the grizzly bear may occur in the project footprint (J. Martin, E-mail communication, U.S. Fish and Wildlife Service, November 24, 2021).

### 7.5.1 Alternative 1—No Action

The No Action Alternative could result in continued deterioration of the dam that may lead to potential failure. Dam failure could negatively impact grizzly bears if present in the affected area. If conditions require it, emergency repairs would likely be undertaken to prevent dam failure. Emergency construction activities could also temporarily impact grizzly bears. The degree of dam failure would determine the magnitude of impacts to threatened and endangered species.

### 7.5.2 Alternative 2—Preferred Alternative

BSB sent a letter requesting comment on the proposed project on September 30, 2021. USFWS responded on November 24, 2021 in an email with recommended conservation measures for grizzly bears (J. Martin, E-mail communication, U.S. Fish and Wildlife Service, November 24, 2021). The conservation measures are standard practices to manage potential bear attractants and reduce the risk of human-grizzly bear conflicts. These conservation measures would be implemented during construction and include the following:

- Promptly clean up any project related spills, litter, garbage, debris, etc.
- No overnight camping within the project vicinity, except in designated campgrounds, by any crew member or other personnel associated with this project.

- Store all food, food related items, petroleum products, antifreeze, garbage, personal hygiene items, and other attractants inside a closed, hard-sided vehicle or commercially manufactured bear resistant container.
- Remove garbage from the project site daily and dispose of it in accordance with all applicable regulations.
- Notify the Project Manager of any animal carcasses found in the area.
- Notify the Project Manager of any bears observed in the vicinity of the project.

USACE Regulatory conducted an analysis of species listed under the Endangered Species Act (ESA) and determined the proposed project would have no effect to ESA-listed species and critical habitat (J. Borrego, E-mail communication, USACE, October 5, 2022). USACE Seattle District reviewed this analysis and concurred with this determination.

## 7.6 Land Use and Recreation

Land use around the Moulton Dam and its reservoir is predominantly municipal water supply storage. There is no public recreation in the project site. However, public recreation opportunities in the region—outside of the project area—include hiking, cross country skiing, hunting. and bird watching.

### 7.6.1 Alternative 1—No Action

Under the No Action Alternative, a higher risk exists for dam failure. If conditions require it, emergency repairs would likely be undertaken to prevent dam failure. If the dam fails, recreational use and access through the affected area could be interrupted or damaged. The degree of dam failure would determine the magnitude of impacts to land use and recreation. Without rehabilitation BSB would be unable to obtain an Operating Permit from the Dam Safety Section of the Montana DNRC for the dam as it is currently operated, and deficiencies would be left unaddressed. This would require Moulton Reservoir operate at less than maximum capacity to prevent spillway flows. Reduced operational capacity may also impact land use that is dependent on municipal water provided by the dam.

### 7.6.2 Alternative 2—Preferred Alternative

Under the preferred alternative, land use within the project footprint would not change. Access to recreational activity would not change. The quality of and access to public lands, waterways, and public open spaces would not change. Effects on land use and recreation would be negligible.

## 7.7 Air Quality and Noise

The Environmental Protection Agency's (EPA) Clean Air Act sets National Ambient Air Quality Standards (NAAQS) to regulate harmful pollutants. NAAQS are set for six common air pollutants: ozone, carbon monoxide, nitrogen dioxide, particulate matter (solid and liquid particles suspended in the air), sulfur dioxide, and lead. Areas that persistently exceed the standards are designated as nonattainment areas. The EPA sets *de minimis* thresholds for pollutants in nonattainment areas. Once a nonattainment area has attained and maintained NAAQS, they may be redesignated as "maintenance areas". The project is not located in an area designated a "Nonattainment" as set by the EPA's NAAQS.

The project site and its surroundings are undeveloped. The nearest residence/structure not owned by BSB is located 0.7 miles from the dam. Activities in the area are primarily recreational and outdoor in nature. Human-related existing noise sources in the vicinity of the project site include minor traffic, occasional construction, internal combustion engines, and tree-clearing activities.

### 7.7.1 Alternative 1—No Action

The No Action Alternative would have no direct effect on air quality or noise. Emergency actions may be required to protect lives and property in the event dam failure. These actions would likely have similar air emissions and noise effects as the preferred alternative but could differ depending on the scope of the emergency action. Effects to air quality and noise would be temporary and within the range of intensity of noise produced by on-going activities in the area. Effects on air quality and noise would be negligible.

### 7.7.2 Alternative 2—Preferred Alternative

The proposed project may cause temporary nuisances such as noise, dust, and exhaust fumes from construction equipment during the daylight hours while construction is occurring. Since no residential areas are in the direct vicinity of the dam, impacts are anticipated to be minimal. No permanent increase in noise is expected to occur because of the project. All local ordinances would be followed by the contractor regarding equipment operation. Effects on air quality and noise would be negligible.

## 7.8 Historic Properties and Cultural Resources

The Moulton Dam was completed in 1907 to take advantage of the opportunity to serve Butte's highest elevation pressure zone by gravity. The dam was constructed with a 24-inch cast iron principal outlet pipe, and an approximately 20- by 10-foot rectangular spillway which transitions to earthen channel. A wet-well tower/gatehouse was constructed on the upstream face of the dam for controlling releases through the outlet pipe. The 24-inch cast iron outlet pipe was slip lined with a 16-inch HDPE pipe in 1995. The original wet-well tower used for operating the outlet works was removed around the time of slip lining of the outlet pipe. In 1995, a geomembrane liner was installed across the upstream face of the dam embankment to help reduce seepage.

### 7.8.1 Alternative 1—No Action

No effects to historic properties and cultural resources would result from this alternative.

### 7.8.2 Alternative 2—Preferred Alternative

A pedestrian inventory and a Class III Cultural Resources Inventory has been completed for the project area (GCM Services Inc. 2021). The report recommended the site as eligible to the National Register of Historic Places (NRHP) under Criteria A and C, as part of the city of Butte's early municipal water supply system and as an example of the type, engineering, method of construction and form of a 1900's dam. The report also recommended that the proposed maintenance of the Moulton Creek Dam No.1 would have no adverse effect to its eligibility.

On September 12, 2022, the USACE sent a letter to the Montana State Historic Preservation Office (SHPO) stating that issuing a permit for the Moulton Dam #1 Spillway and Embankment Improvements Project would have no adverse effect on historic properties and that the Moulton Dam meets the Criteria for inclusion on the NRHP. The USACE letter also requested comment from SHPO on the effect determination as well as concurrence with the USACE determination that the Moulton Dam is Eligible for listing on the NRHP. On October 11, 2022, SHPO concurred with the USACE determination of no adverse effect and that the Moulton Dam is eligible for listing on the National Register under criteria A and C (Appendix B).

# 8. REGULATORY COMPLIANCE

## 8.1 National Environmental Protection Act

The NEPA (42 U.S.C. § 4321 et seq.) commits Federal agencies to considering, documenting, and publicly disclosing the environmental effects of their actions. As required by NEPA, this EA describes the purpose and need of the proposed project, the proposed project and its alternatives, existing environmental conditions, and potential environmental effects of each alternative.

In accordance with NEPA, Federal projects are required to disclose potential environmental impacts and solicit public comment. The following public meetings have occurred where the public had the opportunity to comment on the Moulton Dam #1 Spillway and Embankment Improvements Project:

- During the Council of Commissioners meeting on August 18, 2021, the BSB Public Works Department requested approval of an agreement between HDR Engineering, Inc. and BSB to complete the engineering design from alternatives analysis through final engineering design for the Moulton Dam #1 Spillway and Embankment Improvements Project. The agreement also included the preparation of all drawings, technical specifications, construction bid documents, and an Engineer's Estimate of Probable Costs to complete the project. No public comment was received on the project.

- During the Council of Commissioners meeting on December 15, 2021, a Public Hearing was held for the purpose of soliciting comments on the Preliminary Engineering Report (PER) for the 2021 Water Master Plan Update. The Moulton Dam project was included in the 2021 Water Master Plan Update as well as the presentation on the update that was delivered that evening. No public comment was received on the project.

- During the Council of Commissioners meeting on January 5, 2022, the BSB Public Works Department requested approval of the PER that was completed by HDR Engineering, Inc. for the Moulton Dam Spillway and Embankment Improvements Project. The PER was approved, and no public comment was received on the project.

Additionally, this Draft EA is released for public review and comment. The EA will be finalized after public review and comment period is complete.

## 8.2 Endangered Species Act

The Endangered Species Act (ESA; 16 U.S.C. § 1531 et seq.) establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat upon which they depend. Section 7(a) of the ESA requires that Federal agencies consult with the USFWS and NMFS, as appropriate, to ensure that proposed actions are not likely to jeopardize the continued existence of endangered or threatened species, or to adversely modify or destroy designated critical habitats.

The proposed project would have no effect to ESA-listed species. The USACE Regulatory program evaluated ESA impacts during the Clean Water Act permitting processes (see section 8.4) and determined that proposed project would have no effect to ESA-listed species and critical habitat (J.

Borrego, E-mail communication, USACE, October 5, 2022). USACE Seattle District reviewed Regulatory's analysis and concurred with its determination.

## 8.3 Clean Air Act

The Clean Air Act (42 U.S.C. § 7401 et seq.) requires states to develop plans, called State Implementation Plans, for eliminating or reducing the severity and number of violations of NAAQS while achieving expeditious attainment of the NAAQS. The Act also requires Federal actions to conform to the appropriate State Implementation Plan. An action that conforms to a State Implementation Plan is an action that would not:

1. Cause or contribute to any new violation of any standard in any area;
2. Increase the frequency or severity of any existing violation of any standard in any area; or
3. Delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

Activities during the proposed project would have short-term effects to air quality. There would be a temporary increase in emissions during equipment operation; however, the effects would be minimal given the short duration of the action and type of equipment needed. The pollutant production from equipment would contribute only a small fraction to global greenhouse gas emissions. The proposed alteration is not in an area of concern now or in the past for noncompliance with the NAAQS. Therefore, the proposed project is in compliance with this Act.

## 8.4 Clean Water Act, as Amended

The objective of the Federal Water Pollution Control Act (CWA; 33 U.S.C. § 1252 et seq.), is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands.

Compliance with the CWA is complete. The NFS, BSB, coordinated with the USACE Regulatory program to permit the project under Nationwide Permit 3, Maintenance. The Regulatory file number for the project is NWO-2021-01750-MT. BSB sent a pre-construction notification to the USACE Regulatory program on August 30, 2022. On October 19, 2022, the USACE Regulatory program issued a NWP 3 permit to BSB for the proposed project (Appendix C). USACE Seattle District reviewed the permit and concurs with USACE Regulatory's issuance.

## 8.5 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. § 668) prohibits the taking, possession or commerce of bald and golden eagles, except under certain circumstances. There are no known nests near the proposed project area. The proposed project would have no effect on bald or golden eagles.

## 8.6 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (16 U.S.C. § 470) requires Federal agencies to consider the effects of proposed Federal undertakings on historic properties included or eligible for the NRHP. The implementing regulations for Section 106 (36 CFR § 800) require Federal agencies to consult with various parties, including the Advisory Council on Historic Preservation, SHPO, Indian tribes, and Tribal Historic Preservation Officers, to identify and evaluate historic properties, and to assess and resolve effects to historic properties.

On October 4, 2021, BSB sent the SHPO information on the Moulton Dam #1 Rehabilitation Project. In his response dated October 8, 2021, Damon Murdo, SHPO Cultural Records Manager states, "It is SHPO's position that any structure over fifty years of age is considered historic and is potentially eligible for listing on the NRHP. The Moulton Dam has not been previously recorded as a historical resource. However, if this structure was constructed in 1907, we would recommend that it be recorded, and determination of its eligibility be made prior to any rehabilitation or disturbance taking place."

On October 4, 2021, GCM Services Inc. conducted a pedestrian inventory of the project area and prepared a Class III Cultural Resources Inventory (GCM Services Inc. 2021). The Moulton Creek Dam No.1 was recorded as a historic property and assigned site number 24SB1095. The report recommended the site as eligible to the NRHP under Criteria A and C, as part of the city of Butte's early municipal water supply system and as an example of the type, engineering, method of construction and form of a 1900's dam. The report also recommended that the proposed maintenance of the Moulton Creek Dam No.1 would have no adverse effect to its eligibility.

On September 8, 2022, BSB received a request from U.S. Army Corp of Engineers for GIS files required to complete the Cultural Resource Consultation for the SHPO. The requested files were uploaded on September 11, 2022, and on September 12, 2022, the USACE sent a letter to the SHPO stating that issuing a permit for the Moulton Dam #1 Spillway and Embankment Improvements Project would have no adverse effect on historic properties and that the Moulton Dam meets the Criteria for inclusion on the NRHP. The USACE letter also requested comment from SHPO on the effect determination as well as concurrence with the USACE determination that the Moulton Dam is Eligible for listing on the NRHP. On October 11, 2022, SHPO concurred with the USACE determination of no adverse effect and that the Moulton Dam is eligible for listing on the National Register under criteria A and C (Appendix B). Consultation with SHPO is complete.

## 8.7 Tribal Interests and Federal Trust Responsibility

The Federal government's trust responsibilities include meeting our obligations to federally recognized Tribes, protecting trust resources and obtaining Tribal views of trust and treaty responsibilities or action related to the USACE, in accordance with provisions of treaties, laws and Executive Orders, as well as principles lodged in the Constitution of the United States.

On October 21, 2021, the NFS sent a letter to the Confederated Salish and Kootenai Tribes. The letter included a project description and maps of the area. To date the NFS has received no comment.

## 8.8 Executive Order 12898, Environmental Justice

Executive Order 12898 directs Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of agency programs and activities on minority and low-income populations. The proposed action does not involve a facility siting decision and would not have a disproportionately high adverse human health impact to any environmental justice Community. The dam provides the water supply for the City of Butte's potable water system. Maintaining its operation benefits all members of the community. Therefore, the proposed alteration complies with this order.

