DRAFT
ENVIRONMENTAL ASSESSMENT

Project Name:	City of Missoula/Missoula County Grant Creek Realignment
Proposed Implementation Date:	2024
Proponent:	City of Missoula/County of Missoula
Location:	46.900443, -114.083684
County:	Missoula

I. TYPE AND PURPOSE OF ACTION

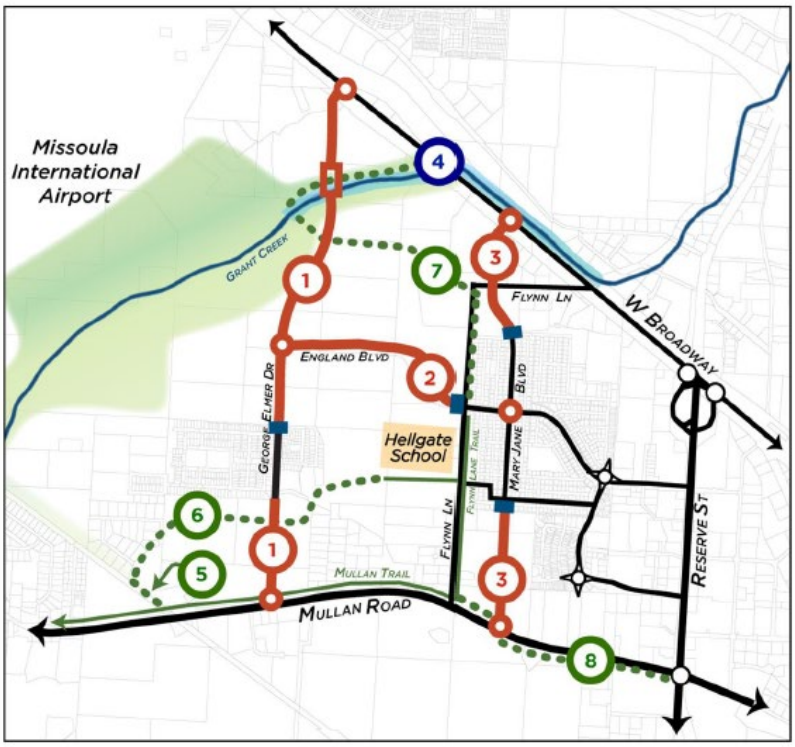
The purpose of the project is to protect public health and safety for users of the Missoula City/County (County) Mullan BUILD Grant Project in the City of Missoula, Montana (City). The project goals are to provide three miles of new collector and minor arterials of roads, new sewer and water mains, 3.7 miles of new trails, and 0.5 miles of stream restoration and flood control.

The Grant Creek project is needed for two primary reasons. First, Grant Creek is in poor ecological condition due to environmental degradation and barriers to fish passage. Second, there are severe flood hazards in the study area, which were previously unknown due to outdated and inaccurate FEMA floodplain mapping. Grant Creek is located in the western Missoula Valley, and currently there are about 70 single-family homes within the 100-year floodplain. The purpose of the Grant Creek project is to evaluate and alleviate flood hazards and reduce environmental degradation. The project goals are to 1) reduce flooding hazards; 2) improve fish passage; 3) improve fish habitat; and 4) improve recreation opportunities and the aesthetic value of the creek.

The following outlines the improvements as identified in the preliminary *Design Report, Grant Creek Environmental Restoration/Flood Control* (PDR; HDR and Maxim Technologies, 2005), and the *Grant Creek Hydrology and Hydraulics, Mullan Build* Report (Build Report; HDR, 2020). The County and City intend to collaborate and coordinate this project with the City's planned water project with the desired outcome of utilizing one contractor by integrating this project as a separate schedule in the construction bidding and contractor selection process. The County will have its own Construction Engineer/Project Manager to oversee and act on behalf of the County.

Grant Creek has a watershed of approximately thirty square miles reaching the confluence of Grant Creek and Mullan Road. The mean annual precipitation is 29.86 inches, and 57.4% of the watershed is covered by forest (StreamStats Report, 2020). The 1-year peak flood is listed at 152 cubic feet per second (CFS), and the 100-year and 500-year peak floods at 749 and 992 cfs, respectively.

LOCATION
The location of the project is between Mullan Road, West Broadway, Reserve Street, and the airport in Missoula, Montana.



STREET IMPROVEMENTS

1. George Elmer Drive
2. England Boulevard
3. Mary Jane Boulevard

STREAM RESTORATION

4. Grant Creek Restoration

TRAIL IMPROVEMENTS

5. Milwaukee Trail
6. Tipperary Way Trail
7. Flynn Lane Trail
8. Mullan Trail

The following are the key project elements:

1. George Elmer Dr – Completes a new street connection between Mullan Road and Broadway, extending the existing section of road to Broadway and upgrading the existing section to the south. Includes a traffic signal or roundabout at its intersection with Mullan Road (including necessary Mullan Road widening/turn lanes east and west of the new intersection control), a bridge over Grant Creek, a traffic signal or roundabout at its intersection with Broadway, and related utility infrastructure.

2. England Blvd – Extends a new street from Flynn Lane to George Elmer Dr, extending England Blvd to the west from its current dead end at Flynn Lane. Includes a roundabout at its intersection with George Elmer Dr, a roundabout or traffic calming at its intersection with Mary Jane Blvd, and related utility infrastructure.

3. Mary Jane Blvd – Completes a new street connection between Mullan Road and Broadway, extending the existing section of road from current dead ends on both the north and south. Includes a traffic signal or roundabout at its intersection with Mullan (including necessary Mullan Road widening/turn lanes east and west of the new intersection control), a traffic signal or roundabout at its intersection with Broadway, and related utility infrastructure.

4. Grant Creek Restoration and Trail – Restores 2,800 feet of stream channel and floodplain to return Grant Creek to a natural condition and constructs 1,600 feet of levee to improve flood protection. Also extends a new shared-use path along the restored Grant Creek corridor, linking to future connections with the Milwaukee Trail and trail connections north of Broadway.

5. Milwaukee Trail – Extends a new shared-use path from Mullan Road to Grant Creek, which is part of a planned trail system extending over 120 miles into eastern Idaho along the former Milwaukee & St. Paul Railroad.

6. Tipperary Way Trail – Extends a new shared-use path connecting residential development to Hellgate School along the Flynn Irrigation Ditch.

7. Flynn Lane Trail – Extends the existing shared-use path north along Flynn Lane, connecting Hellgate School to the Grant Creek trail corridor.

8. Mullan Trail – Extends the existing Mullan Road shared-use path the final 0.75 miles from Flynn Lane to Reserve Street.

The project aims to promote improved stream health, aquatic habitat, and water quality, while providing potential flood mitigation measures.

Funding for the project will be through a grant from the DNRC Renewable Resource Grant and Loan Program (RRGL), ARPA, Sxwtpqyen Area Transportation Special Impact Fee, BUILD program, and match funds from the City.

II. PROJECT DEVELOPMENT

1. **PUBLIC INVOLVEMENT, AGENCIES, GROUPS OR INDIVIDUALS CONTACTED:**
   Provide a brief chronology of the scoping and ongoing involvement for this project. List number of individuals contacted, number of responses received, and newspapers in which notices were placed and for how long. Briefly summarize issues received from the public.

Ongoing communication has occurred between the City, County, DNRC, HDR, MAXIM Technologies, DEQ, the Sxwtpqyen Area, nearby property owners, and other local government entities. The project has been presented at local meetings and made available for public comment. In addition, the applicant provided a letter of commitment from the Mayor of Missoula, John Engen, Missoula Deputy Director of Utilities, Logan McInnis, confirming $1,600,000.00 in match funds, and a letter from Dan Miller, Ronan Public Works Director, indicating intent from the City and County to work together to complete this project.

DNRC will post a draft of this Environmental Assessment to be available for public comment for 30 days on the DNRC – Public Notices webpage. For any comments submitted by the public, the MEPA Coordinator will review and work with the Grant Manager and applicant to adequately address those comments.

2. **OTHER GOVERNMENTAL AGENCIES WITH JURISDICTION, LIST OF PERMITS NEEDED:**
   Examples: cost-share agreement with U.S. Forest Service, 124 Permit, 3A Authorization, Air Quality Major Open Burning Permit.

The City and County both have authority over various portions of the system for this project. The City/County will be required to work with the DEQ and DNRC to ensure that any deviation from the approved plans and specifications will be submitted to the DEQ for review and approval. No other governmental agencies are expected to require issuance of permits.

The contractor may be required to gain the approval of the DEQ prior to proceeding with construction per the Montana Public Water Supplies, Distribution and Treatment Act (MCA 75-6-101 through 75-6-121). Additionally, the contractor must present final as-built drawings to the DEQ within 90 days after the completion of the project.

A Montana Construction General Permit (CGP) and Stormwater Pollution Prevention Plan (SWPPP) will be required to be prepared and submitted to the DEQ for review and approval. If construction dewatering is necessary, a Construction Dewatering General Permit (CDGP) will also need to be prepared and submitted to the DEQ for review and approval. Permits may be required for suspected asbestos-containing material (ACM) and lead-based paint (LBP), depending on the construction of some of the established features, although an assessment of these conditions has not been conducted.

A Clean Water Act (CWA) Section 404 permit will be required due to instream work occurring within Grant Creek, which is a Waters of the U.S. Additional permits that will be required include a 318 Authorization for Turbidity, Stream Protection Act (SPA) 124, CWA Section 401 Water Quality Certification, and a Floodplain Development Permit.

The final restoration recommendations will result in the completion of a CLOMR and LOMR process with FEMA. The project will require a floodplain development permit from the City of Missoula.

3. ALTERNATIVE DEVELOPMENT:

Describe alternatives considered and, if applicable, provide brief description of how the alternatives were developed. List alternatives that were considered but eliminated from further analysis and why. Include the No Action alternative.

Alternative 1 – No-Action Alternative

The No-Action Alternative (NAA) serves as a baseline so that decision-makers can compare the environmental effects of the action alternatives. Under the NAA, no flood control or environmental restoration measures would be completed. No other actions would be conducted. The NAA would not meet the project's purposes and need because flooding would not be mitigated, and the stream habitat will not be restored. Continued flooding could cause further environmental degradation.

Alternative 2 – Preferred Alternative – Grant Creek Design

This alternative was provided in the HDR Build Report (HDR, 2020) and is the recommended alternative. The Existing Conditions model typically builds upon the Corrected Effective model (HDR and Maxim, 2005) by including any modifications that have occurred within the floodplain since the date of the Effective model (Federal Emergency Management Agency, Missoula County, Montana and Incorporated Areas, Flood Insurance Study, July 6, 2015). Since there are no known changes within the modeled reach, there were no changes made to the Corrected Effective model. The Corrected Effective model is considered the Existing Conditions model.

The Proposed Conditions model builds upon the Existing Conditions model. The Proposed Conditions model includes the proposed project grading and channel design associated with the realignment of Grant Creek as well as the new hydraulic crossing where George Elmer Drive crosses the proposed Grant Creek. These design elements are illustrated in Figure 1 and further described below.

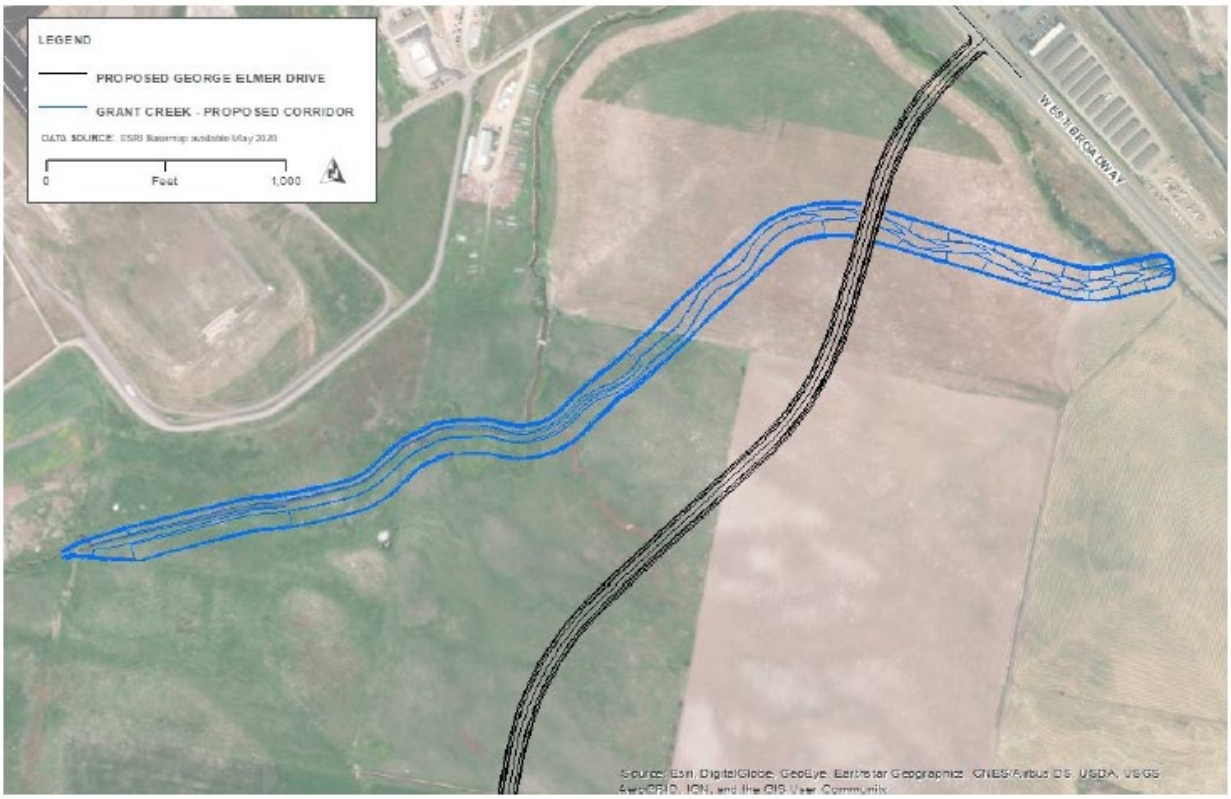


Figure 1. Layout of Grant Creek design elements (HDR, 2020).

The proposed realignment of Grant Creek extends from the downstream side of West Broadway to RS 14020. As a result of the realignment, the reach distance of Grant Creek downstream of West Broadway is decreased approximately 1670 feet. The slope of the proposed channel varies from 0.0086 ft/ft downstream of West Broadway to 0.0006 ft/ft where it ties into the existing alignment. These slopes approximate the existing upstream and downstream slopes of Grant Creek, respectively. The cross section of the proposed channel is designed to stably pass the 2-yr event within the channel with an excavated floodplain that is designed to contain the 100-yr event. This design was referenced from the original design developed in the PDR.

Based on the Build Report, the alternatives assessment concludes that the proposed project is the only suitable alternative and includes:

George Elmer Drive Crossing

The BUILD project proposes a new road to cross the proposed Grant Creek alignment at RS 17862 (approximately Station 135+40). The preliminary design of the hydraulic crossing was developed using the following design parameters:

1. Pass the 100-yr event without overtopping the banks of the excavated floodplain.
2. Limit the velocity of the 10-yr event to less than 10 fps to reduce the likelihood of scour or requirement of scour mitigation at the structure.

3. Structures shall be sunk or bottomless to allow for natural channel sediments to be present within the structure.

Preliminary design of the hydraulic crossing has identified the following hydraulic structures meet the design criteria:

1. 2-10'x4' RCB with wingwalls
2. 2-9.75'x6.5' SSPA mitered to the roadway slope
3. 20'x5' CONSPAN

Both alternatives are placed in the channel at the local channel slope (0.006 ft/ft) and countersunk 0.5' to provide the opportunity for recruitment of native sediments and improve fish passage opportunities.

Floodplain Mitigation

In its existing condition, the 100-yr water surface elevations overtop West Broadway between RS 21762 – 22698. In its existing and proposed state, the area that is flooded by the discharge overtopping West Broadway could be mapped as "Zone X" as it exhibits depths primarily less than 0.5'. To alleviate the flooding potential to the areas downstream of West Broadway Ave, the following mitigation options were analyzed.

Removal of Berm Upstream of West Broadway

To keep the floodwater from overtopping West Broadway, the existing berm in the left overbank was removed from the model to increase the conveyance of the floodplain. By removing the berm down to the elevation of the 2-yr event, the amount of flow overtopping West Broadway is decreased from approximately 125 cfs to approximately 73 cfs. Hence, while it slightly decreases the depth of flooding and inundated area, it does not solve the problem or justify the costs of removing the berm.

Floodplain Swale Downstream of West Broadway

To mitigate the issue of the overland flooding downstream of West Broadway, a floodplain swale was sized to capture the overtopping flood flows of the 100-yr event (125 cfs). The geometry of the swale would parallel the southwest edge of the roadway at a slope of 0.005 ft/ft which approximates the existing ground. Assuming a trapezoidal channel with 2:1 side slopes, a bottom width of 3', 15' top width, and an approximate channel depth of 4', the overtopping discharge would be directed to the proposed Grant Creek floodplain at the downstream end of the Broadway Ave crossing with a 1' freeboard. The outline of the potential swale is illustrated in Figure 2.

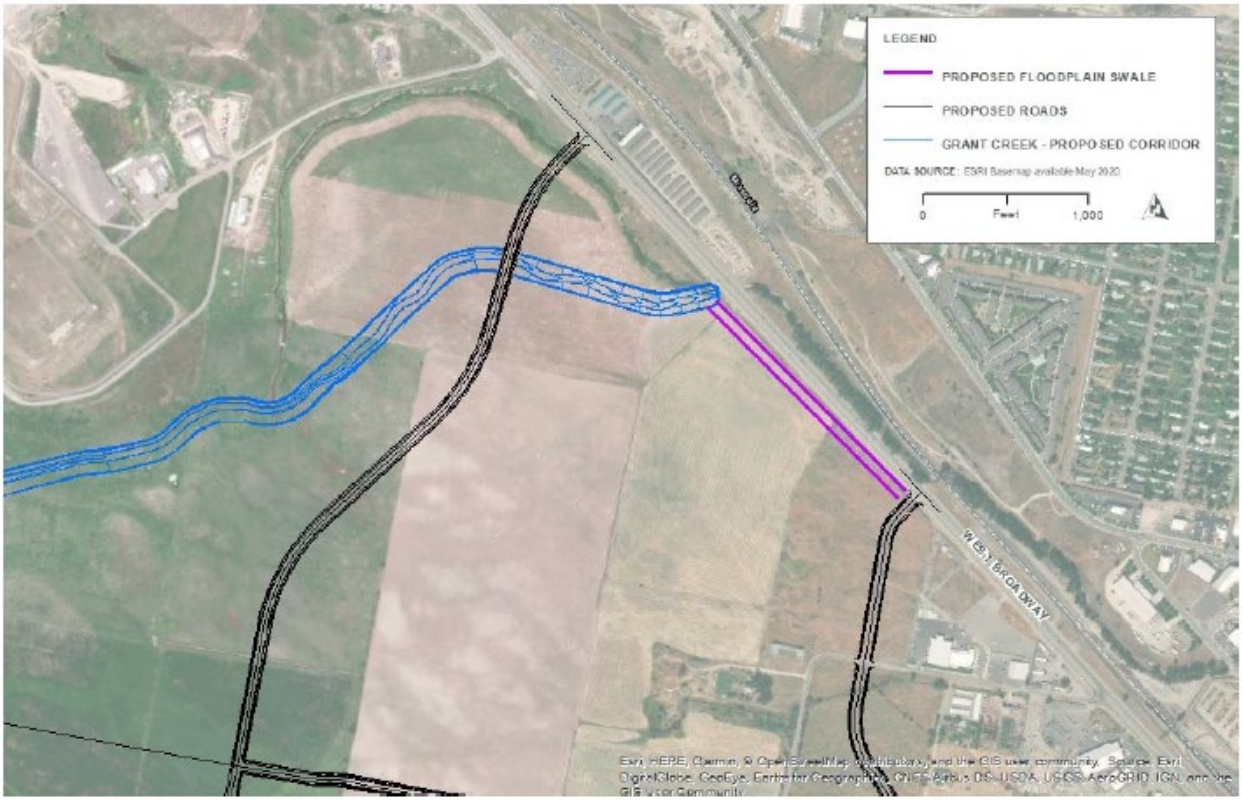


Figure 2. Potential alignment of the floodplain swale (HDR, 2020).

Based on the recommended alternatives, the engineer's opinion of probable cost is $1,201,284.44.

Alternative 3 – Maintain Existing Channel
In general, this system-wide alternative involves the low-cost alternative, including maintaining the existing channel alignment and using flow control levees or berms for flood protection. Specifically, this alternative includes:

Clark Fork Confluence Reach:
Option 1 of the Clark Fork Confluence Reach is included in this alternative. This option involves modification of the existing channel cross section and maintaining the existing channel alignment.

Mullan Road Reach:
This alternative includes Option 1 that maintains the existing culvert at Mullan Road and installs a second parallel culvert.

Prairie Schooner and Mullan Trail Reaches:
This alternative incorporates Option 1 of the Prairie Schooner reach that includes maintaining the existing channel alignment and installing/repairing existing flood control levees.

Hiawatha Lake Reach:

This alternative includes maintaining the existing channel at Hiawatha Lake and continues to allow impoundment of water upgradient of the Hiawatha Railroad grade. This option requires flood protection and an existing residence that is currently within the floodplain.

Irrigation System Flow Control:
This alternative considers abandonment of the Hellgate Valley Irrigation Company's irrigation flows.

Pruyn Property Check Dam:
This alternative would call for removal of the Pruyn check dam.

Horseshoe Bend:
This alternative includes construction of a new channel from the West Broadway Culvert. The alternative to rebuild the existing channel was a higher cost alternative, did not meet the associated landowner's needs, and was eliminated from further consideration.

West Broadway:
Replacing the existing culvert at its current location with a box culvert was selected for all alternatives evaluated because roadway grades on West Broadway preclude moving culvert locations. Other culvert locations would require raising the roadway profile at a considerable cost.

Upper Grant Creek Improvements:
All alternatives considered include removal of the steel culverts at the Pepsi Company plant site, removal of an existing irrigation diversion near International Drive and miscellaneous channel cleaning.

The PDR estimated the cost for this alternative was $2,640,523 (HDR and Maxim, 2005).

Alternative 4 – Relocate Existing Channel and Terrace Channel with Levees
In general, this system-wide alternative includes development of flood control channel terracing to build more natural systems. However, this alternative also utilizes flood control levees or berms for flood protection. Specifically, this alternative includes:

Clark Fork Confluence Reach:
Similar to Alternative No. 3.

Mullan Road Reach:
This alternative includes Option 3 of the Mullan Road Reach, which replaces the existing culvert at Mullan Road with a culvert that has greater hydraulic capacity.

Prairie Schooner and Mullan Trail Reaches:
This alternative includes maintaining the existing channel alignment and grade. This alternative also includes the use of flood control berms or levees, in conjunction with channel terracing, to mitigate flooding to the Mullan Trail Estates subdivision area.

Hiawatha Lake Reach:

This alternative includes construction of floodplain terracing and channel improvements in the Hiawatha Lake area. This alternative also incorporates clay lining of the floodplain area upgradient from the Hiawatha Railroad grade to limit recharge of floodwaters to the groundwater system.

Irrigation System Flow Control: This alternative includes elimination of the south waste ditch on the Hellgate Valley Irrigation Company system, abandonment of the south feeder ditch and re-railing of the north irrigation lateral.

Pruyn Property Check Dam: This alternative includes re-construction of the Pruyn Check Dam and reconstruction of a fish ladder or other fish passage mitigation measures.

Horseshoe Bend and West Broadway Reaches, Upper Grant Creek Improvements: This alternative is like System-Wide Alternative No. 3.

The PDR estimated the cost for this alternative was $4,437,671 (HDR and Maxim, 2005).

The PDR indicated that the County's regulations do not permit levees or berms (HDR and Maxim, 2005).

Alternative 5 – Peak Flow Bypass with Channel Terracing

This system-wide alternative is like System-Wide Alternative 4, except it also includes a peak-flow bypass pipeline system at the Clark Fork Confluence to eliminate the need for flood control levees or berms in the vicinity of the Mullan Trail Estates subdivision. Specifically, this alternative includes:

Clark Fork Confluence Reach: This alternative includes maintaining the existing culvert at Mullan Road and installing a peak flow bypass structure upgradient from Mullan Road that will divert peak flows directly to the Clark Fork River floodplain.

Mullan Road Reach: The existing Mullan Road culvert will remain in this alternative.

Prairie Schooner and Mullan Trail Reaches: This alternative includes the excavation of flood control terracing and realignment of the channel. The channel modifications will function as a more natural operating system that, in conjunction with the peak flow bypass system, will mitigate flooding in the Mullan Trail Estates subdivision areas without the use of levees or flood control berms.

Hiawatha Lake Reach: Similar to System-Wide Alternative No. 4.

Irrigation System Flow Control: Similar to System-Wide Alternative No. 4.

Pruyn Property Check Dam: Similar to System-Wide Alternatives No. 3 and No. 4.

Horseshoe Bend and West Broadway Reaches, Upper Grant Creek Improvements: This alternative is like System-Wide Alternative No. 3.

The PDR estimated the cost for this alternative was $5,435,436.

The PDR selected this alternative as the recommended alternative in 2005 (HDR and Maxm, 2005). HDR and Maxim included a design map in the PDR.

Alternative 6 – Deep Channel Excavation
This system-wide alternative includes excavating the existing channel 5 to 8 feet to eliminate the need for flood control levees or berms and eliminate the need for a peak flow bypass system. This system-wide alternative has the highest capital cost and includes the need for significant easements for construction and channel configuration. Specifically, this system-side alternative includes:

Clark Fork Confluence Reach: The existing alignment is maintained and channel excavation up to eight feet is involved in this reach.

Mullan Road Reach: Deep excavation at the Clark Fork Confluence Reach requires replacing the existing culvert at Mullan Road. This alternative includes Mullan Road Option 3 that replaces the existing culvert with a 9-foot x 18-foot arch or box culvert.

Prairie Schooner and Mullan Trail Reaches: This alternative includes deep channel excavation in the existing alignment like the Clark Fork Confluence Reach noted above. The deep excavation alternative mitigates flooding at Mullan Trail Estates without the need for flood control levees or berms.

Hiawatha Lake Reach: This alternative is similar to Alternatives No. 4 and 5 for this reach.

Irrigation System Flow Control: This alternative is similar to Alternatives No. 4 and No. 5.

Pruyn Property Check Dam: This alternative includes reconstruction of the Pruyn Property Check Dam and the use of an Obermeyer Weir or other automated weir mechanism for irrigation control.

Horseshoe Bend and West Broadway Reaches, Upper Grant Creek Improvements: This system-wide alternative is like system-wide Alternative No. 4 and No. 5 in these areas.

The PDR estimated the cost for this alternative was $6,411,191 (HDR and Maxim, 2005).

III. IMPACTS ON THE PHYSICAL ENVIRONMENT

- *RESOURCES potentially impacted are listed on the form, followed by common issues that would be considered.*
- *Explain POTENTIAL IMPACTS AND MITIGATIONS following each resource heading.*
- *Enter "NONE" If no impacts are identified or the resource is not present.*

---

4. GEOLOGY AND SOIL QUALITY, STABILITY AND MOISTURE:
Consider the presence of fragile, compactable or unstable soils. Identify unusual geologic features. Specify any special reclamation considerations. Identify direct, indirect, and cumulative effects to soils.

The project area is located at the northwest end of Missoula, Montana, extending from the Missoula

International Airport to the north, the Clark Fork River to the south, Reserve Street to the east, and the western edges of Sections 02, 11, and 14, Township 13 North, Range 20 West. The United States Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey indicates that the soil near the project area consists of approximately:

- 30 percent Desmet loam, 0 to 2 percent slopes, Hydrologic Soil Group B, well drained, moderately high to high transmissivity;
- 19 percent Grantsdale loam, 0 to 2 percent slopes, Hydrologic Soil Group B, well drained, moderately high to high transmissivity;
- 12 percent Grassvalley silty clay loam, 4 to 8 percent slopes, Hydrologic Soil Group D, well drained, very low to moderately low transmissivity;
- 10 percent Moise gravelly loam, 0 to 2 percent slopes, Hydrologic Soil Group B, excessively drained, moderately high to high transmissivity;
- 9 percent Grassvalley silty clay loam, 0 to 4 percent slopes, Hydrologic Soil Group D, well drained, very low to moderately low transmissivity;
- 8 percent Newbar very gravelly loamy sand, 0 to 2 percent slopes, Hydrologic Soil Group A, moderately well drained, high to very high transmissivity;
- Corrosivity of concrete for these soil types is indicated to be low across most of the project area;
- Corrosivity of steel for these soil types is indicated to be moderate to high across most of the project area. The western and northwestern ends of the project area are generally rated high, with high ratings across the middle and eastern edge of the project area;
- Soil susceptibility to compaction for these soil types is indicated to be medium across most of the project area, and low along the southern edge of the project area;
- Site degradation susceptibility is indicated to be slightly susceptible across the project area, with moderate and high susceptibility along the southern edge of the project area;
- Most of the project area is listed as drought vulnerable soils;
- Most of the project area is listed under wind erodibility group 5 or 6, indicating moderate resistance to wind erosion (1 is most susceptible and 8 is least susceptible);
- Desmet loam and Grantsdale loam are classified as prime farmland if irrigated; and,
- Grassvalley silty clay loam and Moiese gravelly loam is classified as farmland of local importance.

The United State Geological Survey (USGS) *Geologic Map of the Montana Part of the Missoula West 30x60-minute Quadrangle* (Lewis, R.S., 1998) indicates that the project is primarily located on Quaternary (Q) glacial lake deposit (Qgl), alluvium of modern channels and floodplains (Qal), alluvium of alluvial terrace deposit (Qat), and Triassic Gravel and clay (Tgc). Grant Creek splits the Qgl to the west and Qat to the east, with Qal wrapping around the southern portion of the project area.

Preferred Alternative – Potentially beneficial impacts to soil quality, stability, and moisture. Construction to be conducted within the project area will provide minor improvements to soil quality, stability, and moisture through replacement of potentially compactible soil, providing moisture to backfilled soil prior to compaction, and improving stability along the project extent.

Restoration of the creek may improve soil conditions and quality through vegetative repair. Impacts to the ground surface by construction equipment will be restored to preexisting conditions when construction is completed. Reduced flood potential may improve soil stability and further degradation through erosion.

According to the proponent, once the creek realignment is completed, portions of the existing Grant Creek channel will be filled. Earthwork is anticipated to include stripping, clearing, and grubbing around the creek realignment and floodplain swale. The total disturbance area is currently unknown but will exceed one acre. The disturbance area will be minimized to the extent possible to construct the project. Due to the anticipated area of disturbance exceeding one acre, the contractor will be required to obtain permit coverage under the Montana Pollutant Discharge Elimination System (MPDES) through the Montana Department of Environmental Quality (DEQ). Compliance with the MPDES requires the contractor to develop, implement, and maintain a Storm Water Pollution Prevention Plan (SWPPP), which will include detailed information on best management practices (BMPs) that will be employed during construction to avoid and minimize any adverse effects related to potential erosion and sedimentation. The MDT stormwater outfall will also be improved to eliminate another ongoing source of sediment. The proposed riparian corridor will also provide a vegetated buffer that will provide water quality enhancement by allowing for infiltration of future stormwater from adjacent development as it occurs.

No Action Alternative – No impacts to soil quality, stability, and moisture. Current conditions will be maintained.

---

5. WATER QUALITY, QUANTITY AND DISTRIBUTION:
Identify important surface or groundwater resources. Consider the potential for violation of ambient water quality standards, drinking water maximum contaminant levels, or degradation of water quality. Identify direct, indirect, and cumulative effects to water resources.

The project area includes approximately 1.5 miles of Grant Creek between West Broadway Street to Hiawatha Road. Grant Creek is a tributary to the Clark Fork River. It should be noted that the USGS National Hydrography Dataset incorrectly identifies the location of Grant Creek. Grant Creek has been significantly altered and channelized downstream of I-90. The creek has been impacted by channelization, construction of I-90, past gravel mining activities, flow diversion for irrigation, and other land use and development activities. Most notable within the project area, Grant Creek has been historically realigned around the "horseshoe bend," and has deeply incised eroding and unstable banks.

Grant Creek is an impaired waterbody due to multiple factors including total nitrogen, nitrate/nitrite, sediment, temperature, alteration in streamside or littoral vegetative covers, and flow regime modification (DEQ 2023b).

Channel incision and the subsequent erosion of Grant Creek above Mullan Road are contributing significant amounts of sediment to downstream reaches of the creek, which is reducing the hydraulic conveyance of the creek, degrading the creek ecosystem, and contributing to its impairment due to sediment and total nitrogen. An additional problem relates to a Montana

Department of Transportation (MDT) storm water outfall that drains portions of I-90, Airway Boulevard, Expressway Drive and West Broadway into Grant Creek, where a significant erosion problem exists at the outfall.

Approximately 5,200 lineal feet of Grant Creek will be restored and realigned. A 1,645-foot flood control swale with a berm will be established. In addition, a 150-foot riparian area and setback from the Grant Creek channel will be established, which will be able to convey the 2-year storm with sinuosity and stable channel design, and the swale installed will be able to capture the overtopping flow flows of the 100-year event.

Grant Creek is a perennial surface water body that flows through the project area. The Clark Fork River flows along the southern boundary of the project area. There are various ephemeral water bodies that may fill drainages throughout the project area. Freshwater ponds exist at the southeastern corner of the project area. These ponds are generally excavated and related to anthropogenic surface mining of aggregate.

Shallow groundwater aquifers exist in the project area with static water levels of less than 5 feet below ground surface (bgs) according to the MBMG GWIC, and groundwater is generally shallower at the southern extent of the project area, and near Grant Creek. Surface topography, although relatively flat, generally slopes to the south and southwest in this area. The groundwater flow direction is presumed to follow surface topography.

The NRCS Web Soil Survey indicates that the depth to the water table is listed as >200 cm (roughly 6 ½ feet) bgs for most of the project area, except for the southern edge of the project area (101 cm; roughly 3.3 feet bgs) and some areas in the central portion of the project area near Grant Creek (77 cm; roughly 2 ½ feet bgs).

The project is designed to realign Grant Creek to improve and enhance floodplain function and to prevent issues associated with flooding.

Preferred Alternative – Direct and indirect, recurring, long-term, local, and regional beneficial impacts to water quality, quantity, and distribution. Project will be protective of surface water and groundwater by realigning Grant Creek. Realignment of the creek aims to reduce flood occurrences which can mobilize contaminants on the surface.

Any necessary stormwater discharge for the project will be covered under an MPDES Construction General Permit (CGP) and a Stormwater Pollution Prevention Plan (SWPPP). BMPs should be installed and monitored per the MPDES CGP and SWPPP, and other required permits. If dewatering is necessary, dewatering permits will need to be obtained by the contractor from DEQ. Routine inspections and maintenance of BMPs will be required.

The proponent indicated the proposed project will have negligible effect on groundwater quantity, quality, distribution, or depth to groundwater. Excavation depths vary across the project depending on existing topography, but impact on the aquifer is not anticipated. Groundwater is likely to be encountered during construction and dewatering will occur in accordance with the DEQ General Permit regulations. Grant Creek likely influences local groundwater conditions currently, and the

relocation and realignment of the creek in a location approximately 1,000 feet to the southeast will have negligible effect on groundwater resources. BMPs will be installed to abate pollution by sediment transport, and most construction around the creek will occur late in the year when the Creek is generally dry.

No Action Alternative – Potentially direct, adverse, minor to major, short- and long-term, local impacts to water quality, quantity, and distribution. Continued degradation by erosion may lead to continued sediment transport and buildup of sediment in the waterways around the project area that are currently listed as impaired.

---

6. AIR QUALITY:

What pollutants or particulate would be produced (i.e. particulate matter from road use or harvesting, slash pile burning, prescribed burning, etc.)? Identify the Airshed and Impact Zone (if any) according to the Montana/Idaho Airshed Group. Identify direct, indirect, and cumulative effects to air quality.

The proposed project is in an air quality Attainment Area classified as CO (maintenance, 1971 standard) and PM10 (maintenance, 1987 standard), as set by the U.S. Environmental Protection Agency's National Ambient Air Quality Standards. The project area, however, does not fall under any other attainment area classifications. The project area is listed as impaired in air quality particulates under the PM10 classification per the Montana DEQ Air Quality Nonattainment Status List (Montana DEQ Air Quality Website visit). Two air pollution facilities exist within approximately 1/2-mile of the project area (Hexion Inc., 3670 Grant Creek Road, northeast of the project area; and Pacific Recycling, 2828 Palmer, east of the project area).

The project area is also adjacent to the Missoula International Airport and likely receives emissions from airplane traffic during operations.

Preferred Alternative – Potentially direct, adverse, minor, short-term, local impacts to air quality as there may be some dust introduced to the environment from construction activity and/or exhaust fumes from operation of heavy construction equipment. The contractor will need to provide dust control measures and should limit construction working hours to approximately 7 AM to 7 PM.

No Action Alternative – No impacts to air quality.

---

7. VEGETATION COVER, QUANTITY AND QUALITY:

What changes would the action cause to vegetative communities? Consider rare plants or cover types that would be affected. Identify direct, indirect, and cumulative effects to vegetation.

The project area is primarily adjacent to developed, residential, commercial, and industrial areas, as well as agricultural fields. Construction is indicated to be around these areas. Terrestrial, avian, and aquatic life and habitats are consistent with those expected to be in developed properties and agricultural properties near or within a city. Records from the Montana Natural Heritage Program (MTNHP) indicate the project area is surrounded by mostly private land, primarily within Human Land Use (58%), Grassland Systems (22%), and Wetland and Riparian Systems (13%); see MTNHP Environmental Summary report (MTNHP report) at the end of this document to view other land

cover types, or the MTNHP website. There are five potential plant Species of Concern listed that may occur within the project area (MTNHP report), including:

Species Occurrences

Woolly Clover	*Trifolium microcephalum*
Pointed Broom Sedge	*Carex scoparia*
Spiny-spore Quillwort	*Isoetes echinospora*
Stalk-leaved Monkeyflower	*Mimulus ampliatus*
Missoula Phlox	*Phlox missoulensis*

In addition, there is one other observed species and 23 potential species, including:

Other Observations

Alkali-marsh Ragwort	*Senecio hydrophilus*

Potential Species

Pale-yellow Jewel-weed	*Impatiens aurella*
Panic Grass	*Dichanthelium acuminatum*
Columbia Water-meal	*Wolffia columbiana*
Beaked Spikerush	*Eleocharis rostellata*
Small Yellow Lady's-slipper	*Cypripedium parviflorum*
Flatleaf Bladderwort	*Utricularia intermedia*
Dwarf woolly-heads	*Psilocarphus brevissimus*
Coville's Rush	*Juncus covillei*
Crawe's Sedge	*Carex crawei*
Linearleaf Moonwort	*Botrychium lineare*
Yellow Beardtongue	*Penstemon flavescens*
Chaffweed	*Centunculus minimus*
Long-sheath Waterweed	*Elodea bifoliata*
Fleshy Stitchwort	*Stellaria crassifolia*
Dense-leaf Draba	*Draba densifolia*
Idaho Lovage	*Ligusticum verticillatum*
High Northern Buttercup	*Ranunculus hyperboreus*
Floriferous Monkeyflower	*Mimulus floribundus*
Tufted Club-rush	*Trichophorum cespitosum*
Western Moonwort	*Botrychium hesperium*
Roundleaf Sundew	*Drosera rotundifolia*
Rydberg's Parsley	*Musineon vaginatum*
Letterman's Needlegrass	*Stipa lettermanii*

The project area is located in land classified as freshwater emergent wetlands by the National Wetlands Inventory, and riverine land exists within the project area. Vegetation along the project area is mostly grasses, sedges, and brush, with some trees in the project area.

Preferred Alternative – Potentially direct, minor to moderate, short- to long-term, local, and regional beneficial impacts to vegetation cover, quantity, and quality. Construction that will affect existing vegetation will be required to be revegetated after construction is complete. Vegetation availability and wildlife habitat is anticipated to improve under the Preferred Alternative. The project will construct a 200-foot-wide floodplain and abutting 100-foot-wide riparian buffers on either side of the realigned creek channel that will be planted with native riparian species. This 400-foot-wide buffer will provide a new habitat for a multitude of wildlife.

Aquatic habitat is anticipated to improve as well under the Preferred Alternative. The project will create a more sinuous and natural stream channel that will provide more stable banks, channel complexity, and functioning floodplain. The stream channel will be vegetated with riparian species, which will improve upon current conditions by allowing for woody debris recruitment and shading.

Efforts should be made to preserve existing vegetation during construction where applicable. BMPs should be installed and monitored per the MPDES CGP and SWPPP, and other required permits.

No Action Alternative – Continued flooding may adversely impact vegetation cover, quantity, and quality.

---

8. TERRESTRIAL, AVIAN AND AQUATIC LIFE AND HABITATS:
Consider substantial habitat values and use of the area by wildlife, birds or fish. Identify direct, indirect, and cumulative effects to fish and wildlife.

Project location is not identified as a priority area for terrestrial conservations efforts within the Montana State Wildlife Action Plan (SWAP). The project does not exist within boundaries for Montana Sage Grouse habitat (see attached map; Montana Sage Grouse Habitat Conservation Plan web mapping tool). According to the FWS, critical habitat for threatened Bull Trout exists within or near the project area. The critical habitats are Grant Creek and Clark Fork River.

Records from the MTNHP indicate the project area there are 23 species of concern in and around the project region including the following:

Species Occurrences

Pileated Woodpecker	*Dryocopus pileatus*
Bobolink	*Dolichonyx oryzivorus*
Clark's Nutcracker	*Nucifraga columbiana*
American Bittern	*Botaurus lentiginosus*
Cassin's Finch	*Haemorhous cassinii*
Brewer's Sparrow	*Spizella breweri*

Varied Thrush	*Ixoreus naevius*
Brown Creeper	*Certhia americana*
Pacific Wren	*Troglodytes pacificus*
Westslope Cutthroat Trout	*Oncorhynchus clarkii lewisi*
Bull Trout	*Salvelinus confluentus*
Monarch	*Danaus plexippus*
Suckley Cuckoo Bumble Bee	*Bombus suckleyi*
A Subterranean Amphipod	*Stygobromus tritus*
Long-legged Myotis	*Myotis volans*
Little Brown Myotis	*Myotis lucifugus*
Hoary Bat	*Lasiurus cinereus*
Long-eared Myotis	*Myotis evotis*
Fringed Myotis	*Myotis thysanodes*
Townsend's Big-eared Bat	*Corynorhinus townsendii*
Grizzly Bear	*Ursus arctos*
Fisher	*Pekania pennanti*
Western Skink	*Plestiodon skiltonianus*

MTNHP records (see attached MTNHP report) indicate 28 other observed species and 18 potential species that may exist in the area including the following:

Other Observations

Hooded Merganser	*Lophodytes cucullatus*
Barrow's Goldeneye	*Bucephala islandica*
Rufous Hummingbird	*Selasphorus rufus*
Western Screech-Owl	*Megascops kennicottii*
American White Pelican	*Pelecanus erythrorhynchos*
Trumpeter Swan	*Cygnus buccinator*
Long-billed Curlew	*Numenius americanus*
Horned Grebe	*Podiceps auritus*
Black Tern	*Chlidonias niger*
Ovenbird	*Seiurus aurocapilla*
Black-necked Stilt	*Himantopus mexicanus*
Harlequin Duck	*Histrionicus histrionicus*
Short-eared Owl	*Asio flammeus*
Forster's Tern	*Sterna forsteri*
Great Gray Owl	*Strix nebulosa*
American Goshawk	*Accipiter atricapillus*
Golden Eagle	*Aquila chrysaetos*

Flammulated Owl	*Psiloscops flammeolus*
Boreal Owl	*Aegolius funereus*
Northern Hawk Owl	*Surnia ulula*
Black-and-white Warbler	*Mniotilta varia*
Common Loon	*Gavia immer*
Ferruginous Hawk	*Buteo regalis*
White-faced Ibis	*Plegadis chihi*
Burrowing Owl	*Athene cunicularia*
Lake Trout	*Salvelinus namaycush*
A spur-throat grasshopper	*Melanoplus missoulae*
Silver-haired Bat	*Lasionycteris noctivagans*

Potential Species

Yellow-billed Cuckoo	*Coccyzus americanus*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Black-crowned Night-Heron	*Nycticorax nycticorax*
Common Poorwill	*Phalaenoptilus nuttallii*
Red Knot	*Calidris canutus*
Meesia Moss	*Meesia triquetra*
A Caddisfly	*Leucotrichia notosa*
Lyrate Mountainsnail	*Oreohelix haydeni*
Western Pearlshell	*Margaritifera falcata*
A Caddisfly	*Rhyacophila betteni*
Western Spotted Skunk	*Spilogale gracilis*
North American Porcupine	*Erethizon dorsatum*
Western Pygmy Shrew	*Sorex eximius*
Yuma Myotis	*Myotis yumanensis*
Canada Lynx	*Lynx canadensis*
Wolverine	*Gulo gulo*
Snapping Turtle	*Chelydra serpentina*
Northern Alligator Lizard	*Elgaria coerulea*

Additionally, bat roosts, both cave and non-cave may occur in and around the project area.

Preferred Alternative – Potentially direct, adverse, negligible to moderate, short-term, local, non-recurring impacts to terrestrial, avian, and aquatic life and habitats during construction. The project area is largely comprised of a developed residential and commercial area. The primary disturbance will likely occur on private property; however, disturbance will be minimal, and contractor will be required to restore any disturbance to preexisting conditions.

No Action Alternative – Continued flooding in the area may cause recurring, minor to moderate, short- to long-term, local to regional adverse impacts to terrestrial, avian, and aquatic life and habitats. Flooding may continue to degrade and destabilize riverine and riparian habitats or allow sediment to enter the waterway.

---

9. UNIQUE, ENDANGERED, FRAGILE OR LIMITED ENVIRONMENTAL RESOURCES: *Consider any federally listed threatened or endangered species or habitat identified in the project area. Determine effects to wetlands. Consider Sensitive Species or Species of special concern. Identify direct, indirect, and cumulative effects to these species and their habitat.*

The National Wetlands Inventory (NWI) website was used to determine whether any wetlands were present within the lands adjacent to the project location (map included at the end of this EA). This search indicated several types of wetlands are inside and adjacent to the project area, including riverine habitat, freshwater emergent wetlands, freshwater ponds, lake habitat, freshwater forested/shrub wetlands, herbaceous riparian habitat, and forested/shrub riparian habitat. Most of this habitat exists at the southern end of the project area around the Clark Fork River and around Grant Creek.

According to records from the MTNHP there are no unique, endangered, fragile, or limited environmental resources within the project area. According to the FWS, critical habitat exists within the project area, particularly Grant Creek and the Clark Fork River. The critical habitat is listed for Bull Trout, which is a threatened species. The project proponent and their consultant are aware of this critical habitat. The project does not have any identified unique natural features.

As mentioned in the previous section, there are 69 species of concern listed as present or potentially present using the project area as viable habitat. DNRC also used the U.S. Fish and Wildlife Service IPaC tool to generate a resource list summarizing any endangered or threatened species that are known or expected to be near the project area. The IPaC list generated six (6) Federally-listed threatened species under the Endangered Species Act as potentially occurring in the greater project area, including: Canada Lynx (*Lynx canadensis*), Grizzly Bear (*Ursus arctos horribilis*), North American Wolverine (*Gulo gulo luscus*), Rufa Red Knot (*Calidris canutus rufa*), Yellow-billed Cuckoo (*Coccyzus americanus*), Bull Trout (*Salvelinus confluentus*), and one candidate species, Monarch Butterfly (*Danaus plexippus*); and fifteen (15) migratory bird species: Bald Eagle (*Haliaeetus leucocephalus*), Black Swift (*Cypseloides niger*), Bobolink (*Dolichonyx oryzivorus*), California Gull (*Laurus californicus*), Calliope Hummingbird (*Selasphorus calliope*), Evening Grosbeak (*Coccothraustes vespertinus*), Franklin's Gull (*Leucophaeus pipixcan*), Golden Eagle (*Aquila chrysaetos*), Lesser Yellowlegs (*Tringa flavipes*), Lewis's Woodpecker (*Melanerpes lewis*), Long-eared Owl (*asio otus*), Olive-sided Flycatcher (*Contopus cooperi*), Rufous Hummingbird (*selasphorus rufus*), Western Grebe (a*echmorphorus occidentalis*), and Williamson's Sapsucker (*Sphyrapicus thyroideus nataliae*) (USFWS IPaC Mapping tool, report attached). The ten bird species are protected under the Bald and Golden Eagle Protection Act of 1940, Migratory Bird Treaty Act of 1918, and the Bald Eagle is also protected under the Montana Bald Eagle Management Plan, and Lacey Act of 1900. Bald and Golden Eagles are listed as likely present within the project area.

Preferred Alternative – Potentially direct, adverse, minor to moderate, short-term, local impacts to

unique, endangered, fragile, or limited environmental resources. The Preferred Alternative will require instream work within Grant Creek, which has potential to adversely affect Bull Trout due to minor, short-term effects to water quality resulting from construction. It is anticipated that instream work will occur during a work window as specified by the USFWS and/or FWP when Bull Trout are not likely to be present. It is anticipated that the aquatic habitat improvements resulting from the project will have a long-term direct beneficial impact on bull trout by providing more quality habitat throughout the project reach, as well as by reducing erosion potential and sediment loads within Grant Creek. Disturbance of wetland habitat is expected. Construction that will affect existing vegetation will be required to be revegetated after construction is complete, and the project plan has identified habitat restoration as a major goal as part of its completion.

The project proponent's consultant has indicated that a biological assessment (BA) and consultation with the US FWS will occur during the project. The BA will include mitigation measures to avoid and minimize impacts to unique, endangered, fragile, or limited environmental resources. Observations for nests should be made and if nests are observed, FWP should be consulted to determine whether the nests are active or not. If active, guidance from FWP should be adhered to by the contractor. Breeding season for many of these species generally occurs between March and September, although the breeding season for Bald Eagles typically begins earlier in January. The project proponent's consultant has indicated that work along Grant Creek will primarily occur during winter months when the stream is at its lowest and/or dry. Efforts should be made to preserve existing vegetation where applicable. BMPs should be installed and monitored per the MPDES CGP and SWPPP, and any other required permits.

No Action Alternative – Continued flooding may present short- to long-term, recurring, minor to moderate, local to regional, adverse impacts to unique, endangered, fragile, or limited environmental resources.

---

10. HISTORICAL AND ARCHAEOLOGICAL SITES:

Identify and determine direct, indirect, and cumulative effects to historical, archaeological or paleontological resources.

No cultural or historical sites are expected to be within the construction extent for the project. The project proponent has implemented a cultural survey. The results of the survey are discussed below:

The project area was surveyed for cultural resources during the preliminary design phase of the federal Mullan BUILD project. The Class III cultural resources inventory was completed by Rabbitbrush Archaeological Services, LLC and the report was completed in June 2020 (Rabbitbrush 2020). The report can be downloaded at the following link:
https://www.mullanbuild.com/_files/ugd/570f64_3ff2c26995364314ba749632e78fdb40.pdf
There is one historic irrigation ditch, the Field Dougherty ditch, within the project area. The Field Dougherty ditch (24MO902) was first recorded in 2003 and updated in 2005 as part of the Grant Creek Corridor Environmental Restoration and Flood Control Project. As a result of post 1960s realignments and the Grant Creek restoration project, the ditch is essentially the path of Grant Creek and no longer serves as an irrigation resource but rather as the creek itself. The resource is

considered to be not eligible for inclusion in the National Register of Historic Places (NRHP). The State Historic Preservation Office (SHPO) previously determined Site 24MO0902 as not eligible for inclusion on the NRHP on June 20, 2006.

In addition, there are two lateral segments of another historic ditch, the Flynn-Lowney ditch (24MO0550), that cross the project area. The main ditch is located outside of the project area and was recommended eligible for the NRHP in the June 2020 report. The primary laterals, however, have been reconfigured and their integrity has been compromised and thus were recommended as non-contributing to the site's recommended eligibility.

The Dougherty Ranch (24MO1781) is located approximately one half-mile to the southeast of the project area.

As mitigation to avoid impacting any undiscovered cultural resources, should evidence of historic or pre-historic sites be discovered during construction, the contractor would be required to immediately stop work in the area until the significance of the site is determined, and appropriate measures implemented.

Preferred Alternative and No Action Alternative – No cultural or historical resource impacts are anticipated by the preferred alternative. However, if previously unknown cultural or paleontological materials are identified during project related activities, all work will cease until a professional assessment of such resources can be made.