## 8.9 Executive Order 11988, Floodplain Management

Executive Order 11988 requires Federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy of the floodplain, and to avoid direct and indirect support of floodplain development where there is a practicable alternative. In accomplishing this objective, “each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the effect of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains.” The proposed project would not facilitate floodplain development.

# 9. CONCLUSION

The No Action Alternative (Alternative 1) does not meet the project's purpose and need. The preferred alternative (Alternative 2) fulfills the project’s purpose and need by repairing aging dam infrastructure to address dam safety concerns. Based on the above analysis the Moulton Dam #1 Spillway and Embankment Improvements Project would not constitute a major federal action significantly affecting the quality of the human environment, and therefore does not require preparation of an Environmental Impact Statement.

# 10. REFERENCES

GCM Services Inc. 2021. A Class III Cultural Resources Inventory of the Moulton Creek Dam No. 1 Silver Bow County, Montana. Report prepared for Butte-Silver Bow Water Utility Division 124 West Granite St. Butte, MT 59701. October 26, 2021.

HDR Engineering Inc. 2018. Moulton Dam and Basin Creek Dam Site Visits Memo.

HDR Engineering Inc. 2021. Moulton Dam #1 Spillway and Embankment Improvements, Feasibility Report. September 30, 2021.

HDR Engineering Inc. 2022. Moulton Dam #1 Spillway and Embankment Improvements, 90% Design Report. April 15, 2022.

Montana Natural Heritage Program (MNHP). 2022. Available online at https://mtnhp.org/

Natural Resources Conservation Service (NRCS). 2022. Web Soils Survey. Available online at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Pioneer Technical Services Inc. 2020. Moulton Dam No. 1 Reservoir, 2020 Five-Year Periodic Inspection Report. Report prepared for City and County of Butte-Silver Bow Department of Public Works Water Utility Division, 155 West Granite Butte, MT 59701. August 21, 2020.

U.S. Fish and Wildlife Service (USFWS). 2022. Information for Planning and Consultation. Available online at https://ipac.ecosphere.fws.gov/

# 11. APPENDICES

Appendix A—2021 Feasibility Report
Appendix B—National Historic Preservation Act Compliance
Appendix C—Clean Water Act Compliance

# Appendix A – 2021 Feasibility Report

# Moulton Dam #1 Spillway and Embankment Improvements

Feasibility Report

Butte-Silver Bow

*Silver Bow County, MT*
September 30, 2021

## Contents

## Tables



## Figures

## Appendices

*This page is intentionally left blank.*

# Executive Summary

The purpose of this Project is to evaluate improvement alternatives for Moulton Dam #1 to: a) rehabilitate and/or replace the existing spillway to address existing structural deficiencies and erosion, b) protect the existing liner on the upstream face of the dam embankment to prevent further damage to the liner and/or embankment as well as increased seepage, and c) mitigate seepage at the toe of the dam embankment. Due to the condition of the existing spillway, rehabilitation options are not viable and replacement options will be evaluated. Rehabilitation options to armor the existing liner on the upstream face of the dam embankment are viable and were evaluated.

A limited number of spillway replacement alternatives were considered for this evaluation. These alternatives are summarized in the table below. Additional descriptions and details of the spillway designs can be found in Section 3.

| Spillway Alternative | Description | Cost |
|---|---|---|
| Alternative 1: No-Action | No action to the existing spillway and its appurtenances. | $0 |
| Alternative 2: Buried HDPE Pipe | Remove the existing concrete spillway. Construct a weir with an ogee crest. Replace the existing concrete spillway with a rectangular concrete channel that transitions to the inlet of the HDPE pipe. The HDPE pipe will convey flow past the toe of the dam and outfall to a riprap plunge pool before entering a rock lined channel that outfalls to the natural stream downstream. | $1,072,500 |
| Alternative 3: Concrete Spillway | Remove the existing concrete spillway. Replace the existing concrete spillway with a concrete spillway basin leading to an ogee crest weir. The ogee crest will outfall to a rectangular concrete chute with a Bureau of Reclamation Type 3 stilling basin. The stilling basin will outfall to a rock lined channel that will discharge to the natural stream downstream. | $1,522,500 |
| Alternative 4: Baffled Concrete Spillway | Remove the existing concrete spillway. Replace the existing concrete spillway with a concrete spillway basin leading to an ogee crest weir. The ogee crest will outfall to a Bureau of Reclamation Type IX baffled chute. The baffled chute will outfall to a rock lined channel that discharges to the natural stream downstream. | $1,470,000 |

Observing the cost estimates for each alternative, it is clear that Alternative 2 provides the most cost-effective solution that meets the needs of the Project. The HDPE pipe used for Alternative 2 will also have a greater longevity and lower maintenance than the concrete conveyance options. HDPE pipe will eliminate seepage and is not susceptible to freeze/thaw damage. For these reasons, Alternative 2 is presented as the most apparent beneficial alternative.

Preliminary design alternatives were considered as options to armor the existing liner on the upstream face of the dam embankment. For all alternatives, it was assumed that the existing liner would remain in-place. The alternatives are listed below with further discussion and design details found in Section 4.

| Alternative | Description | Cost |
|---|---|---|
| Alternative 1: No-Action | No-action alternative. | $0 |
| Alternative 2: Riprap | Place riprap protection over the existing liner on the upstream face of the dam. | $1,200,610 |
| Alternative 3a: Articulating Concrete Block Revetment | Place articulating concrete block (ACB) mattresses comprised of precast blocks over the existing liner on the upstream face of the dam. | $1,203,520 |
| Alternative 3b: Fabric-Formed Concrete Block Revetment | Place concrete block mattress which is filled in-place with pumpable concrete over the existing liner on the upstream face of the dam. | $1,027,550 |
| Alternative 4: Shotcrete | Place shotcrete over the existing liner on the upstream face of the dam. | $1,071,540 |
| Alternative 5: Concrete Cloth | Place concrete cloth over the existing liner on the upstream face of the dam. | $983,560 |

While financially similar, the constructability of each armoring alternative provides varying degrees of complexity. In addition, the impact of the alternatives on the existing liner also provides an increased risk for some of the reviewed alternatives. After considering these items, Alternative 3b (Fabric-Formed Concrete Block Revetment) is recommended for further design.

To collect seepage at the embankment toe, the design team proposes installing a new toe drain system or modifying the existing drain extruding from the collapsed tunnel. The toe drain system would be designed to filter and collect seepage expressing from both embankment and foundation soils as well as the collapsed tunnel. Additional details of the toe drain design can be found in Section 5.

# 1 Introduction

## 1.1 Purpose and Introduction

The purpose of this Feasibility Study is to evaluate alternatives to rehabilitate/reconstruct the spillway, protect the existing liner on the upstream face of the embankment, and construct a new toe drain at Moulton Dam #1. The following sections give a brief history of the Project site, a presentation of each alternative (including conceptual design and cost estimates), and a presentation of the apparent most beneficial alternative for the spillway, embankment liner protection, and toe drain.

## 1.2 Project Location

The Project is located Butte-Silver Bow County approximately 5 miles north of Butte, Montana on Yankee Doodle Creek. An area map is provided in Figure 1-1.

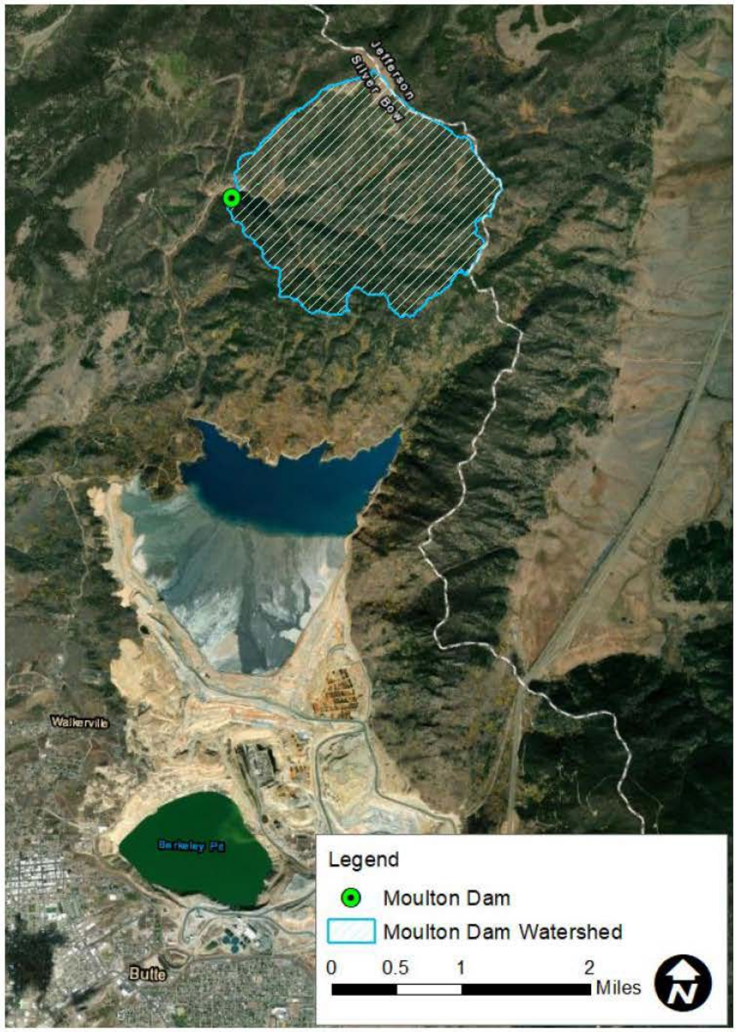



Figure 1-1 Project Location Map

# 2 Project History

## 2.1 Site History

The Moulton Reservoir Dam was constructed in 1907 on the Yankee Doodle Creek. The dam was built for the purpose of potable water supply and is owned and operated by Butte-Silver Bow (BSB). It is a 60 ft high earthen dam with a concrete core wall. The crest of the dam embankment was constructed to an elevation of approximately 6,771.00

ft, with a normal full pool of approximately 6,762 ft. The upstream dam embankment was constructed at a 2:1 slope with rock cover, while the downstream dam embankment was constructed at a 2:1 slope, transitioning to a 3:1.

The dam was constructed with a 24-inch cast iron principal outlet pipe, and approximately a 20 ft x 10 ft rectangular concrete spillway, which transitions to an earthen channel. A wet-well tower/gatehouse was constructed on the upstream face of the dam for controlling releases through the outlet pipe. The 24-inch cast iron outlet pipe was slip lined with a 16-inch high density polyethylene (HDPE) pipe in 1995. The slip lining was continuous from the upstream to the downstream without a break for the wet tower. The original wet well tower used for operating the outlet works was removed around the time of slip lining of the outlet pipe, with the outlet pipe now controlled by a valve located at the downstream toe of the dam.

Additionally, the dam has had seepage issues on the downstream face of the dam near the left groin. This is near the existing spillway and seepage becomes worse when the spillway conveys flow. In 1995, a geomembrane liner was installed across the upstream face of the dam embankment to help reduce seepage and protect the dam embankment. This geomembrane liner was also covered by a geofabric. Details on the geomembrane liner installation are not available, but based on visual observations, rock cover was originally placed on the liner. Tires have also been set to help hold the liner in place along the face of the dam. Since original installation of the geomembrane liner, the liner has become exposed and is degrading, showing signs of damage with holes due to wave action, ice, and exposure. Findings from recent inspections and recommended rehabilitations for Moulton Dam #1 are discussed below.

## 2.2 Recent Inspections for Moulton Dam #1

In 2019, Moulton Dam #1 was categorized as a high hazard dam. The categorization as a high hazard dam requires renewing the Montana Department of Natural Resources and Conservation (DNRC) Operation Permit for High-Hazard Dams. In 2020, a five-year periodic inspection was completed to support this effort. A summary of the results of the 2020 Five-Year Periodic Inspection Report as well as a site visit completed by HDR on May 6, 2021 are summarized below.

### May 6, 2021 Site Visit

HDR staff conducted a walk-through inspection of the dam in May 2021. During the site visit, the team identified additional deficiencies which were not documented in the 2020 Five-Year Periodic Inspection Report:

- The existing liner on the face of the dam has holes and tears. In addition, it appears to not be completely bonded across its extent.
- The liner is completely exposed to natural elements, which will result in further damage to the liner and continued degradation caused by sunlight.

### 2020 Five-Year Periodic Inspection Report

Pioneer Technical Services, Inc. conducted an inspection in November 2019 and a second inspection in May 2020. The second inspection was required to complete the field work due to inclement weather. During the inspections, the project team identified the following deficiencies which are documented in the periodic inspection report:

- The portion of the spillway that is concrete has significant structural issues including concrete deterioration, degradation, truss failure, erosion, and evident wall movement/buckling/cracking.
- The portion of the spillway that is earthen has considerable head cutting, erosion, seepage, piping of fine grain soils, woody debris, and trees.

### 2.2.2 Geotechnical Investigations

A geotechnical Investigation is being prepared by Pioneer Technical Services, Inc. for the embankment, with a draft evaluation prepared in February of 2021.

### 2.2.3 Survey Information

#### Bathymetric Survey

A bathymetric survey was completed for the Moulton Reservoir in June of 2020 (Reference 13) to quantify available storage in the reservoir.

#### Topographical Survey

Pioneer Technical Services, Inc. has completed an updated topographical survey for the dam embankment and spillway and is currently processing the data with the intent of providing sufficient topography, feature locations, and elevations to form the basis for design.

## 2.3 Project Goals

The purpose of this Project is to evaluate improvement alternatives for Moulton Dam #1 to: a) rehabilitate and/or replace the existing spillway to address existing structural deficiencies and erosion, b) protect the existing liner on the upstream face of the dam embankment to prevent further damage to the liner and/or embankment as well as increased seepage, and c) mitigate seepage at the toe of the dam embankment. Due to the condition of the existing spillway, rehabilitation options are not viable and replacement options will be evaluated. Rehabilitation options to armor and protect the existing liner on the upstream face of the dam embankment are viable and were evaluated.

Butte-Silver Bow County is evaluating improvement alternatives with the ultimate goals of: 1) selecting feasible alternatives to be carried forward in the evaluation, 2) developing the preferred alternatives to a 60% level of design, and 3) identifying a final alternative that will proceed towards construction. The sections below provide additional details on the alternative evaluations.

# 3 Spillway Evaluation

This Project is intended to replace the existing structure with an affordable new structure that will safely pass flood flows.

## 3.1 Hydrologic Analysis – Determine Inflow Design Flood (IDF)

Pioneer Technical Services, Inc. completed the report “Moulton Reservoir Dam No. 1 Hydraulic Analysis” on September 10, 2021. The report includes the determination of the IDF as well as the IDF peak flow routed through the reservoir. The IDF and routed IDF are 180 cfs and 114 cfs, respectively. These values are used for the analysis in this report and the routed IDF flow is used for the design of the proposed spillway alternatives.

## 3.2 Discussion of Alternatives

Preliminary design alternatives were considered as options to replace the existing spillway. Alternatives that were determined to have fatal flaws were removed from further consideration as described in Table 3-1.

**Table 3-1. Identification of Fatal Flaws**

| Alternative | Description |
|---|---|
| Above ground steel pipe | Excavation on the face of the dam is required to construct structural supports. |
| Lined riprap channel | A liner was used on the existing spillway in the past and has failed. If the liner is punctured or fails, the seepage issues related to the spillway may return. |
| Concrete channel extending beyond the toe of the dam, then riprap channel to a plunge pool. | This is similar in concept and cost to that of a concrete spillway. There is not an apparent benefit to using this option when compared to a concrete spillway. |
| Concrete stepped spillway | The design requires more earthwork than a standard spillway. Concrete stepped spillways can also be suspect to cavitation issues. |
| Labyrinth weir outlet structure | A labyrinth weir is not required to pass the routed IDF. A labyrinth weir is more difficult to construct and more costly than a weir with an ogee crest. |

A limited number of replacement alternatives were considered for this evaluation. These alternatives are summarized in Table 3-2 and the results of the evaluation of each alternative are discussed in the following sub sections.

**Table 3-2. Spillway Analysis Alternatives**

| Alternative | Description |
|---|---|
| Alternative 1: No-Action | No action to the existing spillway and its appurtenances. |

**Table 3-2. Spillway Analysis Alternatives**

| Alternative | Description |
|---|---|
| Alternative 2: Buried HDPE Pipe | Remove the existing concrete spillway. Construct a weir with an ogee crest. Replace the existing concrete spillway with a rectangular concrete channel that transitions to the inlet of the HDPE pipe. The HDPE pipe will convey flow past the toe of the dam and outfall to a riprap plunge pool before entering a rock lined channel that outfalls to the natural stream downstream. |
| Alternative 3: Concrete Spillway | Remove the existing concrete spillway. Replace the existing concrete spillway with a concrete spillway basin leading to an ogee crest weir. The ogee crest will outfall to a rectangular concrete chute with a Bureau of Reclamation Type 3 stilling basin. The stilling basin will outfall to a rock lined channel that will discharge to the natural stream downstream. |
| Alternative 4: Baffled Concrete Spillway | Remove the existing concrete spillway. Replace the existing concrete spillway with a concrete spillway basin leading to an ogee crest weir. The ogee crest will outfall to a Bureau of Reclamation Type IX baffled chute. The baffled chute will outfall to a rock lined channel that discharges to the natural stream downstream. |

## 3.3 Alternative 1: No-Action

### Discussion

As described previously, the existing spillway is in poor condition. While the 'no-action' alternative has the lowest short-term cost, this option carries the highest risk due to the seven conditions of the existing structure. These known issues will persist and worsen, likely requiring possible emergency action in the future. This option also has the highest risk of catastrophic failure, which would ultimately result in the highest long-term cost. Photographs of the existing concrete and earthen spillway are shown in Figure 3-1 through Figure 3-4.

Figure 3-1. Existing Spillway Wall

Figure 3-2. Existing Spillway Support Beams

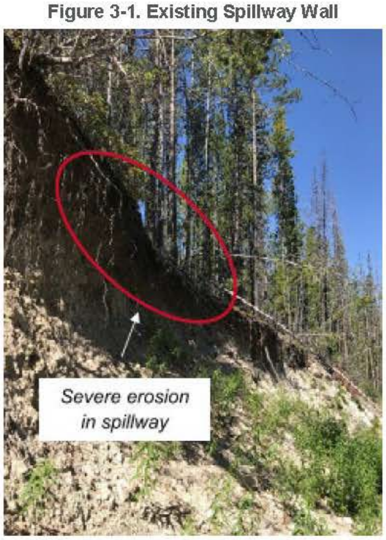



Figure 3-3. Spillway Erosion


Figure 3-4. Spillway Debris

### Pros and Cons

A summary of the pros and cons of Alternative 1 is provided in Table 3-3.

Table 3-3. Alternative 1 Pros and Cons

| Pros | Cons[1] |
|---|---|
| Short term cost | Long term cost. Higher risk of failure and higher risk to downstream landowners. Potential need for emergency repairs. |

[1] The cons assume that the existing structure will fail at some point in the future

#### Operation and Maintenance

The spillway is an uncontrolled, gravity flow spillway that does not require operator action to perform. The existing concrete spillway will continue to deteriorate, and the earthen portion of the spillway will continue to erode. Maintenance will be required in the future and there is a potential for emergency repairs. Because the dam is now categorized as a High Hazard Dam, annual and periodic (5-year) inspections will be completed in accordance with the Montana Department of Natural Resources and Conservation (DNRC) Operation Permit for High Hazard Dams.

#### Conceptual Cost Estimate

No conceptual cost estimate was developed for this alternative.

## 3.4 Alternative 2: Buried HDPE Pipe

#### Discussion

The HDPE pipe option will include an ogee crest weir as the crest control for the reservoir. The ogee crest will allow discharges to be calculated based on the depth of flow that is overtopping the weir. The rectangular concrete channel will convey flow from the weir to the inlet of the HDPE pipe. Options of reducing the length of the concrete channel or replacing a portion of the concrete channel with a large diameter pipe will be evaluated. At the entrance of the pipe, the concrete channel will be manually contoured to the inlet of the pipe to provide a smooth transition to the pipe. The depth of the channel at the inlet of the pipe will be designed such that the pipe will convey flows under orifice flow conditions. The HDPE pipe will be a 48” diameter smooth wall pipe made of materials with a high resistance to abrasion (4710 resin). There is potential to use a smaller diameter pipe for a portion of the length along the slope of the dam, once the flow has accelerated and the flow depth decreases. This could be a cost savings that can be explored further in the evaluation. At this time, Alternative 2 assumes a 48” diameter HDPE pipe for the entire 400 ft length. The HDPE pipe discharges into a standard NRCS riprap lined plunge pool, as shown in Figure 3-5. Preliminary calculations have been completed for the riprap lined basin to inform dimensions and material quantities for the basin. The riprap lined basin will outfall to a rock lined channel that will allow a transition to flow characteristics similar to the existing conditions. Further evaluation of the proposed flow characteristics may demonstrate that a rock lined channel is not required. At this time, it is assumed that a rock lined channel will be necessary.

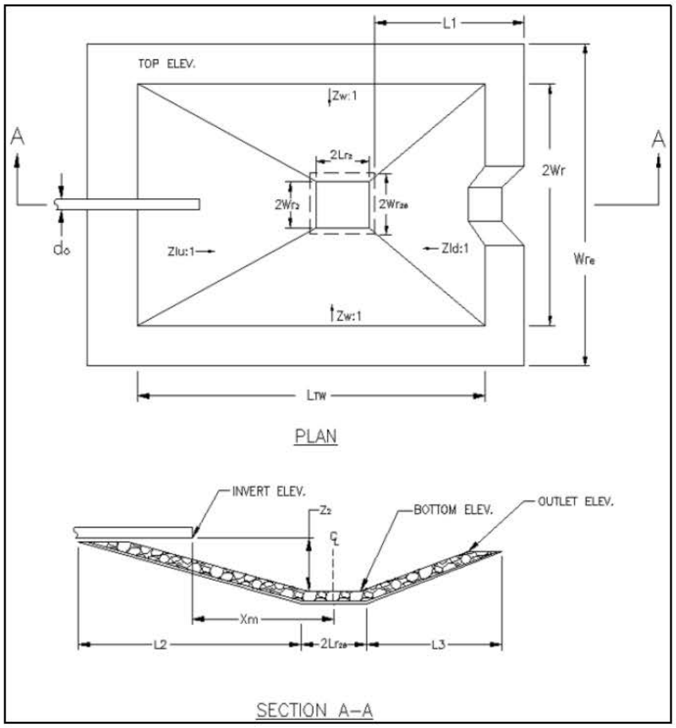



Figure 3-5. NRCS Riprap Lined Plunge Pool

### Table 3-4. Alternative 2 Design and Construction Considerations

| Project Component | Discussion |
|---|---|
| Remove existing concrete spillway | The existing concrete structure is deteriorating and poses a risk to the integrity of the dam. The structure will be removed. |
| Weir with an ogee crest | The ogee crest is an uncontrolled spillway that will allow reservoir discharges to be determined. A minimum crest length of 5 ft is required to pass the design flow. |
| Rectangular concrete channel | Replacing the existing concrete spillway with a new rectangular concrete channel will provide a reliable structure to convey flow to the inlet of the HDPE pipe. This will also reduce seepage from the existing spillway. The preliminary size of the required channel is 10 ft by 5 ft. |
| HDPE Pipe | Approximately 400 ft of HDPE pipe is required to convey flows past the toe of the dam. A diameter of 48" is required at the inlet of the pipe. Because flows will accelerate and decrease in depth down the pipe, there may be potential to reduce the diameter of the pipe. The pipe will be buried above the existing ground using earthen fill. |

Table 3-4. Alternative 2 Design and Construction Considerations

| Project Component | Discussion |
| --- | --- |
| Riprap lined plunge pool | The riprap lined plunge pool will be designed according to the NRCS Design Note 6. Preliminary calculations result in a basin approximately 100 ft in length by 90 ft in width. The estimated size of riprap is rounded rock with a $D_{50}$ of 12 inches. |
| Rock lined channel | Alternative 2 includes a rock lined channel approximately 200 ft in length. The rock lined channel is a trapezoidal channel with a bottom width of 5 ft and 3:1 (H:V) side slopes. The channel depth is anticipated to be 3 ft. The estimated size of the lining is rounded rock with a $D_{50}$ of 6 inches. |

### Pros and Cons

A summary of the pros and cons of Alternative 2 is provided in Table 3-5.

Table 3-5. Alternative 2 Pros and Cons

| Pros | Cons |
| --- | --- |
| HDPE is cheaper than a concrete spillway in both materials and construction costs. | The hydraulics at the inlet of the HDPE pipe must be evaluated in detail to provide confidence in the performance of the spillway. |
| HDPE requires less maintenance than a concrete spillway. | Debris is more detrimental to a conveyance pipe in comparison to a concrete channel. |
| HDPE is completely watertight and there is no risk of seepage in the future. | While the pipe will be sized adequately for the design flow, the pipe will have a lower maximum capacity than a concrete spillway. |
| HDPE is not susceptible to freeze/thaw damage. | A safety barrier (likely a fence) would be required so the inlet is not accessible to the public. |
| The riprap plunge pool is an effective method of energy dissipation. The riprap lined plunge pool is easy to maintain, and the county could add additional rock or larger rock if a problem were to arise. | |

### Operation and Maintenance

The spillway is an uncontrolled, gravity flow spillway that does not require operation. Maintenance may be required to remove debris from a trash rack located prior to the inlet of the pipe. Maintenance could also be necessary if riprap in the plunge pool is displaced. Because the dam is now categorized as a High Hazard Dam, annual inspections, and periodic inspections (5-year) will be completed in accordance with the Montana Department of Natural Resources and Conservation (DNRC) Operation Permit for High Hazard Dams. Any deficiencies discovered during the inspections may require action.

### Conceptual Cost Estimate

The construction cost estimate for Alternative 2 is presented in Table 3-6. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

**Table 3-6. Alternative 2 Cost Estimate**

| Description of Work | Cost |
|---|---|
| Site Preparation / Remove Existing Concrete Spillway | $100,000 |
| Concrete spillway basin and ogee weir | $160,000 |
| HDPE pipe | $275,000 |
| Riprap plunge pool | $140,000 |
| Rock lined channel | $40,000 |
| ***Subtotal*** | ***$715,000*** |
| Mobilization (10%) | $71,500 |
| Contingency (30%) | $214,500 |
| Construction Administration (10%) | $71,500 |
| **Total** | **$1,072,500** |

## 3.5 Alternative 3: Concrete Spillway

### Discussion

The existing concrete spillway will be removed and replaced with a concrete spillway basin leading to the weir located at the top of the downstream slope. To reduce cost, other options could be considered in place of the concrete spillway basin. However, these alternatives will need to be impermeable so that the spillway is not a source of seepage through the dam embankment. The concrete spillway option will include an ogee crest weir located at the end of the spillway basin which will function as the crest control to the reservoir. The ogee crest will allow discharges to be calculated based on the depth of flow that is overtopping the weir. The ogee weir will transition to a rectangular concrete chute (5' x 5') that will convey flow past the toe of the dam. The concrete chute will discharge to a Bureau of Reclamation Type III stilling basin, as shown in Figure 3-6. Preliminary calculations have been completed for the concrete stilling basin to inform dimensions and material quantities for the basin.