---

11. AESTHETICS:

Determine if the project is located on a prominent topographic feature, or may be visible from populated or scenic areas. What level of noise, light or visual change would be produced? Identify direct, indirect, and cumulative effects to aesthetics.

The project will be visible to local property owners. Temporary impacts to aesthetics from construction equipment will occur, including noise and visual appearance. Visual quality and aesthetics may be improved from planned activities for the project. Some noise will occur during the construction phase of the project. The project area currently experiences noise from traffic on West Broadway Street as well as airplane traffic from the adjacent Missoula International Airport.

Preferred Alternative – Potentially direct and indirect, negligible to minor, short-term, local, non-recurring impacts to aesthetics during construction. Indirect, adverse nuisance impacts from heavy construction equipment will be temporary during the project and may include noise and exhaust fumes. Noise mitigation techniques to minimize impacts to the surrounding areas will be used by the contractor whenever possible. Construction working hours should be limited to 7 AM to 7 PM, or as governed by local rules and regulations. Implementation of the Preferred Alternative will result in a beneficial impact on the visual quality of the project area and surrounding environment. The proposed design includes constructing a new floodplain and riparian corridor, in an area where there were none before, which will enhance the visual quality of the project vicinity. The Preferred Alternative is a planned component of the Sxwtpqyen Area Master Plan and will provide a cumulative beneficial impact on the surrounding environment once the master plan area has been

built out.

No Action Alternative – Continued flooding and degradation may lead to short- to long-term, local, recurring, negligible to major adverse impacts to aesthetics.

---

12. DEMANDS ON ENVIRONMENTAL RESOURCES OF LAND, WATER, AIR OR ENERGY:
Determine the amount of limited resources the project would require. Identify other activities nearby that the project would affect. Identify direct, indirect, and cumulative effects to environmental resources.

The current project site is vacant and does not require energy resources. There are no current solid waste management facilities or requirements. There are no wastewater treatment facilities. There are no existing stormwater facilities, although the completion of the project will improve stormwater conveyance. There is no community water supply in the project area.

Preferred Alternative and No Action Alternative – No impacts to demands on environmental resources of land, water, air, or energy. The project is not anticipated to have impacts on energy consumption or conservation exceeding current demands.

---

13. OTHER ENVIRONMENTAL DOCUMENTS PERTINENT TO THE AREA:
List other studies, plans or projects on this tract. Determine cumulative impacts likely to occur as a result of current private, state or federal actions in the analysis area, and from future proposed state actions in the analysis area that are under MEPA review (scoped) or permitting review by any state agency.

The proponent has provided the *Design Report Grant Creek Environmental Restoration / Flood Control* (HDR and Maxim, 2005), *Grant Creek Hydrology and Hydraulics, Mullan Build* Report (HDR, 2020), *Sxwtpquen Area Transportation Special Impact Fee Study* (TischlerBise, 2021), *Cultural Resource Inventory for the Proposed Mullan BUILD Project, Missoula County, Montana* (Rabbitbrush Archaeological Services, LLC, 2020), and an environmental checklist. There were no other environmental documents provided that were pertinent to the area.

IV. IMPACTS ON THE HUMAN POPULATION

- *RESOURCES potentially impacted are listed on the form, followed by common issues that would be considered.*
- *Explain POTENTIAL IMPACTS AND MITIGATIONS following each resource heading.*
- *Enter "NONE" If no impacts are identified or the resource is not present.*

---

14. HUMAN HEALTH AND SAFETY:
Identify any health and safety risks posed by the project.

The project area is within and adjacent to developed residential, commercial, and industrial areas

and contains power lines and other potentially hazardous utilities. There are no known regulated underground storage tanks, sources of hazardous waste, potential source of toxic release, superfund, or brownfields sites in or near to the project area.

Preferred Alternative – Potentially direct and indirect, adverse, minor, short-term, non-recurring local impacts to human health and safety. Heavy equipment would be used during construction of the system. Operation of heavy equipment poses a potential threat to public safety. There should be no impact during construction, but the typical risk to the public's safety may be increased during construction. BMPs should be installed to protect the public from the working construction extents and to mitigate dust exposure, particularly around areas where there are higher-risk or sensitive residents. Spill prevention kits should be available during construction and spill prevention and response plans should be prepared and followed accordingly.

Assessments of LBP and/or ACM containing material have not been conducted, and it is unknown whether the construction will involve activities related to these conditions. In general, the project area is not likely to have infrastructure that would contain lead or asbestos. If an assessment is completed and it is determined these conditions are present in the project area, appropriate safety measures must be enacted during any phase of the construction pertaining to abatement of LBP and/or ACM to protect the health and safety of workers and nearby residents.

Once completed, the project will provide direct, beneficial impacts to human health and safety by reducing the threat of repeated flooding.

No Action Alternative – Potentially direct, adverse, minor to major, short- to long-term, local, recurring impacts may occur to human health and safety due to failure of the water and sewer system.

---

15. INDUSTRIAL, COMMERCIAL AND AGRICULTURE ACTIVITIES AND PRODUCTION:
Identify how the project would add to or alter these activities.

Agricultural facilities exist within the project area. Agricultural and hay (primarily alfalfa) production in the project area has waned over the years as urbanization has steadily replaced agricultural lands in the vicinity of the project. There are no conservation easements protecting farmland in the project area. The project area is within the greater Mullan Area Neighborhoods Master Plan area, later renamed the Sxwtpqyen Area, which has recently completed a regional master plan outlining the development of the project area vicinity. Industrial and commercial facilities occur near to, but outside of the project area and are not generally affected by this project.

Preferred Alternative – Potentially beneficial impacts to the area through mitigated flood risk and improvements to the land which may spur future development. The proposed project also has indirect effects on farmland because it is a component of the overall master plan for the area to be developed with a mix of land uses. Completion of the Grant Creek realignment will remove a portion of land from the floodplain, thus allowing the area to be developed as envisioned under the adopted Sxwtpqyen Area Master Plan.

This Sxwtpqyen Area Master Plan acknowledges the historical significance of this agricultural area, as well as the loss of potential agricultural production, and recommends mitigation by setting aside certain areas for future agricultural uses. Within the plan is a vision of incorporating a portion of agricultural land that will complement and enhance the neighborhoods within the master planning area. Within this area are two areas specifically allocated for farms, along with a provision for community gardens spread throughout the different neighborhoods. In total, nearly 230 acres will be potential areas of agricultural production, and/or community garden space.

No Action Alternative – No impacts to industrial, commercial, and agriculture activities and production.

---

16. QUANTITY AND DISTRIBUTION OF EMPLOYMENT:

Estimate the number of jobs the project would create, move or eliminate. Identify direct, indirect, and cumulative effects to the employment market.

The immediate project area is vacant land with no businesses or residences present. Adjacent developments outside of the immediate project area include the airport and other industrial and commercial land uses. There is no current employment within the project area.

The project service area is within a residential and commercial area in the City. According to the EJSCREEN ACS Summary Report (NEPAssist, 2024), the household income within 1/2-mile of the project area primarily over $75,000 and 75% of the employed population age 16+ years is currently employed in the labor force. According to the US Census Bureau, the median household income of the City is $68,3056 +/- $5,299, and median earnings for full-time, year-round workers with earnings was $49,599 +/-$3,223. In 2022, 90% of households in the county lived at or above the poverty level, and 10% lived below the poverty level. Eighty percent of household income was partially or entirely based off earnings and 20% percent had income collected from supplemental sources, including from social security income (29.6%), food stamp/SNAP benefits (6.6%), and supplemental security income (3%).

Preferred Alternative – Potentially direct and indirect, beneficial, non-recurring impacts to quantity or distribution of employment. The construction of the project may temporarily bring local job opportunities that were not previously present. Realignment of the stream and developed habitat may provide future employment opportunities for parks and recreation. The proposed project will not result in the displacement or relocation of any residences or businesses. As noted above, the proposed project is anticipated to have a beneficial indirect effect on both businesses and population/housing as the vicinity develops in accordance with the Sxwtpqyen Master Plan.

No Action Alternative – No impacts to quantity and distribution of employment.

---

17. LOCAL AND STATE TAX BASE AND TAX REVENUES:

Estimate tax revenue the project would create or eliminate. Identify direct, indirect, and cumulative effects to taxes and revenue.

The current project site consists of several privately-owned, unimproved parcels that are categorized as agricultural land in the tax assessment database. These properties likely contribute a minimal amount of revenue to the local tax base due to their relatively low assessed value. Future opportunities for development may substantially increase the local tax base.

According to Montana Cadastral records, estimated property values for agricultural land range from ~$16,000 to $170,000, commercial land from ~$1,000,000 to $15,000,000, and residential from ~$200,000 to $750,000. According to the Montana Organization of Realtors, the median property assessment for tax purposes in the County was $539,500 and for the City was $533,725 for assessed homes in the area. The average monthly water and sewer rates were not listed by the applicant.

Preferred Alternative – The Preferred Alternative may indirectly result in beneficial economic impacts on the local tax base by allowing an area currently undevelopable within a floodplain to be removed from the floodplain to allow for planned development. Cumulatively, the project is a part of the larger Sxwtpqyen Master Plan, which will result in substantial new positive economic impacts through land subdivision and construction of new commercial, industrial, and residential areas.

No Action Alternative – Continued flooding may lead to direct and indirect, local, recurring, short- and long-term adverse impacts. Flooding may damage properties or destroy land able to be developed, which could lead to reductions in future tax base.

---

18. DEMAND FOR GOVERNMENT SERVICES:

Estimate increases in traffic and changes to traffic patterns. What changes would be needed to fire protection, police, schools, etc.? Identify direct, indirect, and cumulative effects of this and other projects on government services

The current project area is mostly vacant and there are no community or government services or facilities available. The project area vicinity is currently serviced by the Missoula Fire Department. Station #4 is specifically the station that services the project area vicinity.

Work is to be completed in or near the project area and there may be changes necessary to traffic patterns, fire protection, police, schools, or other government services. An increase in activity in the project area due to the improvements provided by this project may have the potential to increase demand for public services.

Preferred Alternative – Potential indirect, adverse, negligible to minor, short-term, local, non-recurring impacts to demand for government services. Construction work may require road closures or traffic control at times which could hinder the ability of government services, such as police, fire, health, or other services. The Preferred Alternative will have a direct positive effect on the availability of parks and open space due to the creation of a new Grant Creek riparian corridor. The new riparian corridor would be usable as open space as well as accessible via the proposed Grant Creek Trail that will parallel the realigned creek.

Because the project is a part of the larger master planning area, the project may indirectly and cumulatively affect community and government services and facilities by indirectly putting more pressure on these facilities as the population of the planning area grows. These potential effects are anticipated to be negligible and have no adverse long-term effect on community or government services. The proposed project will have no effect on fire protection. Future development in the greater project area will continue to be serviced by the City fire department. The Preferred Alternative will have no impact on the existing or planned transportation network. The future extension of George Elmer Drive will cross the realigned Grant Creek. Additional new roads are planned to eventually be built within the project area and vicinity.

No Action Alternative – Continued flooding may present minor to moderate, short- to long-term, local, recurring adverse impacts from flood damages. Should flood damage affect culverts, bridges, or roads, traffic patterns and response times for government services may be affected directly and indirectly.

---

19. LOCALLY ADOPTED ENVIRONMENTAL PLANS AND GOALS:

List State, County, Town, USFS, BLM, Tribal, and other zoning or management plans, and identify how they would affect this project.

The existing channel of Grant Creek has been identified as deficient and failing environmental expectations. Habitat loss and sedimentation could threaten plant and animal species in the area that use the existing channel corridor as habitat or for migratory purposes. The project aims to restore the corridor. As part of the Sxwtpqyen Area Master Plan, property around the project area is expected to be developed further for residential and commercial use.

The City of Missoula is obtaining an easement from the landowner to construct the Grant Creek realignment. The proposed project will have no impact on private property rights.

Preferred Alternative – Direct, long-term, local, and regional, moderate to major beneficial impacts to locally adopted environmental plans and goals. The Preferred Alternative is included in the Sxwtpqyen Area Master Plan and is therefore consistent with existing planning documents and local growth policy. The Preferred Alternative is an integral and necessary component of the overall Sxwtpqyen Master Plan and will provide for environmental restoration of Grant Creek while simultaneously removing land out of the floodplain and allowing for new development to occur in accordance with locally adopted land use plans and growth policy.

No Action Alternative – Potential for adverse, minor to major, short- to long-term, local, recurring impacts to locally adopted environmental plans and goals. Failure of the existing creek corridor through continued flooding may result in degradation of groundwater resources, potentially affect human health and safety, and the potential to harm aquatic life.

20. ACCESS TO AND QUALITY OF RECREATIONAL AND WILDERNESS ACTIVITIES:
Identify any wilderness or recreational areas nearby or access routes through this tract. Determine the effects of the project on recreational potential within the tract. Identify direct, indirect, and cumulative effects to recreational and wilderness activities.

The project is not located in or on a designated recreational, Wild & Scenic River, or Wilderness Area. The project will create a new trail and park space when completed. There are no existing recreational areas, wilderness, public lands, or open space located within the project area.

Preferred Alternative – Direct, long-term, moderate to major beneficial impacts to access to and quality of recreational and wilderness activities. The preferred alternatives will create access to public lands, waterways, and public open spaces by constructing a shared-use path adjacent to the realigned Grant Creek, which will create a new city-owned recreational amenity for area residents. This will improve access to and quality of recreational opportunities and public land in the west end of Missoula.

No Action Alternative – Direct and indirect, long-term, minor to major adverse impacts to access to and quality of recreational and wilderness activities. If the project is not completed, the space for recreational and wilderness activities will not be constructed.

21. DENSITY AND DISTRIBUTION OF POPULATION AND HOUSING:
Estimate population changes and additional housing the project would require. Identify direct, indirect, and cumulative effects to population and housing.

The proposed project site is currently vacant. Surrounding properties include some rural residential uses and generally low population densities. There is currently substantial development of new residential units occurring near the immediate project area.

Preferred Alternative – The Preferred Alternative may have direct, long-term, negligible to moderate adverse impacts on density and distribution of population and housing. Constructed park space and trail systems may attract visitors to the local area and the area to be developed following the remapping of the floodplain may include more residences and may attract new businesses and foster economic development. If development occurs, open land will be lost, and population and housing density and distribution will increase. However, the land to be developed will not affect the realignment of Grant Creek or the restoration of the riparian system.

The Preferred Alternative may have indirect effects on population by removing an area from the floodplain to allow for it to be developed, some of which may include residential development. The potential indirect impacts are beneficial for the urban area, which, per growth policy, is attempting to consolidate growth to keep development near existing infrastructure and reduce the potential for sprawl.

The quality and quantity of housing conditions will not be directly affected by the proposed project. In conjunction with the planned growth occurring in accordance with the Sxwtpqyen Master Plan,

the Preferred Alternative may have cumulative beneficial impacts on the quantity and affordability of general housing conditions.

No Action Alternative – No direct or indirect impacts to density and distribution of population and housing. The existing open land will likely remain open land and no changes to existing conditions will occur.

---

22. SOCIAL STRUCTURES AND MORES:

Identify potential disruption of native or traditional lifestyles or communities.

Social conduct, structures, and behaviors follow conventions that are typical of the City. The project is not anticipated to affect native or traditional lifestyles or communities.

Preferred Action and No Action Alternative – No direct or indirect impacts to social structures and mores.

---

23. CULTURAL UNIQUENESS AND DIVERSITY:

How would the action affect any unique quality of the area?

The project site is currently undeveloped, vacant agricultural land. There are no cultural facitilites in the project area. As previously noted, the project area is a part of the larger Sxwtpqyen master planning area. Because of the cultural uniqueness of the project vicinity and historical use of the area by the Native Americans, the planning area, which was formerly called the Mullan Neighborhoods Master Plan, was renamed the Sxwtpqyen (S-wh-tip-KAYN).

Preferred Alternative and No Action Alternative – The Preferred Alternative and No Action Alternative will have no adverse effect on any cultural/historic resources that are either listed on or recommended eligible for the NRHP.

As mitigation to avoid impacting any undiscovered cultural resources, should evidence of historic or pre-historic sites be discovered during construction, the contractor would be required to immediately stop work in the area until the significance of the site is determined, and appropriate measures implemented.

---

24. OTHER APPROPRIATE SOCIAL AND ECONOMIC CIRCUMSTANCES:

Include appropriate economic analysis. Identify potential future uses for the analysis area other than existing management. Identify direct, indirect, and cumulative economic and social effects likely to occur as a result of the proposed action.

According to the PAR (A&E, 2022), the median annual income of the City is $32,986 +/- $5,089.00, and the proponent listed the median annual household income of the service area as $52,169.00. Proposed improvements to the Fairgrounds may provide beneficial social and economic circumstances.

Preferred Alternative – Potentially direct and indirect, negligible to moderate, short- to long-term, beneficial impacts to appropriate social and economic circumstances. Workers and materials required for the construction of the project may temporarily provide beneficial impacts to local businesses throughout construction. The Preferred Alternative may indirectly result in beneficial economic impacts by allowing an area currently undevelopable within a floodplain to be removed from the floodplain to allow for a diversity of planned development. Upgrades to Grant Creek may be protective of property values and other economic circumstances and may bolster social morale in the project area and City. Proposed improvements to the Creek may provide long-term social and economic boosts. There will be temporary, adverse social and economic impacts during construction of the project. Cumulatively, the project is a part of the larger Sxwtpqyen Master Plan, which will result in substantial new positive economic impacts.

No Action Alternative – Potentially adverse, direct, minor to major, short- to long-term impacts to appropriate social and economic circumstances. Continued flooding may further degrade the Creek corridor and negatively affect nearby properties if flooding causes damage.

---

25. DRINKING WATER AND/OR CLEAN WATER

Identify potential impacts to water and/or sewer infrastructure (e.g., community water supply, stormwater, sewage system, solid waste management) and identify direct, indirect, and cumulative effects likely to occur as a result of the proposed action.

The project area does not have any solid waste facilities or requirements, wastewater treatment facilities, or community water supply. New development in the area will increase stormwater demands. Storm water management will occur in accordance with local requirements.

Preferred Alternative –The creation of a riparian corridor and floodplain will indirectly benefit future storm water facilities and improve water quality because future development will be able to outfall into the riparian vegetative buffer allowing for infiltration treatment of storm water. New development occurring in the project area will be designed in accordance with local storm water requirements, which, in conjunction with the enhanced riparian corridor, will provide cumulative benefits to the water quality of Grant Creek. Additionally, a new vegetative buffer and streambank restoration may help filter stormwater runoff in the event the stormwater or waterway is contaminated. The project will include permanent storm water management considerations that will be accomplished through site design and grading. Storm water during construction will be managed in accordance with the MPDES permit and SWPPP.

No Action Alternative – Although the current system does not affect drinking water and/or clean water, continued flooding has the potential to continue to mobilize sediment into Grant Creek and ultimately the Clark Fork River. Redesigning Grant Creek will alleviate sediment mobilization. No action may create indirect, short- to long-term, recurring, minor to major adverse impacts if flooding is permitted to continue eroding the Creek.

26. ENVIRONMENTAL JUSTICE

Will the proposed project result in disproportionately high or adverse human health or environmental effects on minority or low-income populations per the Environmental Justice Executive Order 12898? Identify potential impacts to and identify direct, indirect, and cumulative effects likely to occur as a result of the proposed action.

The project is designed for the City and County to be affected equally through realignment of Grant Creek, which will be used by and open to all residents equally.

Preferred Alternative and No Action Alternative – No impacts to environmental justice are expected as the proposed project will not result in disproportionately high or adverse human health of environmental effects on minority or low-income populations. The economic impact will ultimately affect all users of the system proportionately. No disproportionate effects on any portion of the community are expected.

EA Prepared By:	**Name:** Samantha Treu	**Date:** 4/9/2026
	Title: MEPA/NEPA Coordinator	**Email:** samantha.treu@mt.gov

V. FINDING

27. ALTERNATIVE SELECTED:

Alternative 2 – Recommended Alternative
The goal of this project is to restore Grant Creek so that flood conditions can be safely passed through the surrounding floodplain and so that the water quality will be improved.

Project Objectives:
Restoration of Grant Creek will result in re-alignment of approximately 5,200 lineal feet of Grant Creek, establishment of a 1,645-foot flood control swale with berm that is located on the southwest right-of way of West Broadway that discharges to the Grant Creek channel, establishment of a 150-foot riparian area and setback from the Grant Creek channel, development of a natural like stream channel capable of conveying the 2-year storm and with sinuosity and stable channel design, design of a roadway crossing of the Grant Creek channel at the extension of George Elmer Drive and design of stormwater facilities to assure the developed runoff from the area will discharge to Grant Creek at pre-developed conditions

Project Effectiveness:
The effectiveness of the project will be measured by the improvement to the Grant Creek water quality, the presence of a functioning riparian corridor to replace the current deeply incised Grant Creek channel and the successful completion of an LOMR to define the new floodplain within the natural functioning riparian corridor and the creation of additional developable lands in areas

previously designated as floodplains A and AE.

---

28. SIGNIFICANCE OF POTENTIAL IMPACTS:

WATER QUALITY, QUANTITY, AND DISTRIBUTION
During construction, the contractor must obtain any applicable permits required for construction. The area is relatively flat and precipitation runoff is not anticipated to pose much of an issue. Work will likely occur when surface water levels and flows are at their lowest. BMPs protective of water quality should be installed, monitored, and maintained by the contractor per the MPDES CGP and SWPPP. If dewatering is necessary during the construction, applicable permit requirements should be followed to be protective of groundwater resources. Spill kits and spill prevention and response plans should be available to help mitigate surface pollutants resulting from a spill from infiltrating surface and groundwater resources, and protective of potential pollutants in shallow groundwater aquifers from polluting deeper groundwater aquifers.

AIR QUALITY
Temporary, potentially direct, adverse impacts to air quality are likely to be minimal as there may be some dust introduced to the environment during construction. The contractor will be required to provide dust control throughout construction to mitigate any generated dust. If an assessment of ACM and/or LBP determines these materials to be present, appropriate measures must be enacted to ensure these materials are not airborne during abatement. Operation of heavy construction equipment should be limited around schools and sensitive individuals. Work should generally be conducted from 7 AM to 7 PM, unless otherwise restricted by local regulations.

VEGETATION COVER, QUANTITY, AND QUALITY
Potentially direct, adverse, minor to moderate, short-term, local impacts to vegetation cover exist during construction. The contractor should preserve existing vegetation where applicable. BMPs should be installed, monitored, and maintained per the MPDES CGP and SWPPP. Disturbed areas from construction activity must be revegetated and restored to preexisting conditions. Actions in the preferred alternative are expected to have impacts on sensitive habitats. These areas should be protected to the maximum extent possible by the contractor. Recommendations resulting from the anticipated BA should be adhered to.

TERRESTRIAL, AVIAN, AND AQUATIC LIFE AND HABITATS
Potentially indirect and direct, adverse, negligible to moderate, short-term, local impacts to terrestrial, avian, and aquatic life and habitats. Vegetative removal should be limited. Final stabilization should be achieved by the end of the proposed construction period. The project is generally within an undeveloped area with agricultural fields and open land, as well as riparian, riverine, and wetlands systems, and species are typical of these areas. No endangered species are expected to be impacted by the project. Threatened bull trout may be affected by construction. It is anticipated that instream work will occur during a work window as specified by the USFWS and/or FWP when bull trout are not likely to be present. It is anticipated that the aquatic habitat improvements resulting from the project will have a long-term direct beneficial impact on bull trout by providing more quality habitat throughout the project reach, as well as by reducing erosion potential and sediment loads within Grant Creek. However, the Creek should be observed to verify

that Bull Trout activity is at its lowest or not occurring in the Creek, if possible. The project will require compliance with the ESA that includes preparation of a BA and consultation with the USFWS. The BA will include mitigation measures to avoid and minimize impacts to bull trout and critical habitat. Wetlands are expected to be impacted by construction, and construction in these areas should be protected to the maximum extent possible by the contractor.

AESTHETICS/NOISE

Potentially adverse impacts exist during construction for aesthetics and noise. Overall, the proposed construction during this project is not anticipated to affect the visual quality negatively because the site will be restored by the end of the project, but general construction at the surface will present some adverse aesthetic/noise conditions. Noise above the project areas typical level will most likely be produced during construction. To minimize the impact of this disturbance, the contractor will only work during daylight, generally within the hours of 7 AM to 7 PM. The increased noise will only be temporary and a minor disturbance during the construction phase of the project. Exhaust fumes may be an adverse condition due to the operation of heavy construction equipment, and idling or operation of equipment near sensitive individuals should be limited.

STORMWATER

There is expected to be little to no impact on stormwater runoff based on the anticipated construction timing and scope of work. During construction, the contractor is anticipated to be required to prepare and submit a SWPPP and acquire the required permits for construction. BMPs must be installed and maintained according to the SWPPP.

HUMAN HEALTH AND SAFETY

Potentially direct and indirect, adverse, minor, short-term, local impacts to human health and safety exist during construction. Heavy equipment would be used during construction of the proposed project. Operation of heavy equipment poses a potential threat to public safety. There should be no impact during construction, but the typical risk to the public's safety may be increased during construction. BMPs should be installed to protect the public from the working construction extents. If an assessment determines that ACM and/or LBP are present in the construction area, abatement of these materials must be conducted in a manner that is protective of human health.

---

29. NEED FOR FURTHER ENVIRONMENTAL ANALYSIS:

No impacts appear to require a mitigated EA or EIS.

This is a Draft.

[ ]	EIS	[ ]	More Detailed EA	[X]	No Further Analysis

EA Approved By:	**Name:** **Title:**

Signature:	**Date**:

United States Department of Agriculture

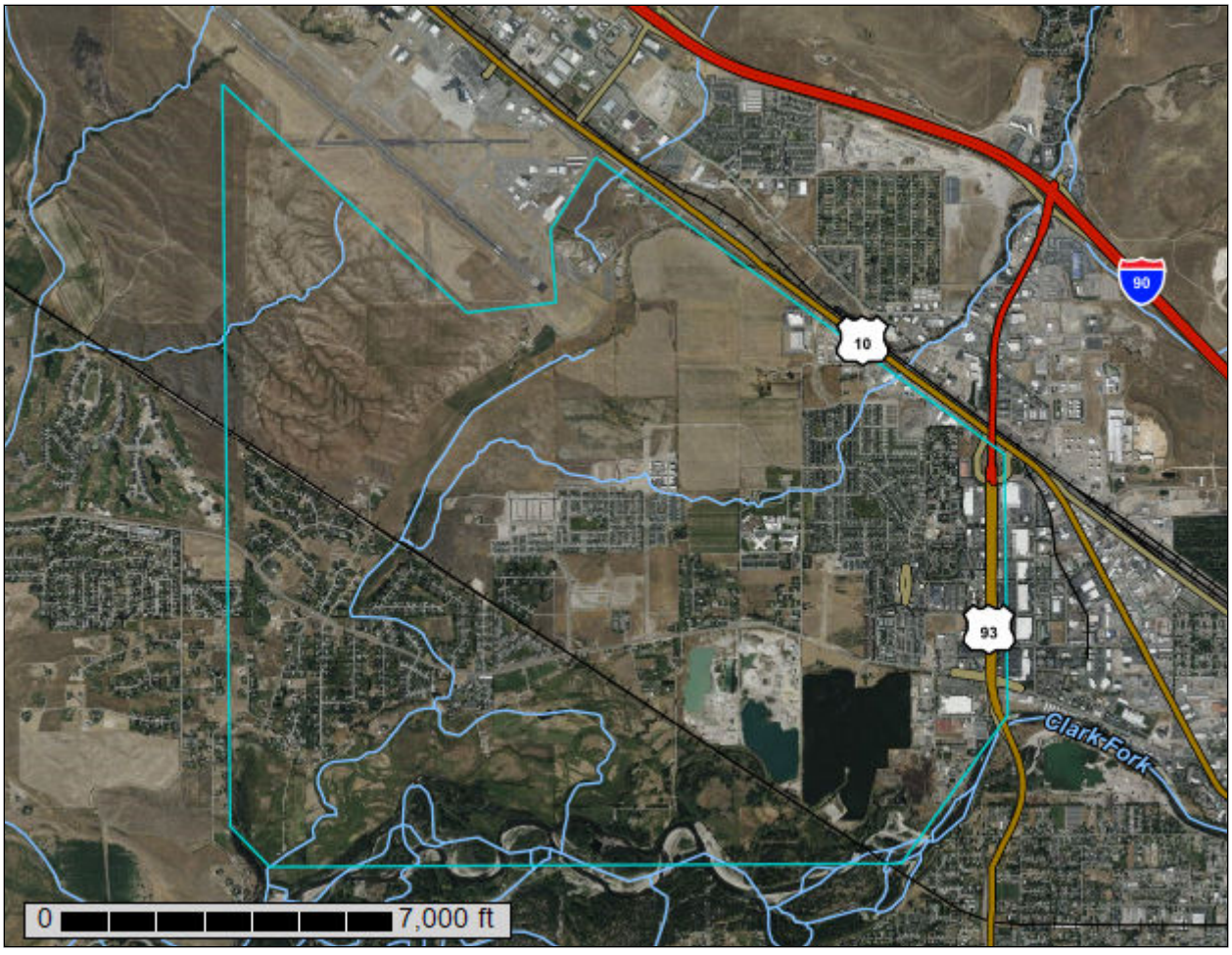
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Missoula County Area, Montana

Grant Creek Realignment, Missoula, MT



April 15, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
Missoula County Area, Montana.....14
4—Aquic Haploxerolls, 0 to 2 percent slopes.....14
34—Desmet loam, 0 to 2 percent slopes.....15
44—Grantsdale loam, 0 to 2 percent slopes.....16
45—Grassvalley silty clay loam, 0 to 4 percent slopes.....18
46—Grassvalley silty clay loam, 4 to 8 percent slopes.....19
47—Grassvalley silty clay loam, 8 to 15 percent slopes.....20
72—Moiese gravelly loam, 0 to 2 percent slopes.....21
73—Orthents, 0 to 4 percent slopes.....23
88—Pits, gravel.....24
93—Riverwash.....24
131—Winkler very gravelly sandy loam, 30 to 60 percent slopes.....25
136—Newbar very gravelly loamy sand, 0 to 2 percent slopes.....26
138—Water-Riverwash complex.....28
Soil Information for All Uses.....29
Suitabilities and Limitations for Use.....29
Building Site Development.....29
Corrosion of Steel.....29
Corrosion of Concrete.....33
Land Classifications.....37
Farmland Classification.....38
Land Management.....43
Site Degradation Susceptibility.....44
Soil Compactibility Risk.....50
Soil Health.....61
Fragile Soil Index.....61
Soil Properties and Qualities.....70
Water Features.....70
Depth to Water Table.....70
References.....75

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

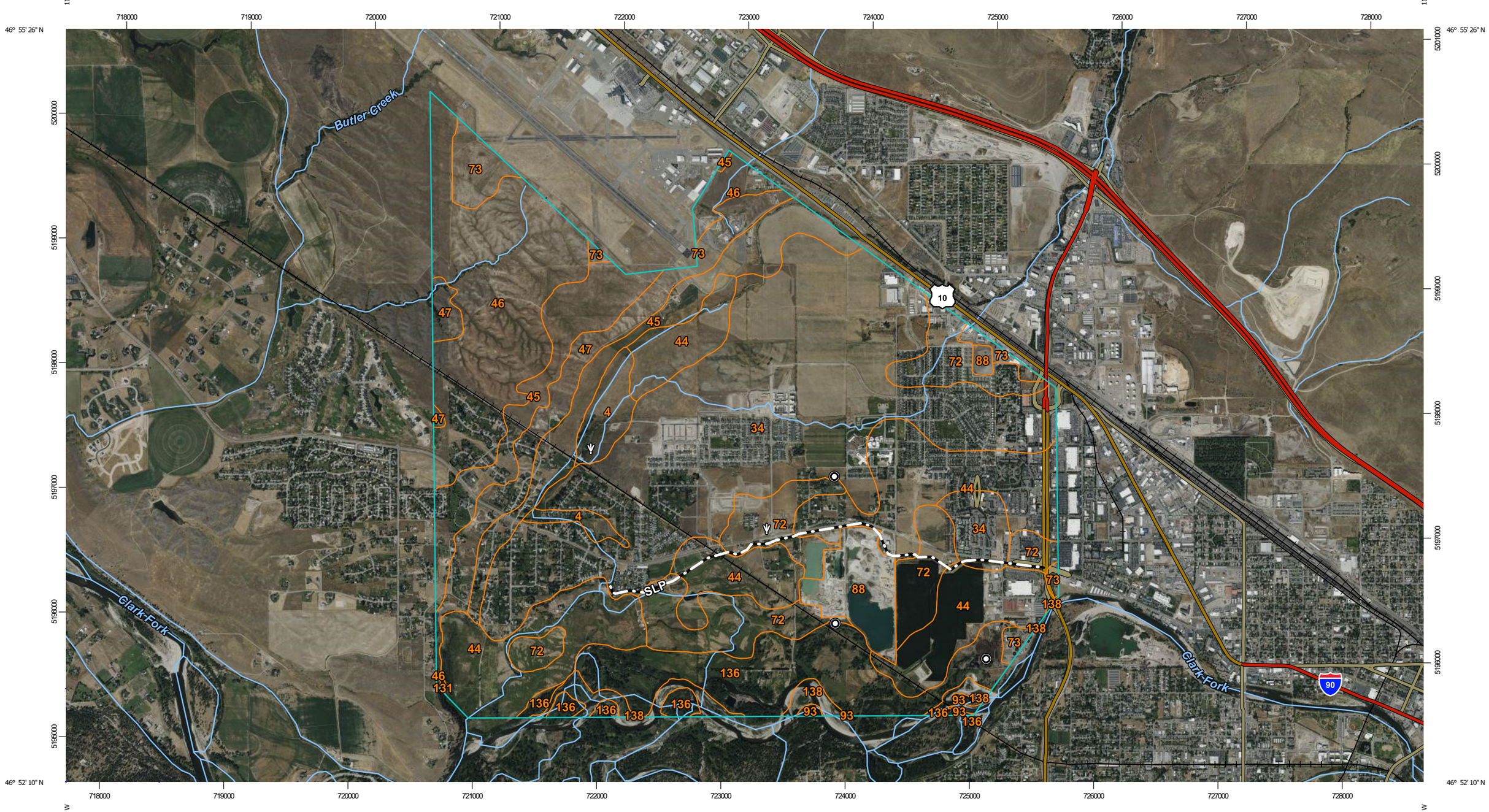
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 400 800 1600 2400

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes	87.7	1.9%
34	Desmet loam, 0 to 2 percent slopes	1,379.9	29.5%
44	Grantsdale loam, 0 to 2 percent slopes	872.0	18.6%
45	Grassvalley silty clay loam, 0 to 4 percent slopes	411.7	8.8%
46	Grassvalley silty clay loam, 4 to 8 percent slopes	545.9	11.7%
47	Grassvalley silty clay loam, 8 to 15 percent slopes	235.9	5.0%
72	Moiese gravelly loam, 0 to 2 percent slopes	456.4	9.7%
73	Orthents, 0 to 4 percent slopes	92.3	2.0%
88	Pits, gravel	131.4	2.8%
93	Riverwash	8.4	0.2%
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	0.6	0.0%
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	382.6	8.2%
138	Water-Riverwash complex	79.9	1.7%
Totals for Area of Interest		**4,684.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion

of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Missoula County Area, Montana

4—Aquic Haploxerolls, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 4wc5
Elevation: 1,900 to 6,200 feet
Mean annual precipitation: 10 to 19 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 70 to 135 days
Farmland classification: Farmland of local importance

Map Unit Composition

Aquic haploxerolls and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aquic Haploxerolls

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Depth to water table: About 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: No

Minor Components

Well drained soils

Percent of map unit: 5 percent
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Poorly drained soils

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: Yes

Areas that occasionally flood

Percent of map unit: 5 percent
Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: No

34—Desmet loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 4wbz
Elevation: 2,700 to 5,200 feet
Mean annual precipitation: 10 to 19 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Desmet and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Desmet

Setting

Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

Ap - 0 to 7 inches: loam
A - 7 to 15 inches: loam
Bk - 15 to 24 inches: loam
BC1 - 24 to 39 inches: very fine sandy loam
BC2 - 39 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R043BP818MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Alberton
Percent of map unit: 5 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB110MT - Sandy (Sy) LRU 44A-B
Hydric soil rating: No

Grantsdale
Percent of map unit: 4 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Moiese
Percent of map unit: 4 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044BA134MT - Shallow to Gravel (SwGr) LRU 01 Subset A
Hydric soil rating: No

Somewhat poorly drained soils
Percent of map unit: 2 percent
Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: No

44—Grantsdale loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 4wcb
Elevation: 2,700 to 5,200 feet
Mean annual precipitation: 10 to 19 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Grantsdale and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grantsdale

Setting
Landform: Stream terraces

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty over sandy and gravelly alluvium

Typical profile

Ap - 0 to 9 inches: loam
Bw - 9 to 17 inches: loam
Bk - 17 to 32 inches: loam
2C - 32 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R043BP818MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Alberton

Percent of map unit: 5 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB110MT - Sandy (Sy) LRU 44A-B
Hydric soil rating: No

Desmet

Percent of map unit: 4 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

Moiese

Percent of map unit: 4 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044BA134MT - Shallow to Gravel (SwGr) LRU 01 Subset A
Hydric soil rating: No

Somewhat poorly drained soils

Percent of map unit: 2 percent

Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: No

45—Grassvalley silty clay loam, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 4wcc
Elevation: 2,500 to 4,500 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 105 to 130 days
Farmland classification: Farmland of local importance

Map Unit Composition

Grassvalley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grassvalley

Setting

Landform: Lake plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Glaciolacustrine deposits

Typical profile

Ap - 0 to 9 inches: silty clay loam
Bt - 9 to 21 inches: clay
Btk - 21 to 28 inches: clay
C - 28 to 60 inches: clay

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: R044AP808MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Dark colored surface layers
Percent of map unit: 5 percent
Hydric soil rating: No

Gravelly clay soils
Percent of map unit: 5 percent
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Moderately sodic soils
Percent of map unit: 5 percent
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

46—Grassvalley silty clay loam, 4 to 8 percent slopes

Map Unit Setting
National map unit symbol: 4wcd
Elevation: 2,500 to 4,500 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 105 to 130 days
Farmland classification: Farmland of local importance

Map Unit Composition
Grassvalley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grassvalley

Setting
Landform: Lake plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Glaciolacustrine deposits

Typical profile
Ap - 0 to 9 inches: silty clay loam
Bt - 9 to 21 inches: clay
Btk - 21 to 28 inches: clay
C - 28 to 60 inches: clay

Properties and qualities
Slope: 4 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R044AP808MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Dark colored surface layers

Percent of map unit: 5 percent
Hydric soil rating: No

Gravelly clay soils

Percent of map unit: 5 percent
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Moderately sodic soils

Percent of map unit: 5 percent
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

47—Grassvalley silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 4wcf
Elevation: 2,500 to 3,800 feet
Mean annual precipitation: 10 to 16 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 100 to 130 days
Farmland classification: Farmland of local importance

Map Unit Composition

Grassvalley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grassvalley

Setting

Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Glaciolacustrine deposits

Typical profile

A - 0 to 7 inches: silty clay loam
Bt - 7 to 24 inches: clay
Btk - 24 to 52 inches: clay
C - 52 to 60 inches: clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R044AP808MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Moderately sodic soils

Percent of map unit: 8 percent
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

Calcareous surface layers

Percent of map unit: 7 percent
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

72—Moiese gravelly loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 4wdb
Elevation: 2,600 to 5,500 feet
Mean annual precipitation: 11 to 19 inches
Mean annual air temperature: 41 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Farmland of local importance

Map Unit Composition

Moiese and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Moiese

Setting

Landform: Stream terraces, alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium over sandy and gravelly alluvium

Typical profile

Ap - 0 to 9 inches: gravelly loam
Bw - 9 to 21 inches: very gravelly sandy loam
2Bk - 21 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: R043BP818MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Bigarm

Percent of map unit: 5 percent
Landform: Stream terraces, alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Alberton

Percent of map unit: 5 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB110MT - Sandy (Sy) LRU 44A-B
Hydric soil rating: No

Grantsdale

Percent of map unit: 5 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

73—Orthents, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 4wdc
Elevation: 2,600 to 5,500 feet
Mean annual precipitation: 11 to 19 inches
Mean annual air temperature: 41 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Orthents and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Orthents

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Ecological site: R044AP808MT - Upland Grassland Group
Hydric soil rating: No

Minor Components

Grantsdale

Percent of map unit: 3 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Moiese

Percent of map unit: 3 percent
Landform: Stream terraces

Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044BA134MT - Shallow to Gravel (SwGr) LRU 01 Subset A
Hydric soil rating: No

Bigarm

Percent of map unit: 3 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AB032MT - Loamy (Lo) LRU 44A-B
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

Argiborolls and similar soils

Percent of map unit: 2 percent
Hydric soil rating: No

Grassvalley

Percent of map unit: 2 percent
Landform: Lake plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AA032MT - Loamy (Lo) LRU 44A-A
Hydric soil rating: No

88—Pits, gravel

Map Unit Composition

Pits: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

93—Riverwash

Map Unit Setting

National map unit symbol: 4wf2
Elevation: 3,600 to 6,200 feet
Mean annual precipitation: 10 to 19 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 70 to 105 days
Farmland classification: Not prime farmland

Map Unit Composition

Riverwash: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Frequently flooded soils
Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Poorly drained soils
Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: Yes

131—Winkler very gravelly sandy loam, 30 to 60 percent slopes

Map Unit Setting
National map unit symbol: 4wb1
Elevation: 3,000 to 4,590 feet
Mean annual precipitation: 17 to 25 inches
Mean annual air temperature: 39 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Not prime farmland

Map Unit Composition
Winkler and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Winkler

Setting
Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from metasedimentary rock

Typical profile
Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 10 inches: very gravelly sandy loam
E - 10 to 27 inches: very gravelly sandy loam
E and Bt - 27 to 44 inches: extremely gravelly sandy loam
C - 44 to 60 inches: extremely gravelly sandy loam

Properties and qualities
Slope: 30 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.13 to 7.09 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: F043BP910MT - Upland Cool Woodland Group
Other vegetative classification: Douglas-fir/snowberry-pinegrass phase (PK312)
Hydric soil rating: No

Minor Components

Repp

Percent of map unit: 8 percent
Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Douglas-fir/snowberry-bluebunch wheatgrass phase (PK311)
Hydric soil rating: No

Sharrott

Percent of map unit: 3 percent
Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Douglas-fir/bluebunch wheatgrass (PK210)
Hydric soil rating: No

Combest

Percent of map unit: 2 percent
Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Douglas-fir/ninebark-ninebark phase (PK261), Douglas-fir/snowberry-pinegrass phase (PK312)
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Hydric soil rating: No

136—Newbar very gravelly loamy sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 4wb6
Elevation: 2,600 to 3,500 feet
Mean annual precipitation: 14 to 19 inches
Mean annual air temperature: 39 to 45 degrees F

Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Newbar and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newbar

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 4 inches: very gravelly loamy sand
C - 4 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (7.09 to 21.26 in/hr)
Depth to water table: About 24 to 43 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 0.8 inches)

Interpretive groups

Land capability classification (irrigated): 7w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: R044AP806MT - Subirrigated Grassland Group
Hydric soil rating: Yes

Minor Components

Poverty

Percent of map unit: 8 percent
Landform: Channels on flood plains
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R044AP808MT - Upland Grassland Group
Hydric soil rating: Yes

Riverwash

Percent of map unit: 5 percent
Landform: Flood plains
Microfeatures of landform position: Bars
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Water

Percent of map unit: 2 percent
Landform: Flood plains
Microfeatures of landform position: Bars
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Unranked

138—Water-Riverwash complex

Map Unit Composition

Water: 65 percent
Riverwash: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Flood plains
Microfeatures of landform position: Bars
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Frequency of flooding: Frequent

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Building Site Development

Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Corrosion of Steel

ENG

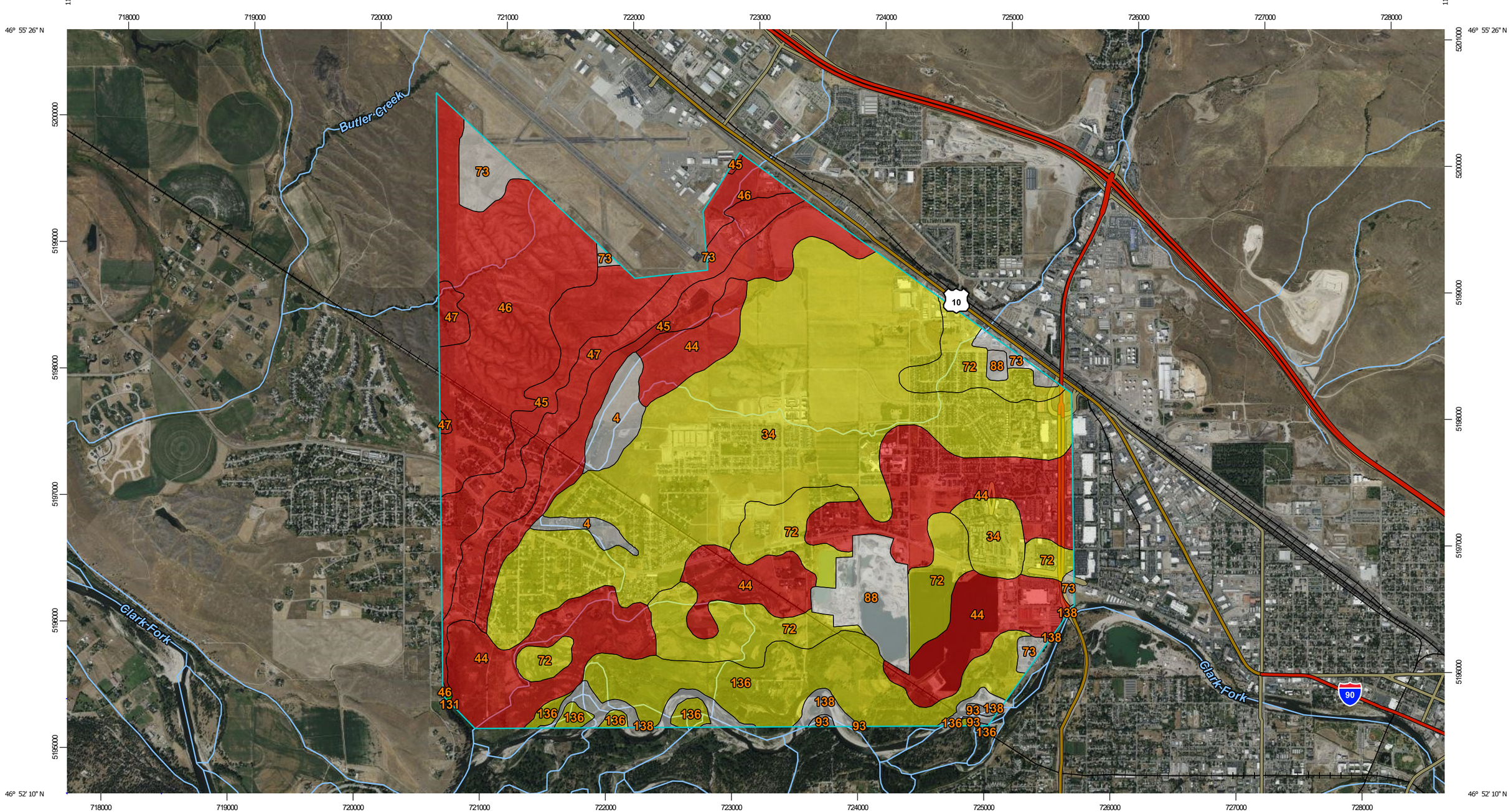
Engineering

AGR

Agronomy

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."



Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.

N

Meters
0 400 800 1600 2400

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- High
- Moderate
- Low
- Not rated or not available

Soil Rating Lines

- High
- Moderate
- Low
- Not rated or not available

Soil Rating Points

- High
- Moderate
- Low
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Steel

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes		87.7	1.9%
34	Desmet loam, 0 to 2 percent slopes	Moderate	1,379.9	29.5%
44	Grantsdale loam, 0 to 2 percent slopes	High	872.0	18.6%
45	Grassvalley silty clay loam, 0 to 4 percent slopes	High	411.7	8.8%
46	Grassvalley silty clay loam, 4 to 8 percent slopes	High	545.9	11.7%
47	Grassvalley silty clay loam, 8 to 15 percent slopes	High	235.9	5.0%
72	Moiese gravelly loam, 0 to 2 percent slopes	Moderate	456.4	9.7%
73	Orthents, 0 to 4 percent slopes		92.3	2.0%
88	Pits, gravel		131.4	2.8%
93	Riverwash		8.4	0.2%
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	Low	0.6	0.0%
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	Moderate	382.6	8.2%
138	Water-Riverwash complex		79.9	1.7%
Totals for Area of Interest			**4,684.9**	**100.0%**

Rating Options—Corrosion of Steel

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Corrosion of Concrete

ENG

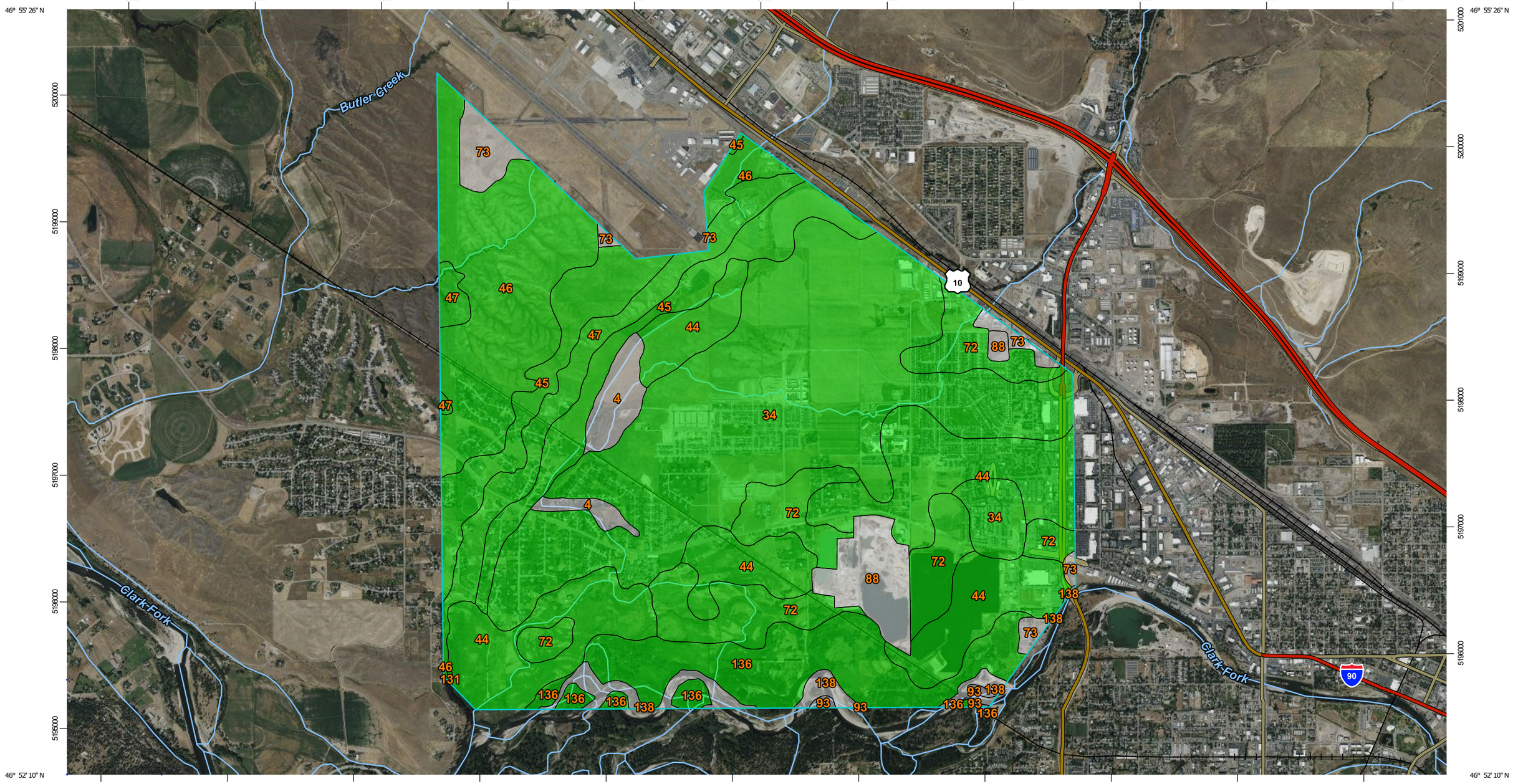
Engineering

AGR

Agronomy

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."