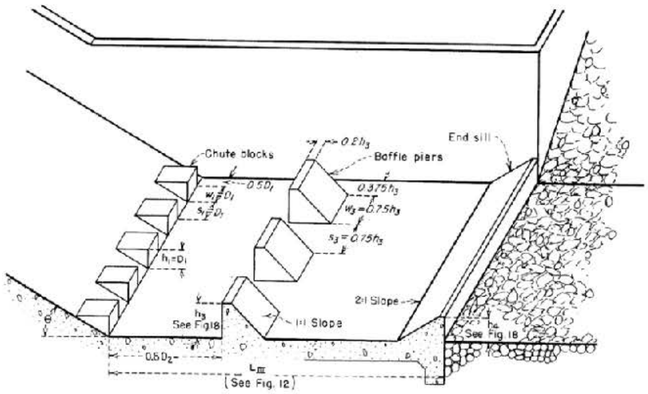



Figure 3-6. Type III Stilling Basin

Table 3-7. Alternative 3 Design and Construction Considerations

| Project Component | Discussion |
|---|---|
| Remove existing concrete spillway | The existing concrete structure is deteriorating and poses a risk to the integrity of the dam. The structure will be removed. |
| Spillway basin | Replacing the existing concrete spillway with a concrete spillway basin will provide a reliable structure that will eliminate seepage from the existing concrete spillway. The preliminary size of the required basin is 10 ft by 5 ft. |
| Weir with an ogee crest | The ogee crest is an uncontrolled spillway that will allow reservoir discharges to be determined. A minimum crest length of 5 ft is required to pass the design flow without increasing the dam height. |
| Rectangular concrete chute | The concrete chute needs to be approximately 400 ft in length to convey flows past the toe of the dam. The preliminary dimensions of the concrete chute are 5 ft by 5 ft. |
| Bureau of Reclamation Type III stilling basin | The stilling basin will provide energy dissipation at the end of the concrete chute. The preliminary size of the stilling basin is 5 ft (width) x 10 ft (height) x 16 ft (length). |
| Rock lined channel | Alternative 3 includes a rock lined channel approximately 275 ft in length. The rock lined channel is a trapezoidal channel with a bottom width of 5 ft and 3:1 (H:V) side slopes. The channel depth is anticipated to be 3 ft. The estimated size of the lining is rounded rock with a $D_{50}$ of 6 inches. |

### Pros and Cons

A summary of the pros and cons of Alternative 3 is provided in Table 3-8.

Table 3-8. Alternative 3 Pros and Cons

| Pros | Cons |
|---|---|
| A concrete chute can pass debris more easily than an HDPE pipe. | A concrete conveyance chute is more costly than HDPE pipe. |
| A concrete chute has a much larger peak capacity when compared to an HDPE pipe. This provides a higher factor of safety for the peak flows that the spillway could convey. | Concrete can be susceptible to cracking and deterioration over time, which may introduce seepage. |
| | Repairs (if necessary) to the concrete stilling basin would require a contractor and would be more costly than minor repairs to a riprap plunge pool. |
| | Safety of an open channel experiencing velocities approximating 40 fps. |

### Operation and Maintenance

The spillway is an uncontrolled, gravity flow spillway that does not require operator action to perform. Maintenance may be required to remove debris from a barrier located in the spillway basin. Because the dam is now categorized as a High Hazard Dam, annual and periodic (5-year) inspections will be completed in accordance with the Montana Department of Natural Resources and Conservation (DNRC) Operation Permit for High Hazard Dams. Any deficiencies discovered during the inspections may require action.

### Conceptual Cost Estimate

The construction cost estimate for Alternative 3 is presented in Table 3-9. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

Table 3-9. Alternative 3 Cost Estimate

| Description of Work | Cost |
|---|---|
| Site Preparation / Remove Existing Concrete Spillway | $100,000 |
| Spillway basin and ogee weir | $170,000 |
| Rectangular concrete chute | $510,000 |
| Bureau of Reclamation Type 3 stilling basin | $180,000 |
| Rock lined channel | $55,000 |
| ***Subtotal*** | ***$1,015,000*** |
| Mobilization (10%) | $101,500 |
| Contingency (30%) | $304,500 |
| Construction Administration (10%) | $101,500 |
| **Total** | **$1,522,500** |

## 3.6 Alternative 4: Baffled Concrete Spillway

### Discussion

The existing concrete spillway will be removed and replaced with a concrete spillway basin leading to the weir. To reduce cost, other options could be considered in place of the concrete spillway basin. However, as previously mentioned, these alternatives will need to be impermeable so that the spillway is not a source of seepage through the dam embankment. The concrete spillway option will include an ogee crest weir located at the end of the spillway basin which will function as the crest control to the reservoir. The ogee crest will allow discharges to be calculated based on the depth of flow that is overtopping the weir. The ogee weir will outfall to a Bureau of Reclamation Type IX baffled concrete chute (8' width x 5' height) that will convey flow past the toe of the dam. The baffled chute functions as an energy dissipator and a stilling basin is not necessary. The baffled chute outfalls directly to a rock lined channel, as shown in Figure 3-7.

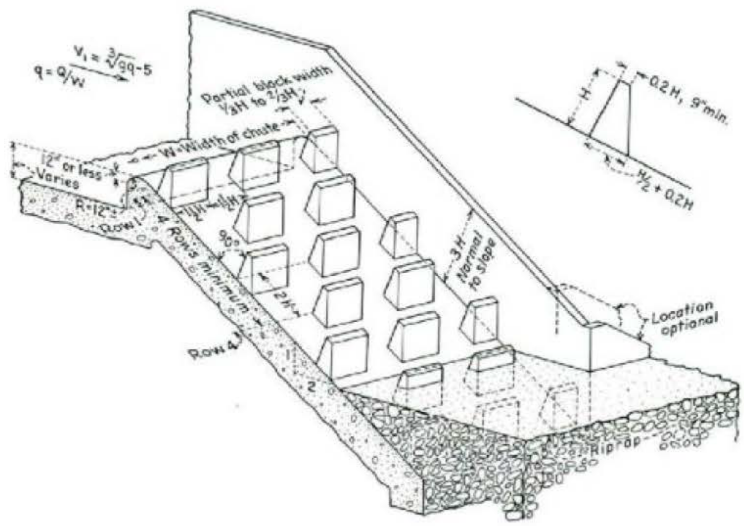



**Figure 3-7. Type IX Baffled Chute**

Table 3-10. Alternative 4 Design and Construction Considerations

| Project Component | Discussion |
|---|---|
| Remove existing concrete spillway | The existing concrete structure is deteriorating and poses a risk to the integrity of the dam. The structure will be removed. |
| Spillway basin | Replacing the existing concrete spillway with a concrete spillway basin will provide a reliable structure that will eliminate seepage from the existing concrete spillway. The preliminary size of the required basin is 10 ft by 5 ft. |
| Weir with an ogee crest | The ogee crest is an uncontrolled spillway that will allow reservoir discharges to be determined. A minimum crest length of 5 ft is required to pass the design flow. |
| Bureau of Reclamation Type IX baffled chute | The baffled chute needs to be approximately 400 ft in length to convey flows past the toe of the dam. The preliminary dimensions of the concrete chute are 8 ft by 5 ft. The chute requires 36 rows of baffle blocks with two blocks per row. |
| Rock lined channel | Alternative 4 includes a rock lined channel approximately 300 ft in length. The rock lined channel is a trapezoidal channel with a bottom width of 5 ft and 3:1 (H:V) side slopes. The channel depth is anticipated to be 3 ft. The estimated size of the lining is rounded rock with a $D_{50}$ of 6 inches. |

### Pros/Cons

A summary of the pros and cons for Alternative 4 is provided in Table 3-11.

Table 3-11. Alternative 4 Pros and Cons

| Pros | Cons |
|---|---|
| A concrete chute can pass debris more easily than an HDPE pipe. | A baffled concrete conveyance chute is more costly than HDPE pipe. |
| A concrete chute has a much larger peak capacity when compared to an HDPE pipe. This provides a higher factor of safety for the peak flows that the spillway could convey. | Concrete can be susceptible to cracking and deterioration over time, which may introduce seepage. |
| A stilling basin is not required for energy dissipation. | A concrete baffled chute could catch debris when compared to an open concrete chute. |

### Operation and Maintenance

The spillway is an uncontrolled, gravity flow spillway that does not require operation. Maintenance may be required to remove debris from a barrier located in the spillway basin. Because the dam is now categorized as a High Hazard Dam, annual and periodic (5-year) inspections will be completed in accordance with the Montana Department of Natural Resources and Conservation (DNRC) Operation Permit for High Hazard Dams. Any deficiencies discovered during the inspections may require action.

### Conceptual Cost Estimate

The construction cost estimate for Alternative 4 is presented in Table 3-12. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

Table 3-12. Alternative 4 Cost Estimate

| Description of Work | Cost |
|---|---|
| Site Preparation / Remove Existing Concrete Spillway | $100,000 |
| Spillway basin and ogee weir | $170,000 |
| Bureau of Reclamation Type IX baffled concrete chute | $650,000 |
| Rock lined channel | $60,000 |
| ***Subtotal*** | ***$980,000*** |
| Mobilization (10%) | $98,000 |
| Contingency (30%) | $294,000 |
| Construction Administration (10%) | $98,000 |
| **Total** | **$1,470,000** |

## 3.7 Apparent Most Beneficial Alternative

Observing the cost estimates for each alternative, it is clear that Alternative 2 provides the most cost-effective solution that meets the needs of the Project. The HDPE pipe used for Alternative 2 will also have a greater longevity and lower maintenance than the concrete conveyance options. HDPE will eliminate seepage and is not susceptible to freeze/thaw damage. For these reasons, Alternative 2 is presented as the most apparent beneficial alternative.

# 4 Embankment Evaluation

This Project is also intended to protect and armor the existing liner on the upstream face of the dam embankment against wave action and ice and to prevent further damage to the existing liner.

## 4.1 Existing Embankment

The existing dam was constructed in 1907 and has a 2:1 embankment slope with additional details provided above. In 1995 a geomembrane liner was placed on the upstream face of the dam to reduce seepage. Details on the geomembrane liner installation were not available. Based on visual observations, a geotextile is present over the liner and rock cover appears to have been placed over the top of the geotextile. The extent and design of the rock cover is unknown; however, rock cover is currently only present near the top and sides with most of the liner exposed. From bathymetric survey data, it also appears that material (assumed to be rock cover) has collected at the toe of the embankment. Therefore, it is assumed that the rock cover has sloughed off and collected at the toe of the embankment. Tires have been placed on the liner to hold it in place. As a result of the liner being unprotected and exposed to wave action, ice, and sun, it has degraded with damage and tears visible. Seepage along the dam embankment is also an identified issue and may increase as the liner continues to degrade. Figure 4-1 through Figure 4-4 show the existing dam embankment and liner.

**Figure 4-1. Existing Dam Embankment and Liner (looking South)**

**Figure 4-2. Existing Dam Embankment and Liner (looking East)**

Figure 4-3. Damage to Existing Liner

Figure 4-4. Damage to Existing Liner

## 4.2 Discussion of Alternatives

Preliminary design alternatives were considered as options to armor the existing liner on the upstream face of the dam embankment. Alternatives that were determined to have fatal flaws were removed from further consideration as described in Table 4-1.

Table 4-1. Identification of Fatal Flaws

| Alternative | Fatal Flaw Description |
|---|---|
| Gabion Basket | Susceptibility to ice damage and constructability challenges on the dam embankment. |
| Rock or Concrete filled Geogrid or Geocell | Susceptibility to ice damage as well as stability and constructability challenges on the dam embankment. |
| Reinforced Concrete Liner | Cost and constructability. |
| Soil Cement | Long-term durability and constructability challenges on the dam embankment. |

A limited number of alternatives were considered for this evaluation and are summarized in Table 4-2. For all alternatives, it was assumed that the existing liner would remain in-place. The alternatives are further discussed in the following sections.

Table 4-2. Embankment Armor Alternatives

| Alternative | Description |
|---|---|
| Alternative 1: No-Action | No-action alternative. |
| Alternative 2: Riprap | Place riprap protection over the existing liner on the upstream face of the dam. |
| Alternative 3a: Articulating Concrete Block Revetment | Place articulating concrete block (ACB) mattresses comprised of precast blocks over the existing liner on the upstream face of the dam. |
| Alternative 3b: Fabric-Formed Concrete Block Revetment | Place concrete block mattress which is filled in-place with pumpable concrete over the existing liner on the upstream face of the dam. |
| Alternative 4: Shotcrete | Place shotcrete over the existing liner on the upstream face of the dam. |
| Alternative 5: Concrete Cloth | Place concrete cloth over the existing liner on the upstream face of the dam. |

#### Liner Replacement Alternative

With all the embankment armor alternatives, optionally, the existing liner could be replaced to reduce seepage and restore the functionality of the liner on the upstream face of the dam. Removal of the existing liner, subgrade preparation, and installation of a new 40 mil reinforced HDPE liner with a geotextile cushion is estimated to cost approximately \$1.50 - \$2.00 per square foot. For longevity of the liner and to protect the face of the dam, one of the armor alternatives presented would be recommended.

## 4.3 Wind-Wave Analysis

For development and conceptual design of the embankment armor alternatives, a wind-wave analysis was completed for the Moulton Reservoir to develop the maximum predicted wave height and required riprap size for protection of the dam embankment. The analysis was completed using two methodologies described in NRCS TR-210-69 (NRCS Method, Reference 8) and Reclamation Design Standard No. 13 (Reclamation Method, Reference 10 and 11).

An 80 mph design overland wind speed used for the Project in accordance with NRCS TR-210-69 Figure 4 for the Project location. A 10% wave height exceedance was used for riprap design per the recommendations provided in the Reclamation Method. In addition, the technical note titled "Slope Protection for Dams and Lakeshores" (Reference 1) recommends the 10% wave height be used for riprap slope protection for high hazard dams. A 100 mph wind was used to check the design per the recommendation of the Design of Small Dams (Reference 9).