114° 8' 34" W
113° 59' 58" W
46° 55' 26" N
46° 52' 10" N
718000
719000
720000
721000
722000
723000
724000
725000
726000
727000
728000
5200000
5199000
5198000
5197000
5196000
5195000
5201000
Butler Creek
Clark Fork
Clark Fork
10
90
73
45
46
73
73
47
46
45
44
47
45
4
47
34
72
88
73
44
4
72
34
72
72
44
72
88
73
138
44
138
72
73
46
131
136
136
136
138
136
136
93
93
136
93
138
93
136
Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.
N
Meters
0 400 800 1600 2400
Feet
0 1000 2000 4000 6000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- High
- Moderate
- Low
- Not rated or not available

Soil Rating Lines

- High
- Moderate
- Low
- Not rated or not available

Soil Rating Points

- High
- Moderate
- Low
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Concrete

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes		87.7	1.9%
34	Desmet loam, 0 to 2 percent slopes	Low	1,379.9	29.5%
44	Grantsdale loam, 0 to 2 percent slopes	Low	872.0	18.6%
45	Grassvalley silty clay loam, 0 to 4 percent slopes	Low	411.7	8.8%
46	Grassvalley silty clay loam, 4 to 8 percent slopes	Low	545.9	11.7%
47	Grassvalley silty clay loam, 8 to 15 percent slopes	Low	235.9	5.0%
72	Moiese gravelly loam, 0 to 2 percent slopes	Low	456.4	9.7%
73	Orthents, 0 to 4 percent slopes		92.3	2.0%
88	Pits, gravel		131.4	2.8%
93	Riverwash		8.4	0.2%
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	Moderate	0.6	0.0%
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	Low	382.6	8.2%
138	Water-Riverwash complex		79.9	1.7%
Totals for Area of Interest			**4,684.9**	**100.0%**

Rating Options—Corrosion of Concrete

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

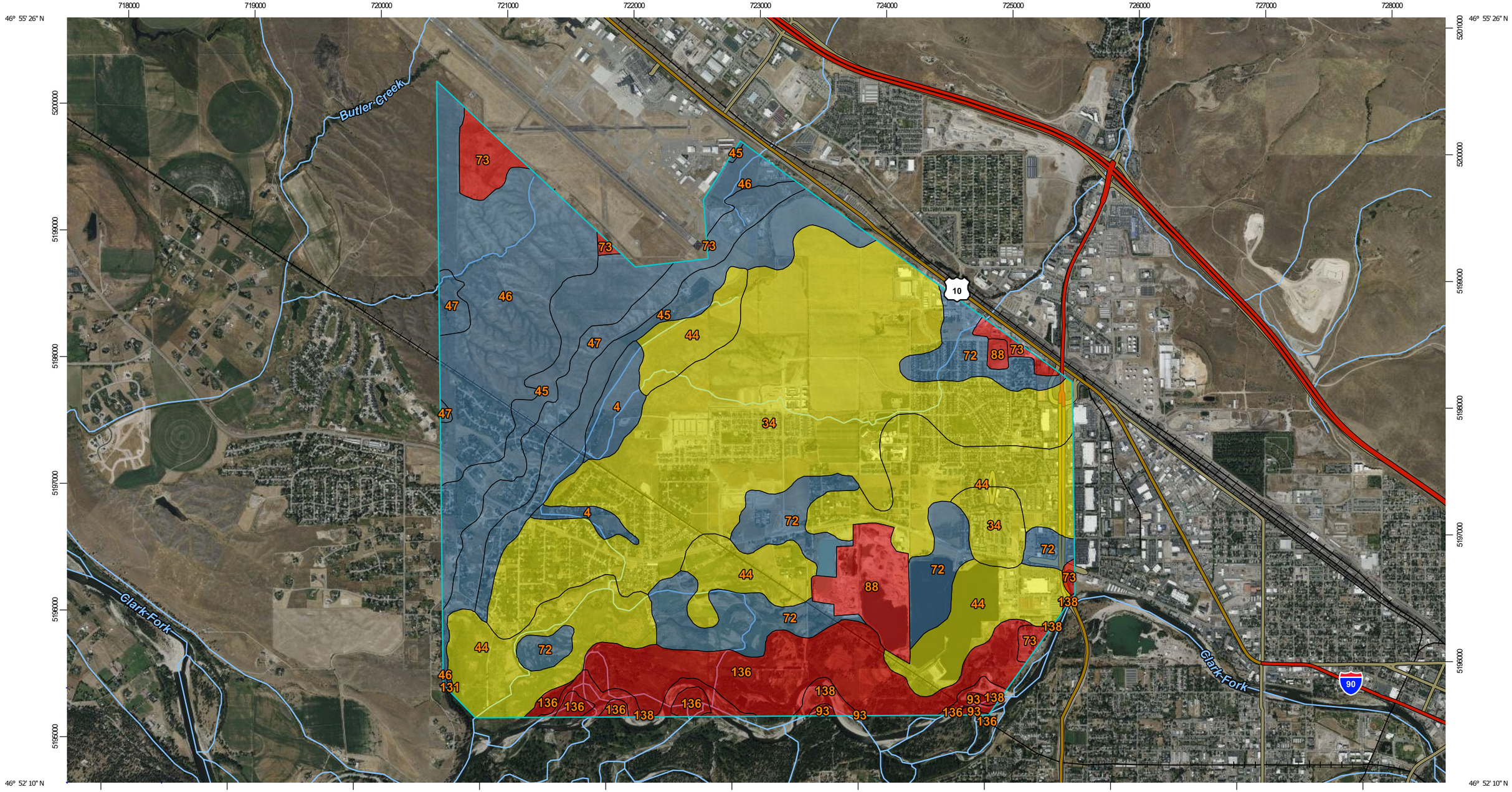
Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site

classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.



Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.

N

Meters
0 400 800 1600 2400

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

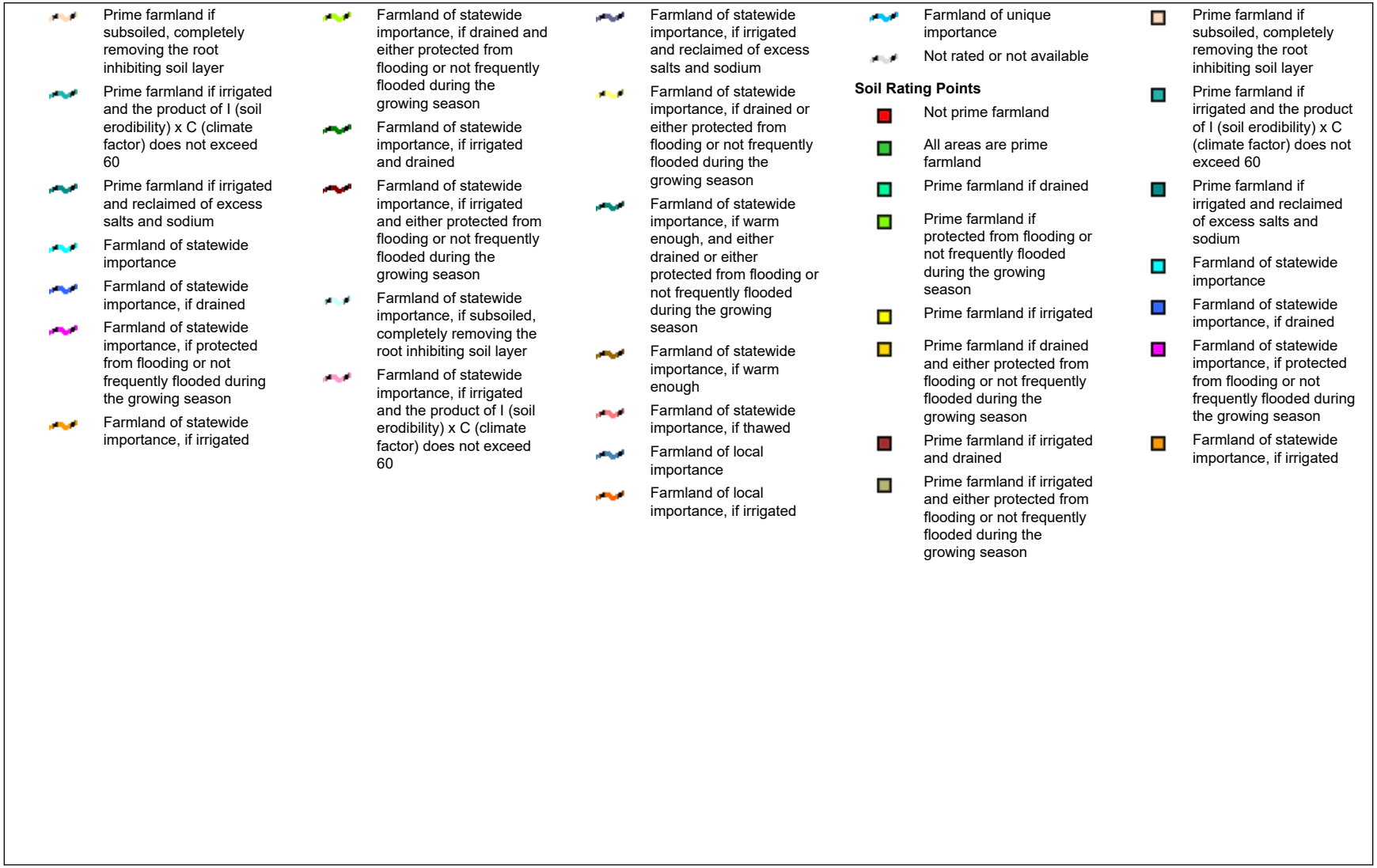
Soils

Soil Rating Polygons

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of statewide importance, if drained
- Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if irrigated
- Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if irrigated and drained
- Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
- Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough
- Farmland of statewide importance, if thawed
- Farmland of local importance
- Farmland of local importance, if irrigated
- Farmland of unique importance
- Not rated or not available

Soil Rating Lines

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season


Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated
Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated and drained
Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if warm enough
Farmland of statewide importance, if thawed
Farmland of local importance
Farmland of local importance, if irrigated
Farmland of unique importance
Not rated or not available
Soil Rating Points
Not prime farmland
All areas are prime farmland
Prime farmland if drained
Prime farmland if protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
Prime farmland if irrigated and drained
Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
Prime farmland if subsoiled, completely removing the root inhibiting soil layer
Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
Prime farmland if irrigated and reclaimed of excess salts and sodium
Farmland of statewide importance
Farmland of statewide importance, if drained
Farmland of statewide importance, if protected from flooding or not frequently flooded during the growing season
Farmland of statewide importance, if irrigated

- Farmland of statewide importance, if drained and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if irrigated and drained
- Farmland of statewide importance, if irrigated and either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if subsoiled, completely removing the root inhibiting soil layer
- Farmland of statewide importance, if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Farmland of statewide importance, if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance, if drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of statewide importance, if warm enough
- Farmland of statewide importance, if thawed
- Farmland of local importance
- Farmland of local importance, if irrigated
- Farmland of unique importance
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Farmland Classification

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes	Farmland of local importance	87.7	1.9%
34	Desmet loam, 0 to 2 percent slopes	Prime farmland if irrigated	1,379.9	29.5%
44	Grantsdale loam, 0 to 2 percent slopes	Prime farmland if irrigated	872.0	18.6%
45	Grassvalley silty clay loam, 0 to 4 percent slopes	Farmland of local importance	411.7	8.8%
46	Grassvalley silty clay loam, 4 to 8 percent slopes	Farmland of local importance	545.9	11.7%
47	Grassvalley silty clay loam, 8 to 15 percent slopes	Farmland of local importance	235.9	5.0%
72	Moiese gravelly loam, 0 to 2 percent slopes	Farmland of local importance	456.4	9.7%
73	Orthents, 0 to 4 percent slopes	Not prime farmland	92.3	2.0%
88	Pits, gravel	Not prime farmland	131.4	2.8%
93	Riverwash	Not prime farmland	8.4	0.2%
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	Not prime farmland	0.6	0.0%
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	Not prime farmland	382.6	8.2%
138	Water-Riverwash complex	Not prime farmland	79.9	1.7%
Totals for Area of Interest			**4,684.9**	**100.0%**

Rating Options—Farmland Classification

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Land Management

Land management interpretations are tools designed to guide the user in evaluating existing conditions in planning and predicting the soil response to various land management practices, for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture, and rangeland. Example interpretations include suitability for a variety of irrigation practices, log landings, haul roads and major skid

trails, equipment operability, site preparation, suitability for hand and mechanical planting, potential erosion hazard associated with various practices, and ratings for fencing and waterline installation.

Site Degradation Susceptibility

BLM - Bureau of Land Management

This interpretation rates each soil for its susceptibility for soil degradation to occur during disturbance, which is a function of resistance to degradation. Resistance to degradation of a rangeland or woodland site is a measure of its ability to function without change throughout a disturbance. The magnitude of decline in the capacity to function determines the degree of resistance to change. Resistance to degradation thus could be described as an area's buffering capacity. This depends upon soil type, vegetation, climate, land use, disturbance regime, temporal and spatial scales. The disturbance regime determines the type of stresses placed upon the soil, vegetation, and wildlife components of the site. Thus, soil factors of vulnerability will vary based upon the disturbance regime for a particular site.

The ratings represent the relative risk of water and wind erosion, salinization, sodification, organic matter and nutrient depletion and/or redistribution, and loss of adequate rooting depth to maintain desired plant communities. Dynamic soil properties which vary with time, e.g. microbial biomass/diversity and carbon/ nitrogen ratio, are not used since they are not contained within the soil database.

Steep slopes increase the potential for water erosion. Shallow rooting depth, and excess salt or sodium can reduce plant diversity, resistance to stress, and seedling survival.

This rating should be used with the objective to protect vulnerable sites from the type of degradation that would result in accelerated erosion, reduction in water and air quality, invasion by annual grasses or noxious weeds, and other large scale potential natural plant community conversions. When degradation of soil and natural plant community characteristics goes beyond the threshold for the ecological site, the ecological site characteristics cannot be restored without artificial restoration efforts.

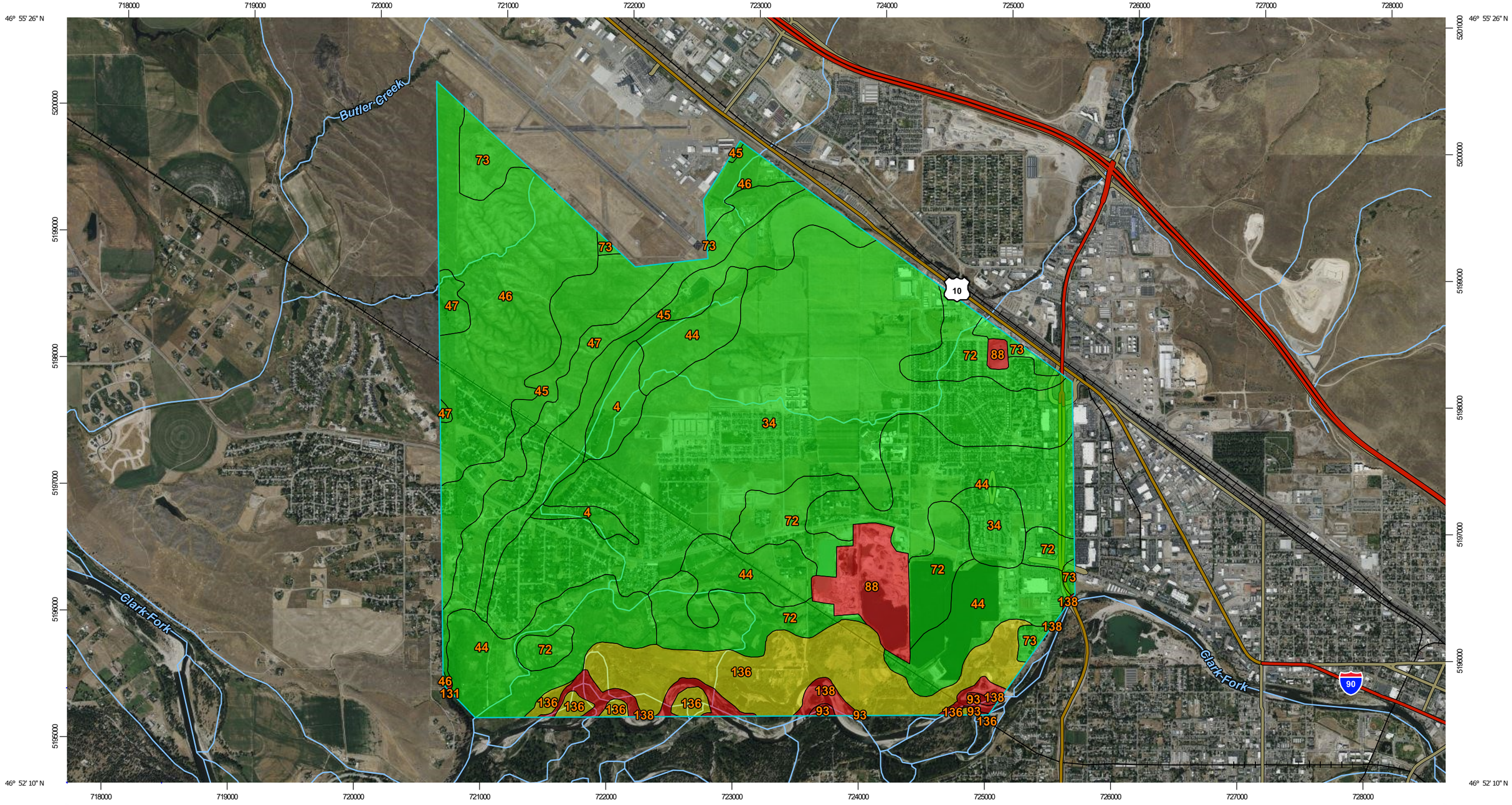
There may be unique circumstances where accelerated soil processes that are normally considered contributing to site degradation are actually beneficial to some attribute of the site, such as Indian ricegrass (Achnatherum hymenoides) being more competitive in shifting sands than most species.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the potential for degradation. "Highly susceptible" indicates that the soil has one or more features that are very favorable for degradation. "Moderately susceptible" indicates that the soil has features that are moderately favorable for damage to occur. "Slightly susceptible" indicates that the soil has features that generally make it unfavorable for degradation to occur.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.



Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.

N

Meters
0 400 800 1600 2400

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Highly susceptible
- Moderately susceptible
- Slightly susceptible
- Not rated or not available

Soil Rating Lines

- Highly susceptible
- Moderately susceptible
- Slightly susceptible
- Not rated or not available

Soil Rating Points

- Highly susceptible
- Moderately susceptible
- Slightly susceptible
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Site Degradation Susceptibility

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes	Slightly susceptible	Aquic Haploxerolls (85%)		87.7	1.9%
			Well drained soils (5%)			
			Poorly drained soils (5%)			
			Areas that occasionally flood (5%)			
34	Desmet loam, 0 to 2 percent slopes	Slightly susceptible	Desmet (85%)		1,379.9	29.5%
			Grantsdale (4%)			
			Moiese (4%)			
			Somewhat poorly drained soils (2%)			
44	Grantsdale loam, 0 to 2 percent slopes	Slightly susceptible	Grantsdale (85%)		872.0	18.6%
			Desmet (4%)			
			Moiese (4%)			
			Somewhat poorly drained soils (2%)			
45	Grassvalley silty clay loam, 0 to 4 percent slopes	Slightly susceptible	Grassvalley (85%)		411.7	8.8%
			Moderately sodic soils (5%)			
			Gravelly clay soils (5%)			
46	Grassvalley silty clay loam, 4 to 8 percent slopes	Slightly susceptible	Grassvalley (85%)		545.9	11.7%
			Gravelly clay soils (5%)			
			Moderately sodic soils (5%)			
47	Grassvalley silty clay loam, 8 to 15 percent slopes	Slightly susceptible	Grassvalley (85%)		235.9	5.0%
			Calcareous surface layers (7%)			
72	Moiese gravelly loam, 0 to 2 percent slopes	Slightly susceptible	Moiese (85%)		456.4	9.7%
			Bigarm (5%)			
			Grantsdale (5%)			

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
73	Orthents, 0 to 4 percent slopes	Slightly susceptible	Orthents (85%)		92.3	2.0%
			Grantsdale (3%)			
			Moiese (3%)			
			Bigarm (3%)			
			Grassvalley (2%)			
88	Pits, gravel	Highly susceptible	Pits (100%)	Water erosion (1.00)	131.4	2.8%
93	Riverwash	Highly susceptible	Riverwash (90%)	Water erosion (1.00)	8.4	0.2%
			Frequently flooded soils (5%)	Water erosion (1.00)		
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	Highly susceptible	Winkler (85%)	Water erosion (1.00)	0.6	0.0%
			Repp (8%)	Water erosion (1.00)		
			Sharrott (3%)	Water erosion (1.00)		
				Restrictive layer (0.68)		
			Combest (2%)	Water erosion (1.00)		
			Rock outcrop (2%)	Water erosion (1.00)		
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	Moderately susceptible	Newbar (85%)	Wind erosion (0.99)	382.6	8.2%
138	Water-Riverwash complex	Highly susceptible	Water (65%)	Water erosion (1.00)	79.9	1.7%
			Riverwash (35%)	Water erosion (1.00)		
Totals for Area of Interest					**4,684.9**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Slightly susceptible	4,081.8	87.1%
Moderately susceptible	382.6	8.2%
Highly susceptible	220.3	4.7%
Totals for Area of Interest	**4,684.9**	**100.0%**

Rating Options—Site Degradation Susceptibility

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Compactibility Risk

FOR - Forestry

This interpretation is designed to predict the potential for soil compaction from operation of ground-based equipment for forest harvesting and site preparation activities when soils are moist. Soils are rated based on their susceptibility to compaction from the operation of ground-based equipment for planting, harvesting, and site preparation activities. Soil compaction is the process in which soil particles are pressed together more closely than in the original state. Typically, the soil must be moist to be compacted because the mineral grains must slide together. Compaction reduces the abundance mostly of large pores in the soil by damaging the structure of the soil. This produces several effects that are unwanted in forest soils since large pores are most effective at transmitting water and air through the soil. Compaction also increases the soil strength, which can limit root penetration and growth. The ability of soil to hold water is adversely affected by compaction since the large pores hold water. The degree of compaction of a soil is measured by its bulk density, which is the mass per unit volume, generally expressed in grams per cubic centimeter.

Compacted soils are less favorable for good plant growth because of high soil bulk density and hardness, reduced pore space, and poor aeration and drainage. Root penetration and growth is decreased in compacted soils because the hardness or strength of these soils prevents the expansion of roots. Supplies of air, water, and nutrients that roots need are also reduced when compaction decreases soil porosity and drainage.

Interpretative ratings are based on soil properties in the upper 12 inches of the profile. Factors considered are soil texture, soil organic matter content, soil structure, rock fragment content, and the existing bulk density. Each of these properties contributes to a soils ability to resist compaction. Organic matter in the soil provides resistance to compaction and the resilience to overcome the effects with time. Soil structure adds strength through discrete aggregates; it is the aggregates that are deformed or destroyed by the forces of compaction, thus strong soil structure lowers the susceptibility to compaction. Similarly, rock fragments in the soil can bridge and provide a framework to resist compaction. Finally, if a soil is already dense, further compaction is more difficult.

The ratings are both verbal and numerical. Rating class terms indicate the soil compaction potential.

Definitions of the ratings:

Low - The potential for compaction is insignificant. The soil is able to support standard equipment with minimal compaction. The soil is moisture insensitive, exhibiting only small changes in density with changing moisture content.

Medium - The potential for compaction is significant. The growth rate of seedlings may be reduced following compaction. After the initial compaction (i.e., the first equipment pass), the soil is able to support standard equipment with only minimal increases in soil density. The soil is intermediate between moisture insensitive and moisture sensitive.

High - The potential for compaction is very significant. The growth rate of seedlings will be reduced following compaction. After initial compaction, the soil is still able to support standard equipment but will continue to compact with each subsequent pass of the equipment. The soil is moisture sensitive, exhibiting large changes in density with changing moisture content.

Numerical ratings indicate the soil compaction potential. The ratings are shown in decimal fractions ranging from 1.00 to 0.00. They indicate gradations between the point where compaction potential is highest (1.00) and the point at which compaction potential is lowest (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

References:

Adams, P.W. 1981. Compaction of forest soils. Oregon State University Extension Publication PNW 217.

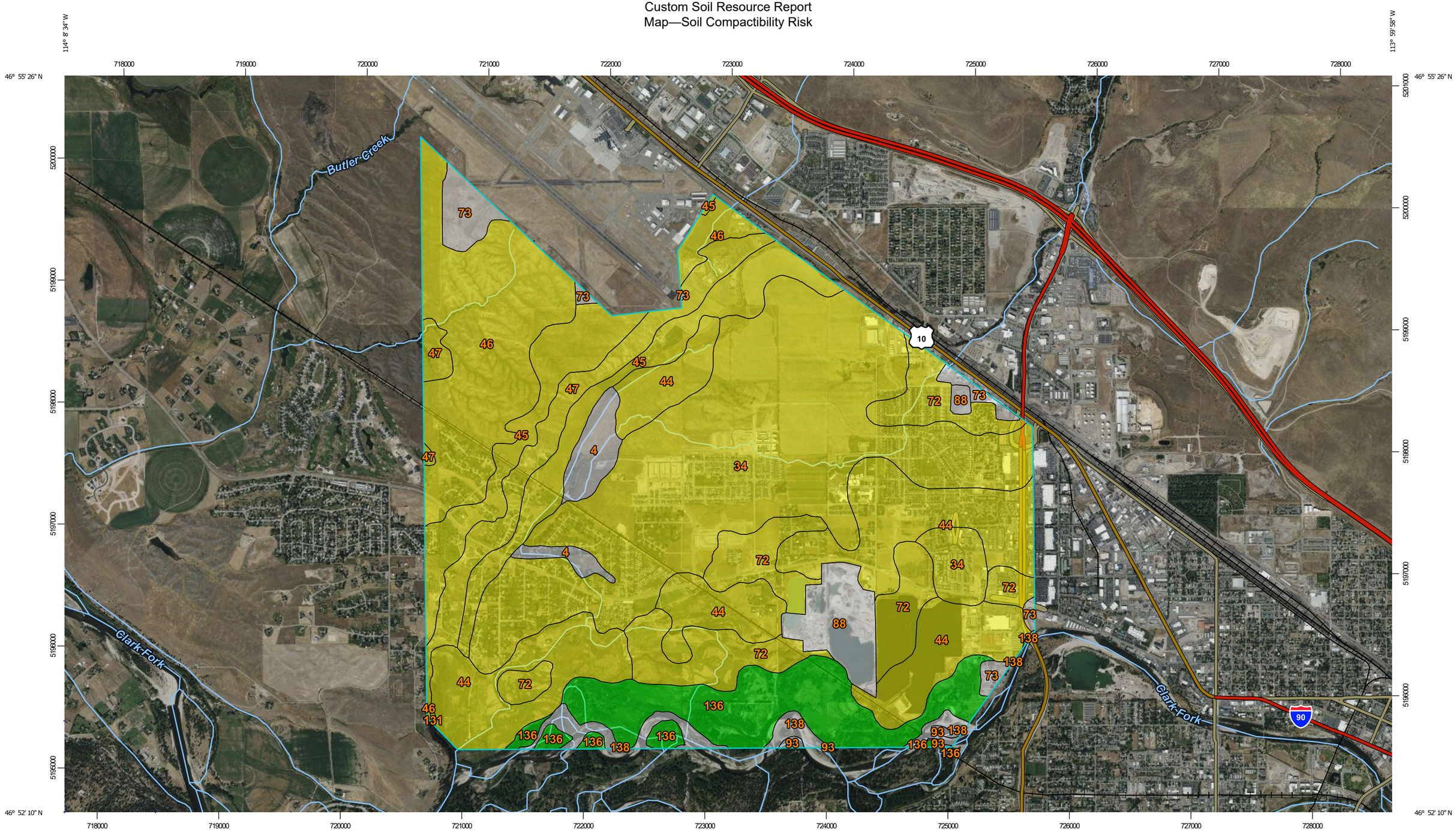
Adams, P.W. 1998. Soil compaction on woodland properties. Oregon State University Extension Publication EC 1109.

Boyer, D. 1997. Guidelines for soil resource protection and restoration for timber harvest and post-harvest activities. U.S Forest Service, Pacific Northwest Region, Watershed Management.

Froehlich, H.A., and D.H. McNab. 1983. Minimizing soil compaction in Pacific Northwest forests. Proceedings of Sixth North American Forest Soils Conference, University of Tennessee.

Geist, J.M., J.W. Hazard, and K.W. Seidel. 1989. Assessing physical conditions of some Pacific Northwest volcanic ash soils after forest harvest. Soil Science Society of America Journal 53:946-950.

Page-Dumrose, D.S. 1993. Susceptibility of volcanic ash influenced soils in northern Idaho to mechanical compaction. U.S. Forest Service Intermountain Research Station. Research Note INT-409.



Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.

N

Meters
0 400 800 1600 2400

Feet
0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

High

Medium

Low

Not rated or not available

Soil Rating Lines

High

Medium

Low

Not rated or not available

Soil Rating Points

High

Medium

Low

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Soil Compactibility Risk

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes	Not rated	Aquic Haploxerolls (85%)		87.7	1.9%
			Well drained soils (5%)			
			Poorly drained soils (5%)			
			Areas that occasionally flood (5%)			
34	Desmet loam, 0 to 2 percent slopes	Medium	Desmet (85%)	Soil texture, 0-12 inches (1.00)	1,379.9	29.5%
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.80)		
			Alberton (5%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Organic matter content, 0-30 cm (0.92)		
				Bulk density-compactibility to 30cm (0.91)		
			Grantsdale (4%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.55)		
			Moiese (4%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.78)		
44	Grantsdale loam, 0 to 2 percent slopes	Medium	Grantsdale (85%)	Soil texture, 0-12 inches (1.00)	872.0	18.6%
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.55)		
			Alberton (5%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Organic matter content, 0-30 cm (0.92)		
				Bulk density-compactibility to 30cm (0.91)		
			Desmet (4%)	Soil texture, 0-12 inches (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.80)		
			Moiese (4%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.78)		
45	Grassvalley silty clay loam, 0 to 4 percent slopes	Medium	Grassvalley (85%)	Soil texture, 0-12 inches (1.00)	411.7	8.8%
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.92)		
46	Grassvalley silty clay loam, 4 to 8 percent slopes	Medium	Grassvalley (85%)	Soil texture, 0-12 inches (1.00)	545.9	11.7%
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Organic matter content, 0-30 cm (0.92)		
47	Grassvalley silty clay loam, 8 to 15 percent slopes	Medium	Grassvalley (85%)	Soil texture, 0-12 inches (1.00)	235.9	5.0%
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (0.94)		
				Organic matter content, 0-30 cm (0.93)		
72	Moiese gravelly loam, 0 to 2 percent slopes	Medium	Moiese (85%)	Soil texture, 0-12 inches (1.00)	456.4	9.7%
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Organic matter content, 0-30 cm (0.78)		
				Bulk density-compactibility to 30cm (0.53)		
			Bigarm (5%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Organic matter content, 0-30 cm (0.69)		
				Bulk density-compactibility to 30cm (0.62)		
			Alberton (5%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Soil structure grade, 0-12 inches (1.00)		
				Organic matter content, 0-30 cm (0.92)		
				Bulk density-compactibility to 30cm (0.79)		
			Grantsdale (5%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (0.57)		
				Organic matter content, 0-30 cm (0.55)		
73	Orthents, 0 to 4 percent slopes	Not rated	Orthents (85%)		92.3	2.0%
			Urban land (2%)			
			Argiborolls and similar soils (2%)			
88	Pits, gravel	Not rated	Pits (100%)		131.4	2.8%
93	Riverwash	Not rated	Riverwash (90%)		8.4	0.2%
			Frequently flooded soils (5%)			
			Poorly drained soils (5%)			
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	Medium	Winkler (85%)	Soil structure grade, 0-12 inches (1.00)	0.6	0.0%
				Organic matter content, 0-30 cm (0.83)		
				Rock fragments, 0-12 inches (0.83)		
				Soil texture, 0-12 inches (0.50)		
				Bulk density-compactibility to 30cm (0.49)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Repp (8%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Organic matter content, 0-30 cm (0.67)		
				Bulk density-compactibility to 30cm (0.47)		
			Sharrott (3%)	Soil texture, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (1.00)		
				Rock fragments, 0-12 inches (0.89)		
			Combest (2%)	Soil texture, 0-12 inches (1.00)		
				Rock fragments, 0-12 inches (1.00)		
				Soil structure grade, 0-12 inches (1.00)		
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (0.82)		
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	Low	Newbar (85%)	Soil structure grade, 0-12 inches (1.00)	382.6	8.2%
				Bulk density-compactibility to 30cm (1.00)		
				Organic matter content, 0-30 cm (1.00)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
138	Water-Riverwash complex	Not rated	Water (65%)		79.9	1.7%
			Riverwash (35%)			
Totals for Area of Interest					**4,684.9**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Medium	3,902.5	83.3%
Low	382.6	8.2%
Null or Not Rated	399.6	8.5%
Totals for Area of Interest	**4,684.9**	**100.0%**

Rating Options—Soil Compactibility Risk

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Health

Soil health interpretations are designed to be used as tools for evaluating and managing a soil's capacity to function as a vital living ecosystem that sustains plants, animals, and humans. Example interpretations include compaction, surface sealing, carbon sequestration, resistance and resilience, management systems and practices, and cover crops.

Fragile Soil Index

SOH - Soil Health

Soils can be rated based on their susceptibility to degradation in the "Fragile Soil Index" interpretation. Fragile soils are those that are most vulnerable to degradation. In other words, they can be easily degradedthey have a low resistance to degradation processes. They tend to be highly susceptible to erosion and can have a low capacity to recover after degradation has occurred (low resilience). Fragile soils are generally characterized by a low content of organic matter, low aggregate stability, and weak soil structure. They are generally located on sloping ground, have sparse plant cover, and tend to be in arid or semiarid regions. The index can be used for conservation and watershed planning to assist in identifying soils and areas highly vulnerable to degradation.

Depending on inherent soil characteristics and the climate, soils can vary from highly resistant, or stable, to vulnerable and extremely sensitive to degradation. Under stress, fragile soils can degrade to a new altered state, which may be less favorable or unfavorable for plant growth and less capable of performing soil functions. To assess the fragility of the soil, indicators of vulnerability to degradation processes are used. They include organic matter, soil structure, rooting depth, vegetative cover, slope, and aridity.

The organic matter content indicates the capacity of the soil to resist and/or recover from degradation processes. Organic matter improves the soil pore structure, increases water infiltration, and reduces soil compaction and soil erosion. Soil structure indicates the capacity of the soil to resist degradation from accelerated water erosion (by increasing the amount of infiltration). Pore structure is the most important aspect of soil structure as pores provide habitat for organism. Shallow soils are more vulnerable to degradation processes because they have limited rooting depth and have a reduced amount of material from which to form new soil. As erosion removes the upper soil profile, productivity will decline if the subsoil is limiting for crop growth. Vegetative cover is very important as uncovered soil is most vulnerable to the processes of soil erosion, both by wind and water. Slope (a measure of the steepness or the degree of inclination) indicates the degree of vulnerability to erosion and mass movement. Aridity is defined by the shortage of moisture. Lack of water is a main factor limiting biological processes and the ability of the soil to resist and/or recover from degradation.

Soils are placed into interpretive classes based on their index rating, which ranges from 0 to 1. An index rating of 1 is the most fragile, while a rating of zero is the least fragile. Interpretative classes are as follows:

Not Fragile (index rating less than or equal to 0.009) These soils have a very high potential to resist degradation and be highly resilient. They are highly structured with an organic matter content greater than 5.7%, are nearly level, are deep or very deep, have greater than 85% vegetative cover, and are in a climate that is wet or very wet.

Slightly Fragile (index rating less than 0.009 and less than or equal to 0.209) These soils have a high potential to resist degradation and be resilient. They are:

— Poorly structured to weakly structured soils that have an extremely low to moderate content of organic matter, are very deep, have high vegetative cover, occur on nearly level ground, and are in wet or very wet climates;

— Highly structured soils that have a very high content of organic matter, are very shallow to moderately deep, have high vegetative cover, occur on nearly level ground, and are in wet or very wet climates;

— Highly structured soils that have a very high content of organic matter, are very deep, have low to moderately high vegetative cover, occur on nearly level ground, and are in wet or very wet climates;

— Highly structured soils that have a very high content of organic matter, are very deep, have high vegetative cover; are on slopes greater than 3%, and are in wet or very wet climates; or

— Highly structured soils that have a very high content of organic matter, are very deep, have high vegetative cover; occur on nearly level ground, and in semi-dry to mildly wet climates;

Moderately Fragile (index rating greater than 0.209 and less than or equal to 0.409) These soils have a moderate potential to resist degradation and be moderately resilient. They are:

— Highly structured soils that have a very high content of organic matter, are very shallow, have high vegetative cover, occur in nearly level to moderately sloping areas, and are in semi-dry climates;

— Poorly structured soils that have an extremely low content of organic matter, are deep, have low vegetative cover, occur in nearly level areas, and are in wet or very wet climates;

— Poorly structured soils that have an extremely low content of organic matter, occur on gentle to very steep slopes, have high vegetative cover, and are in wet or very wet climates;

— Weakly structured soils that have a very low content of organic matter, are deep, occur in nearly level to gently sloping areas, have high vegetative cover, and are in semi-dry climates; or

— Weakly structured soils that have a very low content of organic matter, are very shallow to very deep, occur in nearly level to strongly sloping areas, have high vegetative cover, and are in mildly wet climates.

Fragile (index rating greater than 0.409 and less than or equal to 0.609) These soils have a low potential to resist degradation and low resilience. They are:

— Well structured soils that have a low content of organic matter, are shallow to very deep, have moderate to moderately high vegetative cover, occur on steep slopes, and are in dry climates;

— Well structured soils that have a low content of organic matter, are shallow to very deep, have a low vegetative cover, occur in nearly level to gently sloping areas, and are in dry climates;

— Well structured soils that have a low content of organic matter, are deep, have low vegetative cover, occur on nearly level to very steep slopes, and are in a semi-dry climate;

— Moderately structured soils that have a very low content of organic matter, are deep, have moderately high vegetative cover, occur on moderately steep to very steep slopes, and are in semi-dry climates; or

— Weakly structured soils that have a low content of organic matter, occur on moderately steep to very steep slopes, have low vegetative cover, and are in wet or very wet climates.

Very Fragile (index rating greater than 0.609 and less than or equal to 0.809) These soils have a very low potential to resist degradation and very low resilience. They are:

— Weakly structured soils that have an extremely low content of organic matter, are deep, have low vegetative cover, occur on nearly level to very steep slopes, and are in dry climates;

— Weakly structured soils that have an extremely low content of organic matter, are shallow to very deep, have low vegetative cover, occur on nearly level to very steep slopes, and are in very dry climates; or

— Poorly structured soils that have an extremely low content of organic matter, are very shallow, have no vegetative cover, occur on steep slopes, and are in mildly wet to wet climates.

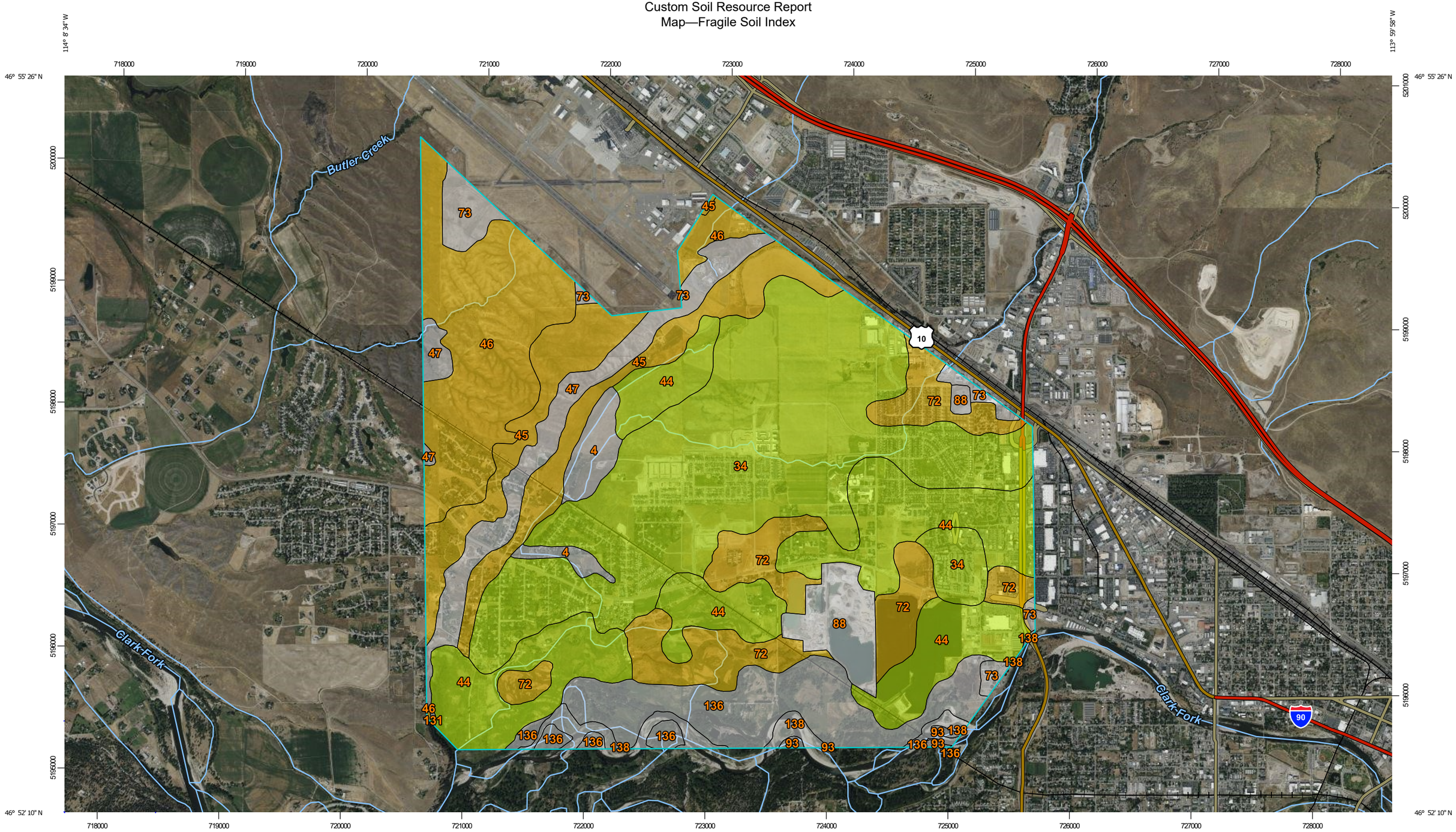
Extremely Fragile (index rating greater than 0.809 and less than or equal to 1.0) These soils can have no potential to resist degradation and no resilience. They are:

— Poorly structured soils that have an extremely low content of organic matter, are very shallow, have low vegetative cover, occur on very steep slopes, and are in dry or very dry climates;

— Weakly structured soils that have a very low content of organic matter, are nearly level to very deep, have low vegetative cover, occur on very steep slopes, and are in dry climates; or

— Very shallow soils on steep slopes.

The interpretive rating is based on soils that occur in the dominant land use for the map unit component and may not represent soils that occur in site-specific land uses.


114° 8' 34" W
113° 59' 58" W
46° 55' 26" N
46° 52' 10" N
718000
719000
720000
721000
722000
723000
724000
725000
726000
727000
728000
5200000
5199000
5198000
5197000
5196000
5195000
5201000
Butler Creek
Clark Fork
Clark Fork
10
90
73
45
46
73
73
47
46
45
44
47
45
4
47
34
72
88
73
44
4
72
34
72
72
44
72
88
73
44
138
72
138
73
44
72
46
131
136
136
136
138
136
136
93
93
93
138
136
136
Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.
N
Meters
0 400 800 1600 2400
Feet
0 1000 2000 4000 6000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Extremely fragile
- Highly fragile
- Fragile
- Moderately fragile
- Slightly fragile
- Not fragile
- Not rated or not available

Soil Rating Lines
- Extremely fragile
- Highly fragile
- Fragile
- Moderately fragile
- Slightly fragile
- Not fragile
- Not rated or not available

Soil Rating Points
- Extremely fragile
- Highly fragile
- Fragile
- Moderately fragile
- Slightly fragile
- Not fragile
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Fragile Soil Index

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes	Not rated	Aquic Haploxerolls (85%)		87.7	1.9%
			Areas that occasionally flood (5%)			
			Well drained soils (5%)			
			Poorly drained soils (5%)			
34	Desmet loam, 0 to 2 percent slopes	Moderately fragile	Desmet (85%)	Low vegetative cover (0.88)	1,379.9	29.5%
				Low organic matter (0.67)		
				Semi-dry (0.41)		
				Well structured (0.25)		
				Nearly level (0.02)		
			Grantsdale (4%)	Low vegetative cover (0.88)		
				Moderate organic matter (0.42)		
				Mildly wet (0.31)		
				Well structured (0.25)		
				Nearly level (0.02)		
44	Grantsdale loam, 0 to 2 percent slopes	Moderately fragile	Grantsdale (85%)	Low vegetative cover (0.88)	872.0	18.6%
				Moderate organic matter (0.42)		
				Mildly wet (0.31)		
				Well structured (0.25)		
				Nearly level (0.02)		
			Desmet (4%)	Low vegetative cover (0.88)		
				Low organic matter (0.67)		
				Semi-dry (0.41)		
				Well structured (0.25)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Nearly level (0.02)		
45	Grassvalley silty clay loam, 0 to 4 percent slopes	Fragile	Grassvalley (85%)	Low vegetative cover (0.88)	411.7	8.8%
				Very low organic matter (0.84)		
				Semi-dry (0.41)		
				Well structured (0.25)		
				Nearly level (0.04)		
46	Grassvalley silty clay loam, 4 to 8 percent slopes	Fragile	Grassvalley (85%)	Low vegetative cover (0.88)	545.9	11.7%
				Very low organic matter (0.84)		
				Semi-dry (0.41)		
				Well structured (0.25)		
				Gently sloping (0.08)		
47	Grassvalley silty clay loam, 8 to 15 percent slopes	Not rated	Grassvalley (85%)		235.9	5.0%
			Moderately sodic soils (8%)			
			Calcareous surface layers (7%)			
72	Moiese gravelly loam, 0 to 2 percent slopes	Fragile	Moiese (85%)	Low vegetative cover (0.88)	456.4	9.7%
				Weakly structured (0.75)		
				Low organic matter (0.67)		
				Semi-dry (0.36)		
				Nearly level (0.02)		
			Alberton (5%)	Low vegetative cover (0.88)		
				Very low organic matter (0.84)		
				Weakly structured (0.75)		
				Semi-dry (0.41)		
				Nearly level (0.02)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
73	Orthents, 0 to 4 percent slopes	Not rated	Orthents (85%)		92.3	2.0%
			Bigarm (3%)			
			Urban land (2%)			
			Argiborolls and similar soils (2%)			
88	Pits, gravel	Not rated	Pits (100%)		131.4	2.8%
93	Riverwash	Not rated	Riverwash (90%)		8.4	0.2%
			Frequently flooded soils (5%)			
			Poorly drained soils (5%)			
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	Slightly fragile	Winkler (85%)	Very steep (0.86)	0.6	0.0%
				High vegetative cover (0.08)		
			Repp (8%)	Very steep (0.86)		
				High vegetative cover (0.08)		
			Combest (2%)	Very steep (0.86)		
				High vegetative cover (0.08)		
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	Not rated	Newbar (85%)		382.6	8.2%
			Riverwash (5%)			
			Water (2%)			
138	Water-Riverwash complex	Not rated	Water (65%)		79.9	1.7%
			Riverwash (35%)			
Totals for Area of Interest					**4,684.9**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Moderately fragile	2,251.9	48.1%
Fragile	1,414.1	30.2%
Slightly fragile	0.6	0.0%
Null or Not Rated	1,018.2	21.7%
Totals for Area of Interest	**4,684.9**	**100.0%**

Rating Options—Fragile Soil Index

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

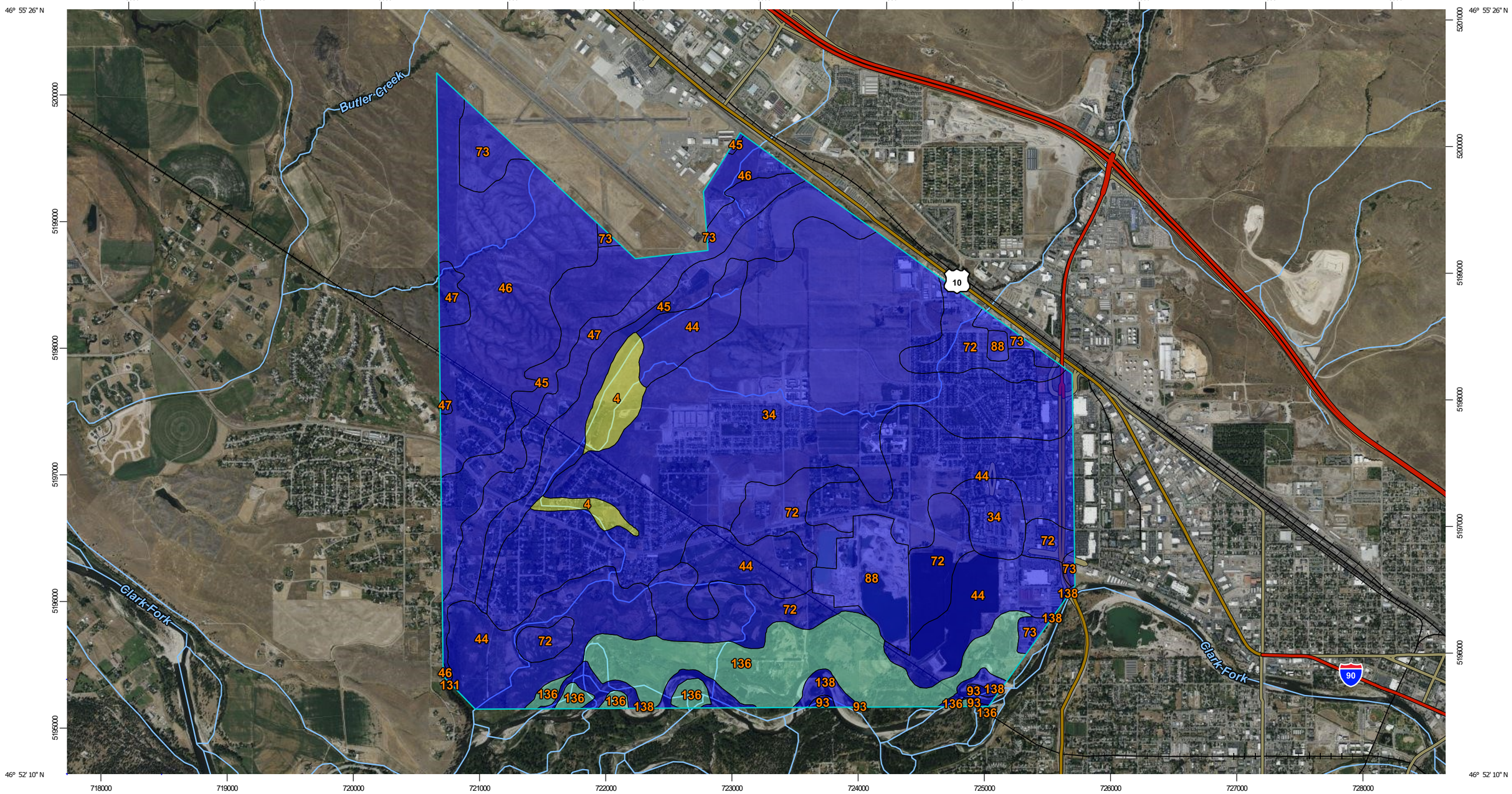
Water Features

Water Features include ponding frequency, flooding frequency, and depth to water table.

Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.