Using the NRCS Method with an 80 mph design overland wind speed and a 10% wave exceedance height, the calculated $D_{50}$ is 12". The calculated $D_{50}$ was more conservative (larger $D_{50}$) than that calculated using the Reclamation Method ($D_{50}$ of 9 inches). Hence, a $D_{50}$ of 12 inches was conservatively used for design. A 100 mph overland design wind speed was also used to check the riprap design. Using a 100 mph overland design windspeed and the NRCS Method, 12 inch riprap meets the design requirements for providing embankment protection up to the 33% wave height but is slightly undersized for the 10% wave height. Using the Reclamation Method, however, 12 inch riprap meets the design requirements for providing protection up to the 10% wave height.

### 4.3.1 Required Protection Elevations

For all amor alternatives, protection will be extended up to an elevation of 6767 ft (NAVD88) along the upstream face of the dam. This elevation corresponds with the required elevation for coverage of the existing liner. Proceeding north to south across the dam, this is just below the minimum elevation of the crest of the dam adjacent to the spillway (approximately 6768 to 6769 ft). This is also approximately 5.8 ft above the identified high-water elevation and 5 ft above the spillway crest elevation of 6,762 ft and provides protection against the calculated wave runup.

In discussions with BSB, the minimum design operating level for the reservoir was identified as 6,746 ft. Protection for all armor alternatives was assumed to extend at least to an elevation of 6,736 ft, corresponding to a minimum of 10 ft below the minimum operating level. For some alternatives, protection was required to extend to the toe of the embankment (approximately 6716, ft) for stability. Along the face of the dam, it was assumed for all alternatives that the armor would extend horizontally 10 ft beyond the existing liner for complete liner coverage.

For all alternatives presented below, with the exception of the riprap alternative, if a minimum design operating pool elevation greater than that identified above could be maintained, the required protection and associated cost could be reduced.

## 4.4 Alternative 1: No-Action

### Discussion

Failure to protect the liner will result in continued degradation of the liner due to impacts from ice and debris carried by wave action on the reservoir. This will further reduce the effectiveness of the existing liner and lead to more potential seepage through the dam. Long term seepage can lead to stability issues that would expose BSB to undue risk as the owners of the facility as well as potentially leading to the inability to use Moulton Reservoir as a water source.

### Pros and Cons

A summary of the pros and cons of Alternative 1 is provided in Table 4-3.

**Table 4-3. Alternative 1 Pros and Cons**

| Pros | Cons[1] |
|---|---|
| Short-term cost | Does not address existing deficiencies. Continued degradation and damage to the existing liner and increased seepage through the dam will occur. |

[1] The cons assume that the existing structure will fail at some point in the future

### Operation and Maintenance

O&M requirements for this alternative will consist of continuing to monitor the existing liner across the upstream face of the dam embankment. The liner will continue to degrade, resulting in increased seepage and the potential for piping/erosion and more significant damage to the dam embankment. Repairs to the existing liner may not be feasibly cost-effective due to its age and condition, and therefore, replacement is expected to be required in the future if not covered and protected.

### Conceptual Cost Estimate

No conceptual cost estimate was developed for this alternative.

## 4.5 Alternative 2: Riprap

### Discussion

The riprap alternative would consist of riprap placement over the existing liner across the upstream face of the dam embankment. Based on the wind-wave analysis, the required $D_{50}$ for protection of the liner and dam face is 12 inches. The riprap should be a minimum thickness of $2xD_{50}$ (24 inches) and placed over sand and gravel bedding, or geotextile fabric, placed over the existing liner. The riprap should be angular, hard, dense, and durable material. For stability, the riprap should extend to the toe of the 2:1 dam embankment. If not extended to the toe, a thickened riprap section keyed into the face of the dam embankment should be constructed to retain riprap on the slope. This may decrease the volume of riprap required but would significantly damage the existing liner.

### Pros and Cons

A summary of the pros and cons of Alternative 2 is provided in Table 4-3.

**Table 4-4. Alternative 2 Pros and Cons**

| Pros | Cons |
|---|---|
| Uses locally sourced materials and simple to maintain (can add riprap if needed). | A significant volume of riprap is required to extend to the toe of the embankment for stability . |
| Riprap sized to provide protection from wave action. | Riprap placement along the entire embankment will be difficult. |
| Minimal subgrade preparation required. | The reservoir will need to be drawn down to facilitate riprap placement at the embankment toe. |
| Flexible system which forms to the subgrade. | Does not address existing seepage issues. |
| Provides complete coverage of the liner. | Damage to the existing liner could occur during riprap placement. |

### Operation and Maintenance

Required O&M associated with this alternative is anticipated to be minimal and would be comprised of monitoring the riprap for any damage and placing new riprap if any is identified. This alternative, however, does not address or reduce existing seepage issues and associated O&M requirements related to managing seepage.

### Conceptual Cost Estimate

The construction cost estimate for Alternative 2 is presented in Table 4-5. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

**Table 4-5. Alternative 2 Cost Estimate**

| Description of Work | Cost |
|---|---|
| Riprap and Geotextile[1] | $763,260 |
| Mobilization (10%) | $76,330 |
| Contingency (30%) | $251,580 |
| Construction Administration (10%) | $109,150 |
| **Total** | **$1,200,610** |

[1]Assumes 24" of 12" riprap extending to the embankment toe (6,000 CY).

## 4.6 Alternative 3a: Articulating Concrete Block Revetment

### Discussion

The articulating concrete block (ACB) revetment alternate would be comprised of ACB mattresses consisting of cabled together precast concrete blocks placed over the existing liner across the upstream face of the dam embankment. The ACB mattresses would be keyed-in at the crest of the dam and extend down the face of the embankment but would not extend to the toe of the embankment. Required surface preparation would be comprised of placement of geotextile fabric over the existing liner. A 6-inch thick ACB mattress was selected which provides protection corresponding to a riprap $D_{50}$ of 12 to 18 inches. Figure 4-5 and Figure 4-6 show a similar example of ACB mattress installations over an existing liner. The mattress layout would be designed for placement along the face of the dam.

**Figure 4-5. Example ACB Revetment**

**Figure 4-6. Example ACB Revetment Installation**

### Pros and Cons

A summary of the pros and cons of Alternative 3a is provided in Table 4-6.

**Table 4-6. Alternative 3a Pros and Cons**

| Pros | Cons |
|---|---|
| Stable system without extending to the toe of the embankment (reduces required materials). | May be difficult to install for further reach applications along the embankment. |
| Minimal subgrade preparation required. | Material shipping cost. |
| Do not need to draw down the reservoir (can be installed in the wet). | May be more susceptible to ice damage (due to cables). |
| Sized to provide protection from wave action. | Does not address existing seepage issues. |
| Entire system is cabled together for stability . | Does not provide complete coverage of the liner (some portions between blocks still exposed). |
| Flexible system which forms to the subgrade. | Potential for block damage during installation. |

### Operation and Maintenance

Required O&M associated with this alternative is anticipated to be minimal and would be comprised of monitoring the ACB mattresses for damage and if needed, replacing mattress sections. This alternative, however, does not address or reduce existing seepage issues and associated O&M requirements related to managing seepage.

### Conceptual Cost Estimate

The construction cost estimate for Alternative 3a is presented in Table 4-7. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

**Table 4-7. Alternative 3a Cost Estimate**

| Description of Work | Cost |
|---|---|
| ACB Revetment[1] | $765,110 |
| Mobilization (10%) | $76,510 |
| Contingency (30%) | $252,490 |
| Construction Administration (10%) | $109,410 |
| **Total** | **$1,203,520** |

[1]Assumes 55,900 SF of ACB mattresses.

## 4.7 Alternative 3b: Fabric-Formed Concrete Revetment

### Discussion

An alternative to an ACB revetment with precast concrete blocks would be a fabric-formed concrete block revetment comprised of a fabric filled with concrete onsite. The final installation would be similar to a ACB revetment, however, the empty mattresses would be shipped to the site, set in-place, and filled with pumpable concrete (which could occur underwater). Surface preparation would be the same as for the ACB revetment as described above. Different systems could be considered including articulating block mats or continuous mats providing complete coverage. A geotextile would be placed over the existing liner. Figure 4-7 through Figure 4-10 examples of a fabric-formed concrete revetment.

Figure 4-7. Example Fabric-Formed Concrete Revetment (Pumping Concrete)

Figure 4-8. Example Fabric-Formed Concrete Revetment (Finished Installation)

Figure 4-9. Example Fabric-Formed Concrete Revetment (Pumping Concrete)

Figure 4-10. Example Fabric-Formed Concrete Revetment (Pumping Concrete)

### Pros and Cons

A summary of the pros and cons of Alternative 3b is provided in Table 4-8.

Table 4-8. Alternative 3b Pros and Cons

| Pros | Cons |
|---|---|
| Same as ACB Revetment. | Some specialized equipment for pumping concrete. |
| Easier mattress placement. | Concrete may vary and may not be of the same uniform quality as precast blocks. |
| Material shipping cost. | Potential environmental impacts associated with underwater concrete pumping. |
| Would not be susceptible to block damage during installation. | Does not address existing seepage issues (may improve slightly). |
| Depending on the system, could provide a uniform surface with complete coverage and less susceptibility to ice damage. | |

### Operation and Maintenance

Required O&M associated with this alternative would be similar to that for the ACB revetment.

### Conceptual Cost Estimate

The construction cost estimate for Alternative 3b is presented in Table 4-9. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

**Table 4-9. Alternative 3b Cost Estimate**

| Description of Work | Cost |
|---|---|
| Concrete Revetment[1] | $653,240 |
| Mobilization (10%) | $65,320 |
| Contingency (30%) | $215,570 |
| Construction Administration (10%) | $92,410 |
| **Total** | **$1,027,550** |

[1]Assumes 55,900 SF of fabric-formed articulating block mattresses.

## 4.8 Alternative 4: Shotcrete

### Discussion

This shotcrete alternative would entail the placement of reinforced shotcrete over the existing liner across the upstream face of the dam embankment. The shotcrete could be either fiber or steel reinforced. For placement directly over the existing liner, a layer of geotextile would be set on the existing liner and reinforced shotcrete would be placed to an approximate thickness of 4 inches. The geotextile and shotcrete system would be keyed-in at the top at the crest of the dam. Soil anchors may be required for stabilization of the shotcrete, particularly if not extended to the toe of the embankment.

As an alternative installation method for improved performance and stability, a geocomposite liner could be placed over the existing liner with 3 inches of reinforced shotcrete then placed over the top. The liner would be comprised of top and bottom layers off nonwoven geotextile for bonding with the shotcrete with a middle polyethylene membrane that would provide an improved bonding/reinforcing layer for the shotcrete surface and improved stability. In addition, the liner would restore the functionality of the existing liner.

### Pros and Cons

A summary of the pros and cons of Alternative 4 is provided in Table 4-10.

### Table 4-10. Alternative 4 Pros and Cons

| Pros | Cons |
|---|---|
| Would provide a uniform surface with complete liner coverage and less susceptibility to ice damage. | If a geocomposite liner is not added, additional soil anchors may be necessary to stabilize the system, further damaging the existing liner. |
| A geocomposite liner could be added to help reduce seepage. | Reservoir would need to be drawn down for installation. |
| Shotcrete will form to the subgrade. | More susceptible to freeze thaw damage over time. |
| Ease of installation. | May not provide as robust protection (not designed specifically for wave action). |
| | Wave runup along the upstream face of the dam embankment will increase (smooth surface). |
| | May be less durable and have a shorter longevity versus Alternatives 2, 3a, and 3b. |

#### Operation and Maintenance

Required O&M associated with this alternative would be comprised of monitoring the shotcrete for damage and repairing if necessary. Over time, cracking and damage to the shotcrete is anticipated and may require repair-work. This alternative reduces existing seepage issues and associated O&M requirements related to managing seepage.

#### Conceptual Cost Estimate

The construction cost estimate for Alternative 4 is presented in Table 4-11. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

### Table 4-11. Alternative 4 Cost Estimate

| Description of Work | Cost |
|---|---|
| Shotcrete[1] | $569,340 |
| Geocomposite Liner[1] | $111,870 |
| Mobilization (10%) | $68,120 |
| Contingency (30%) | $224,800 |
| Construction Administration (10%) | $97,410 |
| **Total** | **$1,071,540** |

[1]Assumes 55,900 SF of 3” shotcrete and a geocomposite liner.

## 4.9 Alternative 5: Concrete Cloth

### Discussion

The concrete cloth alternative would be comprised of concrete cloth placed over the existing liner across the upstream face of the dam embankment. The concrete cloth would be keyed in at the crest of the dam and extend down the face. After placement, the concrete cloth would be hydrated and would provide a final thickness of approximately 0.5 inches. Typical manufacturer's installation recommendations require extending the concrete cloth to the toe of the embankment to prevent undermining; however, the cloth could be set to a required elevation for protection of the dam to reduce required material due to the low likelihood of undermining, similar to other alternatives. The seams would be lapped and could be waterproofed. Soil anchors along the face of the dam may be required for stability in addition to the key trench at the crest of the dam. Figure 4-11 and Figure 4-12 show examples of concrete cloth revetments.

**Figure 4-11. Concrete Cloth Revetment**

**Figure 4-12. Concrete Cloth Hydration**

### Pros and Cons

A summary of the pros and cons of Alternative 5 is provided in Table 4-12.