114° 8' 34" W
113° 59' 58" W
46° 55' 26" N
46° 52' 10" N
718000
719000
720000
721000
722000
723000
724000
725000
726000
727000
728000
5201000
5200000
5199000
5198000
5197000
5196000
5195000
Butler Creek
Clark Fork
Clark Fork
10
90
73
45
46
73
73
47
46
45
44
47
72
88
73
45
4
47
34
4
44
72
72
44
72
88
44
72
73
138
138
73
44
72
46
131
136
136
136
138
136
136
93
93
93
136
136
138
Map Scale: 1:29,400 if printed on B landscape (17" x 11") sheet.
N
0 400 800 1600 2400 Meters
0 1000 2000 4000 6000 Feet
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Missoula County Area, Montana
Survey Area Data: Version 21, Aug 29, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 15, 2022—Sep 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
4	Aquic Haploxerolls, 0 to 2 percent slopes	77	87.7	1.9%
34	Desmet loam, 0 to 2 percent slopes	>200	1,379.9	29.5%
44	Grantsdale loam, 0 to 2 percent slopes	>200	872.0	18.6%
45	Grassvalley silty clay loam, 0 to 4 percent slopes	>200	411.7	8.8%
46	Grassvalley silty clay loam, 4 to 8 percent slopes	>200	545.9	11.7%
47	Grassvalley silty clay loam, 8 to 15 percent slopes	>200	235.9	5.0%
72	Moiese gravelly loam, 0 to 2 percent slopes	>200	456.4	9.7%
73	Orthents, 0 to 4 percent slopes	>200	92.3	2.0%
88	Pits, gravel	>200	131.4	2.8%
93	Riverwash	>200	8.4	0.2%
131	Winkler very gravelly sandy loam, 30 to 60 percent slopes	>200	0.6	0.0%
136	Newbar very gravelly loamy sand, 0 to 2 percent slopes	101	382.6	8.2%
138	Water-Riverwash complex	>200	79.9	1.7%
Totals for Area of Interest			**4,684.9**	**100.0%**

Rating Options—Depth to Water Table

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

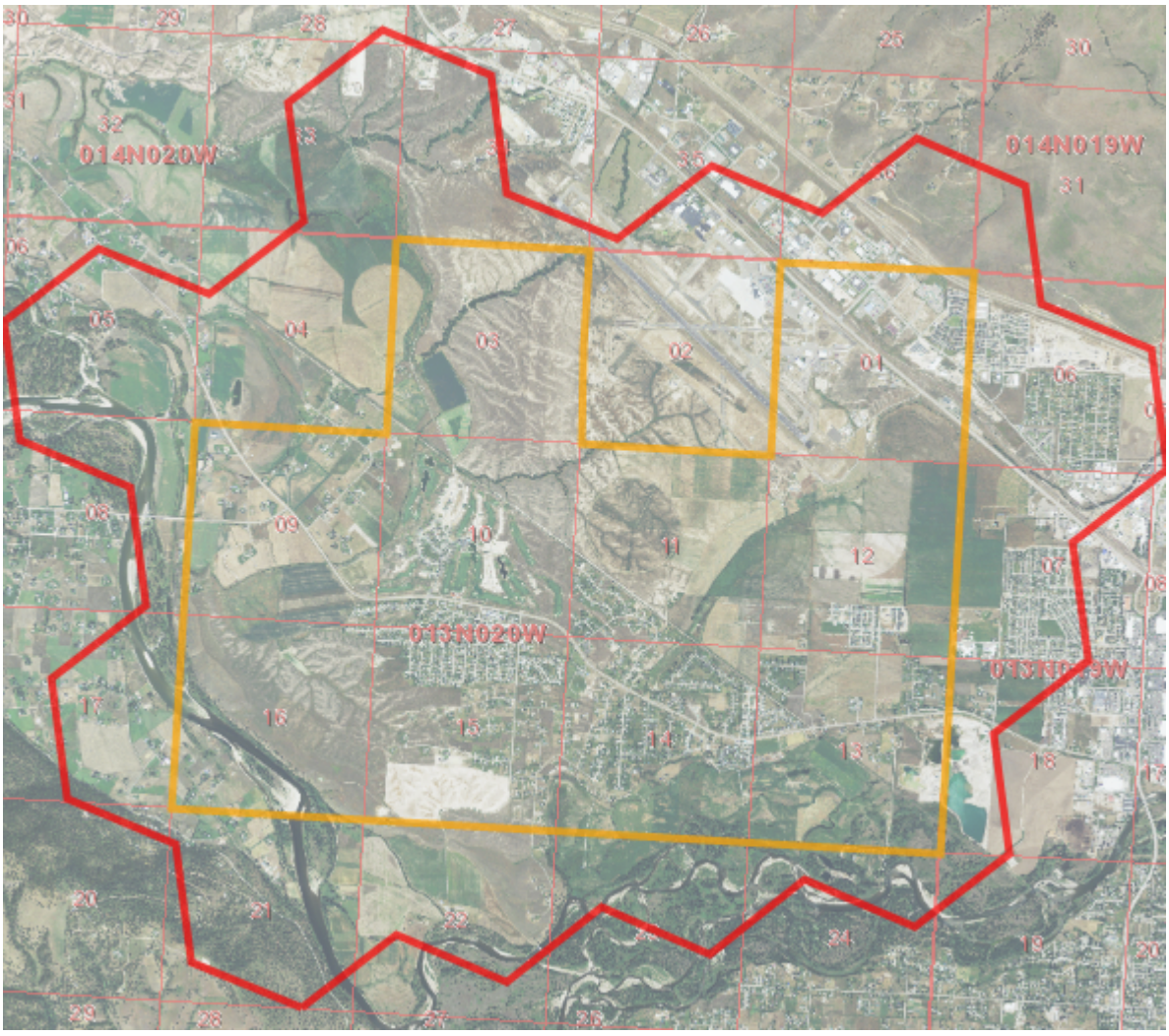
Environmental Summary

MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM mtnhp.org
1201 11th Ave ▫ P.O. Box 201800 ▫ Helena, MT 59620-1800 ▫ fax 406-444-0266 ▫ phone 406-444-3989



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Summarized by:
24prvt0310
(Custom Area of Interest)



Suggested Citation
Montana Natural Heritage Program. Environmental Summary Report.
for Latitude 46.86196 to 46.94055 and Longitude -114.04096 to -114.16194. Retrieved on 4/15/2024.

The Montana Natural Heritage Program is part of the Montana State Library's Natural Resource Information System. Since 1985, it has served as a neutral and non-regulatory provider of easily accessible information on Montana's species and biological communities to inform all stakeholders in environmental review, permitting, and planning processes. The program is part of the NatureServe network that is composed of over 60 member programs across North America that work to provide current and comprehensive distribution and status information on species and biological communities.

MONTANA STATE LIBRARY NATURAL HERITAGE PROGRAM
NATURESERVE

Table of Contents

- Species Report
- Structured Surveys
- Land Cover
- Wetland and Riparian
- Land Management
- Biological Reports
- Invasive and Pest Species
- Introduction to Montana Natural Heritage Program
- Data Use Terms and Conditions
- Suggested Contacts for Natural Resource Agencies
- Introduction to Native Species
- Introduction to Land Cover
- Introduction to Wetland and Riparian
- Introduction to Land Management
- Introduction to Invasive and Pest Species
- Additional Information Resources

Introduction to Environmental Summary Report

Environmental Summary Reports from the Montana Natural Heritage Program (MTNHP) provide information on species and biological communities to inform all stakeholders in environmental review, permitting, and planning processes. For information on environmental permits in Montana, please see permitting overviews by the Montana Department of Environmental Quality, the Montana Department of Natural Resources and Conservation, the Index of Environmental Permits for Montana and our Suggested Contacts for Natural Resource Management Agencies. The report for your area of interest consists of introductory and related materials in this PDF and an Excel workbook with worksheets summarizing information managed in the MTNHP databases for: (1) species occurrences; (2) other observed species without species occurrences; (3) other species potentially present based on their range, presence of associated habitats, or predictive distribution model output if available; (4) structured surveys that follow a protocol capable of detecting one or more species; (5) land cover mapped as ecological systems; (6) wetland and riparian mapping; (7) land management categories; and (8) biological reports associated with plant and animal observations. If your area of interest corresponds to a statewide polygon layer (e.g., watersheds, counties, or public land survey sections) information summaries in your report will exactly match those boundaries. However, if your report is for a custom area, users should be aware that summaries do not correspond to the exact boundaries of the polygon they have specified, but instead are a summary across a layer of hexagons intersected by the polygon they specified as shown on the report cover. Summarizing by these hexagons which are one square mile in area and approximately one kilometer in length on each side allows for consistent and rapid delivery of summaries based on a uniform grid that has been used for planning efforts across North America.

In presenting this information, MTNHP is working towards assisting the user with rapidly assessing the known or potential species and biological communities, land management categories, and biological reports associated with the report area. Users are reminded that this information is likely incomplete and may be inaccurate as surveys to document species are lacking in many areas of the state, species' range polygons often include regions of unsuitable habitat, methods of predicting the presence of species or communities are constantly improving, and information is constantly being added and updated in our databases. **Field verification by professional biologists of the absence or presence of species and biological communities in a report area will always be an important obligation of users of our data. Users are encouraged to only use this environmental summary report as a starting point for more in depth analyses and are encouraged to contact state, federal, and tribal resource management agencies for additional data or management guidelines relevant to your efforts. Please see the Appendix for introductory materials to each section of the report, additional information resources, and a list of relevant agency contacts.**

MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**

Legend

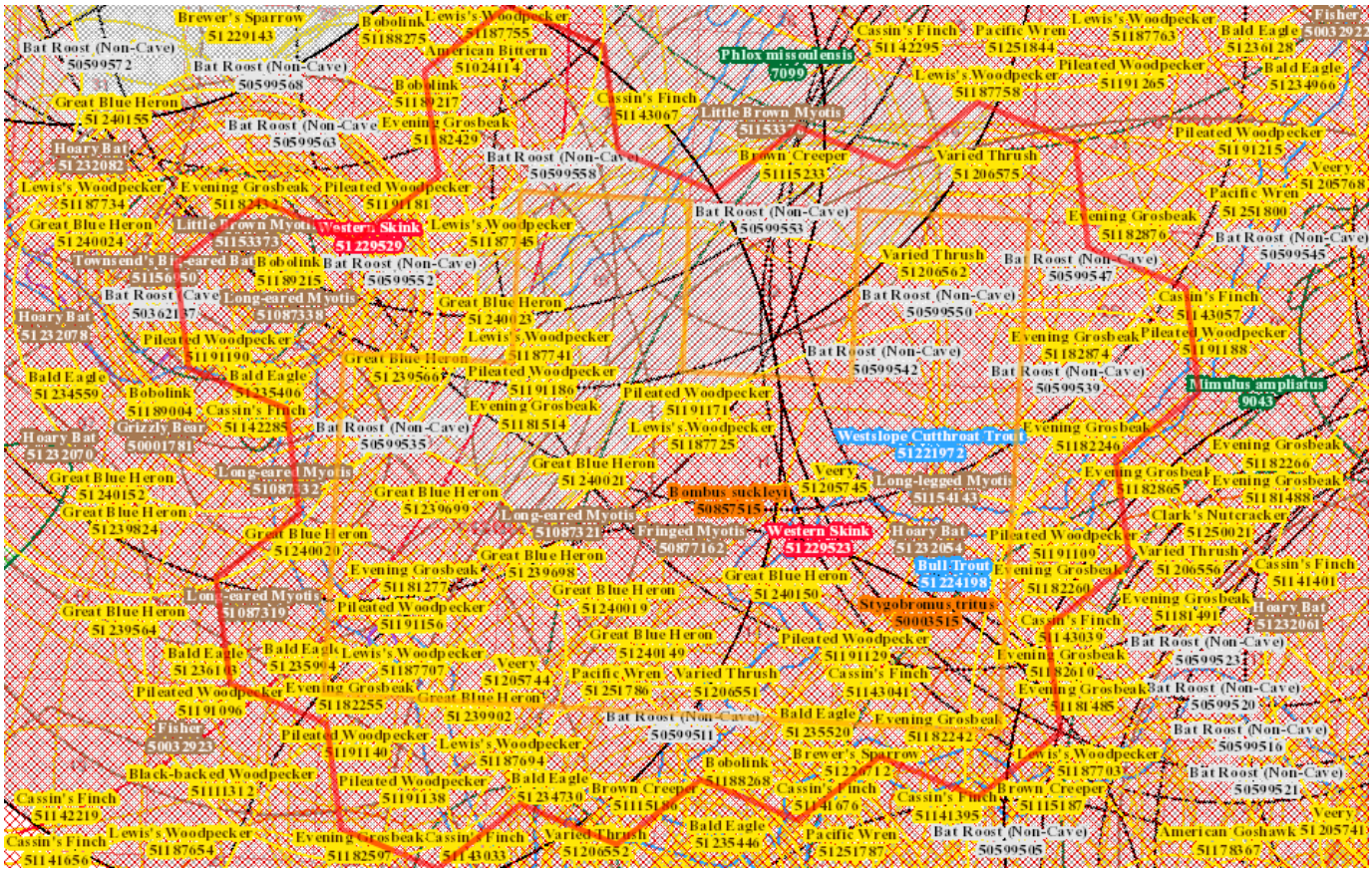
Model Icons	Habitat Icons	Range Icons	Num Obs
N Suitable (native range)	C Common	Y Native / Year-round	Count of obs with 'good precision' (<=1000m)
O Optimal Suitability	O Occasional	S Summer	+ indicates additional 'poor precision' obs (1001m-10,000m)
M Moderate Suitability		W Winter	
L Low Suitability		M Migratory	
I Suitable (introduced range)		N Non-native	
		H Historical	



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Native Species

Summarized by: **24prvt0310** *(Custom Area of Interest)*
Filtered by:
Native Species reports are filtered for Species with MT Status = Species of Concern, Special Status, Important Animal Habitat, Potential SOC



Species Occurrences

	USFWS Sec7	# SO	# Obs	Predicted Model	Range
F - Westslope Cutthroat Trout *(Oncorhynchus clarkii lewisi)* SOC		1	+		Y

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native/Non-native Species - (depends on location or taxa) Global: **G5T4** State: **S2**
USFS: **Sensitive - Known in Forests (BD, BRT, KOOT, LOLO)**
Species of Conservation Concern in Forests (CG, HLC) BLM: **SENSITIVE** FWP SWAP: **SGCN2**

Delineation Criteria Stream reaches and standing water bodies where the species presence has been confirmed through direct capture or where they are believed to be present based on the professional judgement of a fisheries biologist due to confirmed presence in adjacent areas. In order to reflect the importance of adjacent terrestrial habitats to survival, stream reaches are buffered 100 meters, standing water bodies greater than 1 acre are buffered 50 meters, and standing water bodies less than 1 acre are buffered 30 meters into the terrestrial habitat based on PACFISH/INFISH Riparian Conservation Area standards. (Last Updated: Mar 08, 2024)

Predicted Models: N 70% Suitable (native range) (deductive)

F - Bull Trout *(Salvelinus confluentus)* SOC	7	1	+		Y

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G5** State: **S2** USFWS: **LT; CH** BLM: **THREATENED** FWP SWAP: **SGCN2**

Delineation Criteria Stream reaches and standing water bodies where the species is believed to be present based on the professional judgement of a fisheries biologist, potentially supported by habitat assessment, direct capture, or confirmed presence in adjacent areas. In order to reflect the importance of adjacent terrestrial habitats to survival, stream reaches are buffered 100 meters, standing water bodies greater than 1 acre are buffered 50 meters, and standing water bodies less than 1 acre are buffered 30 meters into the terrestrial habitat based on PACFISH/INFISH Riparian Conservation Area standards. (Last Updated: Mar 19, 2024)

Predicted Models: N 60% Suitable (native range) (deductive)

V - Trifolium microcephalum *(Woolly Clover)* SOC		1	1		Y

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G5** State: **S3** Plant Threat Score: **High - Medium**

Predicted Models: N 10% Suitable (native range) (deductive)

B - Lewis's Woodpecker *(Melanerpes lewis)* **SOC** 53 105 S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S2B** USFWS: **MBTA; BCC10; BCC17** USFS: **Species of Conservation Concern in Forests (HLC)** BLM: **SENSITIVE** FWP SWAP: **SGCN2** PIF: **2**

Delineation Criteria Confirmed breeding area based on the presence of a nest, chicks, or territorial adults during the breeding season. Point observation location is buffered by a minimum distance of 300 meters in order to encompass the likely foraging area used by breeding adults around the nest tree and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Dec 28, 2023)

Predicted Models: O 50% Optimal (inductive), M 25% Moderate (inductive), L 25% Low (inductive)

V - Carex scoparia *(Pointed Broom Sedge)* **SOC** 1 1 Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S1S2** USFS: **Sensitive - Known in Forests (BD, BRT)** Plant Threat Score: **No Known Threats**

Delineation Criteria Individual occurrences are generally based upon a discretely mapped area provided by an observer and are not separated by any pre-defined distance. Individual clusters of plants mapped at fine spatial scales (separated by less than approximately 25-50 meters) may be grouped together into one occurrence if they are not separated by distinct areas of habitat or terrain features. Point observations are buffered to encompass any locational uncertainty associated with the observation. (Last Updated: Apr 26, 2018)

Predicted Models: O 35% Optimal (inductive), M 65% Moderate (inductive)

B - Bald Eagle *(Haliaeetus leucocephalus)* **SSS** 7 186 Y

View in Field Guide | View Predicted Models | View Range Maps

Special Status Species - Native Species Global: **G5** State: **S4** USFWS: **BGEPA; MBTA** USFS: **Sensitive - Known in Forests (LOLO)** BLM: **SENSITIVE** PIF: **2**

Delineation Criteria Confirmed nesting area buffered by a minimum distance of 2,000 meters in order to be conservative about encompassing the breeding territory and area commonly used for renesting. Only nesting observations with a locational uncertainty of 1,000 meters or less will be used to delineate a nesting area. (Last Updated: Apr 01, 2024)

Predicted Models: O 25% Optimal (inductive), M 25% Moderate (inductive), L 45% Low (inductive)

B - Great Blue Heron *(Ardea herodias)* **SOC** 14 182 + Y S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** FWP SWAP: **SGCN3**

Delineation Criteria Confirmed nesting area buffered by a minimum distance of 6,500 meters in order to be conservative about encompassing the areas commonly used for foraging near the breeding colony and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Apr 03, 2024)

Predicted Models: O 15% Optimal (inductive), M 35% Moderate (inductive), L 50% Low (inductive)

B - Veery *(Catharus fuscescens)* **SOC** 3 2 S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**

Delineation Criteria Observations with evidence of breeding activity buffered by a minimum distance of 300 meters in order to be conservative about encompassing home ranges and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Dec 28, 2023)

Predicted Models: O 15% Optimal (inductive), M 30% Moderate (inductive), L 55% Low (inductive)

I - Danaus plexippus *(Monarch)* **SOC** 2 S

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S2S3** USFWS: **C** USFS: **Sensitive - Migratory in Forests (BD, BRT, KOOT)**

Delineation Criteria Confirmed breeding area based on the presence of a resident animal of any age/stage. Point observation location is buffered by a minimum distance of 2,000 meters in order to encompass documented travel distances of some butterfly species as well as adjacent habitat likely to support other individuals and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Nov 02, 2023)

Predicted Models: O 10% Optimal (inductive), M 75% Moderate (inductive), L 15% Low (inductive)

I - Bombus suckleyi *(Suckley Cuckoo Bumble Bee)* **SOC** 1 Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G2G3** State: **S1**

Delineation Criteria Confirmed breeding area based on the presence of a resident animal of any age. Point observation location is buffered by a minimum distance of 1700 meters in order to encompass the home range of the individual as well as adjacent habitat likely to support other individuals and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Jun 22, 2022)

Predicted Models: M 100% Moderate (inductive)

B - Evening Grosbeak *(Coccothraustes vespertinus)* **SOC** 27 54 + Y W M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA; BCC10** FWP SWAP: **SGCN3**

Delineation Criteria Confirmed breeding area based on the presence of a nest, chicks, or territorial adults during the breeding season. Point observation location is buffered by a minimum distance of 1,000 meters in order to encompass the maximum foraging distance from nests reported for the species and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Dec 28, 2023)

Predicted Models: M 70% Moderate (inductive), L 30% Low (inductive)

R - Western Skink *(Plestiodon skiltonianus)* **SOC** 2 + Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** FWP SWAP: **SGCN3, SGIN**

Delineation Criteria Confirmed breeding area based on the presence of a resident animal of any age. Point observation location is buffered by a minimum distance of 200 meters in order to encompass habitats supporting other individuals in adjacent territories. Otherwise the point observation is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Mar 22, 2024)

Predicted Models: M 70% Moderate (inductive), L 20% Low (inductive)

M - Long-legged Myotis *(Myotis volans)* **SOC** 1 + Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4G5** State: **S3**

Delineation Criteria Confirmed area of occupancy based on the documented presence (mistnet captures, definitively identified acoustic recordings, and definitively identified roosting individuals) of adults or juveniles. Point observation location is buffered by a minimum distance of 2,000 meters in order to encompass the average distances traveled from capture locations to roosts in Washington, Oregon, and in the Black Hills of South Dakota and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. When cave locations are involved, point observations are mapped in the center of a one-square mile hexagon to protect the exact location of the cave entrance as per the Federal Cave Resource Protection Act and associated regulations (U.S. Code Title 16 Chapter 63, Code of Federal Regulations Title 43 Subtitle A Part 37). The outer edges of the hexagon are then buffered by a distance of 2,000 meters and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. All of the one-square mile hexagons intersecting this buffered area are presented as the Species Occurrence record. (Last Updated: Jul 06, 2023)

Predicted Models: M 45% Moderate (inductive), L 55% Low (inductive)

M - Little Brown Myotis *(Myotis lucifugus)* SOC

2 2 Y

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G3G4** State: **S3** USFS: **Sensitive - Known in Forests (BD, BRT, KOOT)** FWP SWAP: **SGCN3**

Delineation Criteria Confirmed area of occupancy based on the documented presence (mistnet captures, definitively identified acoustic recordings, or definitively identified roosting individuals) of adults or juveniles. Point observation location is buffered by a distance of 1,600 meters in order to encompass the greater than 1,500 meters foraging distance reported for the species in New Brunswick, Canada and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. When cave locations are involved, point observations are mapped in the center of a one-square mile hexagon to protect the exact location of the cave entrance as per the Federal Cave Resource Protection Act and associated regulations (U.S. Code Title 16 Chapter 63, Code of Federal Regulations Title 43 Subtitle A Part 37). The outer edges of the hexagon are then buffered by a distance of 1,600 meters and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. All of the one-square mile hexagons intersecting this buffered area are presented as the Species Occurrence record. (Last Updated: Jul 06, 2023)

Predicted Models: M 45% Moderate (inductive), L 50% Low (inductive)

M - Hoary Bat *(Lasiurus cinereus)* SOC

3 2 S M

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G3G4** State: **S3B** BLM: **SENSITIVE** FWP SWAP: **SGCN3**

Delineation Criteria Confirmed area of occupancy based on the documented presence (mistnet captures, definitively identified acoustic recordings, and definitively identified roosting individuals) of adults or juveniles during the active season. Point observation location is buffered by a minimum distance of 3,500 meters in order to be conservative about encompassing the maximum reported foraging distance for the congeneric Lasiurus borealis and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Mar 22, 2024)

Predicted Models: M 40% Moderate (inductive), L 60% Low (inductive)

M - Long-eared Myotis *(Myotis evotis)* SOC

4 2 + Y

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3**

Delineation Criteria Confirmed area of occupancy based on the documented presence (mistnet captures, definitively identified acoustic recordings, and definitively identified roosting individuals) of adults or juveniles. Point observation location is buffered by a minimum distance of 1,000 meters in order to encompass the average distances traveled from capture locations to roosts and between roosts in western Montana, Alberta, and Oregon and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. When cave locations are involved, point observations are mapped in the center of a one-square mile hexagon to protect the exact location of the cave entrance as per the Federal Cave Resource Protection Act and associated regulations (U.S. Code Title 16 Chapter 63, Code of Federal Regulations Title 43 Subtitle A Part 37). The outer edges of the hexagon are then buffered by a distance of 1,000 meters and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. All of the one-square mile hexagons intersecting this buffered area are presented as the Species Occurrence record. (Last Updated: Mar 22, 2023)

Predicted Models: M 30% Moderate (inductive), L 65% Low (inductive)

A - Western Toad *(Anaxyrus boreas)* SOC

2 6 + Y

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G4** State: **S2** USFS: **Sensitive - Known in Forests (BD, BRT, KOOT, LOLO)** BLM: **SENSITIVE** FWP SWAP: **SGCN2**

Delineation Criteria Standing water bodies or portions of large water bodies with confirmed evidence of reproduction (calling adults, eggs, larvae or new metamorphs) buffered by 100 meters in order to reflect importance of adjacent terrestrial habitats to survival of breeding adults and newly metamorphosed juveniles. (Last Updated: Mar 20, 2024)

Predicted Models: M 25% Moderate (inductive), L 40% Low (inductive)

M - Fringed Myotis *(Myotis thysanodes)* SOC

1 + Y

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G4** State: **S3** BLM: **SENSITIVE** FWP SWAP: **SGCN3**

Delineation Criteria Confirmed area of occupancy based on the documented presence (mistnet captures, definitively identified acoustic recordings, and definitively identified roosting individuals) of adults or juveniles. Point observation location is buffered by a minimum distance of 2,000 meters in order to encompass the range of distances traveled from capture locations to roosts in the Black Hills of South Dakota and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. When cave locations are involved, point observations are mapped in the center of a one-square mile hexagon to protect the exact location of the cave entrance as per the Federal Cave Resource Protection Act and associated regulations (U.S. Code Title 16 Chapter 63, Code of Federal Regulations Title 43 Subtitle A Part 37). The outer edges of the hexagon are then buffered by a distance of 2,000 meters and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. All of the one-square mile hexagons intersecting this buffered area are presented as the Species Occurrence record. (Last Updated: Jul 21, 2022)

Predicted Models: M 25% Moderate (inductive), L 35% Low (inductive)

B - Black-backed Woodpecker *(Picoides arcticus)* SOC

1 + Y

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** USFS: **Sensitive - Known in Forests (LOLO)** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **1**

Delineation Criteria Confirmed breeding area based on the presence of a nest, chicks, or territorial adults during the breeding season. Point observation location is buffered by a minimum distance of 1,000 meters in order to encompass the majority of home range sizes reported for the species and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Jun 28, 2023)

Predicted Models: M 20% Moderate (inductive), L 70% Low (inductive)

B - Pileated Woodpecker *(Dryocopus pileatus)* SOC

36 100 + Y

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **2**

Delineation Criteria Observations with evidence of breeding activity buffered by a minimum distance of 1,500 meters in order to be conservative about encompassing home ranges and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Dec 28, 2023)

Predicted Models: M 20% Moderate (inductive), L 25% Low (inductive)

M - Townsend's Big-eared Bat *(Corynorhinus townsendii)* SOC

1 Y

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G4** State: **S3** USFS: **Sensitive - Known in Forests (LOLO)** BLM: **SENSITIVE** FWP SWAP: **SGCN3**

Delineation Criteria Confirmed area of occupancy based on the documented presence (mistnet captures, definitively identified acoustic recordings, and definitively identified roosting individuals) of adults or juveniles. Point observation location is buffered by a distance of 4,500 meters in order to encompass the 95% confidence interval for nightly foraging distance reported for the species in California and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. When cave locations are involved, point observations are mapped in the center of a one-square mile hexagon to protect the exact location of the cave entrance as per the Federal Cave Resource Protection Act and associated regulations (U.S. Code Title 16 Chapter 63, Code of Federal Regulations Title 43 Subtitle A Part 37). The outer edges of the hexagon are then buffered by a distance of 4,500 meters and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. All of the one-square mile hexagons intersecting this buffered area are presented as the Species Occurrence record. (Last Updated: Jul 06, 2023)

Predicted Models: M 15% Moderate (inductive), L 25% Low (inductive)

B - Bobolink *(Dolichonyx oryzivorus)* SOC

7 5 + S M

View in Field Guide View Predicted Models View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA; BCC10; BCC11; BCC17** FWP SWAP: **SGCN3** PIF: **3**

Delineation Criteria Confirmed breeding area based on the presence of a nest, chicks, or territorial adults during the breeding season. Point observation location is buffered by a minimum distance of 150 meters in order to conservatively encompass male territory size reported for the species and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Dec 28, 2023)

Predicted Models: M 10% Moderate (inductive), L 65% Low (inductive)

B - Clark's Nutcracker *(Nucifraga columbiana)* SOC — 1 — 5 + — Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** USFS: **Species of Conservation Concern in Forests (FLAT)** FWP SWAP: **SGCN3** PIF: **3**

Delineation Criteria Observations with direct evidence of breeding activity or indirect evidence of breeding activity between early March and mid-July within forested habitats containing Whitebark Pine (Pinus albicaulis), Limber Pine (Pinus flexilis), or Ponderosa Pine (Pinus ponderosa). Observations are buffered by a minimum distance of 1,000 meters in order to encompass the spring/summer breeding territory size reported for the species or the locational uncertainty of the observation to a maximum distance of 10,000 meters. (Last Updated: Apr 03, 2024)

Predicted Models: M 5% Moderate (inductive), L 30% Low (inductive)

B - American Bittern *(Botaurus lentiginosus)* SOC — 1 — 1 — S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **3**

Delineation Criteria Wetlands and wetland complexes with evidence of breeding activity buffered by 1,000 meters in order to encompass reported home range sizes. Observations with poor spatial precision where an individual wetland or wetland complex cannot be identified with certainty will be buffered by the locational uncertainty and then an additional 1,000 meters out to a maximum distance of 10,000 meters. (Last Updated: Dec 27, 2023)

Predicted Models: L 60% Low (inductive)

B - Cassin's Finch *(Haemorhous cassinii)* SOC — 12 — 20 + — Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA; BCC10** FWP SWAP: **SGCN3** PIF: **3**

Delineation Criteria Observations with evidence of breeding activity buffered by a minimum distance of 300 meters in order to be conservative about encompassing the courtship and foraging distance from nesting areas and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Jun 30, 2023)

Predicted Models: L 45% Low (inductive)

V - Isoetes echinospora *(Spiny-spore Quillwort)* SOC — 1 — Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** Plant Threat Score: **No Known Threats** CCVI: **Less Vulnerable**

Predicted Models: L 35% Low (inductive)

M - Grizzly Bear *(Ursus arctos)* SOC — 7 — 1 — + — Y — H

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S2S3** USFWS: **LT** BLM: **THREATENED** FWP SWAP: **SGCN2-3**

Delineation Criteria Species Occurrence polygons represent areas delineated by the U.S. Fish and Wildlife Service (USFWS) that encompass both home ranges and potential transitory movements based on verified sightings. Within these areas, the USFWS wants project proponents to consider whether the species â€œmay be presentâ€ when evaluating the potential impacts of a project and to work with the USFWS to develop and implement best management practices to minimize or eliminate project effects on the species. (Last Updated: Dec 22, 2023)

Predicted Models: L 25% Low (inductive)

M - Fisher *(Pekania pennanti)* SOC — 1 — Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFS: **Sensitive - Known in Forests (LOLO)** BLM: **SENSITIVE** FWP SWAP: **SGCN3**

Delineation Criteria Confirmed area of occupancy based on the documented presence of adults or juveniles within tracking regions containing core habitat for the species. Outer boundaries of tracking regions are defined by areas of forest cover on individual mountain ranges or clusters of adjacent mountain ranges with continuous forest cover. (Last Updated: Dec 21, 2022)

Predicted Models: L 10% Low (inductive)

V - Mimulus ampliatus *(Stalk-leaved Monkeyflower)* SOC — 1 — + — Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G3** State: **S3** USFS: **Sensitive - Known in Forests (BD, BRT, KOOT)** Plant Threat Score: **No Known Threats** CCVI: **Highly Vulnerable**

Delineation Criteria Individual occurrences are generally based upon a discretely mapped area provided by an observer and are not separated by any pre-defined distance. Individual clusters of plants mapped at fine spatial scales (separated by less than approximately 25-50 meters) may be grouped together into one occurrence if they are not separated by distinct areas of habitat or terrain features. Point observations are buffered to encompass any locational uncertainty associated with the observation. (Last Updated: Mar 07, 2024)

Predicted Models: L 5% Low (inductive)

B - Brewer's Sparrow *(Spizella breweri)* SOC — 1 — S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**

Delineation Criteria Confirmed breeding area based on the presence of a nest, chicks, or territorial adults during the breeding season. Point observation location is buffered by a minimum distance of 100 meters in order to encompass the maximum territory size reported for the species and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Mar 21, 2024)

Predicted Models: L 5% Low (inductive)

B - Varied Thrush *(Ixoreus naevius)* SOC — 5 — 1 + — S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **3**

Delineation Criteria Confirmed breeding area based on the presence of a nest, chicks, or territorial adults during the breeding season. Point observation location is buffered by a minimum distance of 225 meters in order to encompass the reported minimum stand size occupied by breeding pairs and otherwise is buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Dec 28, 2023)

Predicted Models: L 5% Low (inductive)

B - Brown Creeper *(Certhia americana)* SOC — 3 — 31 + — Not Assessed — Y

View in Field Guide | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **1**

Delineation Criteria Observations with evidence of breeding activity buffered by a minimum distance of 300 meters in order to be conservative about encompassing home ranges and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Jun 29, 2023)

B - Pacific Wren *(Troglodytes pacificus)* SOC — 3 — 5 — Not Assessed — Y

View in Field Guide | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **2**

Delineation Criteria Observations with evidence of breeding activity buffered by a minimum distance of 300 meters in order to be conservative about encompassing home ranges and otherwise buffered by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Apr 03, 2024)

I - Stygobromus tritus *(A Subterranean Amphipod)* SOC | 1 | + | Not Assessed | Y

View in Field Guide **View Range Maps**

Species of Concern - Native Species Global: **G1** State: **S1S2**

Delineation Criteria Confirmed breeding area based on the presence of a resident animal of any age. Point observation location is buffered by a minimum distance of 300 meters in order to encompass the cave system the species is dependent on. (Last Updated: Jan 17, 2008)

V - Phlox missoulensis *(Missoula Phlox)* SOC | 1 | + | Not Assessed | Y

View in Field Guide **View Range Maps**

USFS: **Sensitive - Known in Forests (BD)**
Sensitive - Suspected in Forests (LOLO)

Species of Concern - Native Species Global: **G3** State: **S3** **Species of Conservation Concern in Forests (HLC)** CCVI: **Highly Vulnerable**

Delineation Criteria Individual occurrences are generally based upon a discretely mapped area provided by an observer and are not separated by any pre-defined distance. Individual clusters of plants mapped at fine spatial scales (separated by less than approximately 25-50 meters) may be grouped together into one occurrence if they are not separated by distinct areas of habitat or terrain features. Point observations are buffered to encompass any locational uncertainty associated with the observation. (Last Updated: Mar 07, 2024)

O - Bat Roost (Cave) *(Bat Roost (Cave))* IAH | 1 | Not Assessed

View in Field Guide

Important Animal Habitat - Native Species Global: **GNR** State: **SNR**

Delineation Criteria Confirmed occupancy of a cave based on the documented presence of adults or juveniles of any bat species. Point observation locations are mapped in the center of a one-square mile hexagon to protect the exact location of the cave entrance as per the Federal Cave Resource Protection Act and associated regulations (U.S. Code Title 16 Chapter 63, Code of Federal Regulations Title 43 Subtitle A Part 37). The outer edges of the hexagon are then buffered by a distance of 4,500 meters in order to encompass the 95% confidence interval for nightly foraging distance reported for Townsendâ€™s Big-eared Bat (a resident Montana bat Species of Concern) and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. All of the one-square mile hexagons intersecting this buffered area are presented as the Species Occurrence record. (Last Updated: Sep 05, 2017)

O - Bat Roost (Non-Cave) *(Bat Roost (Non-Cave))* IAH | 13 | Not Assessed

View in Field Guide

Important Animal Habitat - Native Species Global: **GNR** State: **SNR**

Delineation Criteria Confirmed area of occupancy based on the documented presence of adults or juveniles of any bat species at non-cave natural roost sites (e.g. rock outcrops, trees), below ground human created roost sites (e.g. mines), and above ground human created roost sites (e.g., bridges, buildings). Point observation locations are buffered by a distance of 4,500 meters in order to encompass the 95% confidence interval for nightly foraging distance reported for Townsendâ€™s Big-eared Bat (a resident Montana bat Species of Concern) and otherwise by the locational uncertainty associated with the observation up to a maximum distance of 10,000 meters. (Last Updated: Oct 22, 2019)

MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**

Legend

Model Icons
- N Suitable (native range)
- O Optimal Suitability
- M Moderate Suitability
- L Low Suitability
- I Suitable (introduced range)

Habitat Icons
- C Common
- O Occasional

Range Icons
- Y Native / Year-round
- S Summer
- W Winter
- M Migratory
- N Non-native
- H Historical

Num Obs
Count of obs with 'good precision' (<=1000m)
+ indicates additional 'poor precision' obs (1001m-10,000m)



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Native Species

Summarized by: **24prvt0310** *(Custom Area of Interest)*
Filtered by:
Native Species reports are filtered for Species with MT Status = Species of Concern, Special Status, Important Animal Habitat, Potential SOC

Other Observed Species

	USFWS Sec7	# Obs	Predicted Model	Range
B - Hooded Merganser *(Lophodytes cucullatus)* **PSOC**		60 +		Y M
B - Barrow's Goldeneye *(Bucephala islandica)* **PSOC**		43		Y W M
B - Rufous Hummingbird *(Selasphorus rufus)* **PSOC**		10		S M
B - Western Screech-Owl *(Megascops kennicottii)* **PSOC**		2 +		Y
B - American White Pelican *(Pelecanus erythrorhynchos)* **SOC**		3 +		S M
B - Trumpeter Swan *(Cygnus buccinator)* **SOC**		7		Y M
B - Long-billed Curlew *(Numenius americanus)* **SOC**		+		S M
M - Silver-haired Bat *(Lasionycteris noctivagans)* **PSOC**		1 +		Y
B - Horned Grebe *(Podiceps auritus)* **SOC**		1		S M
B - Black Tern *(Chlidonias niger)* **SOC**		+		S M
B - Ovenbird *(Seiurus aurocapilla)* **PSOC**		1 +		S M
B - Black-necked Stilt *(Himantopus mexicanus)* **SOC**		1		S M

View in Field Guide **View Predicted Models** **View Range Maps**
Potential Species of Concern - Native Species Global: **G5** State: **S4** USFWS: **MBTA** FWP SWAP: **SGIN** PIF: **2**
Predicted Models: O 80% Optimal (inductive), M 15% Moderate (inductive), L 5% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Potential Species of Concern - Native Species Global: **G5** State: **S4** USFWS: **MBTA** FWP SWAP: **SGIN** PIF: **2**
Predicted Models: O 25% Optimal (inductive), M 75% Moderate (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Potential Species of Concern - Native Species Global: **G4** State: **S4B** USFWS: **MBTA; BCC10** PIF: **3**
Predicted Models: O 5% Optimal (inductive), M 90% Moderate (inductive), L 5% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Potential Species of Concern - Native Species Global: **G4G5** State: **S3S4** USFWS: **MBTA** FWP SWAP: **SGIN** PIF: **3**
Predicted Models: O 5% Optimal (inductive), M 65% Moderate (inductive), L 25% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G4** State: **S3B** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **3**
Predicted Models: M 70% Moderate (inductive), L 30% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G4** State: **S3** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **1**
Predicted Models: M 45% Moderate (inductive), L 55% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G4** State: **S3B** USFWS: **MBTA; BCC11** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**
Predicted Models: M 20% Moderate (inductive), L 80% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Potential Species of Concern - Native Species Global: **G3G4** State: **S4**
Predicted Models: M 10% Moderate (inductive), L 85% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**
Predicted Models: M 5% Moderate (inductive), L 75% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G4G5** State: **S3B** USFWS: **MBTA; BCC10; BCC11; BCC17** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**
Predicted Models: M 5% Moderate (inductive), L 60% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Potential Species of Concern - Native Species Global: **G5** State: **S4B** USFWS: **MBTA** PIF: **3**
Predicted Models: L 80% Low (inductive)

View in Field Guide **View Predicted Models** **View Range Maps**
Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **3**
Predicted Models: L 75% Low (inductive)

B - Harlequin Duck *(Histrionicus histrionicus)* **SOC** | + | S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S2B** USFWS: **MBTA** USFS: **Sensitive - Known in Forests (BD, KOOT, LOLO)** **Sensitive - Migratory in Forests (BRT)** FWP SWAP: **SGCN2** PIF: **1**

Predicted Models: L 75% Low (inductive)

B - Short-eared Owl *(Asio flammeus)* **PSOC** | 6 + | Y

View in Field Guide | View Predicted Models | View Range Maps

Potential Species of Concern - Native Species Global: **G5** State: **S4** USFWS: **MBTA; BCC11; BCC17** PIF: **3**

Predicted Models: L 40% Low (inductive)

B - Forster's Tern *(Sterna forsteri)* **SOC** | + | S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**

Predicted Models: L 35% Low (inductive)

B - Great Gray Owl *(Strix nebulosa)* **SOC** | 1 + | Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3, SGIN** PIF: **3**

Predicted Models: L 10% Low (inductive)

B - American Goshawk *(Accipiter atricapillus)* **SOC** | 9 | Y W M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **2**

Predicted Models: L 5% Low (inductive)

B - Golden Eagle *(Aquila chrysaetos)* **SOC** | 26 + | Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **BGEPA; MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3**

Predicted Models: L 5% Low (inductive)

B - Flammulated Owl *(Psiloscops flammeolus)* **SOC** | + | S M

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S3B** USFWS: **MBTA; BCC10** USFS: **Sensitive - Known in Forests (LOLO)** **Species of Conservation Concern in Forests (FLAT, HLC)** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **1**

Predicted Models: L 5% Low (inductive)

B - Boreal Owl *(Aegolius funereus)* **PSOC** | 4 | Not Assessed | Y

View in Field Guide | View Range Maps

Potential Species of Concern - Native Species Global: **G5** State: **S3S4** USFWS: **MBTA** FWP SWAP: **SGIN** PIF: **3**

I - Melanoplus missoulae *(A spur-throat grasshopper)* **SSS** | + | Not Assessed | Y

View in Field Guide | View Range Maps

Special Status Species - Native Species Global: **G1** State: **SNR**

B - Northern Hawk Owl *(Surnia ulula)* **SOC** | + | Not Assessed | W M

View in Field Guide | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **MBTA** FWP SWAP: **SGCN3, SGIN**

B - Black-and-white Warbler *(Mniotilta varia)* **PSOC** | 1 | Not Assessed | M

View in Field Guide | View Range Maps

Potential Species of Concern - Native Species Global: **G5** State: **S4B** USFWS: **MBTA**

B - Common Loon *(Gavia immer)* **SOC** | 1 | Not Assessed | M

View in Field Guide | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** USFS: **Sensitive - Known in Forests (LOLO)** FWP SWAP: **SGCN3** PIF: **1**

B - Ferruginous Hawk *(Buteo regalis)* **SOC** | 18 | Not Assessed | M

View in Field Guide | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S3B** USFWS: **MBTA; BCC17** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**

B - White-faced Ibis *(Plegadis chihi)* **SOC** | 1 | Not Assessed | M

View in Field Guide | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **2**

B - Burrowing Owl *(Athene cunicularia)* **SOC** | + | Not Assessed

View in Field Guide

Species of Concern - Native Species Global: **G4** State: **S3B** USFWS: **MBTA; BCC17** BLM: **SENSITIVE** FWP SWAP: **SGCN3** PIF: **1**

F - Lake Trout *(Salvelinus namaycush)* **SOC** | + | Not Assessed | N

View in Field Guide | View Range Maps

Species of Concern - Native/Non-native Species - (depends on location or taxa) Global: **G5** State: **S2** FWP SWAP: **SGCN2**

V - Senecio hydrophilus *(Alkali-marsh Ragwort)* **SOC** | + | Not Assessed

View in Field Guide

Species of Concern - Native Species Global: **G5** State: **S3** Plant Threat Score: **No Known Threats**

MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**

Legend

Model Icons
- N Suitable (native range)
- O Optimal Suitability
- M Moderate Suitability
- L Low Suitability
- I Suitable (introduced range)

Habitat Icons
- C Common
- O Occasional

Range Icons
- Y Native / Year-round
- S Summer
- W Winter
- M Migratory
- N Non-native
- H Historical

Num Obs
Count of obs with 'good precision' (<=1000m)
+ indicates additional 'poor precision' obs (1001m-10,000m)



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Native Species

Summarized by: **24prvt0310** *(Custom Area of Interest)*
Filtered by:
Native Species reports are filtered for Species with MT Status = Species of Concern, Special Status, Important Animal Habitat, Potential SOC

Other Potential Species

M - Western Spotted Skunk *(Spilogale gracilis)* PSOC

View in Field Guide | View Predicted Models | View Range Maps
Potential Species of Concern - Native Species Global: **G5** State: **SU** FWP SWAP: **SGIN**
Predicted Models: O 25% Optimal (inductive), M 75% Moderate (inductive)

I - Leucotrichia notosa *(A Caddisfly)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G2G4** State: **S3**
Predicted Models: O 20% Optimal (inductive), M 15% Moderate (inductive), L 25% Low (inductive)

V - Impatiens aurella *(Pale-yellow Jewel-weed)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G4** State: **S3** Plant Threat Score: **No Known Threats**
Predicted Models: O 10% Optimal (inductive), M 90% Moderate (inductive)

V - Dichanthelium acuminatum *(Panic Grass)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G5** State: **S2S3** Plant Threat Score: **Unknown**
Predicted Models: O 10% Optimal (inductive), M 80% Moderate (inductive), L 5% Low (inductive)

V - Wolffia columbiana *(Columbia Water-meal)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G5** State: **S2S3** Plant Threat Score: **No Known Threats**
Predicted Models: O 5% Optimal (inductive), M 90% Moderate (inductive), L 5% Low (inductive)

B - Yellow-billed Cuckoo *(Coccyzus americanus)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **PS: LT; MBTA** BLM: **THREATENED** FWP SWAP: **SGCN3, SGIN** PIF: **2**
Predicted Models: O 5% Optimal (inductive), M 90% Moderate (inductive), L 5% Low (inductive)

B - Broad-tailed Hummingbird *(Selasphorus platycercus)* PSOC

View in Field Guide | View Predicted Models | View Range Maps
Potential Species of Concern - Native Species Global: **G5** State: **S4B** USFWS: **MBTA; BCC10** FWP SWAP: **SGIN**
Predicted Models: O 5% Optimal (inductive), M 70% Moderate (inductive), L 25% Low (inductive)

V - Eleocharis rostellata *(Beaked Spikerush)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G5** State: **S3** USFS: **Species of Conservation Concern in Forests (CG, FLAT, HLC)** Plant Threat Score: **Unknown**
CCVI: **Less Vulnerable**
Predicted Models: O 5% Optimal (inductive), M 70% Moderate (inductive), L 15% Low (inductive)

V - Cypripedium parviflorum *(Small Yellow Lady's-slipper)* PSOC

View in Field Guide | View Predicted Models | View Range Maps
USFS: **Sensitive - Known in Forests (LOLO)**
Potential Species of Concern - Native Species Global: **G5** State: **S3S4** **Species of Conservation Concern in Forests (CG, HLC)**
Predicted Models: O 5% Optimal (inductive), M 20% Moderate (inductive), L 70% Low (inductive)

B - Black-crowned Night-Heron *(Nycticorax nycticorax)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G5** State: **S3B** USFWS: **MBTA** FWP SWAP: **SGCN3** PIF: **3**
Predicted Models: O 5% Optimal (inductive), M 10% Moderate (inductive), L 60% Low (inductive)

V - Utricularia intermedia *(Flatleaf Bladderwort)* SOC

View in Field Guide | View Predicted Models | View Range Maps
Species of Concern - Native Species Global: **G5** State: **S2** USFS: **Sensitive - Known in Forests (KOOT)** Plant Threat Score: **No Known Threats**
Predicted Models: M 95% Moderate (inductive), L 5% Low (inductive)

M - North American Porcupine *(Erethizon dorsatum)* PSOC

View in Field Guide | View Predicted Models | View Range Maps
Potential Species of Concern - Native Species Global: **G5** State: **S3S4** FWP SWAP: **SGIN**
Predicted Models: M 80% Moderate (inductive), L 20% Low (inductive)

V - Psilocarphus brevissimus *(Dwarf woolly-heads)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S2S3** Plant Threat Score: **No Known Threats**

Predicted Models: M 60% Moderate (inductive), L 15% Low (inductive)

R - Snapping Turtle *(Chelydra serpentina)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native/Non-native Species - (depends on location or taxa) Global: **G5** State: **S3** BLM: **SENSITIVE** FWP SWAP: **SGCN3, SGIN**

Predicted Models: M 55% Moderate (inductive), L 45% Low (inductive)

I - Oreohelix haydeni *(Lyrate Mountainsnail)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G2** State: **S1S3**

Predicted Models: M 35% Moderate (inductive), L 60% Low (inductive)

V - Juncus covillei *(Coville's Rush)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S2S3** Plant Threat Score: **No Known Threats**

Predicted Models: M 30% Moderate (inductive), L 60% Low (inductive)

V - Carex crawei *(Crawe's Sedge)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S2S3** Plant Threat Score: **Low**

Predicted Models: M 30% Moderate (inductive), L 55% Low (inductive)

V - Botrychium lineare *(Linearleaf Moonwort)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G3** State: **S1S2** USFS: **Sensitive - Known in Forests (KOOT)** CCVI: **Less Vulnerable**

Predicted Models: M 25% Moderate (inductive), L 50% Low (inductive)

V - Penstemon flavescens *(Yellow Beardtongue)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G3** State: **S3** USFS: **Sensitive - Known in Forests (BD)** Plant Threat Score: **No Known Threats** CCVI: **Highly Vulnerable**

Predicted Models: M 20% Moderate (inductive), L 10% Low (inductive)

B - Meesia triquetra *(Meesia Moss)* SOC

View in Field Guide | View Predicted Models | View Range Maps

USFS: **Sensitive - Known in Forests (BD, BRT, KOOT)**
Sensitive - Suspected in Forests (LOLO)

Species of Concern - Native Species Global: **G5** State: **S2** **Species of Conservation Concern in Forests (CG, FLAT)**

Predicted Models: M 15% Moderate (inductive), L 85% Low (inductive)

V - Centunculus minimus *(Chaffweed)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S2** Plant Threat Score: **No Known Threats**

Predicted Models: M 15% Moderate (inductive), L 50% Low (inductive)

I - Margaritifera falcata *(Western Pearlshell)* SOC

View in Field Guide | View Predicted Models | View Range Maps

USFS: **Sensitive - Known in Forests (BD, BRT, KOOT, LOLO)**

Species of Concern - Native Species Global: **G5** State: **S2** **Species of Conservation Concern in Forests (CG, HLC)** BLM: **SENSITIVE** FWP SWAP: **SGCN2**

Predicted Models: M 15% Moderate (inductive), L 45% Low (inductive)

M - Western Pygmy Shrew *(Sorex eximius)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S3** FWP SWAP: **SGCN3**

Predicted Models: M 15% Moderate (inductive), L 35% Low (inductive)

M - Yuma Myotis *(Myotis yumanensis)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** FWP SWAP: **SGIN**

Predicted Models: M 15% Moderate (inductive), L 15% Low (inductive)

V - Elodea bifoliata *(Long-sheath Waterweed)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4G5** State: **S2?** Plant Threat Score: **No Known Threats**

Predicted Models: M 10% Moderate (inductive), L 90% Low (inductive)

V - Stellaria crassifolia *(Fleshy Stitchwort)* SOC

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S2** Plant Threat Score: **No Known Threats**

Predicted Models: M 5% Moderate (inductive), L 55% Low (inductive)

V - Draba densifolia *(Dense-leaf Draba)* SOC

View in Field Guide | View Predicted Models | View Range Maps

USFS: **Sensitive - Known in Forests (BD, BRT)**

Species of Concern - Native Species Global: **G5** State: **S2** **Species of Conservation Concern in Forests (CG, HLC)** Plant Threat Score: **Low**
CCVI: **Moderately Vulnerable**

Predicted Models: M 5% Moderate (inductive), L 25% Low (inductive)

V - Ligusticum verticillatum *(Idaho Lovage)* **SOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4G5** State: **S3** Plant Threat Score: **No Known Threats**

Predicted Models: M 5% Moderate (inductive), L 5% Low (inductive)

R - Northern Alligator Lizard *(Elgaria coerulea)* **SOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** FWP SWAP: **SGCN3, SGIN**

Predicted Models: L 100% Low (inductive)

B - Common Poorwill *(Phalaenoptilus nuttallii)* **PSOC** S M

View in Field Guide | View Predicted Models | View Range Maps

Potential Species of Concern - Native Species Global: **G5** State: **S4B** USFWS: **MBTA** FWP SWAP: **SGIN** PIF: **3**

Predicted Models: L 95% Low (inductive)

M - Canada Lynx *(Lynx canadensis)* **SOC** 7 Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S3** USFWS: **LT; CH** BLM: **THREATENED** FWP SWAP: **SGCN3**

Predicted Models: L 85% Low (inductive)

V - Ranunculus hyperboreus *(High Northern Buttercup)* **PSOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Potential Species of Concern - Native Species Global: **G5** State: **S3S4** Plant Threat Score: **No Known Threats**

Predicted Models: L 35% Low (inductive)

V - Mimulus floribundus *(Floriferous Monkeyflower)* **SOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **SH** Plant Threat Score: **No Known Threats** CCVI: **Highly Vulnerable**

Predicted Models: L 30% Low (inductive)

V - Trichophorum cespitosum *(Tufted Club-rush)* **SOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S2** USFS: **Species of Conservation Concern in Forests (FLAT)** Plant Threat Score: **No Known Threats** CCVI: **Moderately Vulnerable**

Predicted Models: L 30% Low (inductive)

V - Botrychium hesperium *(Western Moonwort)* **SOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S3** CCVI: **Less Vulnerable**

Predicted Models: L 25% Low (inductive)

I - Rhyacophila betteni *(A Caddisfly)* **SSS** Y

View in Field Guide | View Predicted Models | View Range Maps

Special Status Species - Native Species Global: **G2G4** State: **S3S4**

Predicted Models: L 20% Low (inductive)

V - Drosera rotundifolia *(Roundleaf Sundew)* **PSOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Potential Species of Concern - Native Species Global: **G5** State: **S3S4** Plant Threat Score: **Unknown**

Predicted Models: L 20% Low (inductive)

V - Musineon vaginatum *(Rydberg's Parsley)* **PSOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Potential Species of Concern - Native Species Global: **G3G4** State: **S3S4** Plant Threat Score: **Medium - Low**

Predicted Models: L 20% Low (inductive)

V - Stipa lettermanii *(Letterman's Needlegrass)* **SOC** Y

View in Field Guide | View Predicted Models | View Range Maps

Species of Concern - Native Species Global: **G5** State: **S1S3** USFS: **Species of Conservation Concern in Forests (HLC)** Plant Threat Score: **No Known Threats**

Predicted Models: L 20% Low (inductive)

M - Wolverine *(Gulo gulo)* **SOC** 7 Not Assessed Y

View in Field Guide | View Range Maps

Species of Concern - Native Species Global: **G4** State: **S3** USFWS: **LT** USFS: **Sensitive - Known in Forests (LOLO)** BLM: **SENSITIVE** FWP SWAP: **SGCN3**

B - Red Knot *(Calidris canutus)* **SSS** 7 Not Assessed

View in Field Guide

Special Status Species - Native Species Global: **G4** State: **SNA** USFWS: **LT; MBTA** BLM: **THREATENED**

MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Structured Surveys

Summarized by: **24prvt0310** *(Custom Area of Interest)*

The Montana Natural Heritage Program (MTNHP) records information on the locations where more than 80 different types of well-defined repeatable survey protocols capable of detecting an animal species or suite of animal species have been conducted by state, federal, tribal, university, or private consulting biologists. Examples of structured survey protocols tracked by MTNHP include: visual encounter and dip net surveys for pond breeding amphibians, point counts for birds, call playback surveys for selected bird species, visual surveys of migrating raptors, kick net stream reach surveys for macroinvertebrates, visual encounter cover object surveys for terrestrial mollusks, bat acoustic or mist net surveys, pitfall and/or snap trap surveys for small terrestrial mammals, track or camera trap surveys for large mammals, and trap surveys for turtles. Whenever possible, photographs of survey locations are stored in MTNHP databases.

MTNHP does not typically manage information on structured surveys for plants; surveys for invasive species may be a future exception.

Within the report area you have requested, structured surveys are summarized by the number of each type of structured survey protocol that has been conducted, the number of species detections/observations resulting from these surveys, and the most recent year a survey has been conducted.

AR-Amphibian/Reptile Lentic *(Lentic Amphibian/Reptile Surveys)*	**Survey Count**: 4	**Obs Count**:	**Recent Survey**: 2002
B-Bald Eagle Nest *(Bald Eagle Nest Survey)*	**Survey Count**: 23	**Obs Count**: 23	**Recent Survey**: 2018
B-Great Blue Heron Rookery *(Great Blue Heron Rookery)*	**Survey Count**: 1	**Obs Count**:	**Recent Survey**: 2021
B-Long-billed Curlew *(Long-billed Curlew, Road-based, Point Count)*	**Survey Count**: 1	**Obs Count**:	**Recent Survey**: 2012
B-Owl Banding *(ORI Owl Nest Survey and Banding)*	**Survey Count**: 222	**Obs Count**: 223	**Recent Survey**: 2011
B-Point Count *(Bird Point Count)*	**Survey Count**: 4	**Obs Count**: 36	**Recent Survey**: 1993
B-Raptor nest *(Raptor Nest Survey)*	**Survey Count**: 8	**Obs Count**: 8	**Recent Survey**: 2010
B-Waterbird/Shorebird *(Colonial-nesting Waterbird/Shorebird/Waterfowl Surveys)*	**Survey Count**: 3	**Obs Count**:	**Recent Survey**: 2011
E-Eurasian Water-milfoil Rake *(Rake tows/pulls for Eurasian Water-milfoil)*	**Survey Count**: 22	**Obs Count**: 25	**Recent Survey**: 2019
E-Kicknet *(Kicknet Collection Survey for Invasive Mussels and Snails)*	**Survey Count**: 3	**Obs Count**: 1	**Recent Survey**: 2019
E-Noxious Weed, Road-based *(Noxious Weed Road-based Visual Surveys)*	**Survey Count**: 22	**Obs Count**: 49	**Recent Survey**: 2003
E-Noxious Weed, Visual *(Noxious Weed Visual Surveys)*	**Survey Count**: 3	**Obs Count**: 62	**Recent Survey**: 2009
E-Visual Aquatic Invasives *(Visual Encounter Surveys for Aquatic Invasives on Shorelines or Underwater)*	**Survey Count**: 9	**Obs Count**: 4	**Recent Survey**: 2018
I-Aquatic Invert Lotic Dipnet *(Invertebrate Lotic Site Dipnet and Visual Encounter Survey)*	**Survey Count**: 5	**Obs Count**: 58	**Recent Survey**: 2003
I-Mosquito Traps *(Montana Mosquito Surveillance Project)*	**Survey Count**: 2	**Obs Count**: 24	**Recent Survey**: 2014
I-Mussel *(Stream Mussel Survey)*	**Survey Count**: 2	**Obs Count**:	**Recent Survey**: 2007
M-Bat Acoustic *(Bat Acoustic Survey)*	**Survey Count**: 2	**Obs Count**: 9	**Recent Survey**: 2010
M-Bat Roost (Active Season) *(Bat Roost (Active Season) Survey)*	**Survey Count**: 4	**Obs Count**: 2	**Recent Survey**: 2014
P-Algal scraping *(Algal Scraping)*	**Survey Count**: 2	**Obs Count**: 66	**Recent Survey**: 2004

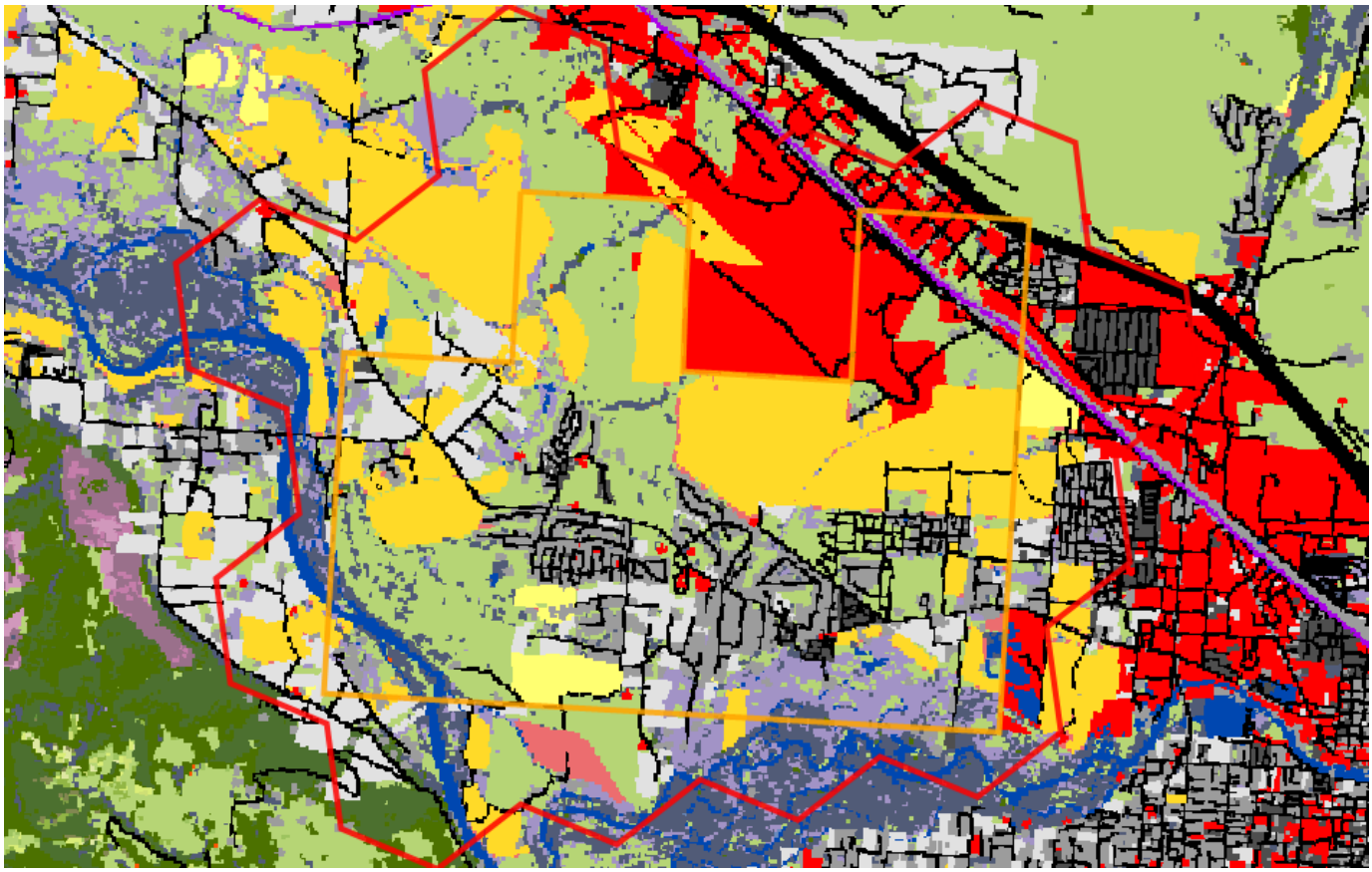
MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Land Cover

Summarized by: **24prvt0310** *(Custom Area of Interest)*





22% (*2,866 Acres*)

Grassland Systems
Montane Grassland
Rocky Mountain Lower Montane, Foothill, and Valley Grassland

This grassland system of the northern Rocky Mountains is found at lower montane to foothill elevations in mountains and valleys throughout Montana. These grasslands are floristically similar to Big Sagebrush Steppe but are defined by shorter summers, colder winters, and young soils derived from recent glacial and alluvial material. They are found at elevations from 548 - 1,650 meters (1,800-5,413 feet). In the lower montane zone, they range from small meadows to large open parks surrounded by conifers; below the lower treeline, they occur as extensive foothill and valley grasslands. Soils are relatively deep, fine-textured, often with coarse fragments, and non-saline. Microphytic crust may be present in high-quality occurrences. This system is typified by cool-season perennial bunch grasses and forbs (>25%) cover, with a sparse shrub cover (<10%). Rough fescue (*Festuca campestris*) is dominant in the northwestern portion of the state and Idaho fescue (*Festuca idahoensis*) is dominant or co-dominant throughout the range of the system. Bluebunch wheatgrass (*Pseudoroegneria spicata*) occurs as a co-dominant throughout the range as well, especially on xeric sites. Western wheatgrass (*Pascopyrum smithii*) is consistently present, often with appreciable coverage (>10%) in lower elevation occurrences in western Montana and virtually always present, with relatively high coverages (>25%), on the edge of the Northwestern Great Plains region. Species diversity ranges from a high of more than 50 per 400 square meter plot on mesic sites to 15 (or fewer) on xeric and disturbed sites. Most occurrences have at least 25 vascular species present. Farmland conversion, noxious species invasion, fire suppression, heavy grazing and oil and gas development are major threats to this system.



19% (*2,483 Acres*)

Human Land Use
Agriculture
Cultivated Crops

These areas used for the production of crops, such as corn, soybeans, small grains, sunflowers, vegetables, and cotton, typically on an annual cycle. Agricultural plant cover is variable depending on season and type of farming. Other areas include more stable land cover of orchards and vineyards.

No Image

11% (*1,421 Acres*)

Human Land Use
Developed
Commercial / Industrial

Businesses, industrial parks, hospitals, airports; utilities in commercial/industrial areas.

No Image

10% (*1,269 Acres*)

Human Land Use
Developed
Other Roads

County, city and or rural roads generally open to motor vehicles.



8% (*1,050 Acres*)

Human Land Use
Developed
Low Intensity Residential

Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-50% of total cover. These areas most commonly include single-family housing units in rural and suburban areas. Paved roadways may be classified into this category.



7% (*872 Acres*)

Wetland and Riparian Systems
Floodplain and Riparian
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland

This ecological system is found throughout the Rocky Mountain and Colorado Plateau regions. In Montana, sites occur at elevations of 609-1,219 meters (2,000-4,000 feet) west of the Continental Divide. East of the Continental Divide, this system ranges up to 1,676 meters (5,500 feet). It generally comprises a mosaic of multiple communities that are tree-dominated with a diverse shrub component. It is dependent on a natural hydrologic regime with annual to episodic flooding, so it is usually found within the flood zone of rivers, on islands, sand or cobble bars, and along streambanks. It can form large, wide occurrences on mid-channel islands in larger rivers, or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains, swales and irrigation ditches. In some locations, occurrences extend into moderately high intermountain basins where the adjacent vegetation is sage steppe. Black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) is the key indicator species. Other dominant trees may include boxelder maple (*Acer negundo*), narrowleaf cottonwood (*Populus angustifolia*), eastern cottonwood (*Populus deltoides*), Douglas-fir (*Pseudotsuga menziesii*), peachleaf willow (*Salix amygdaloides*), or Rocky Mountain juniper (*Juniperus scopulorum*). Dominant shrubs include Rocky Mountain maple (*Acer glabrum*), thinleaf alder (*Alnus incana*), river birch (*Betula occidentalis*), redoiser dogwood (*Cornus sericea*), hawthorne (*Crataegus* species), chokecherry (*Prunus virginiana*), skunkbush sumac (*Rhus trilobata*), willows (*Salix* species), rose (*Rosa* species), silver buffaloberry (*Shepherdia argentea*), or snowberry (*Symphoricarpos* species).



7% (*860 Acres*)

Human Land Use
Developed
Developed, Open Space

Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Impervious surfaces account for less than 20% of total cover. This category often includes highway and railway rights of way and graveled rural roads.



6% (*745 Acres*)

Wetland and Riparian Systems
Wet meadow
Alpine-Montane Wet Meadow

These moderate-to-high-elevation systems are found throughout the Rocky Mountains, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. Occurrences range in elevation from montane to alpine at 1,000 to 3,353 meters (3,280-11,000 feet). This system typically occurs in cold, moist basins, seeps and alluvial terraces of headwater streams or as a narrow strip adjacent to alpine lakes (Hansen et al., 1996). Wet meadows are typically found on flat areas or gentle slopes, but may also occur on sub-irrigated sites with slopes up to 10 percent. In alpine regions, sites are typically small depressions located below late-melting snow patches or on snowbeds. The growing season may only last for one to two months. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations, often dominated by graminoids such as tufted hairgrass (*Deschampsia caespitosa*), and a diversity of montane or alpine sedges such as small-head sedge (*Carex illota*), small-winged sedge (*Carex microptera*), black alpine sedge (*Carex nigricans*), Holmâ€™s Rocky Mountain sedge (*Carex scopulorum*) shortstalk sedge (*Carex podocarpa*) and Paysonâ€™s sedge (*Carex paysonis*). Drummondâ€™s rush (*Juncus drummondii*), Mertenâ€™s rush (*Juncus mertensianus*), and high elevation bluegrasses (*Poa arctica* and *Poa alpina*) are often present. Forbs such as arrow-leaf groundsel (*Senecio triangularis*), slender-sepal marsh marigold (*Caltha leptosepala*), and spreading globeflower (*Trollius laxus*) often form high cover in higher elevation meadows. Wet meadows are associated with snowmelt and are usually not subjected to high disturbance events such as flooding.



3% (*399 Acres*)

Wetland and Riparian Systems
Open Water
Open Water

All areas of open water, generally with less than 25% cover of vegetation or soil

Additional Limited Land Cover

1% (*190 Acres*) Pasture/Hay
1% (*152 Acres*) High Intensity Residential
1% (*148 Acres*) Introduced Upland Vegetation - Annual and Biennial Forbland
1% (*114 Acres*) Rocky Mountain Mesic Montane Mixed Conifer Forest
1% (*107 Acres*) Interstate
<1% (*53 Acres*) Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest
<1% (*46 Acres*) Railroad
<1% (*4 Acres*) Emergent Marsh
<1% (*3 Acres*) Rocky Mountain Ponderosa Pine Woodland and Savanna
<1% (*2 Acres*) Insect-Killed Forest
<1% (*0 Acres*) Major Roads
<1% (*0 Acres*) Rocky Mountain Montane-Foothill Deciduous Shrubland
<1% (*0 Acres*) Rocky Mountain Subalpine-Montane Mesic Meadow

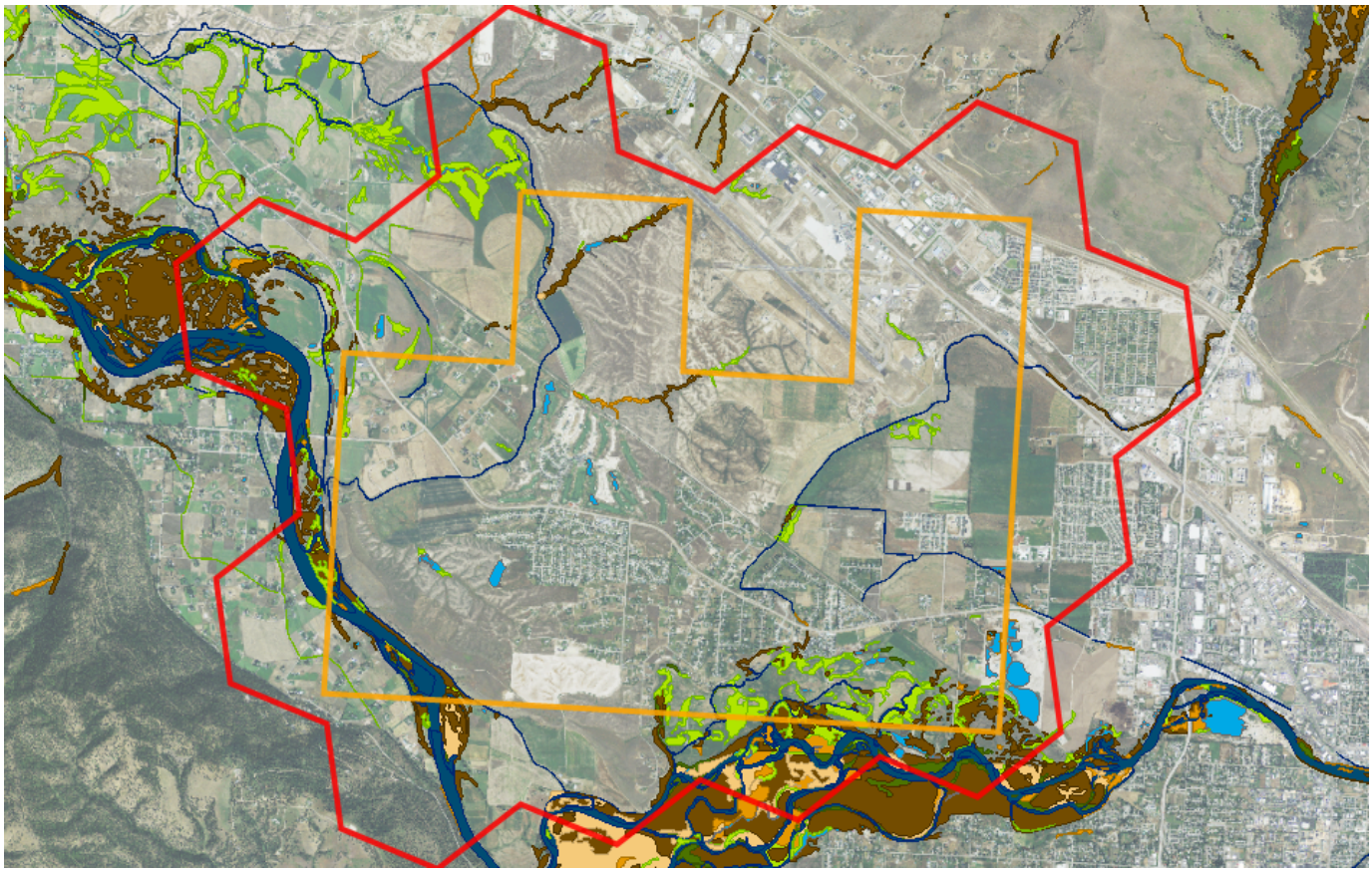
MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Wetland and Riparian

Summarized by: **24prvt0310** *(Custom Area of Interest)*



Wetland and Riparian Mapping

P - Palustrine

UB - Unconsolidated Bottom

F - Semipermanently Flooded	<1 Acres	
(no modifier)	**<1 Acres**	**PUBF**

P - Palustrine, UB - Unconsolidated Bottom
Wetlands where mud, silt or similar fine particles cover at least 25% of the bottom, and where vegetation cover is less than 30%.

AB - Aquatic Bed

F - Semipermanently Flooded	74 Acres	
(no modifier)	**9 Acres**	**PABF**
b - Beaver	**1 Acres**	**PABFb**
h - Diked/Impounded	**17 Acres**	**PABFh**
x - Excavated	**47 Acres**	**PABFx**
G - Intermittently Exposed	5 Acres	
x - Excavated	**5 Acres**	**PABGx**
K - Artificially Flooded	1 Acres	
x - Excavated	**1 Acres**	**PABKx**

P - Palustrine, AB - Aquatic Bed
Wetlands with vegetation growing on or below the water surface for most of the growing season.

US - Unconsolidated Shore

A - Temporarily Flooded	3 Acres	
h - Diked/Impounded	**3 Acres**	**PUSAh**
C - Seasonally Flooded	5 Acres	
x - Excavated	**5 Acres**	**PUSCx**

P - Palustrine, US - Unconsolidated Shore
Wetlands with less than 75% areal cover of stones, boulders, or bedrock. AND with less than 30% vegetative cover AND the wetland is irregularly exposed due to seasonal or irregular flooding and subsequent drying.

EM - Emergent

A - Temporarily Flooded	247 Acres	
(no modifier)	**218 Acres**	**PEMA**
f - Farmed	**23 Acres**	**PEMAf**
h - Diked/Impounded	**2 Acres**	**PEMAh**
x - Excavated	**4 Acres**	**PEMAx**
C - Seasonally Flooded	68 Acres	
(no modifier)	**58 Acres**	**PEMC**
h - Diked/Impounded	**<1 Acres**	**PEMCh**
x - Excavated	**10 Acres**	**PEMCx**

P - Palustrine, EM - Emergent
Wetlands with erect, rooted herbaceous vegetation present during most of the growing season.

F - Semipermanently Flooded — 7 Acres

(no modifier)	**7 Acres**	**PEMF**
h - Diked/Impounded	**<1 Acres**	**PEMFh**

SS - Scrub-Shrub

P - Palustrine, SS - Scrub-Shrub
Wetlands dominated by woody vegetation less than 6 meters (20 feet) tall. Woody vegetation includes tree saplings and trees that are stunted due to environmental conditions.

A - Temporarily Flooded — 46 Acres

(no modifier)	**46 Acres**	**PSSA**
x - Excavated	**<1 Acres**	**PSSAx**

C - Seasonally Flooded — 9 Acres

(no modifier)	**9 Acres**	**PSSC**

R - Riverine (Rivers)

2 - Lower Perennial

UB - Unconsolidated Bottom

R - Riverine (Rivers), 2 - Lower Perennial, UB - Unconsolidated Bottom
Stream channels where the substrate is at least 25% mud, silt or other fine particles.

H - Permanently Flooded — 74 Acres

(no modifier)	**74 Acres**	**R2UBH**

US - Unconsolidated Shore

R - Riverine (Rivers), 2 - Lower Perennial, US - Unconsolidated Shore
Shorelines with less than 75% areal cover of stones, boulders, or bedrock and less than 30% vegetation cover. The area is also irregularly exposed due to seasonal or irregular flooding and subsequent drying.

A - Temporarily Flooded — 18 Acres

(no modifier)	**18 Acres**	**R2USA**

C - Seasonally Flooded — 3 Acres

(no modifier)	**3 Acres**	**R2USC**

3 - Upper Perennial

UB - Unconsolidated Bottom

R - Riverine (Rivers), 3 - Upper Perennial, UB - Unconsolidated Bottom
Stream channels where the substrate is at least 25% mud, silt or other fine particles.

H - Permanently Flooded — 199 Acres

(no modifier)	**199 Acres**	**R3UBH**

US - Unconsolidated Shore

R - Riverine (Rivers), 3 - Upper Perennial, US - Unconsolidated Shore
Shorelines with less than 75% areal cover of stones, boulders, or bedrock and less than 30% vegetation cover. The area is also irregularly exposed due to seasonal or irregular flooding and subsequent drying.

A - Temporarily Flooded — 58 Acres

(no modifier)	**58 Acres**	**R3USA**

C - Seasonally Flooded — 1 Acres

(no modifier)	**1 Acres**	**R3USC**

4 - Intermittent

SB - Stream Bed

R - Riverine (Rivers), 4 - Intermittent, SB - Stream Bed
Active channel that contains periodic water flow.

C - Seasonally Flooded — 58 Acres

(no modifier)	**7 Acres**	**R4SBC**
x - Excavated	**51 Acres**	**R4SBCx**

Rp - Riparian

1 - Lotic

SS - Scrub-Shrub
(no modifier) — **69 Acres** **Rp1SS**

Rp - Riparian, 1 - Lotic, SS - Scrub-Shrub
This type of riparian area is dominated by woody vegetation that is less than 6 meters (20 feet) tall. Woody vegetation includes tree saplings and trees that are stunted due to environmental conditions.

FO - Forested
(no modifier) — **521 Acres** **Rp1FO**

Rp - Riparian, 1 - Lotic, FO - Forested
This riparian class has woody vegetation that is greater than 6 meters (20 feet) tall.

EM - Emergent
(no modifier) — **91 Acres** **Rp1EM**

Rp - Riparian, 1 - Lotic, EM - Emergent
Riparian areas that have erect, rooted herbaceous vegetation during most of the growing season.

2 - Lentic

SS - Scrub-Shrub
(no modifier) — **2 Acres** **Rp2SS**

Rp - Riparian, 2 - Lentic, SS - Scrub-Shrub
This type of riparian area is dominated by woody vegetation that is less than 6 meters (20 feet) tall. Woody vegetation includes tree saplings and trees that are stunted due to environmental conditions.

FO - Forested
(no modifier) — **1 Acres** **Rp2FO**

Rp - Riparian, 2 - Lentic, FO - Forested
This riparian class has woody vegetation that is greater than 6 meters (20 feet) tall.

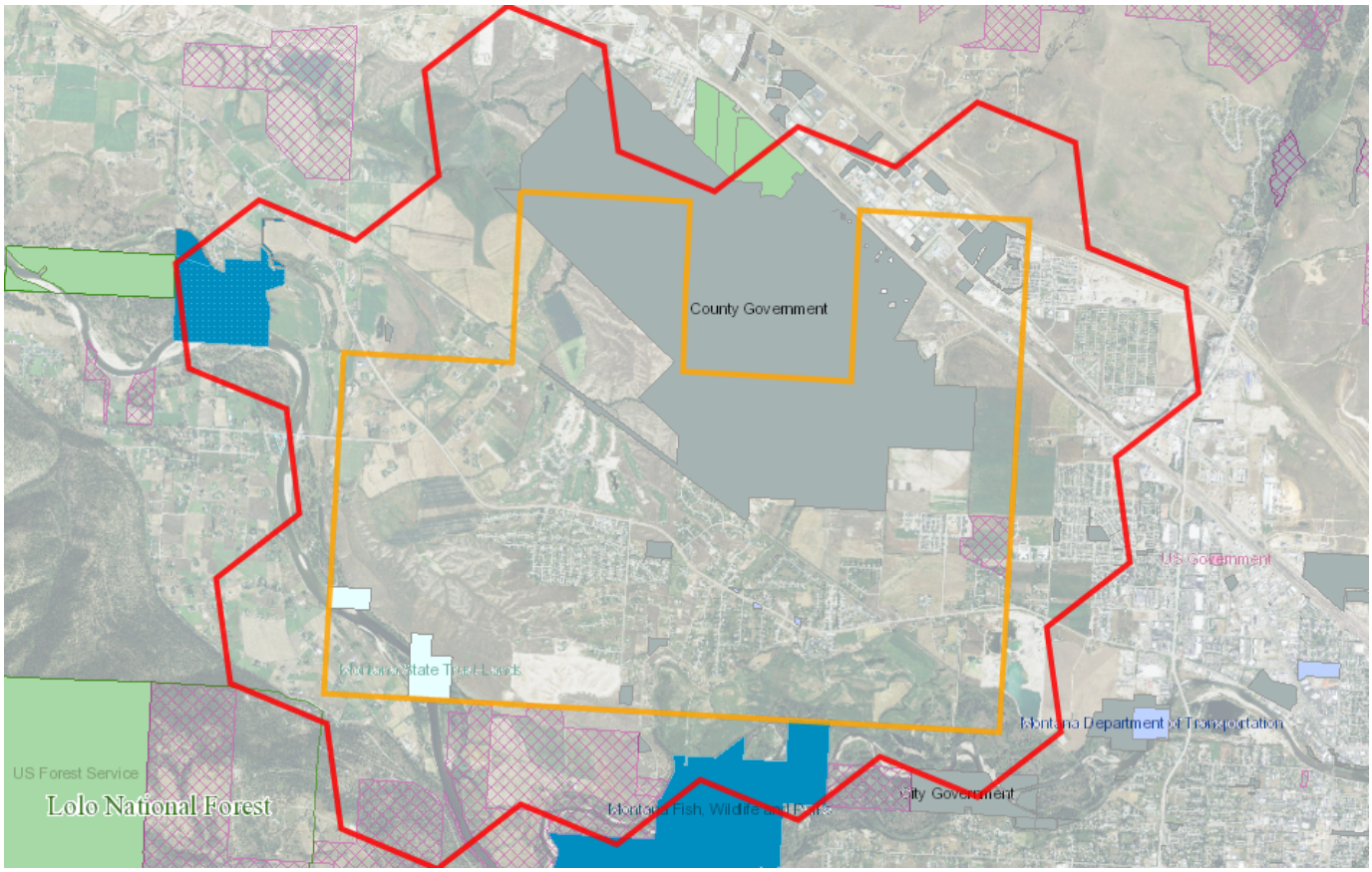
MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Land Management

Summarized by: **24prvt0310** *(Custom Area of Interest)*



Land Management Summary

	Ownership	Tribal	Easements	Other Boundaries (possible overlap)
Public Lands	2,860 Acres (22%)			
Federal	46 Acres (<1%)			
US Forest Service	46 Acres (<1%)			
USFS Owned	46 Acres (<1%)			
USFS Ranger Districts				15 Acres
Lolo National Forest, Missoula Ranger District				15 Acres
USFS National Forest Boundaries				15 Acres
Lolo National Forest				15 Acres
State	439 Acres (3%)			
Montana State Trust Lands	70 Acres (1%)			
MT State Trust Owned	70 Acres (1%)			
Montana Fish, Wildlife and Parks	367 Acres (3%)			
MTFWP Owned	367 Acres (3%)			
MTFWP State Parks				171 Acres
Council Grove State Park				171 Acres
MTFWP Fishing Access Sites				185 Acres
Kelly Island Fishing Access Site				185 Acres
Montana Department of Transportation	2 Acres (<1%)			
MTDOT Owned	2 Acres (<1%)			
Local	2,375 Acres (19%)			
Local Government	2,375 Acres (19%)			
Local Government Owned	2,375 Acres (19%)			
Conservation Easements			652 Acres (5%)	
Private			638 Acres (5%)	
Rocky Mountain Elk Foundation			126 Acres (1%)	
Five Valleys Land Trust			512 Acres (4%)	
State & Local			14 Acres (<1%)	
City Government			14 Acres (<1%)	
Private Lands or Unknown Ownership	9,273 Acres (73%)			

MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Biological Reports

Summarized by: **24prvt0310** *(Custom Area of Interest)*

Within the report area you have requested, citations for all reports and publications associated with plant or animal observations in Montana Natural Heritage Program (MTNHP) databases are listed and, where possible, links to the documents are included.

The MTNHP plans to include reports associated with terrestrial and aquatic communities in the future as allowed for by staff resources. If you know of reports or publications associated with species or biological communities within the report area that are not shown in this report, please let us know: mtnhp@mt.gov

- Missoula County Weed District. ***Geodatabases with sample site location data related to AIS surveys beginning in 2011 on waterbodies in western Montana***

MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM
A program of the **Montana State Library's Natural Resource Information System**

Legend

Model Icons
- N Suitable (native range)
- O Optimal Suitability
- M Moderate Suitability
- L Low Suitability
- I Suitable (introduced range)

Habitat Icons
- C Common
- O Occasional

Range Icons
- N Non-native

Num Obs
Count of obs with 'good precision' (<=1000m)
+ indicates additional 'poor precision' obs (1001m-10,000m)



Latitude	Longitude
46.86196	-114.04096
46.94055	-114.16194

Invasive and Pest Species

Summarized by: **24prvt0310** *(Custom Area of Interest)*

	# Obs	Predicted Model	Range

Aquatic Invasive Species

V - Iris pseudacorus *(Yellowflag Iris)* **N2A/AIS** — # Obs: 109 — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 2A - Aquatic Invasive Species - Non-native Species — Global: **GNR** State: **SNA**
Predicted Models: O 95% Optimal (inductive), M 5% Moderate (inductive)

A - American Bullfrog *(Lithobates catesbeianus)* **AIS** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Aquatic Invasive Species - Non-native Species — Global: **G5** State: **SNA**
Predicted Models: O 30% Optimal (inductive), M 35% Moderate (inductive), L 35% Low (inductive)

V - Potamogeton crispus *(Curly-leaf Pondweed)* **N2B/AIS** — # Obs: 20 — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 2B - Aquatic Invasive Species - Non-native Species — Global: **G5** State: **SNA**
Predicted Models: O 15% Optimal (inductive), M 25% Moderate (inductive), L 35% Low (inductive)

V - Butomus umbellatus *(Flowering-rush)* **N2A/AIS** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 2A - Aquatic Invasive Species - Non-native Species — Global: **G5** State: **SNA**
Predicted Models: M 10% Moderate (inductive), L 50% Low (inductive)

V - Myriophyllum spicatum *(Eurasian Water-milfoil)* **N2A/AIS** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 2A - Aquatic Invasive Species - Non-native Species — Global: **GNR** State: **SNA**
Predicted Models: L 35% Low (inductive)

V - Nymphaea odorata *(American Water-lily)* **AIS** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Aquatic Invasive Species - Non-native Species — Global: **G5** State: **SNA**
Predicted Models: I 65% Suitable (introduced range) (deductive)

I - Faxonius virilis *(Virile Crayfish)* **AIS** — # Obs: 1 — Not Assessed — Range: N

View in Field Guide | View Range Maps
Aquatic Invasive Species - Native/Non-native Species - (depends on location or taxa) — Global: **G5** State: **S5**

Noxious Weeds: Priority 1A

V - Centaurea solstitialis *(Yellow Starthistle)* **N1A** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 1A - Non-native Species — Global: **GNR** State: **SNA**
Predicted Models: O 85% Optimal (inductive), M 15% Moderate (inductive)

V - Isatis tinctoria *(Dyer's Woad)* **N1A** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 1A - Non-native Species — Global: **GNR** State: **SNA**
Predicted Models: O 35% Optimal (inductive), M 50% Moderate (inductive), L 15% Low (inductive)

V - Taeniatherum caput-medusae *(Medusahead)* **N1A** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 1A - Non-native Species — Global: **G4G5** State: **SNA**
Predicted Models: O 15% Optimal (inductive), M 35% Moderate (inductive), L 50% Low (inductive)

V - Phragmites australis ssp. australis *(European Common Reed)* **N1A** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 1A - Non-native Species — Global: **G5T5** State: **SNA**
Predicted Models: M 25% Moderate (inductive), L 65% Low (inductive)

Noxious Weeds: Priority 1B

V - Lythrum salicaria *(Purple Loosestrife)* **N1B** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 1B - Non-native Species — Global: **G5** State: **SNA**
Predicted Models: O 90% Optimal (inductive), M 10% Moderate (inductive)

V - Echium vulgare *(Blueweed)* **N1B** — Range: N

View in Field Guide | View Predicted Models | View Range Maps
Noxious Weed: Priority 1B - Non-native Species — Global: **GNR** State: **SNA**
Predicted Models: O 75% Optimal (inductive), M 20% Moderate (inductive), L 5% Low (inductive)

V - Polygonum cuspidatum *(Japanese Knotweed)* **N1B** 6

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 1B - Non-native Species Global: **GNRTNR** State: **SNA**

Predicted Models: O 30% Optimal (inductive), M 60% Moderate (inductive), L 10% Low (inductive)

V - Cytisus scoparius *(Scotch Broom)* **N1B**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 1B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 5% Optimal (inductive), M 30% Moderate (inductive), L 55% Low (inductive)

V - Polygonum x bohemicum *(Bohemian Knotweed)* **N1B**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 1B - Non-native Species Global: **GNA** State: **SNA**

Predicted Models: O 5% Optimal (inductive), M 5% Moderate (inductive), L 45% Low (inductive)

V - Chondrilla juncea *(Rush Skeletonweed)* **N1B**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 1B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 25% Moderate (inductive), L 75% Low (inductive)

Noxious Weeds: Priority 2A

V - Ventenata dubia *(Ventenata)* **N2A**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 100% Optimal (inductive)

V - Iris pseudacorus *(Yellowflag Iris)* **N2A/AIS** 109

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Aquatic Invasive Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 95% Optimal (inductive), M 5% Moderate (inductive)

V - Rhamnus cathartica *(Common Buckthorn)* **N2A** 3

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 85% Optimal (inductive), M 15% Moderate (inductive)

V - Lepidium latifolium *(Perennial Pepperweed)* **N2A** 426

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 50% Optimal (inductive), M 15% Moderate (inductive), L 30% Low (inductive)

V - Ranunculus acris *(Tall Buttercup)* **N2A**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **G5** State: **SNA**

Predicted Models: M 50% Moderate (inductive), L 50% Low (inductive)

V - Hieracium praealtum *(Kingdevil Hawkweed)* **N2A**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 45% Moderate (inductive), L 40% Low (inductive)

V - Hieracium aurantiacum *(Orange Hawkweed)* **N2A**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 10% Moderate (inductive), L 90% Low (inductive)

V - Butomus umbellatus *(Flowering-rush)* **N2A/AIS**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Aquatic Invasive Species - Non-native Species Global: **G5** State: **SNA**

Predicted Models: M 10% Moderate (inductive), L 50% Low (inductive)

V - Hieracium caespitosum *(Meadow Hawkweed)* **N2A**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: L 65% Low (inductive)

V - Senecio jacobaea *(Tansy Ragwort)* **N2A**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: L 60% Low (inductive)

V - Myriophyllum spicatum *(Eurasian Water-milfoil)* **N2A/AIS**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2A - Aquatic Invasive Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: L 35% Low (inductive)

Noxious Weeds: Priority 2B

V - Tanacetum vulgare *(Common Tansy)* **N2B** 718

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 90% Optimal (inductive), M 10% Moderate (inductive)

V - Lepidium draba *(Whitetop)* **N2B** 640

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 50% Optimal (inductive), M 50% Moderate (inductive)

V - Linaria dalmatica *(Dalmatian Toadflax)* **N2B** 200

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **G5** State: **SNA**

Predicted Models: O 40% Optimal (inductive), M 60% Moderate (inductive)

V - Potamogeton crispus *(Curly-leaf Pondweed)* **N2B/AIS** 20

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Aquatic Invasive Species - Non-native Species Global: **G5** State: **SNA**

Predicted Models: O 15% Optimal (inductive), M 25% Moderate (inductive), L 35% Low (inductive)

V - Potentilla recta *(Sulphur Cinquefoil)* **N2B** 37

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 10% Optimal (inductive), M 85% Moderate (inductive), L 5% Low (inductive)

V - Linaria vulgaris *(Yellow Toadflax)* **N2B** 3

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 10% Optimal (inductive), M 70% Moderate (inductive), L 20% Low (inductive)

V - Tamarix ramosissima *(Salt Cedar)* **N2B** 4

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 5% Optimal (inductive), M 70% Moderate (inductive), L 25% Low (inductive)

V - Cynoglossum officinale *(Common Hound's-tongue)* **N2B** 204

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 100% Moderate (inductive)

V - Leucanthemum vulgare *(Oxeye Daisy)* **N2B** 19

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 100% Moderate (inductive)

V - Centaurea diffusa *(Diffuse Knapweed)* **N2B**

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 95% Moderate (inductive), L 5% Low (inductive)

V - Hypericum perforatum *(Common St. John's-wort)* **N2B** 5

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 95% Moderate (inductive), L 5% Low (inductive)

V - Centaurea stoebe *(Spotted Knapweed)* **N2B** 747

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 85% Moderate (inductive), L 15% Low (inductive)

V - Acroptilon repens *(Russian Knapweed)* **N2B** 161

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 70% Moderate (inductive), L 30% Low (inductive)

V - Cirsium arvense *(Canada Thistle)* **N2B** 727

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **G5** State: **SNA**

Predicted Models: M 35% Moderate (inductive), L 65% Low (inductive)

V - Euphorbia virgata *(Leafy Spurge)* **N2B** 719

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 25% Moderate (inductive), L 75% Low (inductive)

V - Convolvulus arvensis *(Field Bindweed)* **N2B** 78

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 20% Moderate (inductive), L 75% Low (inductive)

V - Berteroa incana *(Hoary False-alyssum)* **N2B** 2

View in Field Guide | View Predicted Models | View Range Maps

Noxious Weed: Priority 2B - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 10% Moderate (inductive), L 75% Low (inductive)

Regulated Weeds: Priority 3

V - Elaeagnus angustifolia *(Russian Olive)* R3 — 17

View in Field Guide | View Predicted Models | View Range Maps

Regulated Weed: Priority 3 - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 10% Optimal (inductive), M 45% Moderate (inductive), L 45% Low (inductive)

V - Bromus tectorum *(Cheatgrass)* R3 — 80

View in Field Guide | View Predicted Models | View Range Maps

Regulated Weed: Priority 3 - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 65% Moderate (inductive), L 35% Low (inductive)

Biocontrol Species

I - Oberea erythrocephala *(Red-headed Leafy Spurge Stem Borer)* BIOCNTRL

View in Field Guide | View Predicted Models | View Range Maps

Biocontrol Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 85% Optimal (inductive), M 15% Moderate (inductive)

I - Cyphocleonus achates *(Knapweed Root Weevil)* BIOCNTRL

View in Field Guide | View Predicted Models | View Range Maps

Biocontrol Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 60% Optimal (inductive), M 40% Moderate (inductive)

I - Mecinus janthiniformis *(Dalmatian Toadflax Stem-boring Weevil)* BIOCNTRL

View in Field Guide | View Predicted Models | View Range Maps

Biocontrol Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 45% Optimal (inductive), M 55% Moderate (inductive)

I - Mecinus janthinus *(Yellow Toadflax Stem-boring Weevil)* BIOCNTRL

View in Field Guide | View Predicted Models | View Range Maps

Biocontrol Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: O 10% Optimal (inductive), M 70% Moderate (inductive), L 20% Low (inductive)

I - Aphthona lacertosa *(Brown-legged Leafy Spurge Flea Beetle)* BIOCNTRL

View in Field Guide | View Predicted Models | View Range Maps

Biocontrol Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 75% Moderate (inductive), L 25% Low (inductive)

I - Aphthona nigriscutis *(Black Dot Leafy Spurge Flea Beetle)* BIOCNTRL

View in Field Guide | View Predicted Models | View Range Maps

Biocontrol Species - Non-native Species Global: **GNR** State: **SNA**

Predicted Models: M 35% Moderate (inductive), L 45% Low (inductive)

I - Hyles euphorbiae *(Spurge Hawkmoth)* BIOCNTRL — 1 — Not Assessed

View in Field Guide | View Range Maps

Biocontrol Species - Non-native Species Global: **G5** State: **SNA**

Introduction to Montana Natural Heritage Program

PO Box 201800 • 1201 11th Avenue • Helena, MT 59620-1800 • fax 406.444.0266 • phone 406.444.3989 • mtnhp.org

Introduction

The Montana Natural Heritage Program (MTNHP) is Montana's source for reliable and objective information on Montana's native species and habitats, emphasizing those of conservation concern. MTNHP was created by the Montana legislature in 1983 as part of the Natural Resource Information System (NRIS) at the Montana State Library (MSL). MTNHP is "a program of information acquisition, storage, and retrieval for data relating to the flora, fauna, and biological community types of Montana" (MCA 90-15-102). MTNHP's activities are guided by statute as well as through ongoing interaction with, and feedback from, principal data source agencies such as Montana Fish, Wildlife, and Parks, the Montana Department of Environmental Quality, the Montana Department of Natural Resources and Conservation, the Montana University System, the US Forest Service, and the US Bureau of Land Management. Since the first staff was hired in 1985, the Program has logged a long record of success, and developed into a highly respected, service-oriented program. MTNHP is widely recognized as one of the most advanced and effective of over 60 natural heritage programs that are distributed across North America.

Vision

Our vision is that public agencies, the private sector, the education sector, and the general public will trust and rely upon MTNHP as the source for information and expertise on Montana's species and habitats, especially those of conservation concern. We strive to provide easy access to our information to allow users to save time and money, speed environmental reviews, and make informed decisions.

Core Values

- We endeavor to be a single statewide source of accurate and up-to-date information on Montana's plants, animals, and aquatic and terrestrial biological communities.
- We actively listen to our data users and work responsively to meet their information and training needs.
- We strive to provide neutral, trusted, timely, and equitable service to all of our information users.
- We make every effort to be transparent to our data users in setting work priorities and providing data products.

Confidentiality

All information requests made to the Montana Natural Heritage Program are considered library records and are protected from disclosure by the Montana Library Records Confidentiality Act (MCA 22-1-11).

Information Managed

Information managed at the Montana Natural Heritage Program is botanical, zoological, and ecological information that describes the distribution (e.g., observations, structured surveys, range polygons, predicted habitat suitability models), conservation status (e.g., global and state conservation status ranks, including threats), and other supporting information (e.g., accounts and references) on the biology and ecology of species and biological communities.

Data Use Terms and Conditions

- Montana Natural Heritage Program (MTNHP) products and services are based on biological data and the objective interpretation of those data by professional scientists. MTNHP does not advocate any particular philosophy of natural resource protection, management, development, or public policy.
- MTNHP has no natural resource management or regulatory authority. Products, statements, and services from MTNHP are intended to inform parties as to the state of scientific knowledge about certain natural resources, and to further develop that knowledge. The information is not intended as natural resource management guidelines or prescriptions or a determination of environmental impacts. MTNHP recommends consultation with appropriate state, federal, and tribal resource management agencies and authorities in the area where your project is located.
- Information on the status and spatial distribution of biological resources produced by MTNHP are intended to inform parties of the state-wide status, known occurrence, or the likelihood of the presence of those resources. **These products are not intended to substitute for field-collected data, nor are they intended to be the sole basis for natural resource management decisions.**
- MTNHP does not portray its data as exhaustive or comprehensive inventories of rare species or biological communities. **Field verification of the absence or presence of sensitive species and biological communities will always be an important obligation of users of our data.**
- MTNHP responds equally to all requests for products and services, regardless of the purpose or identity of the requester.
- Because MTNHP constantly updates and revises its databases with new data and information, products will become outdated over time. Interested parties are encouraged to obtain the most current information possible from MTNHP, rather than using older products. We add, review, update, and delete records on a daily basis. Consequently, we strongly advise that you update your MTNHP data sets at a minimum of every four months for most applications of our information.
- MTNHP data require a certain degree of biological expertise for proper analysis, interpretation, and application. Our staff is available to advise you on questions regarding the interpretation or appropriate use of the data that we provide. See Contact Information for MTNHP Staff
- The information provided to you by MTNHP may include sensitive data that if publicly released might jeopardize the welfare of threatened, endangered, or sensitive species or biological communities. This information is intended for distribution or use only within your department, agency, or business. Subcontractors may have access to the data during the course of any given project, but should not be given a copy for their use on subsequent, unrelated work.
- MTNHP data are made freely available. Duplication of hard-copy or digital MTNHP products with the intent to sell is prohibited without written consent by MTNHP. Should you be asked by individuals outside your organization for the type of data that we provide, please refer them to MTNHP.
- MTNHP and appropriate staff members should be appropriately acknowledged as an information source in any third-party product involving MTNHP data, reports, papers, publications, or in maps that incorporate MTNHP graphic elements.
- Sources of our data include museum specimens, published and unpublished scientific literature, field surveys by state and federal agencies and private contractors, and reports from knowledgeable individuals. MTNHP actively solicits and encourages additions, corrections and updates, new observations or collections, and comments on any of the data we provide.
- MTNHP staff and contractors do not enter or cross privately-owned lands without express permission from the landowner. However, the program cannot guarantee that information provided to us by others was obtained under adherence to this policy.

Suggested Contacts for Natural Resource Management Agencies

As required by Montana statute (MCA 90-15), the Montana Natural Heritage Program works with state, federal, tribal, nongovernmental organizations, and private partners to ensure that the latest animal and plant distribution and status information is incorporated into our databases so that it can be used to inform a variety of permitting and planning processes and management decisions. We encourage you to contact state, federal, and tribal resource management agencies in the area where your project is located and review the permitting overviews by the Montana Department of Environmental Quality, the Montana Department of Natural Resources and Conservation and the Index of Environmental Permits for Montana for guidelines relevant to your efforts. In particular, we encourage you to contact the Montana Department of Fish, Wildlife, and Parks for the latest data and management information regarding hunted and high-profile management species and to use the U.S. Fish and Wildlife Service's Information Planning and Consultation (IPAC) website regarding U.S. Endangered Species Act listed Threatened, Endangered, or Candidate species.