**Table 4-12. Alternative 5 Pros and Cons**

| Pros | Cons |
|---|---|
| Minimal subgrade preparation required (installed over the existing liner). | Fasteners would be required which would puncture the existing liner, although seepage would still likely be reduced. |
| Easy to install system and much cheaper to ship. | May be less durable and have a shorter longevity versus Alternatives 2, 3a, and 3b. |
| Would generally form an impermeable surface and reduce seepage. | The reservoir will need to be drained to facilitate installation at the toe. |
| Would form to the subgrade and offer some flexibility. | Wave runup along the upstream face of the dam embankment will increase (smooth surface). |
| Would provide a uniform surface with complete liner coverage and less susceptibility to ice damage. | May not provide as robust protection (not designed specifically for wave action). |

### Operation and Maintenance

Required O&M associated with this alternative would be comprised of monitoring the concrete cloth for damage and repairing/patching if necessary. This alternative reduces existing seepage issues and associated O&M requirements related to managing seepage.

### Conceptual Cost Estimate

The construction cost estimate for Alternative 5 is presented in Table 4-13. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. Additional details on the cost estimate and cost breakdowns associated with specific items of work are available upon request.

**Table 4-13. Alternative 5 Cost Estimate**

| Description of Work | Cost |
|---|---|
| Concrete Cloth[1] | $625,270 |
| Mobilization (10%) | $62,530 |
| Contingency (30%) | $206,340 |
| Construction Administration (10%) | $89,410 |
| **Total** | **$983,560** |

[1]Assumes 55,900 SF of concrete cloth.

## 4.10 Apparent Most Beneficial Alternative

Based on the alternatives evaluated it is recommended that Alternative 3b be constructed to protect the existing liner and embankment. While the armoring alternatives are similar in costs, there is a large difference in the constructability, such as required dewatering of the reservoir (riprap, shotcrete, and concrete cloth alternatives). In addition, the stability of the alternatives greatly varies, with Alternatives 2, 4, and 5 requiring additional anchoring techniques that would puncture or cut the existing liner. This would further expose the embankment to seepage. Conversely, Alternative 3a and 3b would not require any impacts to the liner and can be anchored from the top of the embankment. Furthermore, due to the assumed simplicity of shipping and working with the fabric-formed revetment (Alternative 3b) compared to the ACB revetment (Alternative 3a), it is recommended that Alternatives 3b be progressed for further design.

# 5 Seepage Evaluation

## 5.1 Existing Seepage

Seepage has been problematic throughout Moulton Dam's history at the embankment toe, the left downstream embankment groin (location of the collapsed tunnel which is currently being collected in pipe), and from the left native hillside adjacent to spillway.

Moulton Dam's existing drain consists of a 10" diameter PVC pipe which currently discharges ponded seepage at the embankment toe into the Yankee Doodle Creek channel. The Project's intent is to improve this system such that it collects water below ground surface and filters water prior to collection. Survey data (to gather inlet and outlet pipe elevations and pipe alignment) is required to determine if the existing system can be modified or if a new toe drain system should be constructed.

## 5.2 Alternative 1: No-Action

### Discussion

Failure address existing seepage issues at the dam embankment toe will result in continued seepage, which could increase. Over time, this could result in embankment instability, erosion, and potential piping. As aforementioned, long term seepage can lead to stability issues that would expose BSB to undue risk as the owners of the facility as well as potentially leading to the inability to use Moulton Reservoir as a water source.

## 5.3 Alternative 2: Downstream Toe Drain

### Discussion

To collect seepage at the embankment toe, the design team proposes installing a new toe drain system or modifying the existing drain extruding from the collapsed tunnel. The toe drain system would be designed to filter (protect against soil particle movement through existing embankment) and collect seepage expressing from both embankment and foundation soils as well as the collapsed tunnel. Collected seepage would be discharged through a collection pipe into the Yankee Doodle Creek channel or the existing pre-cast concrete box vault which collects seepage from the left abutment. The toe drain system will be about 100 ft long, should be constructed in short segments (to avoid creating slope instability by opening up the entire toe), and should be constructed during low pool. The drain system will be designed so seepage discharge volume can be monitored to detect changes in volume. This offers a way to detect internal issues within the dam.

### Conceptual Cost Estimate

The construction cost estimate for the toe drain is presented in Table 5-1. The costs are based on a combination of bids for similar projects, manufacturer quotes, and local contractor input. This cost estimate is approximate and based on 2021 rates, assumes a private contractor will perform the work, and will be refined as the design progresses.

Table 5-1. Alternative 2 Cost Estimate

| Description of Work | Cost |
|---|---|
| Construction | $30,000 |
| Mobilization (10%) | $3,000 |
| Contingency (30%) | $9,900 |
| Construction Administration (10%) | $4,290 |
| **Total** | **$47,190** |

# 6 Permitting Overview

Specific permitting requirements applicable to the project will depend on the conceptual design alternative selected for final design and associated impacts. Applicable permitting agencies and permits anticipated to apply to the work include the following:

- US Army Corps of Engineers
  - Section 404 permitting
  - Section 10 permitting
- Montana Fish Wildlife and Parks
  - SPA 124 permit
- Mile High Conservation District
  - 310 permit
- Butte Silver Bow County
  - Floodplain Development Permit
- Montana Department of Environmental Quality
  - 318 authorization
  - MPDES General Permit for Stormwater Discharges
  - MPDES General Permit for Construction Dewatering
- DNRC
  - Montana Easement on Navigable Waters

## 6.1 Permitting Cost

BSB has agreed to complete all work and bear costs associated with environmental compliance and permitting for the Project. As such, at this time, costs associated with these items have not been included in the estimates above.

# 7 Summary and Recommendations

XXX

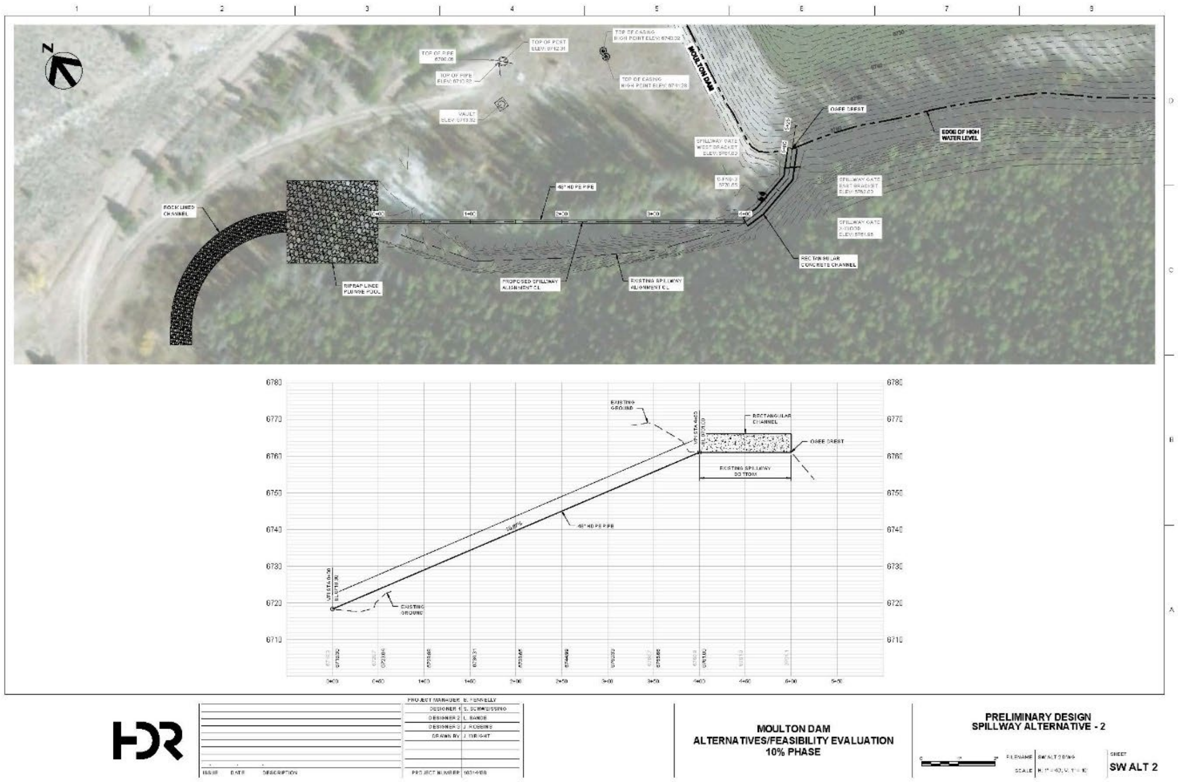
# 8 Bibliography

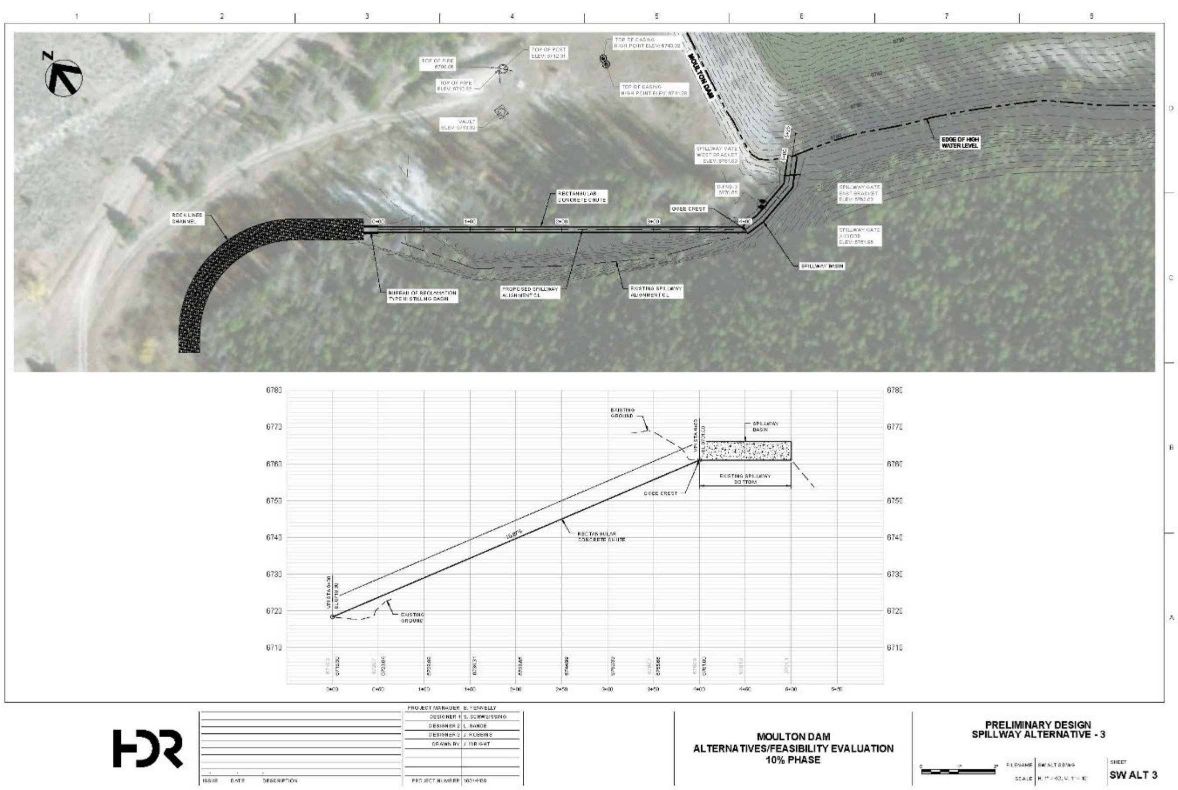

1. Armorform. http://www.armorform.com/. 2020
2. Contech. https://www.conteches.com/. 2020
3. Huesker. https://www.huesker.us/. 2020
4. Nilex. https://nilex.com/. 2020
5. Shotcrete Montana. http://shotcretemt.com/. 2020.
6. Sythetex. https://synthetex.com/. 2020.
7. United States Department of Agriculture: Natural Resources Conservation Services, *Slope Protection for Dam and Lakeshores, Minnesota Technical Note 2*, October 1997.
8. United States Department of Agriculture: Natural Resources Conservation Services, *Technical Release-210-69 Riprap for Slope Protection Against Wave Action*, May 1983.
9. United States Department of the Interior: Bureau of Reclamation, *Design of Small Dams*, 1977.
10. United States Department of the Interior: Bureau of Reclamation, *Design Standards No. 13 Embankment Dam, Chapter 6: Freeboard*, June 2021.
11. United States Department of the Interior: Bureau of Reclamation, *Design Standards No. 13 Embankment Dam, Chapter 7: Riprap Slope Protection*, May 2014.
12. Western Dam Engineering Technical Notes, *Predicting Wave Runup on Dam Slopes and Design of Riprap for Slope Protection against Wave Action*, Volume 1, Issue 2, July 2013.
13. Water & Environmental Technologies. *Moulton Reservoir Bathymetry Survey*. June 2020.