For your convenience, we have compiled a list of relevant agency contacts and links below:

Montana Fish, Wildlife, and Parks

Fish Species	Zachary Shattuck zshattuck@mt.gov (406) 444-1231 or Eric Roberts eroberts@mt.gov (406) 444-5334
American Bison Black-footed Ferret Black-tailed Prairie Dog Bald Eagle Golden Eagle Common Loon Least Tern Piping Plover Whooping Crane	Kristina Smucker KSmucker@mt.gov (406) 444-5209
Grizzly Bear Greater Sage Grouse Trumpeter Swan Big Game Upland Game Birds Furbearers	Brian Wakeling brian.wakeling@mt.gov (406) 444-3940
Managed Terrestrial Game Data	Adam Messer – MFWP GIS Coordinator amesser@mt.gov (406) 444-0095
Fisheries Data and Nongame Animal Data	Adam Messer – MFWP GIS Coordinator amesser@mt.gov (406) 444-0095
Wildlife and Fisheries Scientific Collector's Permits	https://fwp.mt.gov/buyandapply/commercialwildlifeandscientificpermits/scientific Kristina Smucker for Wildlife ksmucker@mt.gov (406) 444-5209 Dave Schmetterling for Fisheries dschmetterling@mt.gov (406) 542-5514
Fish and Wildlife Recommendations for Subdivision Development	Stevie Burton stevie.burton@mt.gov (406) 594-7354 See https://fwp.mt.gov/conservation/living-with-wildlife/subdivision-recommendations
Regional Contacts  	Region 1 (Kalispell) (406) 752-5501 fwprg12@mt.gov Region 2 (Missoula) (406) 542-5500 fwprg22@mt.gov Region 3 (Bozeman) (406) 577-7900 fwprg3@mt.gov Region 4 (Great Falls) (406) 454-5840 fwprg42@mt.gov Region 5 (Billings) (406) 247-2940 fwprg52@mt.gov Region 6 (Glasgow) (406) 228-3700 fwprg62@mt.gov Region 7 (Miles City) (406) 234-0900 fwprg72@mt.gov

Montana Department of Agriculture
General Contact Information: https://agr.mt.gov/About/Office-Locations/Office-Locations-and-Field-Offices
Noxious Weeds: https://agr.mt.gov/Noxious-Weeds

Montana Department of Environmental Quality
Permitting and Operator Assistance for all Environmental Permits: https://deq.mt.gov/Permitting

Montana Department of Natural Resources and Conservation
Overview of, and contacts for, licenses and permits for state lands, water, and forested lands: https://dnrc.mt.gov/Permits-Services

Stream Permitting (310 permits) and an overview of various water and stream related permits (e.g., Stream Protection Act 124, Federal Clean Water Act 404, Federal Rivers and Harbors Act Section 10, Short-term Water Quality Standard for Turbidity 318 Authorization, etc.).
https://dnrc.mt.gov/Licenses-and-Permits/Stream-Permitting

Wildfire Resources: https://dnrc.mt.gov/Forestry/Wildfire

Bureau of Land Management

Montana Field Office Contacts:



Billings	(406) 896-5013
Butte	(406) 533-7600
Dillon	(406) 683-8000
Glasgow	(406) 228-3750
Havre	(406) 262-2820
Lewistown	(406) 538-1900
Malta	(406) 654-5100
Miles City	(406) 233-2800
Missoula	(406) 329-3914

United States Army Corps of Engineers
Montana Regulatory Office for federal permits related to construction in water and wetlands
https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Montana/ (406) 441-1375

United States Environmental Protection Agency
Environmental information, notices, permitting, and contacts https://www.epa.gov/mt
Gateway to state resource locators https://www.envcap.org/srl/index.php

United States Fish and Wildlife Service
Information Planning and Conservation (IPAC) website: https://ipac.ecosphere.fws.gov
Montana Ecological Services Field Office: https://www.fws.gov/office/montana-ecological-services (406) 449-5225

United States Forest Service

Regional Office – Missoula, Montana Contacts			
Wildlife Program Leader	Tammy Fletcher	tammy.fletcher2@usda.gov	(406) 329-3086
Wildlife Ecologist	Cara Staab	cara.staab@usda.gov	(406) 329-3677
Aquatic Ecologist	Justin Jimenez	justin.jimenez@usda.gov	(435) 370-6830
TES Program	Lydia Allen	lydia.allen@usda.gov	(406) 329-3558
Interagency Grizzly Bear Coordinator	Scott Jackson	scott.jackson@usda.gov	(406) 329-3664
Regional Botanist	Amanda Hendrix	amanda.hendrix@usda.gov	(651) 447-3016
Regional Vegetation Ecologist	Mary Manning	marry.manning@usda.gov	(406) 329-3304
Invasive Species Program Manager	Michelle Cox	michelle.cox2@usda.gov	(406) 329-3669

Tribal Nations



[Assiniboine & Gros Ventre Tribes – Fort Belknap Reservation]

[Assiniboine & Sioux Tribes – Fort Peck Reservation]

[Blackfeet Tribe - Blackfeet Reservation]

[Chippewa Creek Tribe - Rocky Boy's Reservation]

[Crow Tribe – Crow Reservation]

[Little Shell Chippewa Tribe]

[Northern Cheyenne Tribe – Northern Cheyenne Reservation]

[Salish & Kootenai Tribes - Flathead Reservation]

Natural Heritage Programs and Conservation Data Centers in Surrounding States and Provinces

[Alberta Conservation Information Management System]
[British Columbia Conservation Data Centre]
[Idaho Natural Heritage Program]
[North Dakota Natural Heritage Program]
[Saskatchewan Conservation Data Centre]
[South Dakota Natural Heritage Program]
[Wyoming Natural Diversity Database]

Invasive Species Management Contacts and Information

Aquatic Invasive Species

[Montana Fish, Wildlife, and Parks Aquatic Invasive Species staff]
[Montana Department of Natural Resources and Conservation's Aquatic Invasive Species Grant Program]
[Montana Invasive Species Council (MISC)]
[Western Montana Conservation Commission]

Noxious Weeds

[Montana Weed Control Association Contacts Webpage]
[Montana Biological Weed Control Coordination Project]
[Montana Department of Agriculture - Noxious Weeds]
[Montana Weed Control Association]
[Montana Fish, Wildlife, and Parks - Noxious Weeds]
[Montana State University Integrated Pest Management Extension]
[Integrated Noxious Weed Management after Wildfires]
[Fire Management and Invasive Plants]

Introduction to Native Species

Within the report area you have requested, separate summaries are provided for: (1) Species Occurrences (SO) for plant and animal Species of Concern, Special Status Species (SSS), Important Animal Habitat (IAH) and some Potential Plant Species of Concern; (2) other observed non Species of Concern or Species of Concern without suitable documentation to create Species Occurrence polygons; and (3) other non-documented species that are potentially present based on their range, predicted suitable habitat model output, or presence of associated habitats. Each of these summaries provides the following information when present for a species: (1) the number of Species Occurrences and associated delineation criteria for construction of these polygons that have long been used for considerations of documented Species of Concern in environmental reviews; (2) the number of observations of each species; (3) the geographic range polygons for each species that the report area overlaps; (4) predicted relative habitat suitability classes that are present if a predicted suitable habitat model has been created; (5) the percent of the report area that is mapped as commonly associated or occasionally associated habitat as listed for each species in the Montana Field Guide; and (6) a variety of conservation status ranks and links to species accounts in the Montana Field Guide. Details on each of these information categories are included under relevant section headers below or are defined on our Species Status Codes page. In presenting this information, the Montana Natural Heritage Program (MTNHP) is working towards assisting the user with rapidly determining what species have been documented and what species are potentially present in the report area. We remind users that this information is likely incomplete as surveys to document native and introduced species are lacking in many areas of the state, information on introduced species has only been tracked relatively recently, the MTNHP's staff and resources are restricted by budgets, and information is constantly being added and updated in our databases. **Thus, field verification by professional biologists of the absence or presence of species and biological communities will always be an important obligation of users of our data.**

If you are aware of observation datasets that the MTNHP is missing, please report them to the Program Botanist apipp@mt.gov or Senior Zoologist dbachen@mt.gov If you have animal or plant observations that you would like to contribute, you can also submit them via Excel spreadsheets, geodatabases, iNaturalist, or a Survey123 form. Various methods of data submission are reviewed in this playlist of videos: https://www.youtube.com/playlist?list=PLRaydtZpHu2qOHPoSPq9cnM9uXGmEXACx

Observations

The MTNHP manages information on several million animal and plant observations that have been reported by professional biologists and private citizens from across Montana. The majority of these observations are submitted in digital format from standardized databases associated with research or monitoring efforts and spreadsheets of incidental observations submitted by professional biologists and amateur naturalists. At a minimum, accepted observation records must contain a credible species identification (i.e. appropriate geographic range, date, and habitat and, if species are difficult to identify, a photograph and/or notes on key identifying features), a date or date range, observer name, locational information (ideally with latitude and longitude in decimal degrees), notes on numbers observed, and species behavior or habitat use (e.g., is the observation likely associated with reproduction). Bird records are also required to have information associated with date-appropriate breeding or overwintering status of the species observed. MTNHP reviews observation records to ensure that they are mapped correctly, occur within date ranges when the species is known to be present or detectable, occur within the known seasonal geographic range of the species, and occur in appropriate habitats. MTNHP also assigns each record a locational uncertainty value in meters to indicate the spatial precision associated with the record's mapped coordinates. Only records with locational uncertainty values of 10,000 meters or less are included in environmental summary reports and number summaries are only provided for records with locational uncertainty values of 1,000 meters or less.

Species Occurrences

The MTNHP evaluates plant and animal observation records for species of higher conservation concern to determine whether they are worthy of inclusion in the Species Occurrence (SO) layer for use in environmental reviews; observations not worthy of inclusion in this layer include long distance dispersal events, migrants observed away from key migratory stopover habitats, and winter observations. An SO is a polygon depicting what is known about a species occupancy from direct observation with a defined level of locational uncertainty and any inference that can be made about adjacent habitat use from the latest peer-reviewed science. If an observation can be associated with a map feature that can be tracked (e.g., a wetland boundary for a wetland associated plant) then this polygon feature is used to represent the SO. Areas that can be inferred as probable occupied habitat based on direct observation of a species location and what is known about the foraging area or home range size of the species may be incorporated into the SO. Species Occurrences generally belong to one of the following categories:

Plant Species Occurrences

A documented location of a specimen collection or observed plant population. In some instances, adjacent, spatially separated clusters are considered subpopulations and are grouped as one occurrence (e.g., the subpopulations occur in ecologically similar habitats, and their spatial proximity likely allows them to interbreed). Tabular information for multiple observations at the same SO location is generally linked to a single polygon. Plant SO's are only created for Species of Concern and Potential Species of Concern.

Animal Species Occurrences

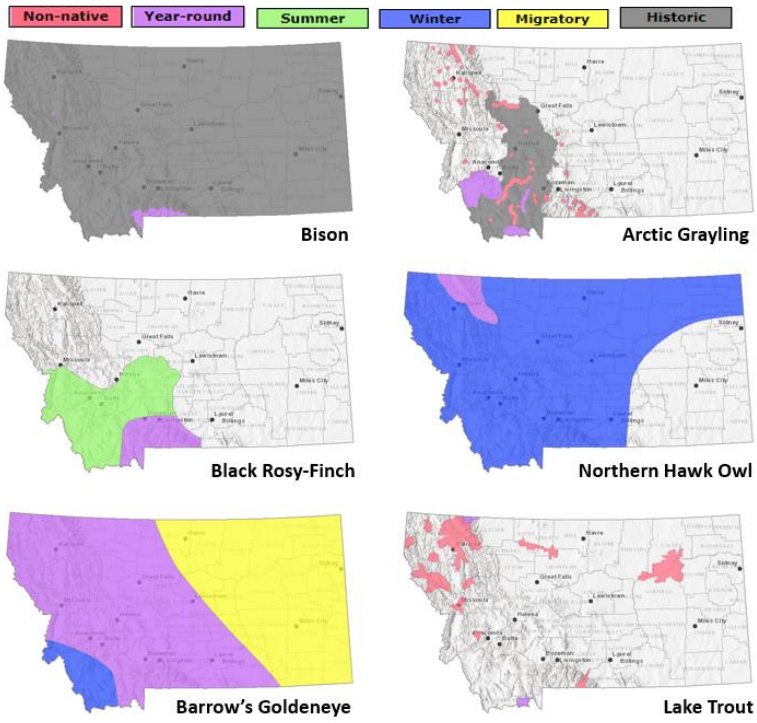
The location of a verified observation or specimen record typically known or assumed to represent a breeding population or a portion of a breeding population. Animal SO's are generally: (1) buffers of terrestrial point observations based on documented species' home range sizes; (2) buffers of stream segments to encompass occupied streams and immediate adjacent riparian habitats; (3) polygonal features encompassing known or likely breeding populations (e.g., a wetland for some amphibians or a forested portion of a mountain range for some wide-ranging carnivores); or (4) combinations of the above. Tabular information for multiple observations at the same SO location is generally linked to a single polygon. Species Occurrence polygons may encompass some unsuitable habitat in some instances in order to avoid heavy data processing associated with clipping out habitats that are readily assessed as unsuitable by the data user (e.g., a point buffer of a terrestrial species may overlap into a portion of a lake that is obviously inappropriate habitat for the species). Animal SO's are only created for Species of Concern and Special Status Species (e.g., Bald Eagle).

Other Occurrence Polygons

These include significant biological features not included in the above categories, such as Important Animal Habitats like bird rookeries and bat roosts, and peatlands or other wetland and riparian communities that support diverse plant and animal communities.

Geographic Range Polygons

Geographic range polygons are still under development for most plant and invertebrate species. Native year-round, summer, winter, migratory and historic geographic range polygons as well as polygons for introduced populations have been defined for most vertebrate animal species for which there are enough observations, surveys, and knowledge of appropriate seasonal habitat use to define them (see examples to left). These native or introduced range polygons bound the extent of known or likely occupied habitats for non-migratory and relative sedentary species and the regular extent of known or likely occupied habitats for migratory and long-distance dispersing species; polygons may include unsuitable intervening habitats. For most species, a single polygon can represent the year-round or seasonal range, but breeding ranges of some colonial nesting water birds and some introduced species are represented more patchily when supported by data. Some ranges are mapped more broadly than actual distributions in order to be visible on statewide maps (e.g., fish).



Predicted Suitable Habitat Models

Predicted habitat suitability models have been created for plant and animal Species of Concern and are undergoing development for non-Species of Concern. For species for which models have been completed, the environmental summary report includes simple rule-based associations with streams for aquatic species and seasonal habitats for game species as well as mathematically complex Maximum Entropy models (Phillips et al. 2006, Ecological Modeling 190:231-259) constructed from a variety of statewide biotic and abiotic layers and presence only data for individual species for most terrestrial species. For the Maximum Entropy models, we reclassified 90 x 90-meter continuous model output into suitability classes (unsuitable, low, moderate, and optimal) then aggregated that into the one square mile hexagons used in the environmental summary report; this is the finest spatial scale we suggest using this information in management decisions and survey planning. Full model write ups for individual species that discuss model goals, inputs, outputs, and evaluation in much greater detail are posted on the MTNHP's Predicted Suitable Habitat Models webpage. Evaluations of predictive accuracy and specific limitations are included with the metadata for models of individual species. **Model outputs should not be used in place of on-the-ground surveys for species. Instead model outputs should be used in conjunction with habitat evaluations to determine the need for on-the-ground surveys for species.** We suggest that the percentage of predicted optimal and moderate suitable habitat within the report area be used in conjunction with geographic range polygons and the percentage of commonly associated habitats to generate lists of potential species that may occupy broader landscapes for the purposes of landscape-level planning.

Associated Habitats

Within the boundary of the intersected hexagons, we provide the approximate percentage of commonly or occasionally associated habitat for vertebrate animal species that regularly breed, overwinter, or migrate through the state; a detailed list of commonly and occasionally associated habitats is provided in individual species accounts in the Montana Field Guide We assigned common or occasional use of each of the ecological

systems mapped in Montana by: (1) using personal knowledge and reviewing literature that summarizes the breeding, overwintering, or migratory habitat requirements of each species; (2) evaluating structural characteristics and distribution of each ecological system relative to the species' range and habitat requirements; (3) examining the observation records for each species in the state-wide point observation database associated with each ecological system; and (4) calculating the percentage of observations associated with each ecological system relative to the percent of Montana covered by each ecological system to get a measure of numbers of observations versus availability of habitat. Species that breed in Montana were only evaluated for breeding habitat use, species that only overwinter in Montana were only evaluated for overwintering habitat use, and species that only migrate through Montana were only evaluated for migratory habitat use. In general, species were listed as associated with an ecological system if structural characteristics of used habitat documented in the literature were present in the ecological system or large numbers of point observations were associated with the ecological system. However, species were not listed as associated with an ecological system if there was no support in the literature for use of structural characteristics in an ecological system, even if point observations were associated with that system. Common versus occasional association with an ecological system was assigned based on the degree to which the structural characteristics of an ecological system matched the preferred structural habitat characteristics for each species as represented in the scientific literature. The percentage of observations associated with each ecological system relative to the percent of Montana covered by each ecological system was also used to guide assignment of common versus occasional association.

We suggest that the percentage of commonly associated habitat within the report area be used in conjunction with geographic range polygons and the percentage of predicted optimal and moderate suitable habitat from predictive models to generate lists of potential species that may occupy broader landscapes for the purposes of landscape-level planning. Users of this information should be aware that land cover mapping accuracy is particularly problematic when the systems occur as small patches or where the land cover types have been altered over the past decade. Thus, particular caution should be used when using the associations in assessments of smaller areas (e.g., evaluations of public land survey sections).

Introduction to Land Cover

Land Use/Land Cover is one of 15 Montana Spatial Data Infrastructure framework layers considered vital for making statewide maps of Montana and understanding its geography. The layer records all Montana natural vegetation, land cover and land use, classified from satellite and aerial imagery, mapped at a scale of 1:100,000, and interpreted with supporting ground-level data. The baseline map is adapted from the Northwest ReGAP (NWGAP) project land cover classification, which used 30m resolution multi-spectral Landsat imagery acquired between 1999 and 2001. Vegetation classes were drawn from the Ecological System Classification developed by NatureServe (Comer et al. 2003). The land cover classes were developed by Anderson et al. (1976). The NWGAP effort encompasses 12 map zones. Montana overlaps seven of these zones. The two NWGAP teams responsible for the initial land cover mapping effort in Montana were Sanborn and NWGAP at the University of Idaho. Both Sanborn and NWGAP employed a similar modeling approach in which Classification and Regression Tree (CART) models were applied to Landsat ETM+ scenes. The Spatial Analysis Lab within the Montana Natural Heritage Program was responsible for developing a seamless Montana land cover map with a consistent statewide legend from these two separate products. Additionally, the Montana land cover layer incorporates several other land cover and land use products (e.g., MSDI Structures and Transportation themes and the Montana Department of Revenue Final Land Unit classification) and reclassifications based on plot-level data and the latest NAIP imagery to improve accuracy and enhance the usability of the theme. Updates are done as partner support and funding allow, or when other MSDI datasets can be incorporated. Recent updates include fire perimeters and agricultural land use (annually), energy developments such as wind, oil and gas installations (2014), roads, structures and other impervious surfaces (various years): and local updates/improvements to specific ecological systems (e.g., central Montana grassland and sagebrush ecosystems). Current and previous versions of the Land Use/Land Cover layer with full metadata are available for download from the Montana State Library's GIS Data List More information on the land cover layer is available at: https://msl.mt.gov/geoinfo/msdi/land_use_land_cover/

Within the report area you have requested, land cover is summarized by acres of Level 1, Level 2, and Level 3 Ecological Systems.

Literature Cited

Anderson, J.R. E.E. Hardy, J.T. Roach, and R.E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. U.S. Geological Survey Professional Paper 964.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological systems of the United States: A working classification of U.S. terrestrial systems. NatureServe, Arlington, VA.

Introduction to Wetland and Riparian

Within the report area you have requested, wetland and riparian mapping is summarized by acres of each classification present. Summaries are only provided for modern MTNHP wetland and riparian mapping and not for outdated (NWI Legacy) or incomplete (NWI Scalable) mapping efforts; described here. MTNHP has made all three of these datasets and associated metadata available for separate download on the Montana Wetland and Riparian Framework web page.

Wetland and Riparian mapping is one of 15 Montana Spatial Data Infrastructure framework layers considered vital for making statewide maps of Montana and understanding its geography. The wetland and riparian framework layer consists of spatial data representing the extent, type, and approximate location of wetlands, riparian areas, and deep water habitats in Montana.

Wetland and riparian mapping is completed through photointerpretation of 1-m resolution color infrared aerial imagery acquired from 2005 or later. A coding convention using letters and numbers is assigned to each mapped wetland. These letters and numbers describe the broad landscape context of the wetland, its vegetation type, its water regime, and the kind of alterations that may have occurred. Ancillary data layers such as topographic maps, digital elevation models, soils data, and other aerial imagery sources are also used to improve mapping accuracy. Wetland mapping follows the federal Wetland Mapping Standard and classifies wetlands according to the Cowardin classification system of the National Wetlands Inventory (NWI) (Cowardin et al. 1979, FGDC Wetlands Subcommittee 2013). Federal, State, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands differently than the NWI. Similar coding, based on U.S. Fish and Wildlife Service conventions, is applied to riparian areas (U.S. Fish and Wildlife Service 2009). These are mapped areas where vegetation composition and growth is influenced by nearby water bodies, but where soils, plant communities, and hydrology do not display true wetland characteristics. **These data are intended for use at a scale of 1:12,000 or smaller. Mapped wetland and riparian areas do not represent precise boundaries and digital wetland data cannot substitute for an on-site determination of jurisdictional wetlands.**

See detailed overviews, with examples, of both wetland and riparian classification systems and associated codes as a storymap and companion guide

Literature Cited

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, FWS/OBS-79/31. Washington, D.C. 103pp.

Federal Geographic Data Committee. 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, D.C.

U.S. Fish and Wildlife Services. 2009. A system for mapping riparian areas in the western United States. Division of Habitat and Resource Conservation, Branch of Resource and Mapping Support, Arlington, Virginia.

Introduction to Land Management

Within the report area you have requested, land management information is summarized by acres of federal, state, and local government lands, tribal reservation boundaries, private conservation lands, and federal, state, local, and private conservation easements. Acreage for "Owned", "Tribal", or "Easement" categories represents non-overlapping areas that may be totaled. However, "Other Boundaries" represents managed areas such as National Forest boundaries containing private inholdings and other mixed ownership which may cause boundaries to overlap (e.g. a wilderness area within a forest). Therefore, acreages may not total in a straight-forward manner.

Because information on land stewardship is critical to effective land management, the Montana Natural Heritage Program (MTNHP) began compiling ownership and management data in 1997. The goal of the Montana Land Management Database is to manage a single, statewide digital data set that incorporates information from both public and private entities. The database assembles information on public lands, private conservation lands, and conservation easements held by state and federal agencies and land trusts and is updated on a regular basis. Since 2011, the Information Management group in the Montana State Library's Digital Library Division has led the Montana Land Management Database in partnership with the MTNHP.

Public and private conservation land polygons are attributed with the name of the entity that owns it. The data are derived from the statewide Montana Cadastral Parcel layer Conservation easement data shows land parcels on which a public agency or qualified land trust has placed a conservation easement in cooperation with the landowner. The dataset contains no information about ownership or status of the mineral estate. For questions about the dataset or to report errors, please contact the Montana Natural Heritage Program at (406) 444-5363 or mtnhp@mt.gov. You can download various components of the Land Management Database and view associated metadata at the Montana State Library's GIS Data List at the following links:

Public Lands
Conservation Easements
Private Conservation Lands
Managed Areas

Map features in the Montana Land Management Database or summaries provided in this report are not intended as a legal depiction of public or private surface land ownership boundaries and should not be used in place of a survey conducted by a licensed land surveyor. Similarly, map features do not imply public access to any lands. The Montana Natural Heritage Program makes no representations or warranties whatsoever with respect to the accuracy or completeness of this data and assumes no responsibility for the suitability of the data for a particular purpose. The Montana Natural Heritage Program will not be liable for any damages incurred as a result of errors displayed here. Consumers of this information should review or consult the primary data and information sources to ascertain the viability of the information for their purposes.

Introduction to Invasive and Pest Species

Within the report area you have requested, separate summaries are provided for: Aquatic Invasive Species, Noxious Weeds, Agricultural Pests, Forest Pests, and Biocontrol species that have been documented or potentially occur there based on the predicted suitability of habitat. Definitions for each of these invasive and pest species categories can be found on our Species Status Codes page.

Each of these summaries provides the following information when present for a species: (1) the number of observations of each species; (2) the geographic range polygons for each species, if developed, that the report area overlaps; (3) predicted relative habitat suitability classes that are present if a predicted suitable habitat model has been created; (4) the percent of the report area that is mapped as commonly associated or occasionally associated habitat as listed for each species in the Montana Field Guide; and (5) links to species accounts in the Montana Field Guide. Details on each of these information categories are included under relevant section headers under the Introduction to Native Species above or are defined on our Species Status Codes page. In presenting this information, the Montana Natural Heritage Program (MTNHP) is working towards assisting the user with rapidly determining what invasive and pest species have been documented and what species are potentially present in the report area. We remind users that this information is likely incomplete as surveys to document introduced species are lacking in many areas of the state, information on introduced species has only been tracked relatively recently, the MTNHP's staff and resources are limited, and information is constantly being added and updated in our databases. **Thus, field verification by professional biologists of the absence or presence of species will always be an important obligation of users of our data.**

If you are aware of observation or survey datasets for invasive or pest species that the MTNHP is missing, please report them to the Program Coordinator bmaxell@mt.gov Program Botanist apipp@mt.gov or Senior Zoologist dbachen@mt.gov If you have animal or plant observations that you would like to contribute, you can also submit them via Excel spreadsheets, geodatabases, iNaturalist, or a Survey123 form. Various methods of data submission are reviewed in this playlist of videos:
https://www.youtube.com/playlist?list=PLRaydtZpHu2qOHPoSPq9cnM9uXGmEXACx

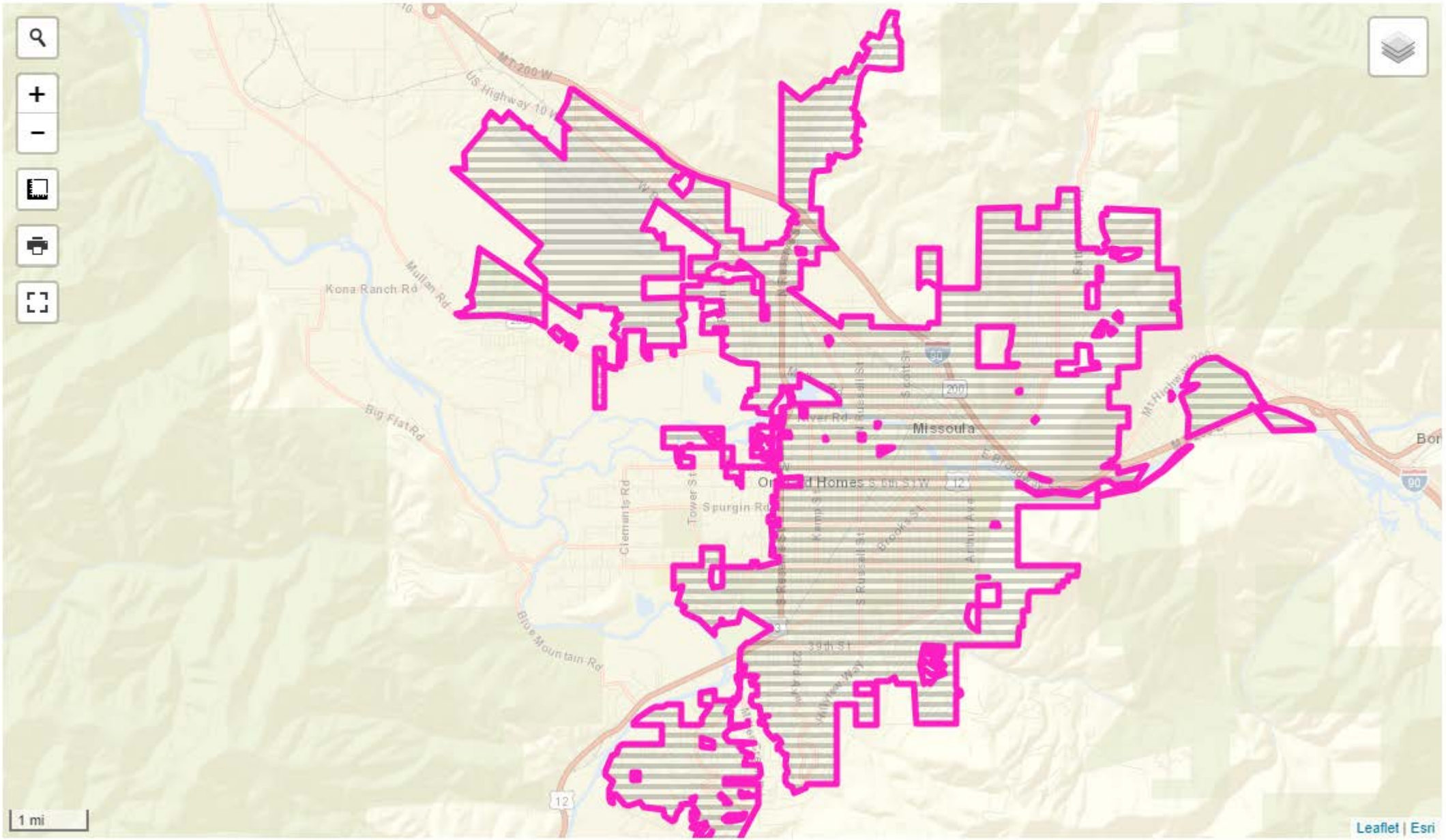
Additional Information Resources

- MTNHP Staff Contact Information
- Montana Field Guide
- MTNHP Species of Concern Report - Animals and Plants
- MTNHP Species Status Codes - Explanation
- MTNHP Predicted Suitable Habitat Models (for select Animals and Plants)
- MTNHP Request Information page
- Montana Cadastral
- Montana Code Annotated
- Montana Fisheries Information System
- Montana Fish, Wildlife, and Parks Subdivision Recommendations
- Montana GIS Data Layers
- Montana GIS Data Bundler
- Montana Greater Sage-Grouse Project Submittal Site
- Montana Ground Water Information Center
- Montana Index of Environmental Permits, 21st Edition (2018)
- Montana Environmental Policy Act (MEPA)
- Montana Environmental Policy Act Analysis Resource List
- Laws, Treaties, Regulations, and Agreements on Animals and Plants
- Montana Spatial Data Infrastructure Layers
- Montana State Historic Preservation Office Review and Compliance
- Montana Stream Permitting: a guide for conservation district supervisors and others
- Montana Water Information System
- Montana Web Map Services
- National Environmental Policy Act
- Penalties for Misuse of Fish and Wildlife Location Data (MCA 87-6-222)
- U.S. Fish and Wildlife Service Information for Planning and Consultation (Section 7 Consultation)
- Web Soil Survey Tool

Montana Sage Grouse Habitat Conservation Map

Use this map to view and explore types of sage grouse habitat designated as core (blue), general (green), connectivity (light-blue) habitats or BLM priority areas. To zoom into an area, hold the Shift key and draw a rectangle. Anyone proposing new development activities in sage grouse habitat must submit a development project application for consultation.

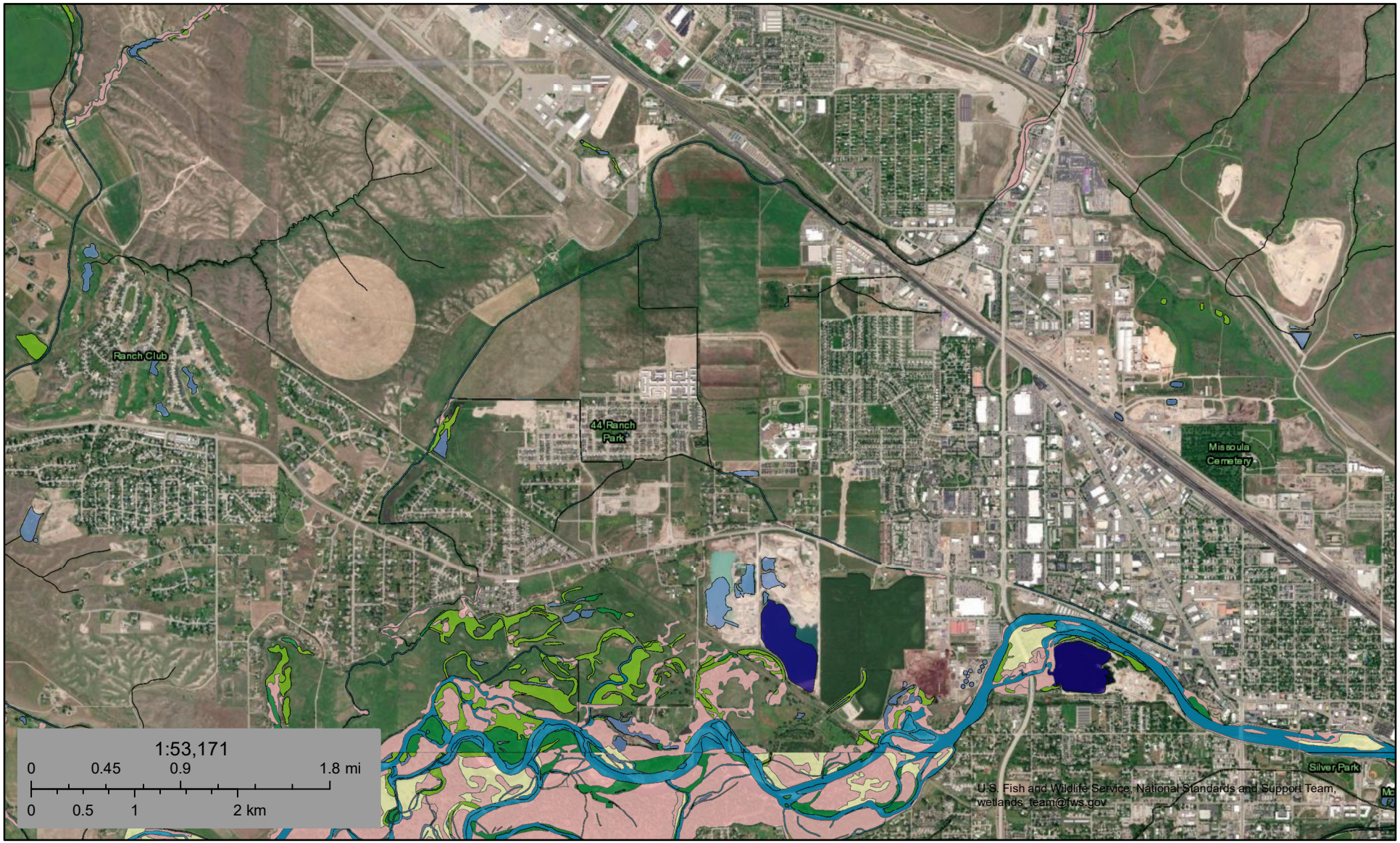
If your project is close to designated sage grouse habitat or BLM Priority area, or if you are unsure your project is within designated sage grouse habitat or BLM Priority area, please submit your project for review as permitting agencies will be checking to see if your project is located within these designated sage grouse habitats. If your permitting agency requires evidence that your project is outside of designated sage grouse habitat, we recommend that you log in and start a project application and take a screenshot of your project's location.



U.S. Fish and Wildlife Service

National Wetlands Inventory

Grant Creek Realignment



April 17, 2024

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

NOT FOR CONSULTATION

Location

Missoula County, Montana



Local office

Montana Ecological Services Field Office

(406) 449-5225
(406) 449-5339

585 Shephard Way, Suite 1
Helena, MT 59601-6287

NOT FOR CONSULTATION

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

NOT FOR CONSULTATION

2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Canada Lynx Lynx canadensis There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/3652	Threatened
Grizzly Bear Ursus arctos horribilis There is **proposed** critical habitat for this species. https://ecos.fws.gov/ecp/species/7642	Threatened
North American Wolverine Gulo gulo luscus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5123	Threatened

Birds

NAME	STATUS
Rufa Red Knot Calidris canutus rufa Wherever found There is **proposed** critical habitat for this species. https://ecos.fws.gov/ecp/species/1864	Threatened
Yellow-billed Cuckoo Coccyzus americanus There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/3911	Threatened

Fishes

NAME	STATUS
Bull Trout Salvelinus confluentus There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/8212	Threatened

NOT FOR CONSULTATION

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Bull Trout Salvelinus confluentus https://ecos.fws.gov/ecp/species/8212#crithab	Final

NOT FOR CONSULTATION

Bald & Golden Eagles

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are likely bald eagles present in your project area. For additional information on bald eagles, refer to Bald Eagle Nesting and Sensitivity to Human Activity

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Golden Eagle *Aquila chrysaetos* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31

NOT FOR CONSULTATION

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted

Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

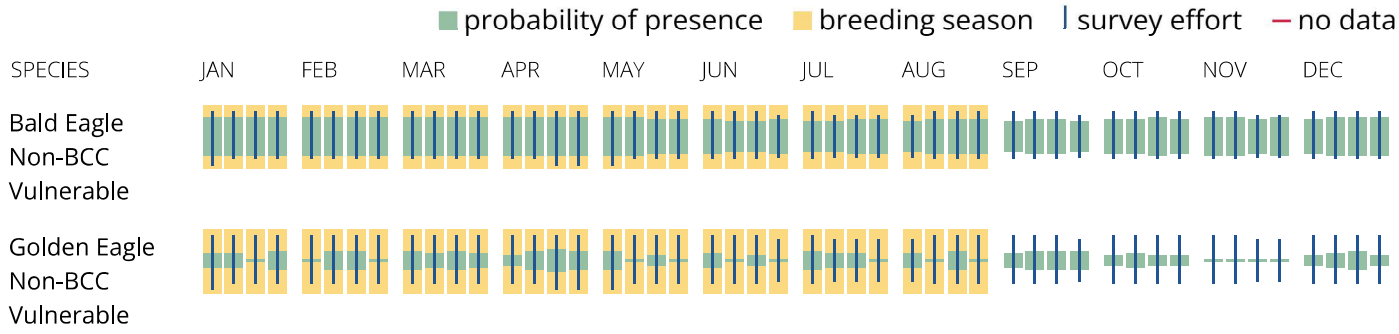
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

NOT FOR CONSULTATION



What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply). To see a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs of bald and golden eagles in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur. Please contact your local Fish and Wildlife Service Field Office if you have questions.

NOT FOR CONSULTATION

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management

- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NOT FOR CONSULTATION

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Black Swift *Cypseloides niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8878	Breeds Jun 15 to Sep 10
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31

California Gull Larus californicus — Breeds Mar 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Calliope Hummingbird Selasphorus calliope — Breeds May 1 to Aug 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9526

Evening Grosbeak Coccothraustes vespertinus — Breeds May 15 to Aug 10

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Franklin's Gull Leucophaeus pipixcan — Breeds May 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Lesser Yellowlegs Tringa flavipes — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9679

Lewis's Woodpecker Melanerpes lewis — Breeds Apr 20 to Sep 30

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9408

Long-eared Owl asio otus — Breeds Mar 1 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3631

NOT FOR CONSULTATION

Olive-sided Flycatcher Contopus cooperi This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Rufous Hummingbird Selasphorus rufus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds Apr 15 to Jul 15
Western Grebe aechmophorus occidentalis This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31
Williamson's Sapsucker Sphyrapicus thyroideus nataliae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds May 1 to Jul 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

NOT FOR CONSULTATION

2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

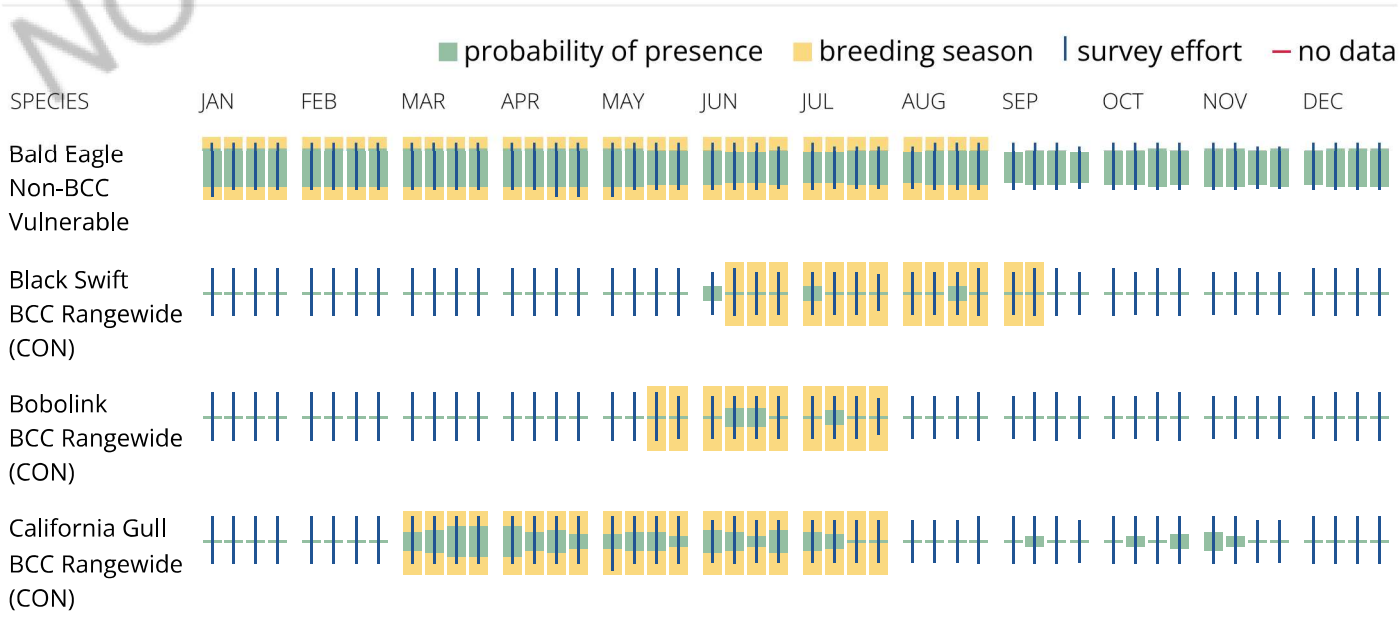
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

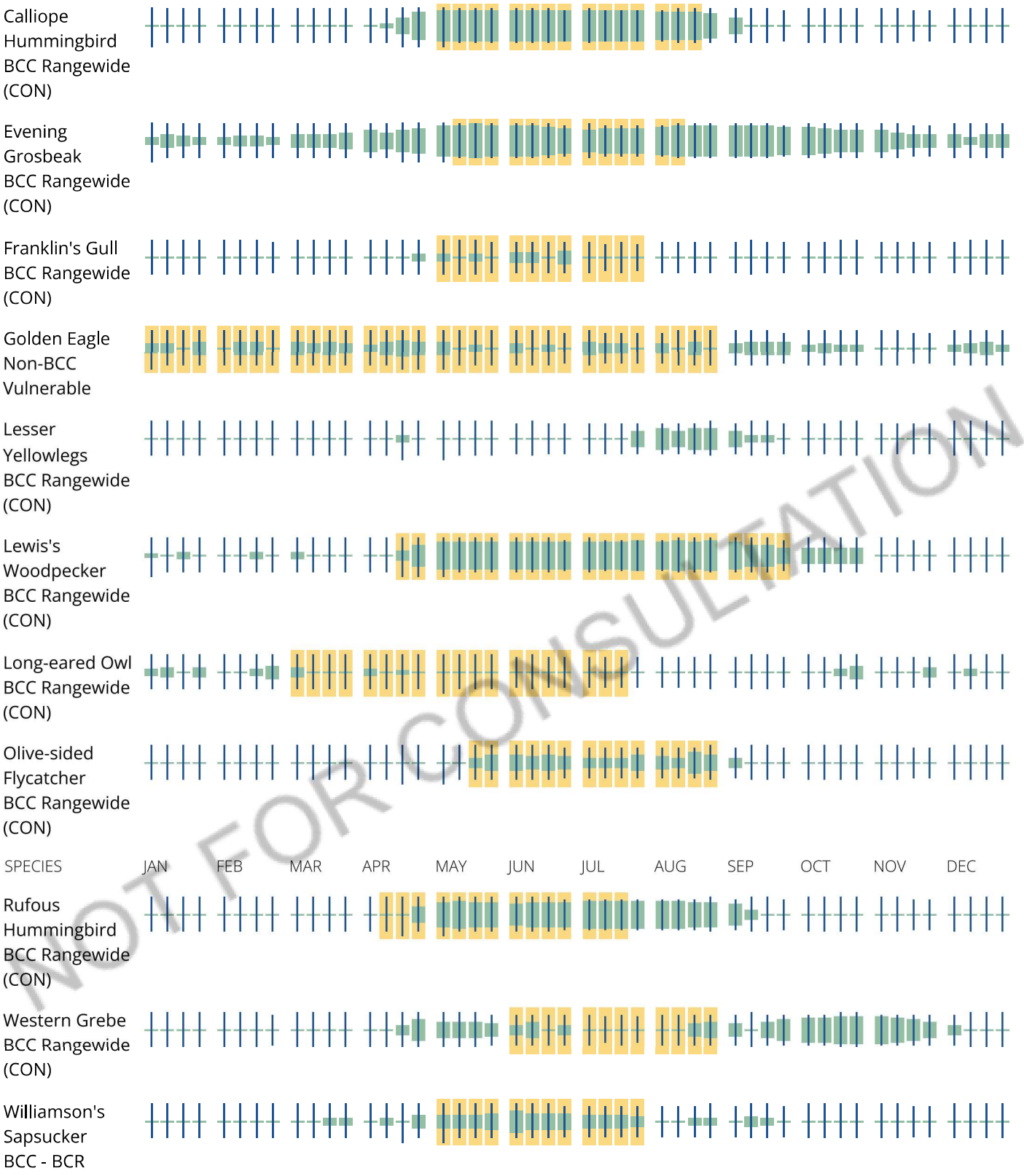
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

NOT FOR CONSULTATION





NOT FOR CONSULTATION

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure.

To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in

NOT FOR CONSULTATION

offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

NOT FOR CONSULTATION

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

- PEM1A
- PEM1C
- PEM1F
- PEM1Eb
- PEM1Cx
- PEM1Ch
- PEM1Ah

NOT FOR CONSULTATION

PEM1Ax
PEM1Fx

FRESHWATER FORESTED/SHRUB WETLAND

PSS1A
PSS1C
PSSA
PSSC

FRESHWATER POND

PABFh
PABFx
PUBFx
PUSCx
PABF
PUSAh
PABFb

LAKE

L2UBFx

RIVERINE

R3UBH
R2UBH
R4SBCx
R4SBC
R3USA
R2USA
R3USC
R4SBA
R3UBG
R4SBAx
R2UBF

NOT FOR CONSULTATION

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A

margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

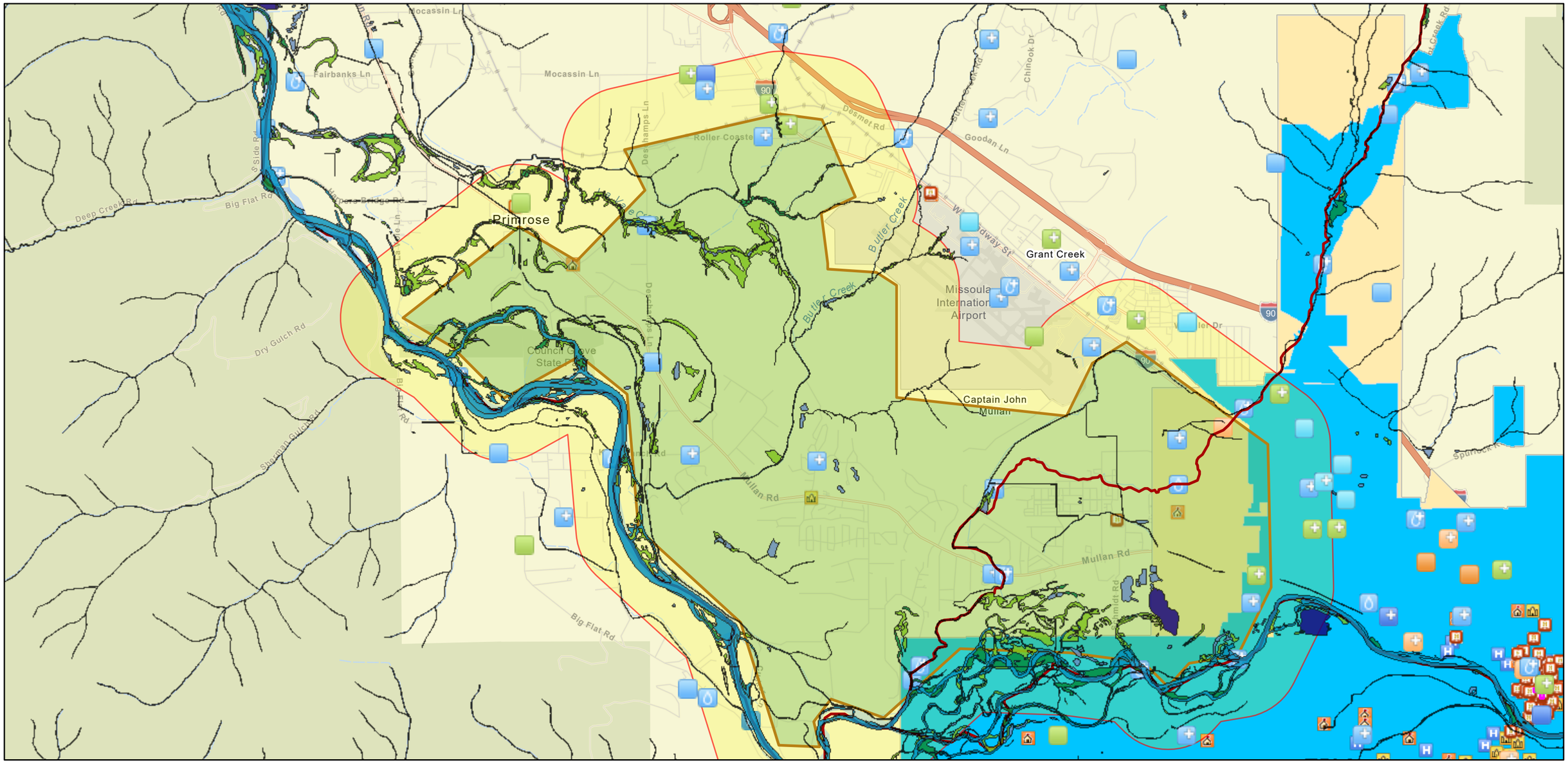
Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION

Grant Creek Realignment



April 15, 2024

Wetlands
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake

- Other
- Riverine
- Critical Habitat - Linear Features - Final
- EPA Water Monitors (STORET)
- EPA Water Monitors (STORET)
- USGS Water Monitors (NWIS)
- Brownfields (ACRES)

- Brownfields (ACRES)
- Superfund (NPL)
- Toxic Releases (TRI)
- Toxic Releases (TRI)
- Water Dischargers (NPDES)
- Water Dischargers (NPDES)

- Air Pollution (ICIS-AIR)
- Air Pollution (ICIS-AIR)
- Hazardous Waste (RCRAInfo)
- Hazardous Waste (RCRAInfo)
- Project Buffer
- Sxwtpqyen Area
- Search Result (point)

- National Register of Historic Places
- Schools
- Places of Worship
- Hospitals

PM10 (1987 standard)
- Maintenance

CO (1971 Standard)
- Maintenance

1:72,224

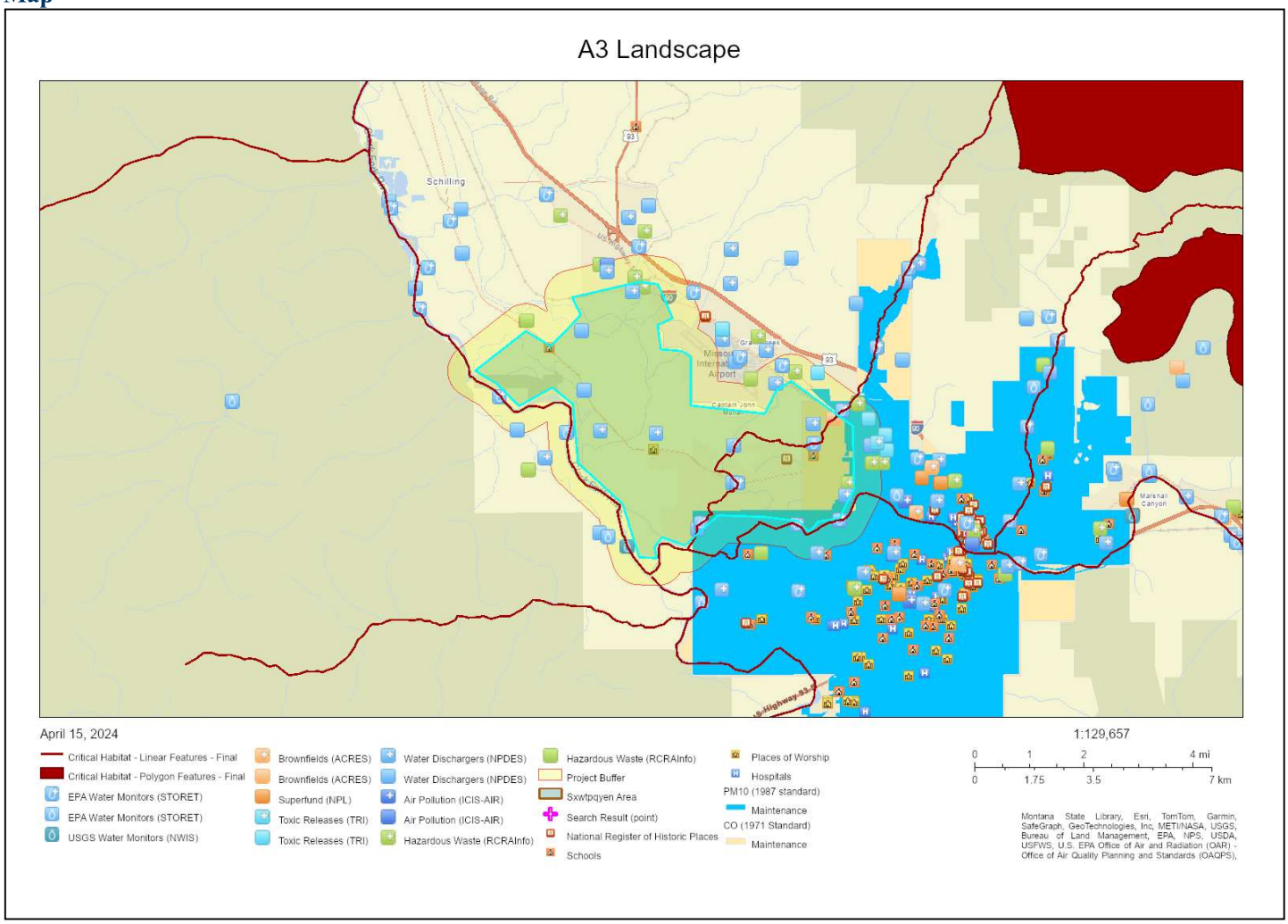
0 0.5 1 2 mi

0 0.75 1.5 3 km

U.S. Fish and Wildlife Service, National Standards and Support Team, wetlands_team@fws.gov, Montana State Library, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS, U.S. EPA Office of Air and Radiation (OAR) - Office of Air Quality

Sxwtpqyen Area

Map



Geographic coordinates:

POLYGON
(46.912360,-114.064259,46.900538,-114.040363,46.884021,-114.039814,46.876183,-114.045449,46.875245,-114.053689,46.872522,-114.057259,46.875339,-114.061379,46.876465,-114.074013,46.876934,-114.092415,46.868955,-114.105324,46.871114,-114.114251,46.868494,-114.117143,46.865583,-114.116182,46.865771,-114.123048,46.879947,-114.129503,46.890741,-114.146806,46.906318,-114.148729,46.910727,-114.156694,46.905848,-114.169603,46.911759,-114.178255,46.915136,-114.186632,46.925642,-114.166994,46.921702,-114.157243,46.929862,-114.145708,46.934551,-114.149141,46.938677,-114.122911,46.938020,-114.115770,46.929112,-114.110139,46.927236,-114.115907,46.921421,-114.114809,46.920858,-114.114809,46.920764,-114.114809,46.920389,-114.106569,46.918888,-114.103136,46.905942,-114.103136,46.903808,-114.074434,46.909906,-114.070039,46.912360,-114.064259)

with buffer 0.5 miles

Note: The information in the following reports is based on publicly available databases and web services. The National Report uses nationally available datasets and the State Reports use datasets available through the EPA Regions. Click on the hyperlinked question to view the data source and associated metadata.

National Report

Project Area	16.19 sq mi
Within 0.5 miles of an Ozone 1-hr (1979 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of an Ozone 8-hr (1997 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of an Ozone 8-hr (2008 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of an Ozone 8-hr (2015 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a Lead (2008 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a SO2 1-hr (2010 standard) Non-Attainment/Maintenance Area?	no

Within 0.5 miles of a PM2.5 24hr (2006 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a PM2.5 Annual (1997 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a PM2.5 Annual (2012 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a PM10 (1987 standard) Non-Attainment/Maintenance Area?	yes
Within 0.5 miles of a CO Annual (1971 standard) Non-Attainment/Maintenance Area?	yes
Within 0.5 miles of a NO2 Annual (1971 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a Federal Land?	yes
Within 0.5 miles of an impaired stream?	yes
Within 0.5 miles of an impaired waterbody?	no
Within 0.5 miles of a waterbody?	yes
Within 0.5 miles of a stream?	yes
Within 0.5 miles of an NWI wetland?	click here ***May take several minutes***
Within 0.5 miles of a Brownfields site?	yes
Within 0.5 miles of a Superfund site?	no
Within 0.5 miles of a Toxic Release Inventory (TRI) site?	yes
Within 0.5 miles of a water discharger (NPDES)?	yes
Within 0.5 miles of a hazardous waste (RCRA) facility?	yes
Within 0.5 miles of an air emission facility?	yes
Within 0.5 miles of a school?	yes
Within 0.5 miles of an airport?	no
Within 0.5 miles of a hospital?	no
Within 0.5 miles of a designated sole source aquifer?	yes
Within 0.5 miles of a historic property on the National Register of Historic Places?	yes
Within 0.5 miles of a Land Cession Boundary?	yes
Within 0.5 miles of a tribal area (lower 48 states)?	no
Within 0.5 miles of the service area of a mitigation or conservation bank?	yes
Within 0.5 miles of the service area of an In-Lieu-Fee Program?	yes
Within 0.5 miles of a Public Property Boundary of the Formerly Used Defense Sites?	no
Within 0.5 miles of a Munitions Response Site?	no
Within 0.5 miles of an Essential Fish Habitat (EFH)?	no
Within 0.5 miles of a Habitat Area of Particular Concern (HAPC)?	no
Within 0.5 miles of an EFH Area Protected from Fishing (EFHA)?	no
Within 0.5 miles of a Bureau of Land Management Area of Critical Environmental Concern?	no
Within 0.5 miles of an ESA-designated Critical Habitat Area per U.S. Fish & Wildlife Service?	no
Within 0.5 miles of an ESA-designated Critical Habitat river, stream or water feature per U.S. Fish & Wildlife Service?	yes

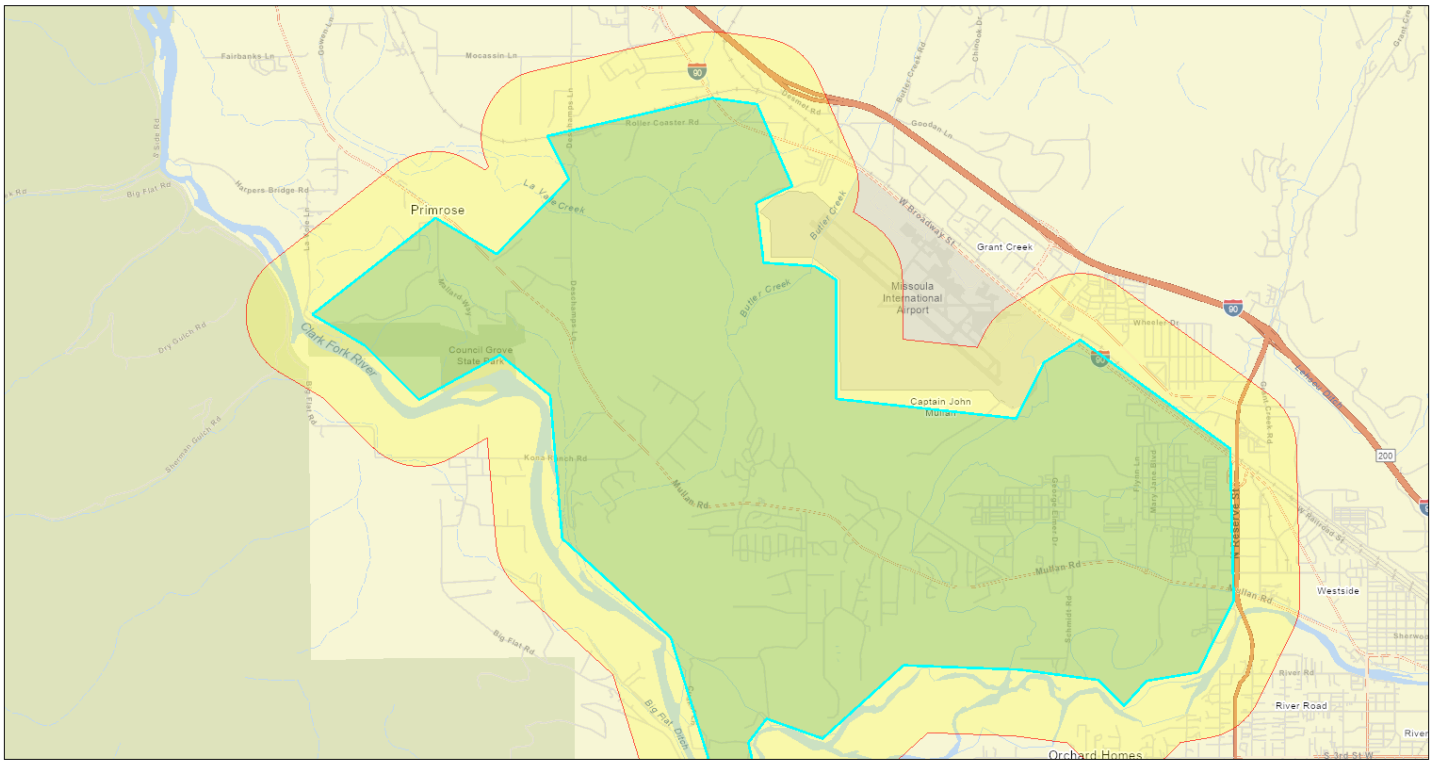
Save to Excel | Save as PDF

Montana Report
Demographic Reports
USFWS IPaC Report

NEPAssist Report

Sxwtpqyen Area

A3 Landscape



April 15, 2024

Project Buffer

Sxwtpqyen Area

1:63,156

0 0.5 1 2 mi

0 0.75 1.5 3 km

Montana State Library, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS

Input Coordinates: 46.912360,-114.064259,46.900538,-114.040363,46.884021,-114.039814,46.876183,-114.045449,46.875245,-114.053689,46.872522,-114.057259,46.875339,-114.061379,46.876465,-114.074013,46.876934,-114.092415,46.868955,-114.105324,46.871114,-114.114251,46.868494,-114.117143,46.865583,-114.116182,46.865771,-114.123048,46.879947,-114.129503,46.890741,-114.146806,46.906318,-114.148729,46.910727,-114.156694,46.905848,-114.169603,46.911759,-114.178255,46.915136,-114.186632,46.925642,-114.166994,46.921702,-114.157243,46.929862,-114.145708,46.934551,-114.149141,46.938677,-114.122911,46.938020,-114.115770,46.929112,-114.110139,46.927236,-114.115907,46.921421,-114.114809,46.920858,-114.114809,46.920764,-114.114809,46.920389,-114.106569,46.918888,-114.103136,46.905942,-114.103136,46.903808,-114.074434,46.909906,-114.070039,46.912360,-114.064259

Project Area	16.19 sq mi
Within 0.5 miles of an Ozone 1-hr (1979 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of an Ozone 8-hr (1997 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of an Ozone 8-hr (2008 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of an Ozone 8-hr (2015 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a Lead (2008 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a SO2 1-hr (2010 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a PM2.5 24hr (2006 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a PM2.5 Annual (1997 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a PM2.5 Annual (2012 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a PM10 (1987 standard) Non-Attainment/Maintenance Area?	yes
Within 0.5 miles of a CO Annual (1971 standard) Non-Attainment/Maintenance Area?	yes
Within 0.5 miles of a NO2 Annual (1971 standard) Non-Attainment/Maintenance Area?	no
Within 0.5 miles of a Federal Land?	yes

Within 0.5 miles of an impaired stream?	yes
Within 0.5 miles of an impaired waterbody?	no
Within 0.5 miles of a waterbody?	yes
Within 0.5 miles of a stream?	yes
Within 0.5 miles of an NWI wetland?	Available Online
Within 0.5 miles of a Brownfields site?	yes
Within 0.5 miles of a Superfund site?	no
Within 0.5 miles of a Toxic Release Inventory (TRI) site?	yes
Within 0.5 miles of a water discharger (NPDES)?	yes
Within 0.5 miles of a hazardous waste (RCRA) facility?	yes
Within 0.5 miles of an air emission facility?	yes
Within 0.5 miles of a school?	yes
Within 0.5 miles of an airport?	no
Within 0.5 miles of a hospital?	no
Within 0.5 miles of a designated sole source aquifer?	yes
Within 0.5 miles of a historic property on the National Register of Historic Places?	yes
Within 0.5 miles of a Land Cession Boundary?	yes
Within 0.5 miles of a tribal area (lower 48 states)?	no
Within 0.5 miles of the service area of a mitigation or conservation bank?	yes
Within 0.5 miles of the service area of an In-Lieu-Fee Program?	yes
Within 0.5 miles of a Public Property Boundary of the Formerly Used Defense Sites?	no
Within 0.5 miles of a Munitions Response Site?	no
Within 0.5 miles of an Essential Fish Habitat (EFH)?	no
Within 0.5 miles of a Habitat Area of Particular Concern (HAPC)?	no
Within 0.5 miles of an EFH Area Protected from Fishing (EFHA)?	no
Within 0.5 miles of a Bureau of Land Management Area of Critical Environmental Concern?	no
Within 0.5 miles of an ESA-designated Critical Habitat Area per U.S. Fish & Wildlife Service?	no
Within 0.5 miles of an ESA-designated Critical Habitat river, stream or water feature per U.S. Fish & Wildlife Service?	yes

Created on: 4/15/2024 11:48:03 AM

EJSCREEN ACS Summary Report

Location: User-specified polygonal location
Ring (buffer): 0.5-miles radius
Description: Sxwtpqyen Area

Summary of ACS Estimates	2017 - 2021
Population	15,485
Population Density (per sq. mile)	535
People of Color Population	1,702
% People of Color Population	11%
Households	6,409
Housing Units	6,807
Housing Units Built Before 1950	182
Per Capita Income	35,556
Land Area (sq. miles) (Source: SF1)	28.95
% Land Area	97%
Water Area (sq. miles) (Source: SF1)	0.97
% Water Area	3%

	2017 - 2021 ACS Estimates	Percent	MOE (±)
Population by Race			
Total	15,485	100%	945
Population Reporting One Race	14,983	97%	1,912
White	14,149	91%	927
Black	59	0%	173
American Indian	176	1%	174
Asian	309	2%	294
Pacific Islander	18	0%	27
Some Other Race	271	2%	317
Population Reporting Two or More Races	502	3%	220
Total Hispanic Population	544	4%	152
Total Non-Hispanic Population	14,940		
White Alone	13,783	89%	924
Black Alone	59	0%	173
American Indian Alone	174	1%	174
Non-Hispanic Asian Alone	309	2%	294
Pacific Islander Alone	17	0%	27
Other Race Alone	206	1%	315
Two or More Races Alone	392	3%	220
Population by Sex			
Male	7,426	48%	542
Female	8,059	52%	477
Population by Age			
Age 0-4	696	4%	168
Age 0-17	3,401	22%	359
Age 18+	12,084	78%	515
Age 65+	2,173	14%	198

Data Note: Detail may not sum to totals due to rounding. Hispanic population can be of any race.
N/A means not available. **Source:** U.S. Census Bureau, American Community Survey (ACS) 2017 - 2021 .

EJSCREEN ACS Summary Report

Location: User-specified polygonal location
Ring (buffer): 0.5-miles radius
Description: Sxwtpqyen Area

	2017 - 2021 ACS Estimates	Percent	MOE (±)
Population 25+ by Educational Attainment			
Total	10,063	100%	513
Less than 9th Grade	112	1%	71
9th - 12th Grade, No Diploma	285	3%	80
High School Graduate	2,439	24%	275
Some College, No Degree	2,145	21%	239
Associate Degree	1,249	12%	147
Bachelor's Degree or more	3,833	38%	312
Population Age 5+ Years by Ability to Speak English			
Total	14,788	100%	872
Speak only English	14,031	95%	788
Non-English at Home[1+2+3+4]	757	5%	296
[1]Speak English "very well"	479	3%	176
[2]Speak English "well"	259	2%	182
[3]Speak English "not well"	20	0%	53
[4]Speak English "not at all"	0	0%	38
[3+4]Speak English "less than well"	20	0%	66
[2+3+4]Speak English "less than very well"	278	2%	192
Linguistically Isolated Households*			
Total	71	100%	87
Speak Spanish	11	16%	36
Speak Other Indo-European Languages	56	79%	85
Speak Asian-Pacific Island Languages	4	5%	11
Speak Other Languages	0	0%	11
Households by Household Income			
Household Income Base	6,409	100%	304
< $15,000	666	10%	196
$15,000 - $25,000	511	8%	145
$25,000 - $50,000	1,544	24%	237
$50,000 - $75,000	898	14%	196
$75,000 +	2,790	44%	281
Occupied Housing Units by Tenure			
Total	6,409	100%	304
Owner Occupied	4,070	64%	247
Renter Occupied	2,339	36%	249
Employed Population Age 16+ Years			
Total	12,499	100%	702
In Labor Force	9,350	75%	666
Civilian Unemployed in Labor Force	289	3%	101
Not In Labor Force	3,149	25%	269

Data Note: Datail may not sum to totals due to rounding. Hispanic population can be of anyrace.
N/A means not available. **Source:** U.S. Census Bureau, American Community Survey (ACS)
*Households in which no one 14 and over speaks English "very well" or speaks English only.

EJSCREEN ACS Summary Report

Location: User-specified polygonal location
Ring (buffer): 0.5-miles radius
Description: Sxwtpqyen Area

	2017 - 2021 ACS Estimates	Percent	MOE (±)
Population by Language Spoken at Home*			
Total (persons age 5 and above)	14,314	100%	944
English	13,529	95%	945
Spanish	140	1%	103
French, Haitian, or Cajun	14	0%	48
German or other West Germanic	108	1%	117
Russian, Polish, or Other Slavic	134	1%	187
Other Indo-European	10	0%	48
Korean	29	0%	43
Chinese (including Mandarin, Cantonese)	3	0%	15
Vietnamese	9	0%	17
Tagalog (including Filipino)	55	0%	82
Other Asian and Pacific Island	201	1%	294
Arabic	0	0%	15
Other and Unspecified	81	1%	198
Total Non-English	785	5%	1,336

Data Note: Detail may not sum to totals due to rounding. Hispanic popultion can be of any race.
N/A meansnot available. **Source:** U.S. Census Bureau, American Community Survey (ACS) 2017 - 2021.
*Population by Language Spoken at Home is available at the census tract summary level and up.

EJSCREEN Census 2010 Summary Report

Location: User-specified polygonal location
Ring (buffer): 0.5-miles radius
Description: Sxwtpqyen Area

Summary	Census 2010
Population	11,628
Population Density (per sq. mile)	401
People of Color Population	950
% People of Color Population	0.08169457856421311%
Households	4,885
Housing Units	5,152
Land Area (sq. miles)	29.00
% Land Area	0.9700943235787473%
Water Area (sq. miles)	0.89
% Water Area	0.0299056764212527%

Population by Race	Number	Percent
Total	11,628	-------
Population Reporting One Race	11,337	).9749595472411278%
White	10,854	0.933454004756631%
Black	47	40279318921786055%
American Indian	210	)1810013611419173%
Asian	169	14542397511265126%
Pacific Islander	19	.6278111486460317%
Some Other Race	37	32072658182151397%
Population Reporting Two or More Races	291	25040452758872362%
Total Hispanic Population	260	22333304154848996%
Total Non-Hispanic Population	11,368	).9776666958451513%
White Alone	10,678	.9183054214357872%
Black Alone	45	38742635953184943%
American Indian Alone	191	)1643233235813855%
Non-Hispanic Asian Alone	167	14324959901686219%
Pacific Islander Alone	18	15418118351183813%
Other Race Alone	8	)6627510949665814%
Two or More Races Alone	262	22525155624135883%

Population by Sex	Number	Percent
Male	5,617	.4830271239378246%
Female	6,011	).5169728760621755%

Population by Age	Number	Percent
Age 0-4	787	6768349395506248%
Age 0-17	2,743	2358781520115462%
Age 18+	8,885	76412184798845 38%
Age 65+	1,501	2911420277831054%

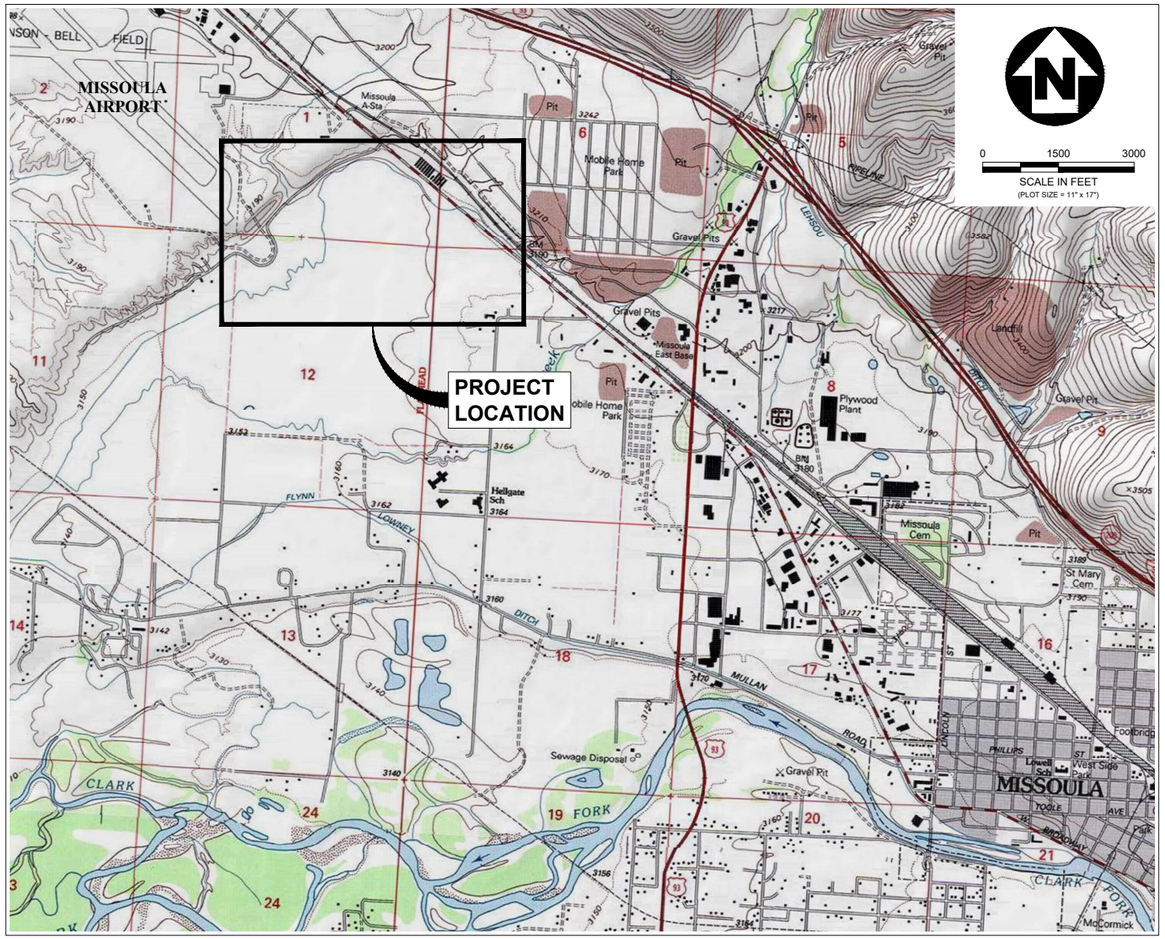
Households by Tenure	Number	Percent
Total	4,885	
Owner Occupied	3,399	6958467429620023%
Renter Occupied	1,486	0415325703799756%

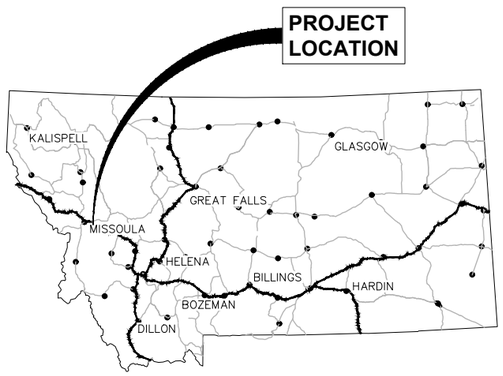
Data Note: Detail may not sum to totals due to rounding. Hispanic population can be of any race.
Source: U.S. Census Bureau, Census 2010 Summary File 1.

MISSOULA COUNTY
AND
CITY OF MISSOULA

GRANT CREEK RESTORATION AND FLOOD CONTROL

MISSOULA, MONTANA





ENGINEERS
PLANNERS
SURVEYORS

PLANS PREPARED FOR

MISSOULA COUNTY
AND THE
CITY OF MISSOULA

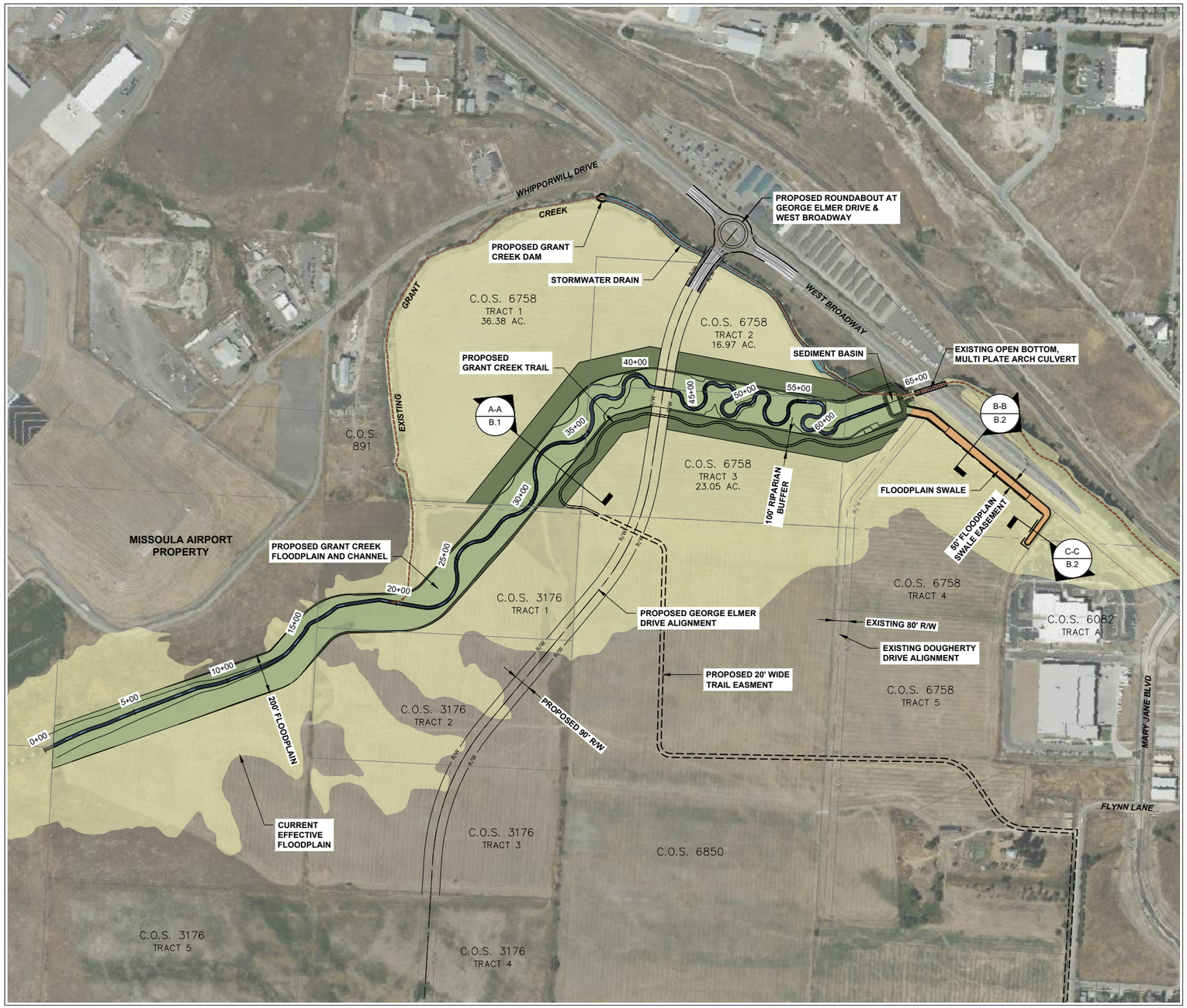
PROJECT MANAGER
D. PFEIFER

0 300 600

SCALE IN FEET
(PLOT SIZE = 11" x 17")

LEGEND

- STREAM CHANNEL
- 200' FLOODPLAIN
- 100' RIPARIAN BUFFER
- FLOODPLAIN SWALE
- STORMWATER DRAIN
- CURRENT EFFECTIVE FLOODPLAIN
- EXISTING GRANT CREEK
- EXISTING ROAD CENTERLINE
- PROPOSED ROAD CENTERLINE
- EXISTING RIGHT-OF-WAY
- PROPOSED RIGHT-OF-WAY
- EXISTING PROPERTY LINE
- SECTION LINE
- PROPOSED TRAIL
- PROPOSED TRAIL EASEMENT



1 / - PROJECT OVERVIEW
SCALE: 1" = 300'

SHEET INDEX

A. GENERAL INFORMATION

A.1 COVER
A.2 PROJECT OVERVIEW AND SHEET INDEX
A.3 LEGEND AND ABBREVIATIONS
A.4 GENERAL NOTES
A.5 GRANT CREEK - MASS HAUL VIEW AND ESTIMATED QUANTITIES
A.6 FLOODPLAIN SWALE - MASS HAUL VIEW AND ESTIMATED QUANTITIES
A.7 EARTHWORK STOCKPILING AND - ALTERNATE BID SCHEDULES
A.8 SURVEY CONTROL POINTS

B. TYPICAL SECTIONS

B.1 GRANT CREEK FLOODPLAIN AND CHANNEL
B.2 FLOODPLAIN SWALE
B.3 GRANT CREEK TRAIL

C. GRANT CREEK PLAN, PROFILE & CROSS SECTIONS

C.1 PLAN AND PROFILE - STA 0+00 TO STA 12+50
C.2 PLAN AND PROFILE - STA 12+50 TO STA 25+50
C.3 PLAN AND PROFILE - STA 25+50 TO STA 38+50
C.4 PLAN AND PROFILE - STA 38+50 TO STA 51+00
C.5 PLAN AND PROFILE - STA 51+00 TO STA 64+00
C.6 CROSS SECTIONS - STA 2+00 TO STA 8+00
C.7 CROSS SECTIONS - STA 10+00 TO STA 16+00
C.8 CROSS SECTIONS - STA 18+00 TO STA 24+00
C.9 CROSS SECTIONS - STA 26+00 TO STA 32+00
C.10 CROSS SECTIONS - STA 34+00 TO STA 40+00
C.11 CROSS SECTIONS - STA 42+00 TO STA 49+00
C.12 CROSS SECTIONS - STA 50+00 TO STA 60+00
C.13 CROSS SECTIONS - STA 62+00 TO STA 64+00

D. SEDIMENT BASIN PLAN, PROFILE AND CROSS SECTIONS

D.1 SEDIMENT BASIN PLAN & PROFILE
D.2 SEDIMENT BASIN CROSS SECTIONS

E. FLOODPLAIN SWALE PLAN, PROFILE & CROSS SECTIONS

E.1 FLOODPLAIN SWALE PLAN & PROFILE
E.2 FLOODPLAIN SWALE CROSS SECTIONS

F. STORMWATER DRAIN PLAN, PROFILE & DETAILS

F.1 STORMWATER DRAIN PLAN & PROFILE
F.2 ENLARGED GRANT CREEK DAM

G. TRAIL PLAN, PROFILE AND CROSS SECTIONS

G.1 VICINITY MAP
G.2 PLAN & PROFILE - STA 10+00 TO 12+30
G.3 PLAN & PROFILE - STA 12+30 TO 14+80
G.4 PLAN & PROFILE - STA 14+80 TO 17+30
G.5 PLAN & PROFILE - STA 17+30 TO 19+80
G.6 PLAN & PROFILE - STA 19+80 TO 22+30
G.7 PLAN & PROFILE - STA 22+30 TO 24+80
G.8 PLAN & PROFILE - STA 24+80 TO 27+30
G.9 PLAN & PROFILE - STA 27+30 TO 29+80
G.10 PLAN & PROFILE - STA 29+80 TO 32+30
G.11 PLAN & PROFILE - STA 32+30 TO 33+00
G.12 - G.19 CROSS SECTIONS

H. REVEGETATION PLAN

H.1 PLANTING PLAN
H.2 PLANTING SCHEDULE

I. SOIL EROSION, SEDIMENT CONTROL

I.1 EROSION CONTROL DETAILS (1 OF 2)
I.2 EROSION CONTROL DETAILS (2 OF 2)

J. GRANT CREEK CROSSING

J.1 ROAD PLAN AND PROFILE
J.2 CULVERT GENERAL LAYOUT

REVISION	DATE	DESCRIPTION
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

A. GENERAL INFORMATION
PROJECT OVERVIEW AND SHEET INDEX

SHEET OF A.2 A.8

ABBREVIATIONS

ALUMINUM CAP	AC
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS	AASHTO
AMERICAN NATIONAL STANDARDS INSTITUTE	ANSI
AND	&
AVENUE	AVE.
BALLED AND BURLAPPED	B&B
BEGIN VERTICAL CURVE ELEVATION	BVCE
BEGIN VERTICAL CURVE STATION	BVCS
BEGINNING POINT	BP
BRASS CAP	BC
CENTERLINE	CL, C/L
CONTROL POINT	CP
CUBIC YARD	CY
DIAMETER	DIA., D, ø
DRY DENSITY	DD
EAST	E
ELEVATION	ELEV., EL.
END POINT	EP
END VERTICAL CURVE ELEVATION	EVCE
END VERTICAL CURVE STATION	EVCS
FINISH GROUND	FG
FOOT (MEASUREMENT)	FT. OR '
FOUND	FND
INCH	IN. OR "
LENGTH OF VERTICAL CURVE	LVC
LIQUID LIMIT	LL
MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES	MUTCD
MAXIMUM	MAX.
MILIMETER	MM
MINIMUM	MIN.
MOISTURE CONTENT	MC
NORTH	N
NORTH AMERICAN DATUM	NAD
NORTH AMERICAN VERTICAL DATUM	NAVD
NUMBER	NO.
ON CENTER	OC
OUNCE	OZ
PERCENT	PCT. OR %
PLASTIC LIMIT	PL
POINT OF CURVE	PC
POINT OF INTERSECTION	PI
POINT OF TANGENT	PT
POINT OF VERTICAL INTERSECTION	PVI
QUANTITIES	QUANT., QTY
RADIUS	R
REBAR	RB
SQUARE FOOT	FT^2, FT2 OR SF
STANDARD	STD
STATION	STA
TOP BACK OF CURB	TBC
TYPICAL	TYP

LEGEND

	EXISTING	PROPOSED
EDGE OF ASPHALT		
EDGE OF GRAVEL		
ROAD CENTERLINE		
DITCH/SWALE		
SIGNS		
MINOR CONTOUR		
MAJOR CONTOUR		
FENCE		
NATURAL GAS LINE		
OVERHEAD POWER LINE		
UNDERGROUND POWER LINE		
FIBER OPTIC LINE		
UNDERGROUND TELEPHONE LINE		
UNDERGROUND TELEVISION LINE		
POWER POLE		
POWER POLE ANCHOR		
UTILITY BOX		
VEGETATION		
RECORD ROADWAY RIGHT-OF-WAY LINE		
RECORD RIGHT-OF-WAY LINE		
CURB AND GUTTER		
DRAINAGE SUMP		CB
CONSTRUCTION LIMITS		
CONTROL POINT		
ASPHALT CONCRETE PAVEMENT		
CONCRETE		
BOLLARD		
WELL / GROUND WATER MONITORING	W GWM	
BORE HOLE		
TOPSOIL AND SEEDING		
FIRE HYDRANT		
WATER BLOW-OFF VALVE		
WATER VALVE	WV	
WATER LINE		
SEWER MANHOLE	S	S
SEWER LINE		
STORM DRAIN MANHOLE	D	D

	EXISTING	PROPOSED
APPROACH PIPE/CULVERT		
TEMPORARY CONSTRUCTION EASEMENT		

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

A. GENERAL INFORMATION
LEGEND AND ABBREVIATIONS

SHEET OF A.3 A.8

GENERAL NOTES

1. SPECIFICATIONS: CONSTRUCT THE PROJECT IN COMPLIANCE WITH THE PROJECT SPECIFICATIONS AND TO MISSOULA CITY PUBLIC WORKS STANDARDS AND SPECIFICATIONS (MCPWSS) AND BEST MANAGEMENT PRACTICES. THE PROJECT SPECIFICATIONS ARE DERIVED FROM THE MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS (MPWSS) AND HAVE BEEN REVISED AND SUPPLEMENTED FOR THIS PROJECT.

2. EROSION CONTROL PLAN: THE CONTRACTOR IS RESPONSIBLE FOR SUBMITTING AN EROSION CONTROL PLAN TO THE CITY ENGINEER FOR APPROVAL PRIOR TO BEGINNING ANY WORK. WORK WILL NOT BE CONDUCTED UNTIL THE EROSION CONTROL PLAN HAS BEEN APPROVED BY THE CITY ENGINEER. THE CONTRACTOR WILL PROVIDE METHODS TO PREVENT RUNOFF FROM THE CONSTRUCTION SITE FROM ENTERING DIRECTLY INTO THE ADJACENT WATERWAYS.

3. GENERAL STORM WATER PERMITS: THE CONTRACTOR IS RESPONSIBLE FOR FOLLOWING AND COMPLETING ALL REQUIREMENTS OF THE MPDES STORM WATER PERMIT ADMINISTERED UNDER THE MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY. AN AUTHORIZATION UNDER THE GENERAL PERMIT FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY IS REQUIRED FOR CONSTRUCTION ACTIVITIES THAT INCLUDE CLEARING, EXCAVATING, GRADING, GRUBBING, OR PLACEMENT/REMOVAL OF EARTH MATERIAL WITH A TOTAL AREA OF ONE OR MORE ACRES. ADDITIONAL INFORMATION IS PROVIDED IN THE SPECIFICATIONS.

4. CITY OF MISSOULA STORM WATER PERMIT: THE CONTRACTOR SHALL OBTAIN A REQUIRED CITY OF MISSOULA STORM WATER PERMIT. THE CONTRACTOR MUST SUBMIT ALL REQUIRED FORMS TO THE ENGINEER SO THAT THE ENGINEER CAN TURN IN SAID FORMS TO CITY OF MISSOULA ENGINEERING AS PART OF THE STAGE 6 PROCESS IN ORDER FOR CITY OF MISSOULA ENGINEERING TO ACCEPT INFRASTRUCTURE. THE CONTRACTOR IS ALSO REQUIRED TO SUBMIT TO THE CITY OF MISSOULA A COPY OF THE NOTICE OF INTENT (NOI) PROVIDED TO MT DEQ, A COPY OF THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) PROVIDED TO MT DEQ AND A COPY OF MT DEQ'S CONFIRMATION LETTER.

5. UTILITIES: UTILITY LOCATIONS SHOWN ON THE PLANS ARE APPROXIMATE. NOT ALL EXISTING UTILITIES ARE SHOWN. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY LOCATIONS OF ALL UTILITIES THAT MAY BE IMPACTED BY THIS PROJECT. THE CONTRACTOR SHALL COORDINATE ALL UTILITY RELOCATIONS WITH THE UTILITY PROVIDERS AT NO COST TO THE OWNER.

6. COODINATION WITH LANDOWNERS: IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO COORDINATE WITH LANDOWNERS ADJACENT TO THE PROJECT TO SCHEDULE NECESSARY WORK ON DRIVEWAYS, APPROACHES, AND OTHER WORK THAT MAY AFFECT ACCESS TO THEIR PROPERTIES.

7. MAILBOXES: ALL MAILBOXES ARE TO REMAIN OPERATIONAL DURING CONSTRUCTION, EITHER BY INSTALLING CLUSTER MAILBOXES BEFORE REMOVING EXISTING MAILBOXES OR BY PROVIDING TEMPORARY MAILBOX USE.

8. RESETTING EXISTING SIGNS: RESET STREET SIGNS IN ACCORDANCE WITH PROJECT SPECIFICATION SECTION 02114 AND CITY OF MISSOULA STANDARD DETAILS. THE CONTRACTOR SHALL CONTACT CHAD PANCAKE, CITY OF MISSOULA TRAFFIC SERVICES, AT (406) 552-6372 PRIOR TO REMOVAL AND INSTALLATION OF ALL SIGNS. COORDINATE SIGN REINSTALLATION PROCEDURES AND SIGN LOCATIONS WITH CHAD PANCAKE.

9. BASIS OF QUANTITIES: SEE THE COST NARRATIVE FOR ASSUMPTIONS AND METHODS USED IN THE COST ESTIMATION.

DESIGN STANDARDS

1. ROADWAYS: STREETS WERE DESIGNED TO MISSOULA CITY PUBLIC WORKS STANDARDS AND SPECIFICATIONS (MCPWSS) INCLUDING DRAWINGS AND CONFORM TO GUIDANCE SET FORTH IN AASHTO GREEN BOOK: A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS, 2018 7TH EDITION THE DESIGN BASIS REPORT FURTHER SUMMARIZES AND DOCUMENTS THE PRELIMINARY INTERSECTION DESIGN.

2. INTERSECTIONS: ROUNDABOUTS WERE DESIGNED TO MDT STANDARDS AND CONFORM TO GUIDANCE SET FORTH IN NCHRP REPORT 672, ROUNDABOUTS: AN INFORMATION AL GUIDE, SECOND EDITION. THE DESIGN BASIS REPORT FURTHER SUMMARIZES AND DOCUMENTS THE PRELIMINARY ROADWAY DESIGN.

3. TRAILS: TRAILS WERE DESIGNED TO CITY OF MISSOULA STANDARDS & DETAILS AND CONFORM TO GUIDANCE SET FORTH IN THE AASHTO GUIDE FOR THE DEVELOPMENT OF BICYCLE FACILITIES. THE DESIGN BASIS REPORT FURTHER SUMMARIZES AND DOCUMENTS THE PRELIMINARY TRAIL DESIGN.

SUMMARY OF QUANTITIES

1. QUANTITY SUMMARY FRAMES: ALL QUANTITY SUMMARY ESTIMATES HAVE ARE PROVIDED IN A SEPARATE DOCUMENT.

2. SCOPE DEFERMENT: DUE TO FUNDING CONSTRAINTS ONLY PORTIONS OF THE PROJECT WILL BE INCLUDED IN THIS CONTRACT. REFERENCE THE SCOPE DEFERMENT EXHIBIT ON SHEET A.4 AND THE SPECIAL PROVISIONS.

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

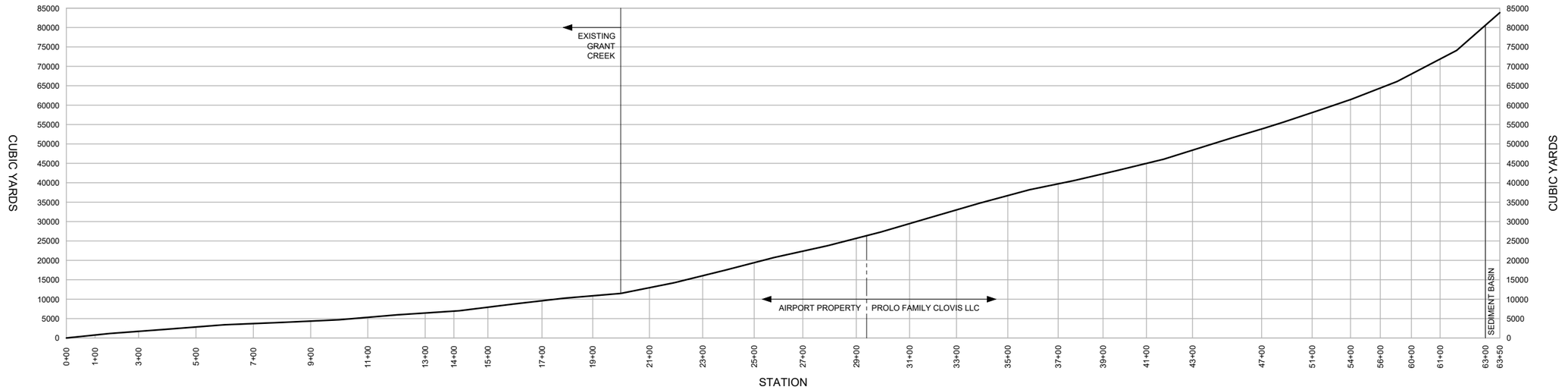
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

A. GENERAL INFORMATION
GENERAL NOTES

SHEET
OF
A.4 A.8

GRANT CREEK MASS HAUL VIEW



ESTIMATED QUANTITIES							
STATION	CUT AREA	FILL AREA	CUT VOL	FILL VOL	CUMULATIVE CUT VOL	CUMULATIVE FILL VOL	NET VOL
0+00.00	324.55 SF	7.54 SF	0.00 CY	0.00 CY	0.00 CY	0.00 CY	**0.00 CY**
2+00.00	387.01 SF	290.55 SF	1996.64 CY	836.44 CY	1996.64 CY	836.44 CY	**1160.20 CY**
4+00.00	316.02 SF	112.93 SF	2601.13 CY	1492.85 CY	4597.76 CY	2329.28 CY	**2268.48 CY**
6+00.00	366.48 SF	260.72 SF	2525.36 CY	1382.59 CY	7123.13 CY	3711.87 CY	**3411.25 CY**
8+00.00	372.66 SF	313.07 SF	2736.14 CY	2124.08 CY	9859.26 CY	5835.95 CY	**4023.31 CY**
10+00.00	484.66 SF	362.01 SF	3159.38 CY	2487.79 CY	13018.64 CY	8323.74 CY	**4694.90 CY**
12+00.00	477.01 SF	259.27 SF	3558.37 CY	2298.86 CY	16577.02 CY	10622.60 CY	**5954.41 CY**
14+00.00	521.66 SF	387.21 SF	4009.82 CY	2947.33 CY	20586.83 CY	13569.94 CY	**7016.90 CY**
16+00.00	562.51 SF	240.23 SF	3772.85 CY	2043.98 CY	24359.68 CY	15613.92 CY	**8745.77 CY**
18+00.00	491.95 SF	457.42 SF	3505.65 CY	1997.98 CY	27865.33 CY	17611.90 CY	**10253.43 CY**
20+00.00	580.55 SF	279.41 SF	3924.52 CY	2696.21 CY	31789.86 CY	20308.11 CY	**11481.75 CY**

ESTIMATED QUANTITIES							
STATION	CUT AREA	FILL AREA	CUT VOL	FILL VOL	CUMULATIVE CUT VOL	CUMULATIVE FILL VOL	NET VOL
22+00.00	804.47 SF	454.51 SF	4798.07 CY	2051.78 CY	36587.93 CY	22359.89 CY	**14228.04 CY**
24+00.00	827.67 SF	249.05 SF	5454.12 CY	2180.18 CY	42042.05 CY	24540.06 CY	**17501.98 CY**
26+00.00	784.16 SF	331.47 SF	5060.84 CY	1822.71 CY	47102.89 CY	26362.77 CY	**20740.11 CY**
28+00.00	766.49 SF	328.92 SF	5346.92 CY	2299.36 CY	52449.80 CY	28662.13 CY	**23787.68 CY**
30+00.00	701.67 SF	114.48 SF	5045.01 CY	1523.65 CY	57494.81 CY	30185.78 CY	**27309.03 CY**
32+00.00	738.90 SF	154.93 SF	4358.81 CY	815.18 CY	61853.61 CY	31000.96 CY	**30852.65 CY**
34+00.00	676.65 SF	96.16 SF	4684.61 CY	830.95 CY	66538.23 CY	31831.91 CY	**34706.31 CY**
36+00.00	621.02 SF	125.12 SF	4216.52 CY	719.00 CY	70754.75 CY	32550.91 CY	**38203.83 CY**
38+00.00	653.27 SF	154.26 SF	3621.09 CY	1237.82 CY	74375.83 CY	33788.73 CY	**40587.10 CY**
40+00.00	570.37 SF	114.99 SF	3435.81 CY	838.30 CY	77811.64 CY	34627.04 CY	**43184.60 CY**
42+00.00	728.86 SF	130.06 SF	3892.21 CY	999.33 CY	81703.85 CY	35626.37 CY	**46077.48 CY**

ESTIMATED QUANTITIES							
STATION	CUT AREA	FILL AREA	CUT VOL	FILL VOL	CUMULATIVE CUT VOL	CUMULATIVE FILL VOL	NET VOL
44+00.00	819.06 SF	165.94 SF	4699.39 CY	898.62 CY	86403.24 CY	36524.99 CY	**49878.25 CY**
46+00.00	754.75 SF	164.39 SF	2242.08 CY	470.59 CY	88645.32 CY	36995.58 CY	**51649.74 CY**
49+00.00	696.13 SF	95.55 SF	2938.01 CY	526.38 CY	91583.33 CY	37521.95 CY	**54061.38 CY**
50+00.00	732.55 SF	72.49 SF	1762.34 CY	207.29 CY	93345.67 CY	37729.24 CY	**55616.43 CY**
53+00.00	763.68 SF	91.07 SF	3704.19 CY	404.92 CY	97049.86 CY	38134.16 CY	**58915.70 CY**
55+00.00	802.73 SF	107.26 SF	3003.94 CY	380.35 CY	100053.80 CY	38514.52 CY	**61539.29 CY**
59+50.00	856.81 SF	0.00 SF	4868.48 CY	314.67 CY	104922.28 CY	38829.19 CY	**66093.09 CY**
62+00.00	1244.23 SF	0.00 SF	8023.85 CY	0.00 CY	112946.13 CY	38829.19 CY	**74116.94 CY**
63+50.00	2254.13 SF	0.19 SF	9717.66 CY	0.53 CY	122663.79 CY	38829.72 CY	**83834.06 CY**

EXCESS EMBANKMENT
(AVAILABLE FOR EXPORT)

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

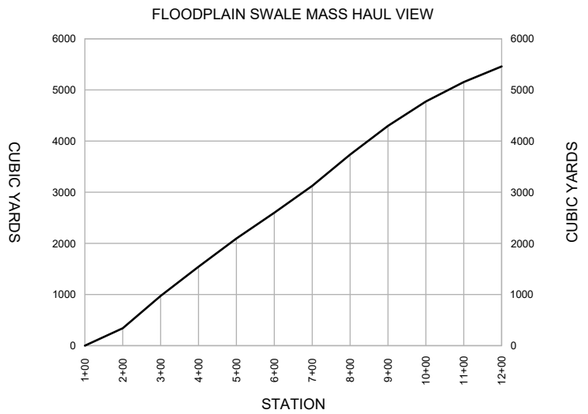
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

A. GENERAL INFORMATION
GRANT CREEK
MASS HAUL VIEW AND ESTIMATED QUANTITIES

SHEET
A.5 OF A.8



ESTIMATED QUANTITIES							
STATION	CUT AREA	FILL AREA	CUT VOL	FILL VOL	CUMULATIVE CUT VOL	CUMULATIVE FILL VOL	NET VOL
1+00.00	0.00 SF	0.00 SF	0.00 CY	0.00 CY	0.00 CY	0.00 CY	**0.00 CY**
2+00.00	183.95 SF	0.00 SF	340.65 CY	0.00 CY	340.65 CY	0.00 CY	**340.65 CY**
3+00.00	157.69 SF	0.00 SF	631.86 CY	0.00 CY	972.52 CY	0.00 CY	**972.52 CY**
4+00.00	150.30 SF	0.00 SF	570.34 CY	0.00 CY	1542.86 CY	0.00 CY	**1542.86 CY**
5+00.00	147.67 SF	0.00 SF	551.79 CY	0.00 CY	2094.64 CY	0.00 CY	**2094.64 CY**
6+00.00	124.19 SF	0.00 SF	503.45 CY	0.00 CY	2598.09 CY	0.00 CY	**2598.09 CY**
7+00.00	160.08 SF	0.00 SF	526.42 CY	0.00 CY	3124.51 CY	0.00 CY	**3124.51 CY**
8+00.00	170.11 SF	0.00 SF	611.46 CY	0.00 CY	3735.97 CY	0.00 CY	**3735.97 CY**
9+00.00	132.72 SF	0.00 SF	560.80 CY	0.00 CY	4296.78 CY	0.00 CY	**4296.78 CY**
10+00.00	124.86 SF	0.00 SF	477.00 CY	0.00 CY	4773.77 CY	0.00 CY	**4773.77 CY**
11+00.00	79.56 SF	0.01 SF	380.72 CY	0.01 CY	5154.49 CY	0.01 CY	**5154.48 CY**
12+00.00	85.01 SF	0.00 SF	304.76 CY	0.02 CY	5459.25 CY	0.03 CY	**5459.22 CY**

EXCESS EMBANKMENT
(AVAILABLE FOR EXPORT)