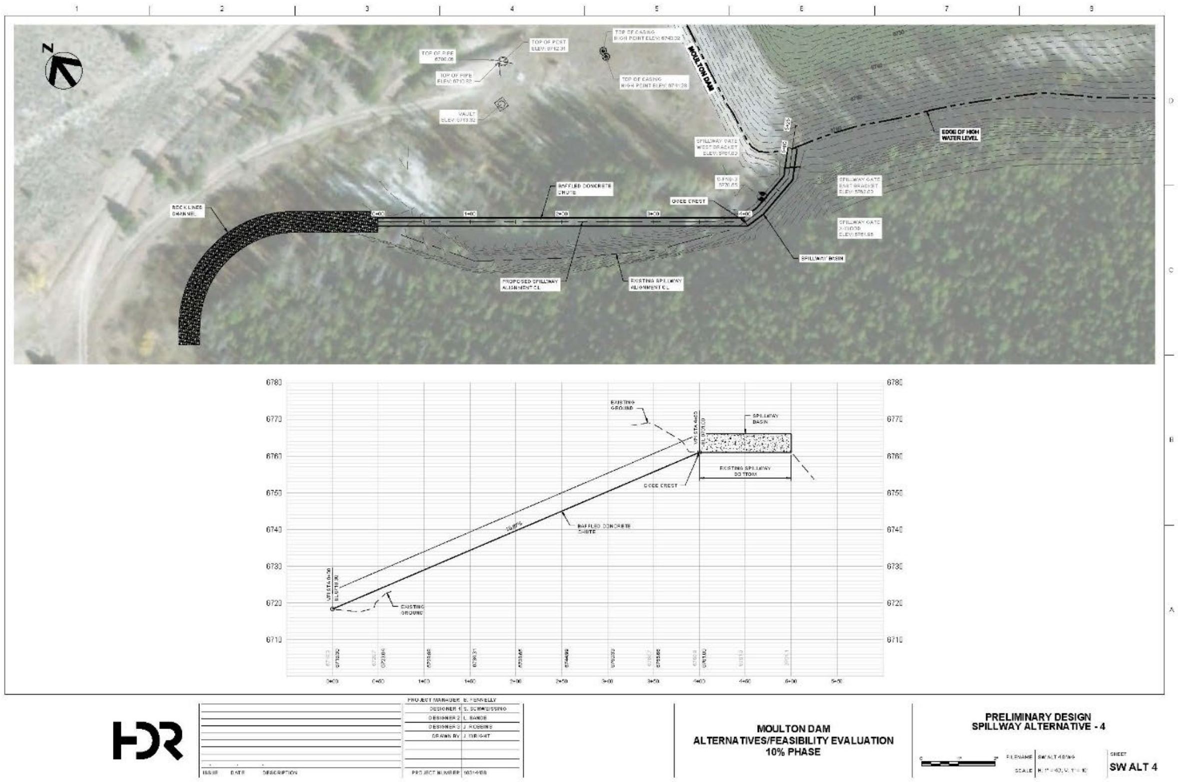
# 9 Acronyms

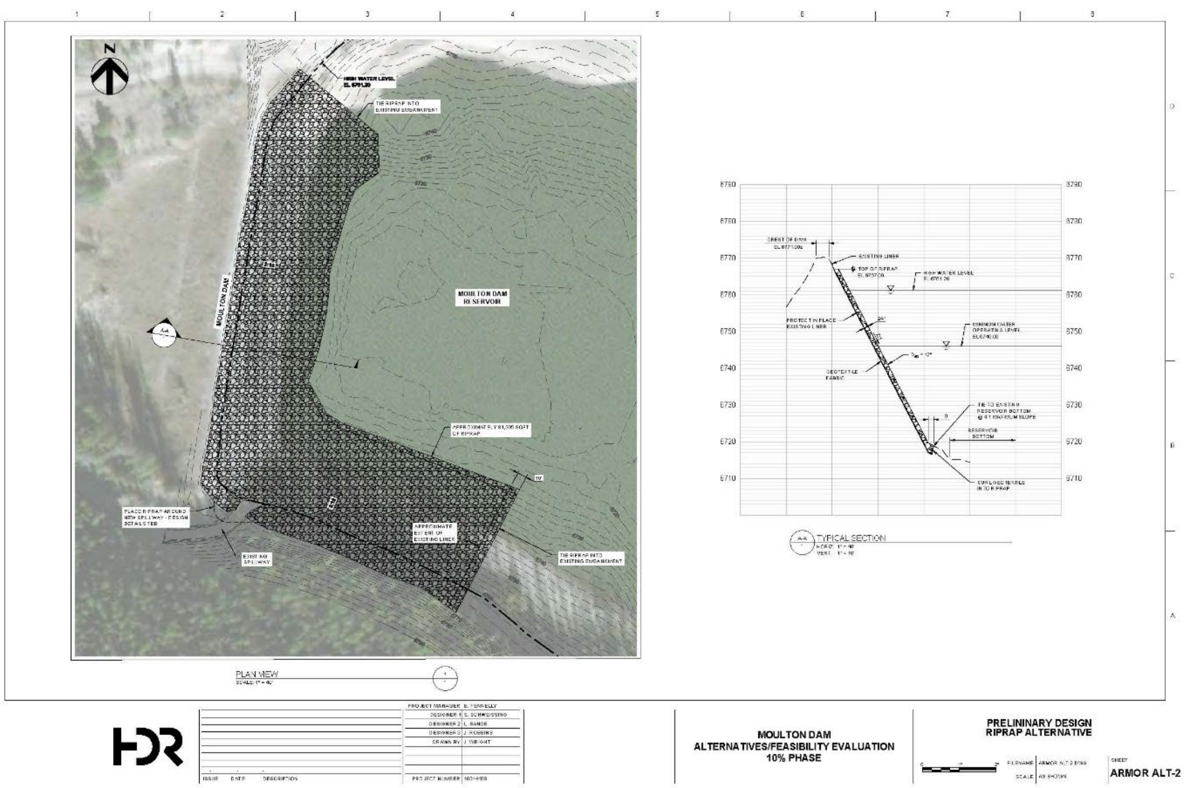
| | |
|---|---|
| ACB | Articulating Concrete Block |
| BSB | Butte-Silver Bow |
| cfs | cubic feet per second |
| DTM | digital terrain model |
| NAVD88 | North American Vertical Datum of 1988 |
| NOAA | National Oceanic and Atmospheric Administration |
| WGS84 | World Geodetic System 1984 |

# Appendix A. Conceptual Design Drawings

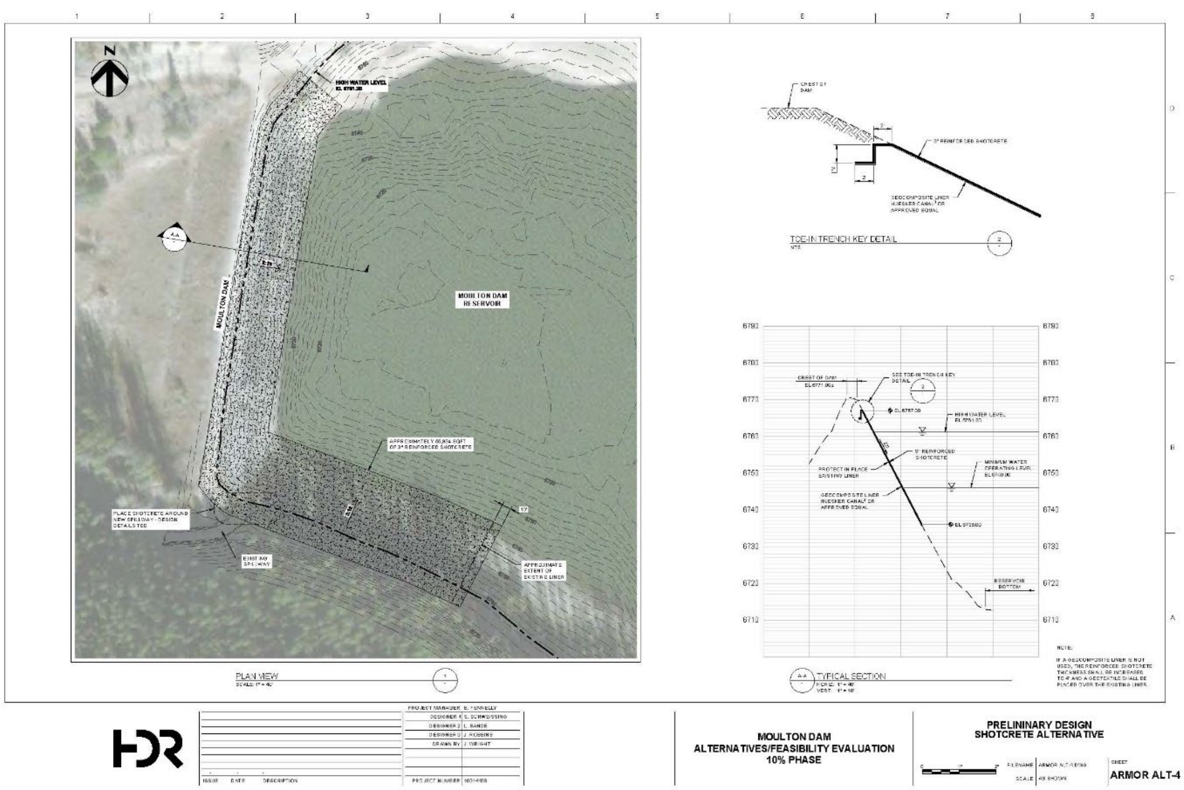

MOULTON DAM
EDGE OF HIGH WATER LEVEL
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
PRELIMINARY DESIGN
SPILLWAY ALTERNATIVE - 2
SW ALT 2

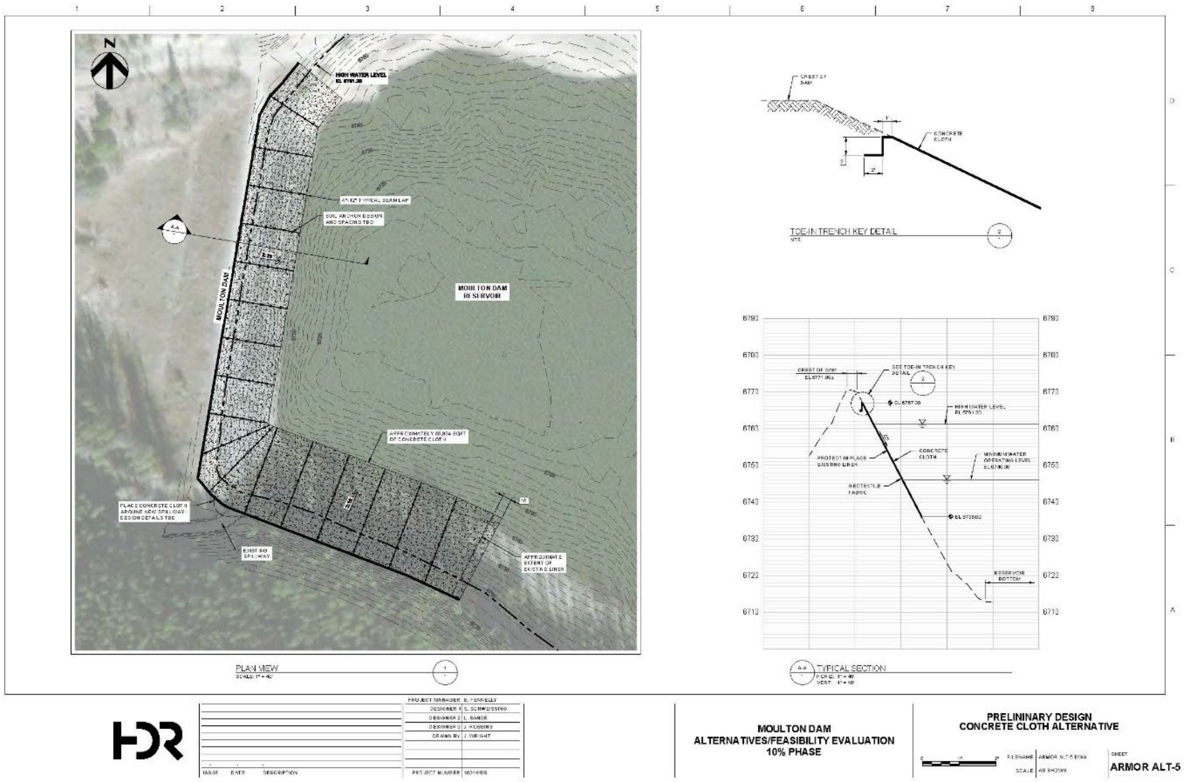

MOULTON DAM
EDGE OF HIGH WATER LEVEL
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
PRELIMINARY DESIGN
SPILLWAY ALTERNATIVE - 3
SW ALT 3

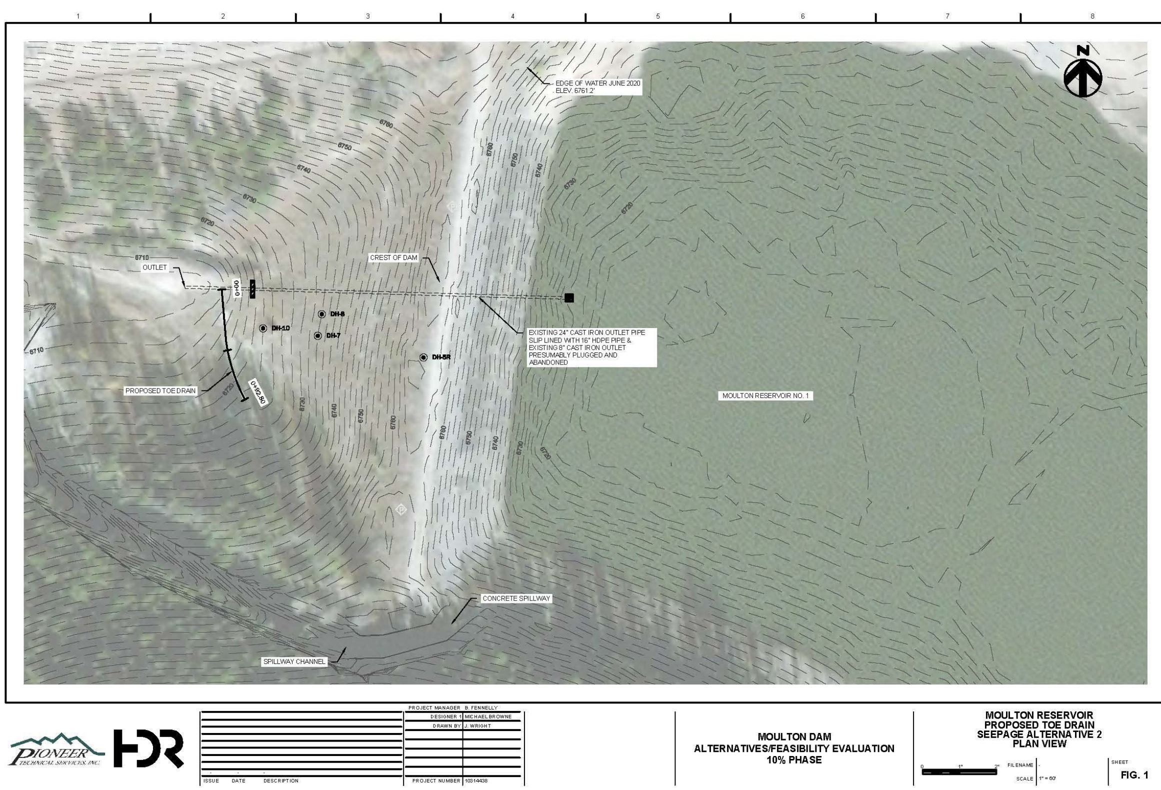

MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
PRELIMINARY DESIGN
SPILLWAY ALTERNATIVE - 4
SW ALT 4

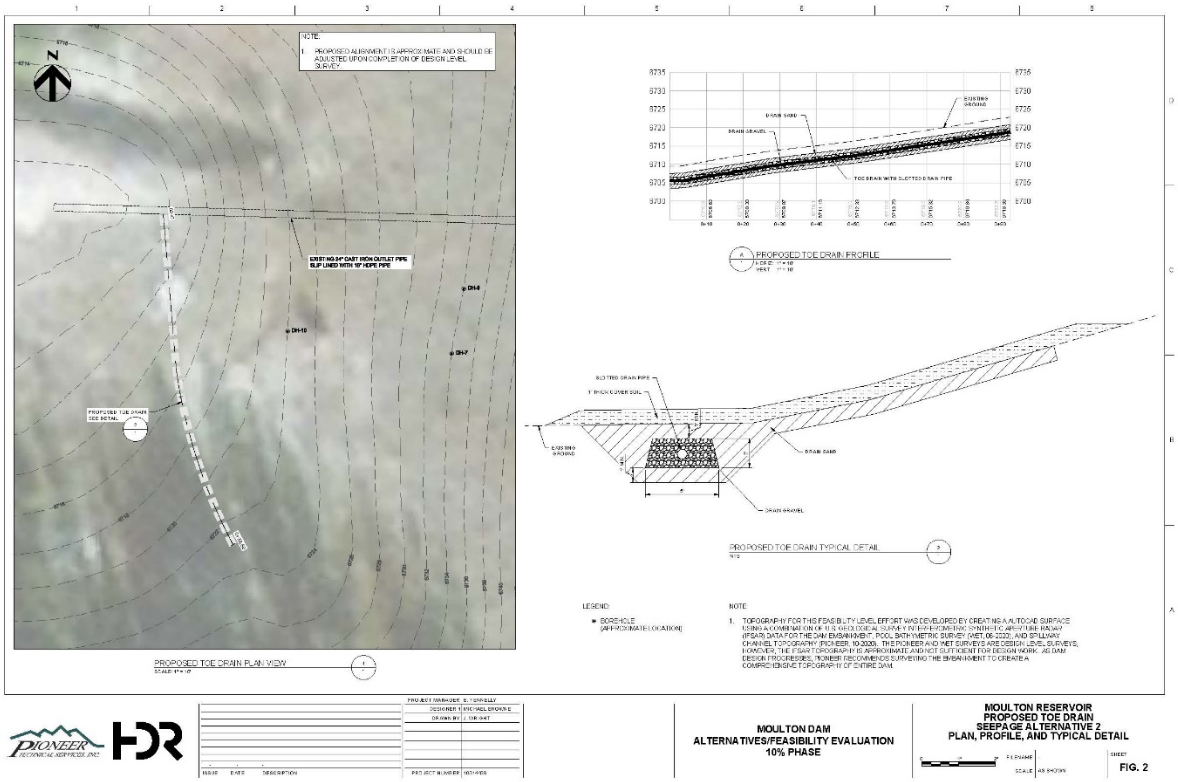

MOULTON DAM
RESERVOIR
TYPICAL SECTION
PLAN VIEW
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
PRELIMINARY DESIGN
RIPRAP ALTERNATIVE
ARMOR ALT-2


MOULTON DAM RESERVOIR
MOULTON DAM
TOP TERMINATION DETAIL
PLAN VIEW
TYPICAL SECTION
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
PRELIMINARY DESIGN
ARTICULATING CONCRETE BLOCK (ACB)
REVETMENT ALTERNATIVE
ARMOR ALT-3


MOULTON DAM RESERVOIR
MOULTON DAM
TOE-IN TRENCH KEY DETAIL
PLAN VIEW
TYPICAL SECTION
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
PRELIMINARY DESIGN
SHOTCRETE ALTERNATIVE
ARMOR ALT-4


HIGH WATER LEVEL
MOULTON DAM RESERVOIR
MOULTON DAM
TOE-IN TRENCH KEY DETAIL
PLAN VIEW
TYPICAL SECTION
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
PRELIMINARY DESIGN
CONCRETE CLOTH ALTERNATIVE
ARMOR ALT-5


EDGE OF WATER JUNE 2020
ELEV. 6761.2'
CREST OF DAM
OUTLET
EXISTING 24" CAST IRON OUTLET PIPE SLIP LINED WITH 16" HDPE PIPE & EXISTING 8" CAST IRON OUTLET PRESUMABLY PLUGGED AND ABANDONED
PROPOSED TOE DRAIN
MOULTON RESERVOIR NO. 1
CONCRETE SPILLWAY
SPILLWAY CHANNEL
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
MOULTON RESERVOIR
PROPOSED TOE DRAIN
SEEPAGE ALTERNATIVE 2
PLAN VIEW
FIG. 1


NOTE:
1. PROPOSED ALIGNMENT IS APPROXIMATE AND SHOULD BE ADJUSTED UPON COMPLETION OF DESIGN LEVEL SURVEY.
PROPOSED TOE DRAIN PROFILE
PROPOSED TOE DRAIN TYPICAL DETAIL
NTS
DRAIN GRAVEL
DRAIN SAND
PROPOSED TOE DRAIN PLAN VIEW
LEGEND:
BOREHOLE (APPROXIMATE LOCATION)
NOTE:
1. TOPOGRAPHY FOR THIS FEASIBILITY LEVEL EFFORT WAS DEVELOPED BY CREATING A AUTOCAD SURFACE USING A COMBINATION OF U.S. GEOLOGICAL SURVEY INTERFEROMETRIC SYNTHETIC APERTURE RADAR (IFSAR) DATA FOR THE DAM EMBANKMENT, POOL BATHYMETRIC SURVEY (WET, 06-2020), AND SPILLWAY CHANNEL TOPOGRAPHY (PIONEER, 10-2020). THE PIONEER AND WET SURVEYS ARE DESIGN LEVEL SURVEYS, HOWEVER, THE IFSAR TOPOGRAPHY IS APPROXIMATE AND NOT SUFFICIENT FOR DESIGN WORK. AS DAM DESIGN PROGRESSES, PIONEER RECOMMENDS SURVEYING THE EMBANKMENT TO CREATE A COMPREHENSIVE TOPOGRAPHY OF ENTIRE DAM.
MOULTON DAM
ALTERNATIVES/FEASIBILITY EVALUATION
10% PHASE
MOULTON RESERVOIR
PROPOSED TOE DRAIN
SEEPAGE ALTERNATIVE 2
PLAN, PROFILE, AND TYPICAL DETAIL
SCALE AS SHOWN
FIG. 2

# Appendix B – National Historic Preservation Act Compliance

Big Sky. Big Land. Big History.
**Montana**
**Historical Society**

*Historic Preservation*
*Museum*
*Outreach & Interpretation*
*Publications*
*Research Center*

October 11, 2022

Sage Joyce
Helena Corps of Engineers Regulatory Office
100 Neill Avenue
Helena, MT 59601-3329

Re: Moulton Dam No. 1 Rehabilitation, Yankee Doodle Creek

Dear Ms. Joyce,

Thank you for your letter (received September 13, 2022) regarding the Moulton Dam Project. We concur with your determination of No Adverse Effect. We also concur that the Moulton Dam (24SB1095) is Eligible for listing in the National Register under Criteria A and C.

Please note that our concurrence does not substitute for a good faith effort to consult with interested parties, local government authorities, and American Indian tribes. If you receive a comment that substantially relates to a historic property located within or adjacent to the Area of Potential Effect, please submit it to our office for review. Include documentation of how the comment was addressed. If you have any questions or concerns, do not hesitate to contact me at (406) 444-7719 or Laura.Evilsizer@MT.gov. Thank you for consulting with us.

Sincerely,

Laura Evilsizer

Laura Evilsizer, M.A.
Compliance Officer, Deputy SHPO
Montana State Historic Preservation Office

225 North Roberts Street
P.O. Box 201201
Helena, MT 59620-1201
(406) 444-2694
(406) 444-2696 FAX
montanahistoricalsociety.org

FILE: USACE – 2022 - 2022091304

# Appendix C – Clean Water Act Compliance

**DEPARTMENT OF THE ARMY**
CORPS OF ENGINEERS, OMAHA DISTRICT
MONTANA REGULATORY OFFICE
100 NEILL AVENUE
HELENA, MT 59601-3329

October 19, 2022

SUBJECT: 2021 Nationwide Permit Verification, Moulton Dam Rehabilitation Project; USACE File Number: **NWO-2021-01750-MT**

Butte-Silver Bow Department of Public Works
Attn: Mr. Jim Keenan
126 West Granite Street
Butte, MT 59701

Dear Mr. Keenan:

This letter is in response to your August 30, 2022, Pre-construction Notification (PCN), requesting Department of the Army (DA) Nationwide Permit (NWP) verification for the above-referenced project. The proposed activity is located at the Moulton Reservoir at Latitude 46.090203°, Longitude -112.509208°, on Yankee Doodle Creek, within Section 19, Township 4 N, Range 7 W, near Butte, Silver Bow County, Montana.

**Project-specific components:**

a. Yankee Doodle Creek at Moulton Reservoir: All repair, replacement and rehabilitation work will occur within the general footprint of the existing dam infrastructure.

   **Revetment:** Permanently impact approximately 1.51-acres below the ordinary highwater mark (OHWM) and 690 linear feet (LF) of bank for repair of the upstream dam crest face, left abutment, and south bank through placement of a 6-inch-thick fabric formed concrete revetment.

   **Spillway:** Impact approximately 0.32-acre below the OHWM and 466 LF of bank for replacement of the dam spillway. Closest to the dam, the concrete section of the new spillway will have a total length of 135.5 feet along its south wall and 93.5 feet along its north wall. The concrete spillway will lead to a 330-foot-long by 63-inch diameter HDPE spillway conveyance pipe. The HDPE pipe will outlet into a stilling pool with riprap that leads to a re-graded outlet channel.

   **Two toe drains:** Two toe drains constructed from 8-inch slotted pipe will be installed on the downstream slope of the dam. The north toe drain will have a total length of 109 feet and the south toe drain will have a total length of 151 feet. Approximately

195 feet of CMP will also be installed on the downstream slope of the dam to capture and direct drainage from sand filters that will be constructed around the 63-inch HDPE pipe.

**Temporary Construction Access**: Following construction completion, the temporarily impacted areas for construction access will be restored to pre-construction elevations.

b. The work will be completed as detailed in the joint application received on August 30, 2022, submitted by the applicant.

The U.S. Army Corps of Engineers (USACE) regulates the discharge of dredged and fill material into waters of the United States under Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344) and structures or work in, over, and under navigable waters of the United States under Section 10 of the Rivers and Harbors Act (RHA) (33 U.S.C. 403). USACE regulations are published in the *Code of Federal Regulations* at 33 CFR parts 320 through 332. NWPs are defined in the *Federal Register* published on December 27, 2021, (86 FR 73522) and January 13, 2021, (86 FR 2744). Based on a review of the information you furnished and available to us, we have determined the above referenced work requires DA authorization under Section 404 of the CWA.

Based upon the information you provided, we hereby verify that the work described above, which would be performed in accordance with the plans you provided, dated August 30, 2022, is authorized by NWP 3, Maintenance. Please note that deviations from the original plans and specifications of your project could require additional authorization from this office. This NWP and associated Regional and General Conditions are enclosed and can be accessed on our website at: *https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Montana/*. Failure to comply with the General and Regional Conditions of these NWPs may result in the suspension or revocation of your authorization, and you may be subject to appropriate enforcement action. You shall comply with all terms and conditions associated with these NWPs.

The Montana Department of Environmental Quality has provided the enclosed CWA Section 401 water quality certification for these NWPs which includes General Conditions, all of which must be complied with for that certification to remain valid. This does not eliminate the need to obtain other permits that may be required by that agency.

Unless this NWP is suspended, modified, or revoked, it is valid until **March 14, 2026**. It is incumbent upon you to remain informed of changes to this NWP. We will issue a public notice when the NWPs are reissued.

To assist in your compliance with NWP General Condition 30, enclosed is a "Compliance Certification" form, which shall be signed and returned within 30 days of completion of the project, including any required mitigation. Your signature on this form certifies that you have completed the work in accordance with the terms and conditions of the NWP. Activities completed under the authorization of an NWP which was in effect at the time the activity was completed continue to be authorized by that NWP.

Authorizations under this NWP does not relieve permittees from obtaining permits or other authorizations from any required federal, state, or local agency.

If you have any questions, please contact Jerin Borrego via email at Jerin.E.Borrego@usace.army.mil, by mail at the address above, or by phone at (406) 441-1364.

Sincerely,

Jerin Borrego Date: 2022.10.19 15:56:40 -06'00'

Jerin E. Borrego
Regulatory Project Manager

3 Enclosures
1. NWP 3 Fact Sheet with Regional and General Conditions
2. Compliance Certification
3. CWA Section 401 Water Quality Certification

The Omaha District, Regulatory Branch is committed to providing quality and timely service to our customers. In an effort to improve customer service, please take a moment to complete our Customer Service Survey found on our website at: https://regulatory.ops.usace.army.mil/customer-service-survey/.