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

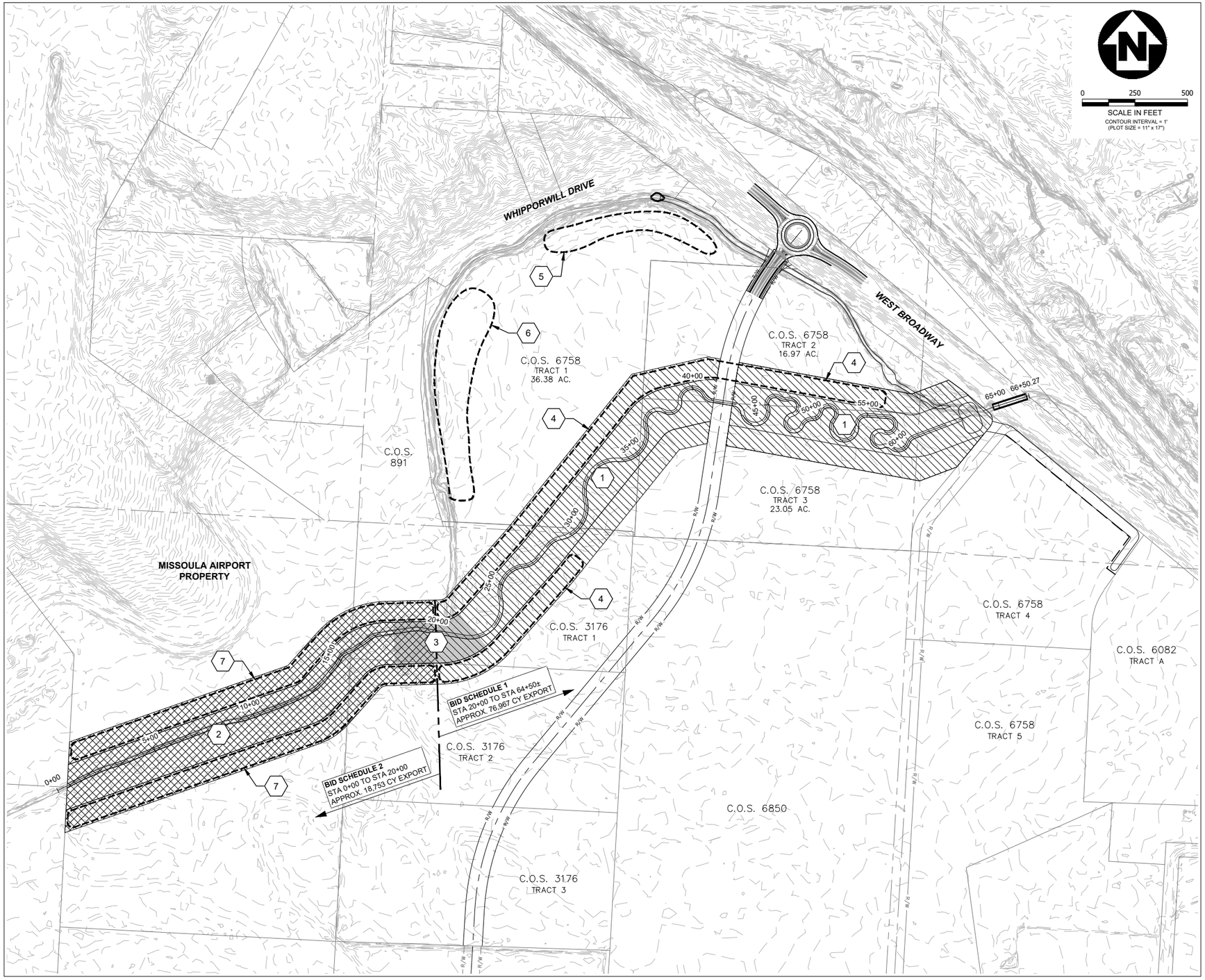
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

A. GENERAL INFORMATION
FLOODPLAIN SWALE
MASS HAUL VIEW AND ESTIMATED QUANTITIES

SHEET
OF
A.6 A.8



LEGEND

- BID SCHEDULE 1
- BID SCHEDULE 2
- BID SCHEDULE 1 - TRANSITION
- EARTHWORK STOCKPILING

KEY NOTES:

1. **BID SCHEDULE 1**
   STA 20+00 TO STA 64+50±
   APPROXIMATELY 76,967 CY EXPORT
2. **BID SCHEDULE 2**
   STA 0+00 TO STA 20+00
   APPROXIMATELY 18,753 CY EXPORT
3. **BID SCHEDULE 1 - TRANSITION**
   STA 18+00 TO STA 22+00
   APPROXIMATELY 8,392 CY
4. **BID ALTERNATE 1A**
   EXCAVATION MATERIAL STOCKPILE LOCATION
   APPROXIMATELY 18,490 CY
5. **BID ALTERNATE 1B**
   EXCAVATION MATERIAL STOCKPILE LOCATION
   APPROXIMATELY 58,477 CY
6. **BID ALTERNATE 1B & 2B**
   EXCAVATION MATERIAL STOCKPILE LOCATION
   APPROXIMATELY 58,477 CY & 12,755 CY
7. **BID ALTERNATE 2A**
   EXCAVATION MATERIAL STOCKPILE LOCATION
   APPROXIMATELY 12,755 CY

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

A. GENERAL INFORMATION
EARTHWORK STOCKPILING AND
ALTERNATE BID SCHEDULES

SHEET
A.7 OF A.8



SURVEY CONTROL POINT TABLE

POINT NO.	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	1003548.726	828822.516	3165.70	1-1/4" YPC 4468S
2	1003453.788	828951.491	3164.50	1-1/4" YPC 4468S
3	1003429.711	828933.753	3163.20	1-1/4" YPC 4468S
4	1002726.306	829894.125	3165.00	2" AL CAP MDT CP43
5	1002560.461	830115.631	3164.80	1-1/4" YPC 4468S
6	1002395.491	830314.896	3163.10	1-3/4"OPC 5609S
7	1002353.713	830396.749	3162.20	1-1/4" YPC 4468S
8	1002071.436	830737.598	3163.80	4X4 CONC MON 450+00
9	1001932.556	830905.299	3163.70	1-1/4" YPC 4468S
10	1001792.988	829877.057	3157.00	3" AL CAP ILLEGIBLE
11	1001973.361	829966.411	3158.60	1-3/4" OPC 5609S
12	1002066.308	824624.237	3199.80	IRON PIPE W/ LARGE SPIKE
13	1001930.445	827250.765	3158.20	2" AL CAP 4468S
14	1000006.796	825834.334	3149.80	1-1/4" YPC 4468S
15	999938.035	827143.393	3153.20	1-1/4" YPC SORENSON & CO
16	999895.327	828446.617	3157.30	1-1/4" YPC 3713S

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

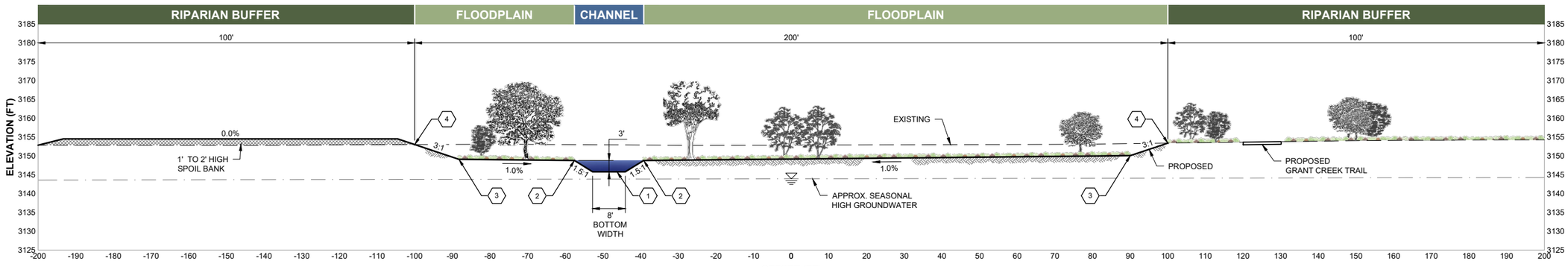
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

A. GENERAL INFORMATION
SURVEY CONTROL POINTS

SHEET
OF
A.8 A.8

GRANT CREEK CROSS SECTION: A-A



A-A / A.2

TYPICAL CROSS SECTION VIEW
GRANT CREEK FLOODPLAIN AND CHANNEL
SCALE: 1" = 15'

KEY NOTES:

1. CHANNEL THALWEG
2. TOP OF CHANNEL
3. TOE OF BANK
4. TOP OF BANK (POINT OF INTERSECTION WITH EXISTING GROUND)

REVISION	DATE	DESCRIPTION
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

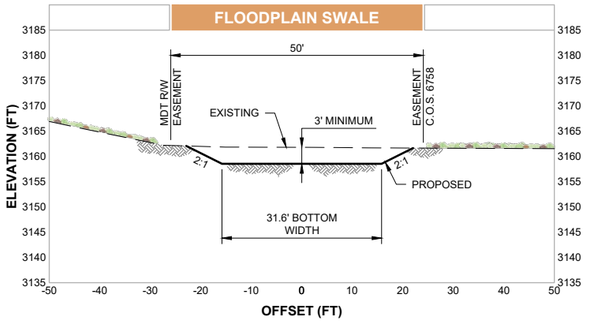
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

B. TYPICAL SECTIONS
GRANT CREEK FLOODPLAIN AND CHANNEL

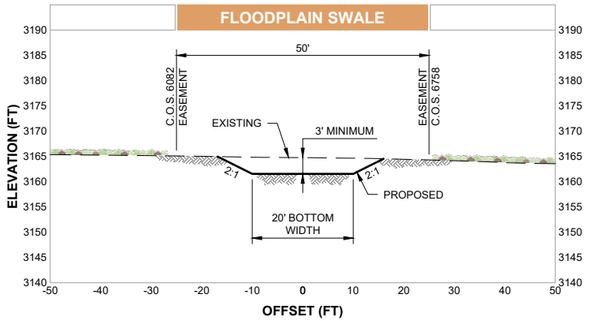
SHEET
OF
B.1 B.3

FLOODPLAIN SWALE CROSS SECTION: B-B



B-B / A.2 TYPICAL CROSS SECTION VIEW
FLOODPLAIN SWALE - STA 0+00 TO STA 10+00
SCALE: 1" = 15'

FLOODPLAIN SWALE CROSS SECTION: C-C



C-C / A.2 TYPICAL CROSS SECTION VIEW
FLOODPLAIN SWALE - STA 10+50 TO STA 12+25
SCALE: 1" = 15'

0 15 30
SCALE IN FEET
(PLOT SIZE = 11" x 17")

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED D.J&A. P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

B. TYPICAL SECTIONS
FLOODPLAIN SWALE

SHEET
OF
B.2 B.3

TBD

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

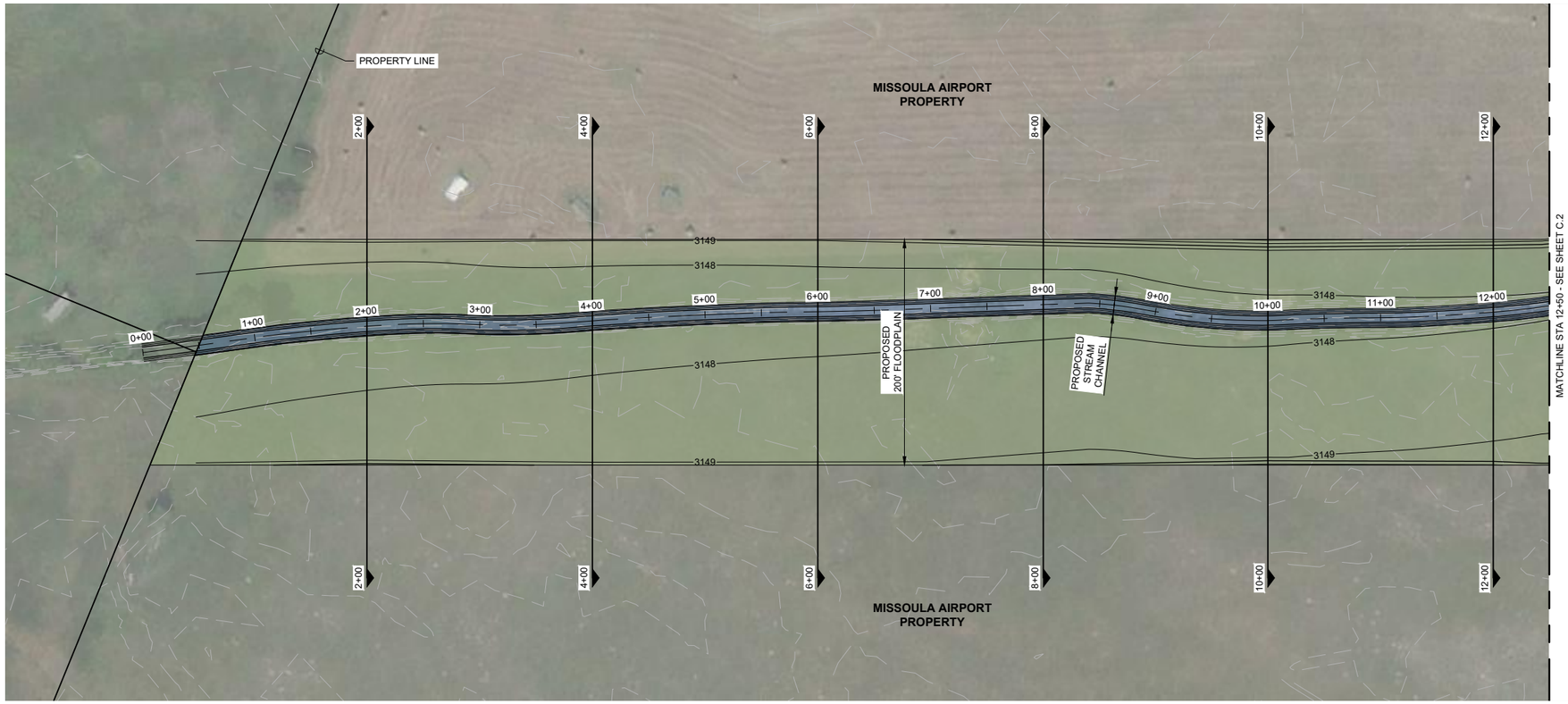
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

B. TYPICAL SECTIONS
GRANT CREEK TRAIL

SHEET
OF
B.3 B.3



0 60 120

SCALE IN FEET

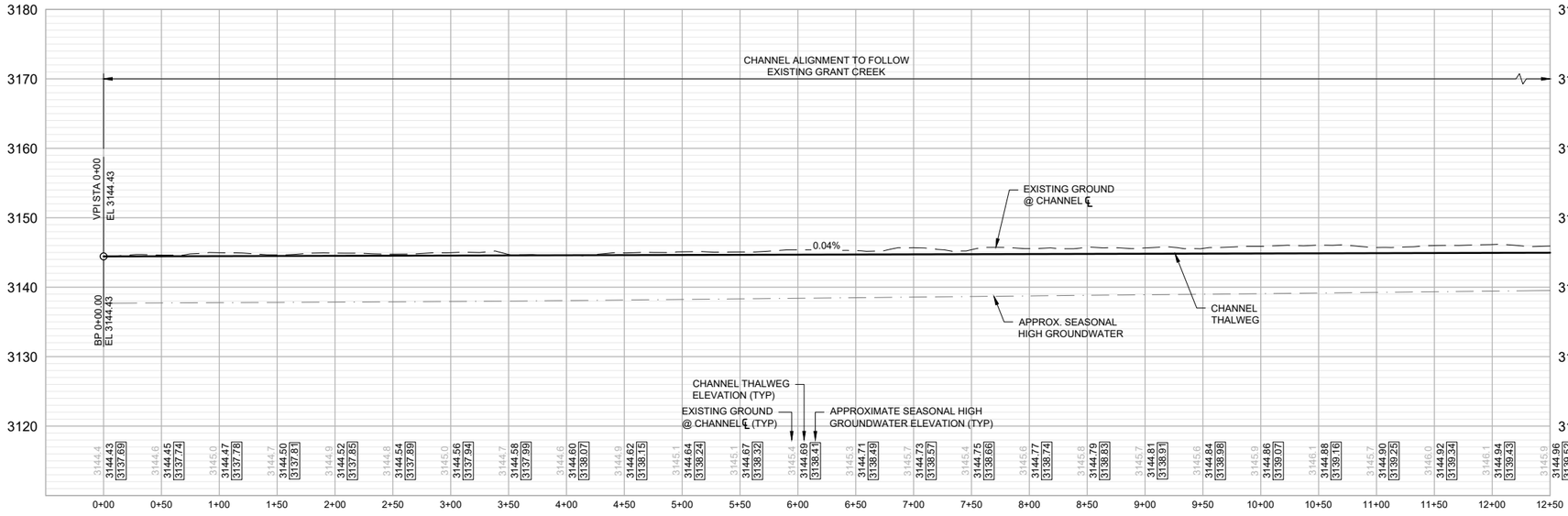
CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

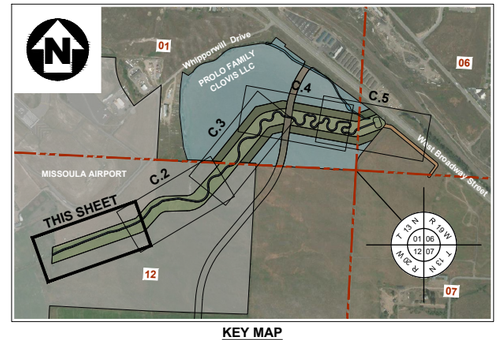
LEGEND

- STREAM CHANNEL
- 200' FLOODPLAIN

NOTES:

1. GROUNDWATER ELEVATIONS ARE DERIVED FROM A NUMERICAL GROUNDWATER FLOW MODEL AND HYDROGEOLOGIC INVESTIGATION (HDR/MAXIM 2005).
2. SEE SHEETS C.6 THROUGH C.13 FOR GRANT CREEK CROSS SECTIONS.





KEY MAP
SCALE: 1" = 1,000'

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

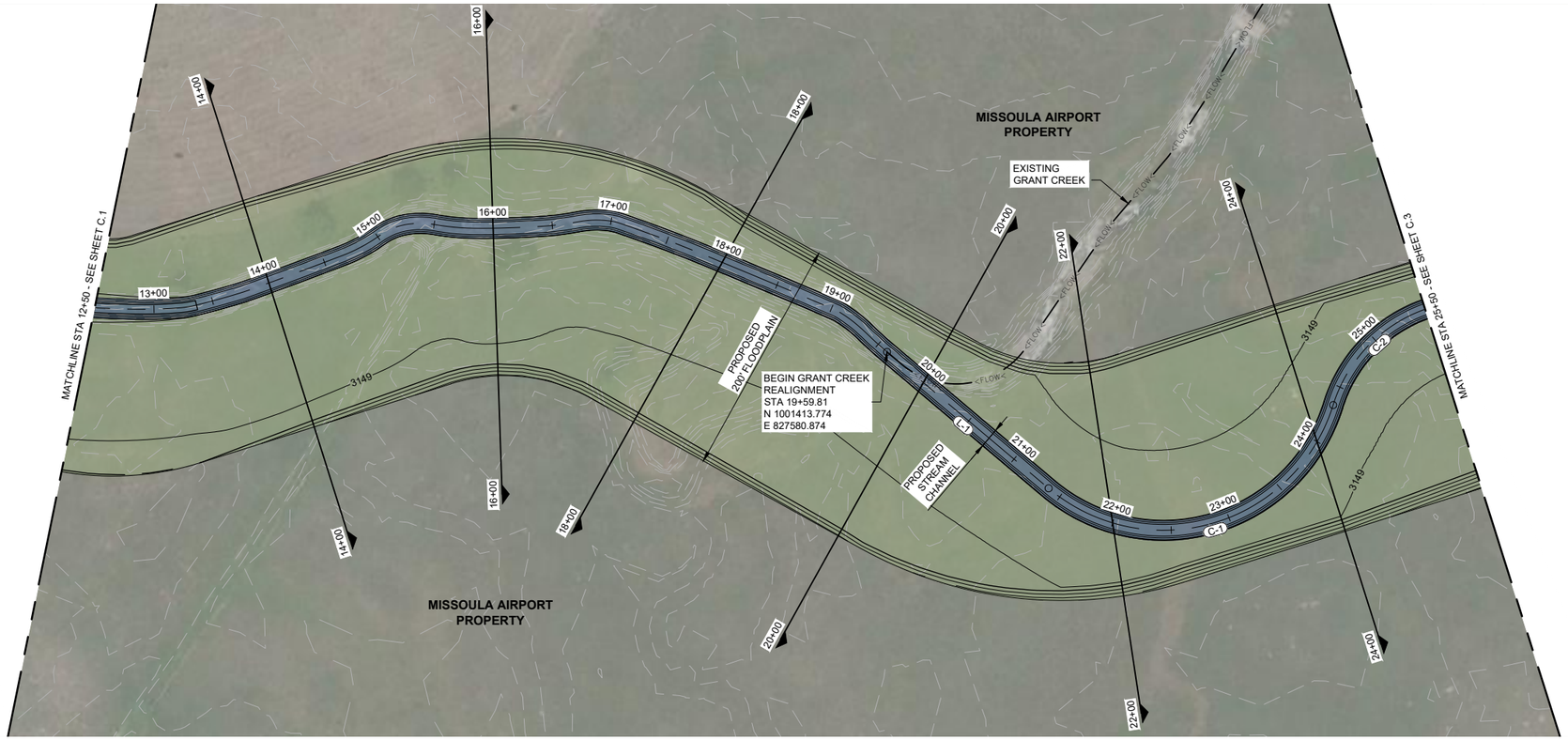
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
PLAN AND PROFILE
STA 0+00 TO STA 12+50

SHEET
OF
C.1 C.13



0 60 120

SCALE IN FEET

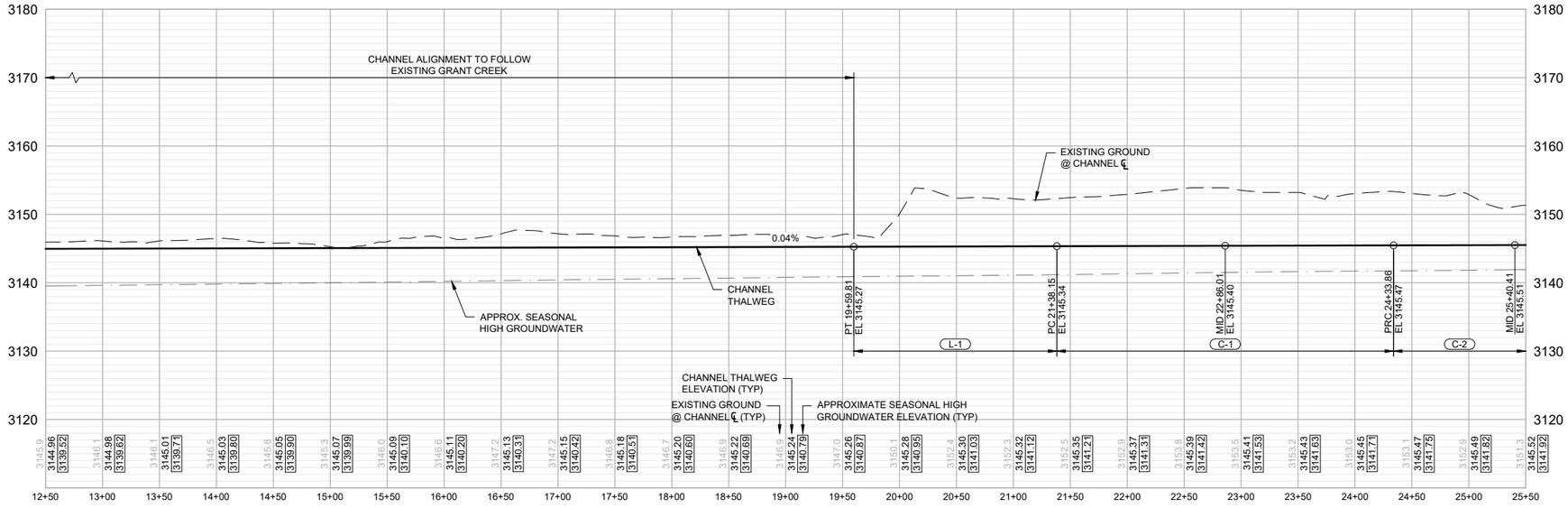
CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

LEGEND

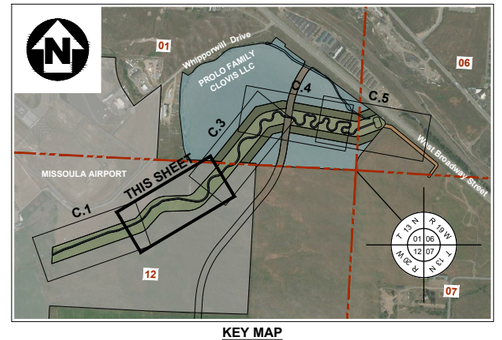
- STREAM CHANNEL
- 200' FLOODPLAIN

NOTES:

1. GROUNDWATER ELEVATIONS ARE DERIVED FROM A NUMERICAL GROUNDWATER FLOW MODEL AND HYDROGEOLOGIC INVESTIGATION (HDR/MAXIM 2005).
2. SEE SHEETS C.6 THROUGH C.13 FOR GRANT CREEK CROSS SECTIONS.
3. TRANSITION CONSTRUCTED STREAM CHANNEL TO EXISTING CHANNEL NEAR STATION 19+59 AS DIRECTED BY OWNER.



GRANT CREEK ALIGNMENT TABLE							
NO.	START STA.	START COORD.	END STA.	END COORD.	LEN.	RAD.	LINE/CHORD DIRECTION
L-1	19+59.81	N 1001413.774 E 827580.874	21+38.15	N 1001384.499 E 827756.803	178.35'	NA	S80°33'09"E
C-1	21+38.15	N 1001384.499 E 827756.803	24+33.86	N 1001567.491 E 827927.278	295.71'	150.00'	N42°58'19"E
C-2	24+33.86	N 1001567.491 E 827927.278	26+46.96	N 1001721.034 E 828036.135	213.10'	125.00'	N35°20'08"E



KEY MAP
SCALE: 1" = 1,000'

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

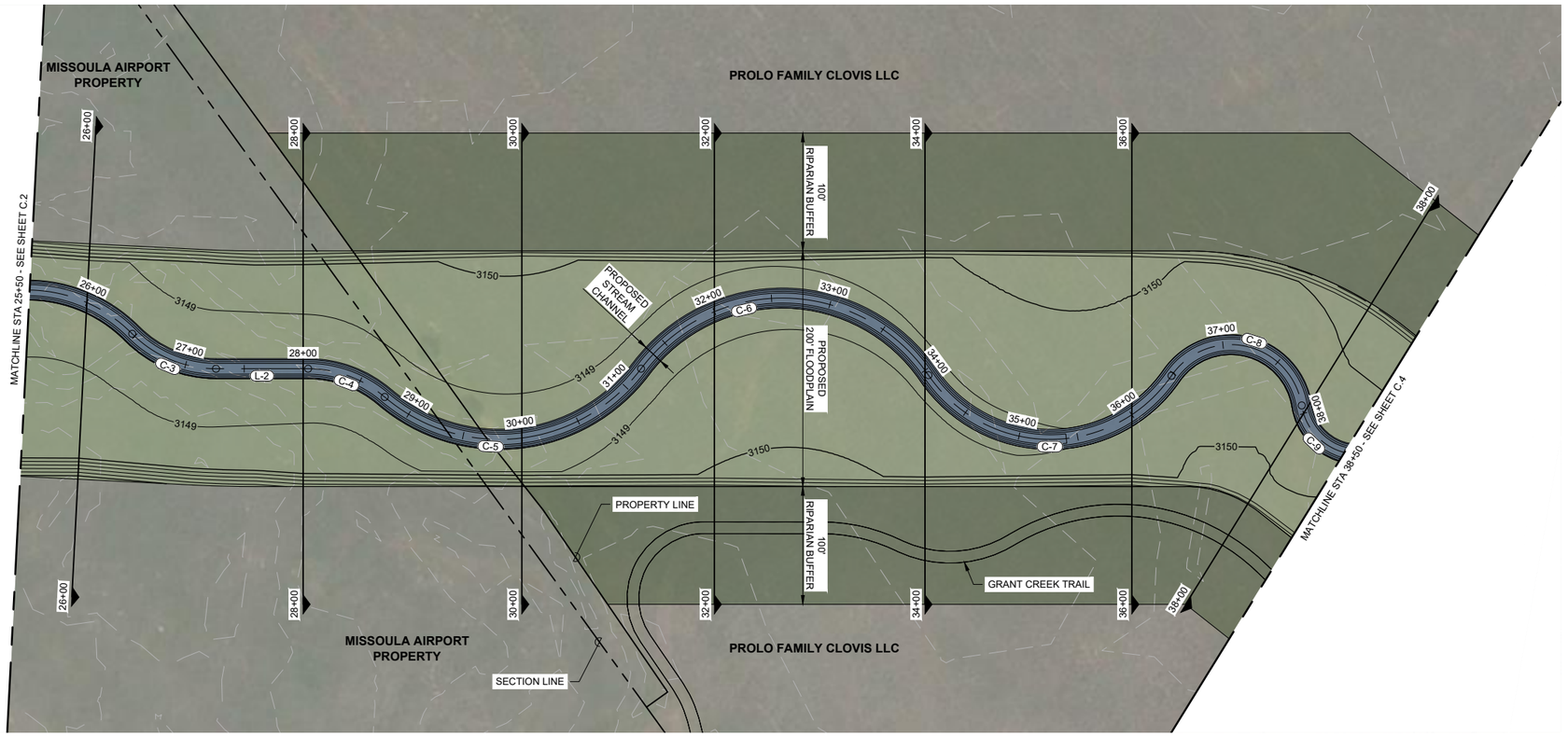
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED D.J&A. P.C.

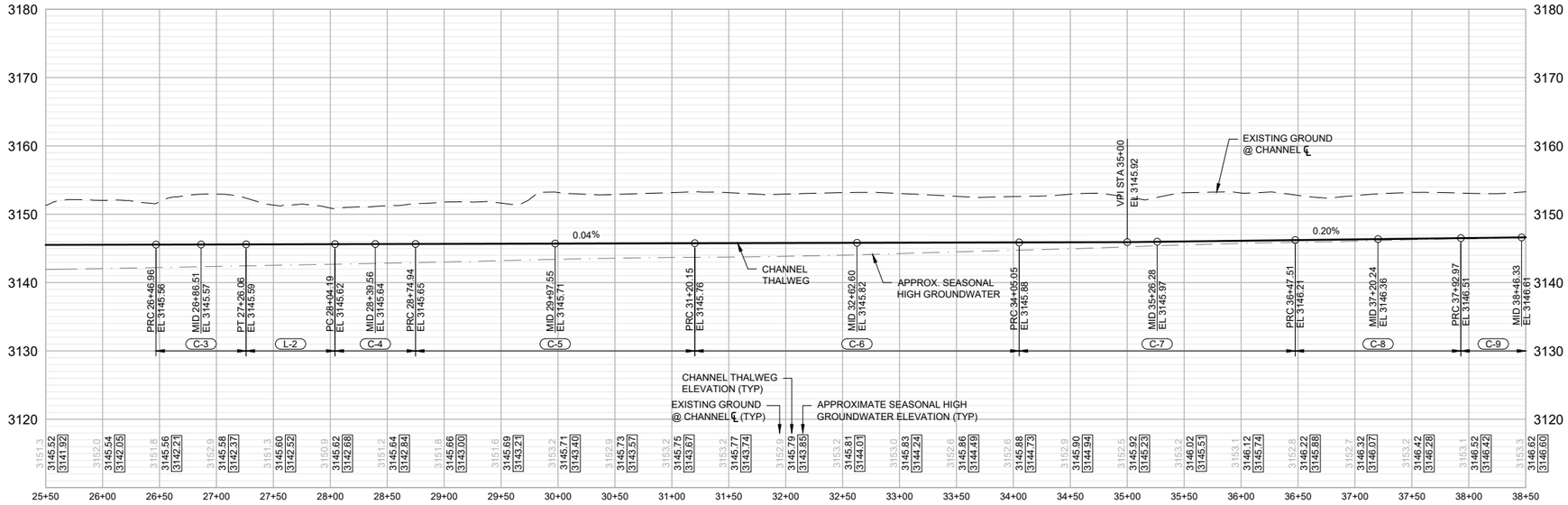
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
PLAN AND PROFILE
STA 12+50 TO STA 25+50

SHEET OF C.2 C.13







LEGEND

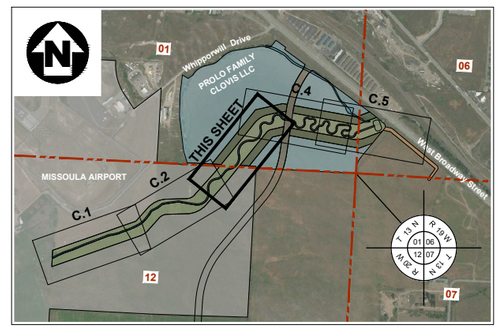
- STREAM CHANNEL
- 200' FLOODPLAIN
- 100' RIPARIAN AREA

NOTES:

1. GROUNDWATER ELEVATIONS ARE DERIVED FROM A NUMERICAL GROUNDWATER FLOW MODEL AND HYDROGEOLOGIC INVESTIGATION (HDR/MAXIM 2005).
2. SEE SHEETS C.6 THROUGH C.13 FOR GRANT CREEK CROSS SECTIONS.

GRANT CREEK ALIGNMENT TABLE

NO.	START STA.	START COORD.	END STA.	END COORD.	LEN.	RAD.	LINE/CHORD DIRECTION
C-3	26+46.96	N 1001721.034 E 828036.135	27+26.06	N 1001757.786 E 828103.863	79.10'	100.00'	N61°30'48"E
L-2	27+26.06	N 1001757.786 E 828103.863	28+04.19	N 1001818.629 E 828152.872	78.13'	NA	N38°51'07"E
C-4	28+04.19	N 1001818.629 E 828152.872	28+74.94	N 1001854.187 E 828212.333	70.75'	100.00'	N59°07'12"E
C-5	28+74.94	N 1001854.187 E 828212.333	31+20.15	N 1002038.616 E 828330.075	245.22'	150.00'	N32°33'17"E
C-6	31+20.15	N 1002038.616 E 828330.075	34+05.05	N 1002225.139 E 828487.326	284.90'	150.00'	N40°07'59"E
C-7	34+05.05	N 1002225.139 E 828487.326	36+47.51	N 1002385.437 E 828617.026	242.46'	125.00'	N38°58'37"E
C-8	36+47.51	N 1002385.437 E 828617.026	37+92.97	N 1002455.664 E 828706.018	145.46'	61.00'	N51°43'17"E
C-9	37+92.97	N 1002455.664 E 828706.018	38+99.69	N 1002502.149 E 828779.374	106.72'	49.00'	N57°38'16"E



KEY MAP
SCALE: 1" = 1,000'

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

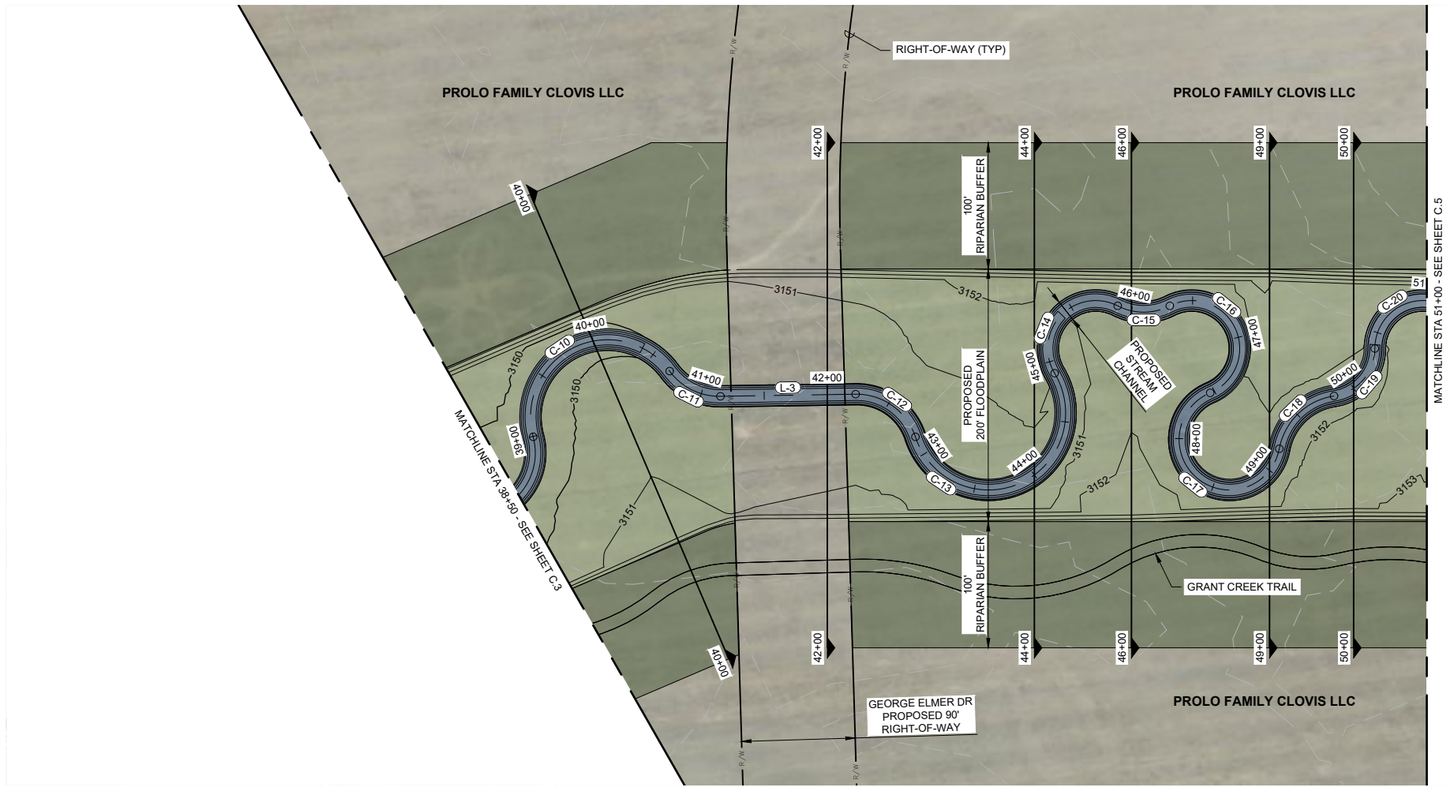
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

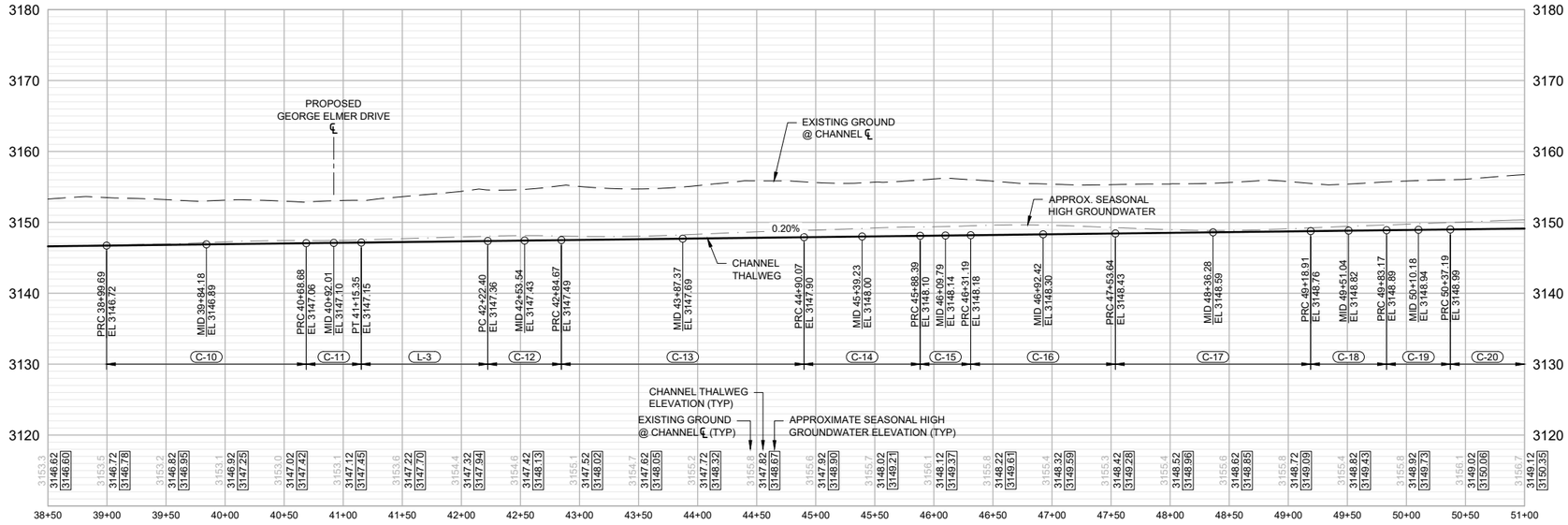
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
PLAN AND PROFILE
STA 25+50 TO STA 38+50

SHEET
OF
C.3 C.13







0 60 120

SCALE IN FEET
CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

LEGEND

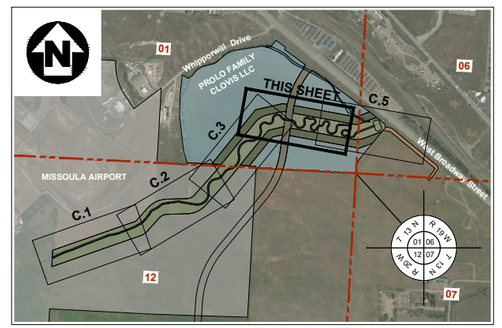
- STREAM CHANNEL
- 200' FLOODPLAIN
- 100' RIPARIAN AREA

NOTES:

1. GROUNDWATER ELEVATIONS ARE DERIVED FROM A NUMERICAL GROUNDWATER FLOW MODEL AND HYDROGEOLOGIC INVESTIGATION (HDR/MAXIM 2005).
2. SEE SHEETS C.6 THROUGH C.13 FOR GRANT CREEK CROSS SECTIONS.

GRANT CREEK ALIGNMENT TABLE

NO.	START STA.	START COORD.	END STA.	END COORD.	LEN.	RAD.	LINE/CHORD DIRECTION
C-10	38+99.69	N 1002502.149 E 828779.374	40+68.68	N 1002533.978 E 828894.976	168.99'	61.00'	N74°36'23"E
C-11	40+68.68	N 1002533.978 E 828894.976	41+15.35	N 1002507.139 E 828931.000	46.67'	49.00'	S53°18'46"E
L-3	41+15.35	N 1002507.139 E 828931.000	42+22.40	N 1002489.648 E 829036.614	107.05'	NA	S80°35'47"E
C-12	42+22.40	N 1002489.648 E 829036.614	42+84.67	N 1002447.938 E 829077.157	62.28'	49.00'	S44°11'14"E
C-13	42+84.67	N 1002447.938 E 829077.157	44+90.07	N 1002477.754 E 829194.658	205.39'	61.00'	N75°45'41"E
C-14	44+90.07	N 1002477.754 E 829194.658	45+88.39	N 1002521.311 E 829253.367	98.33'	38.00'	N53°25'41"E
C-15	45+88.39	N 1002521.311 E 829253.367	46+31.19	N 1002513.937 E 829293.907	42.80'	45.00'	S79°41'30"E
C-16	46+31.19	N 1002513.937 E 829293.907	47+53.64	N 1002440.460 E 829313.081	122.45'	38.00'	S14°37'31"E
C-17	47+53.64	N 1002440.460 E 829313.081	49+18.91	N 1002387.073 E 829358.964	165.27'	40.00'	S40°40'39"E
C-18	49+18.91	N 1002387.073 E 829358.964	49+83.17	N 1002420.450 E 829409.121	64.26'	52.00'	N56°21'29"E
C-19	49+83.17	N 1002420.450 E 829409.121	50+37.19	N 1002451.632 E 829447.674	54.02'	38.00'	N51°02'01"E
C-20	50+37.19	N 1002451.632 E 829447.674	51+77.14	N 1002419.745 E 829513.602	139.95'	38.00'	S64°11'17"E



KEY MAP
SCALE: 1" = 1,000'

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

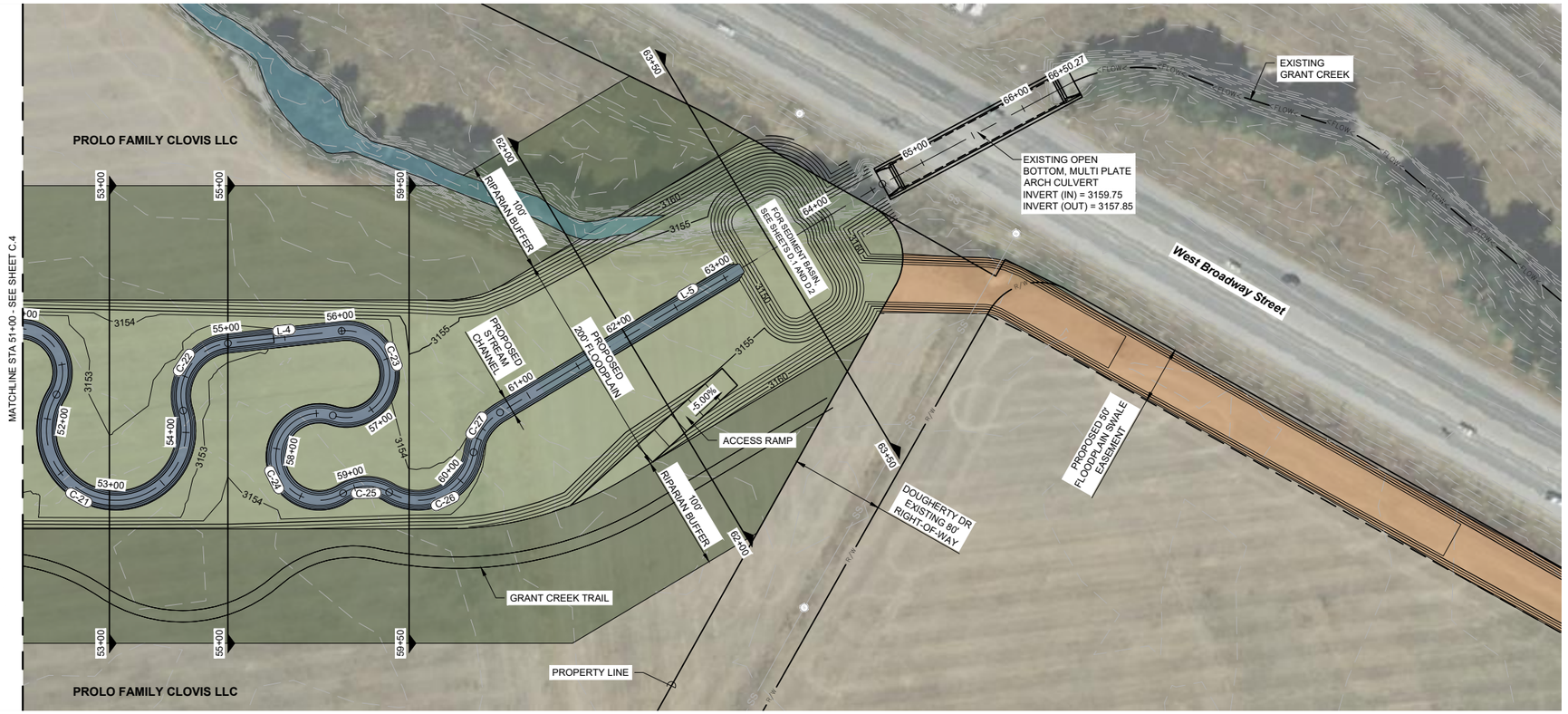
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED D.J&A. P.C.

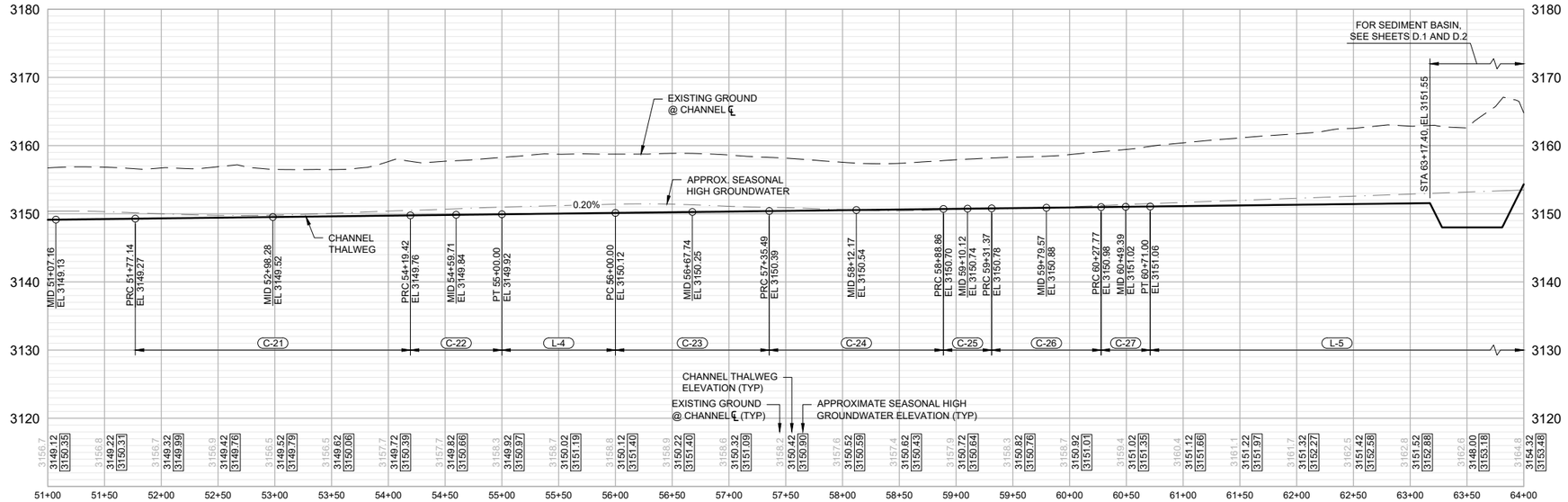
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
PLAN AND PROFILE
STA 38+50 TO STA 51+00

SHEET OF C.4 C.13





0 60 120

SCALE IN FEET
CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

LEGEND

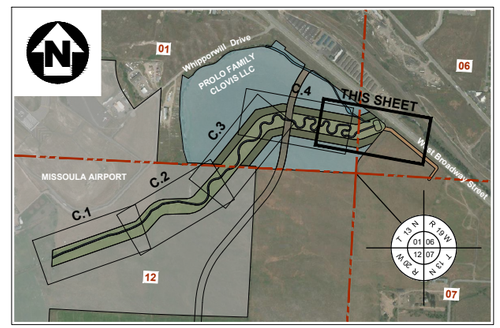
- STREAM CHANNEL
- 200' FLOODPLAIN
- 100' RIPARIAN AREA
- FLOODPLAIN SWALE
- STORMWATER DRAIN

NOTES:

1. GROUNDWATER ELEVATIONS ARE DERIVED FROM A NUMERICAL GROUNDWATER FLOW MODEL AND HYDROGEOLOGIC INVESTIGATION (HDR/MAXIM 2005).
2. SEE SHEETS C.6 THROUGH C.13 FOR GRANT CREEK CROSS SECTIONS.
3. SEE SHEETS D.1 AND D.2 FOR SEDIMENT BASIN PLAN, PROFILE, AND CROSS SECTIONS.
4. SEE SHEETS E.1 AND E.2 FOR FLOODPLAIN SWALE PLAN, PROFILE, AND CROSS SECTIONS.
5. SEE SHEETS F.1 AND F.2 FOR STORMWATER DRAIN PLAN, PROFILE, AND ENLARGED GRANT CREEK DAM.
6. SEE SHEETS G.1 THROUGH G.19 FOR TRAIL PLAN, PROFILE, AND CROSS SECTIONS.

GRANT CREEK ALIGNMENT TABLE

NO.	START STA.	START COORD.	END STA.	END COORD.	LEN.	RAD.	LINE/CHORD DIRECTION
C-21	51+77.14	N 1002419.745 E 829513.602	54+19.42	N 1002386.116 E 829620.055	242.28'	61.00'	S72°28'07"E
C-22	54+19.42	N 1002386.116 E 829620.055	55+00.00	N 1002437.008 E 829669.082	80.58'	46.00'	N43°55'50"E
L-4	55+00.00	N 1002437.008 E 829669.082	56+00.00	N 1002429.833 E 829768.824	100.00'	NA	S85°53'08"E
C-23	56+00.00	N 1002429.833 E 829768.824	57+35.49	N 1002358.505 E 829748.023	135.49'	38.00'	S16°15'27"W
C-24	57+35.49	N 1002358.505 E 829748.023	58+88.86	N 1002290.061 E 829744.708	153.37'	38.00'	S02°46'23"W
C-25	58+88.86	N 1002290.061 E 829744.708	59+31.37	N 1002283.616 E 829784.521	42.51'	38.00'	S80°48'13"E
C-26	59+31.37	N 1002283.616 E 829784.521	60+27.77	N 1002304.888 E 829863.287	96.40'	49.00'	N74°53'12"E
C-27	60+27.77	N 1002304.888 E 829863.287	60+71.00	N 1002334.970 E 829892.327	43.22'	48.63'	N43°59'23"E
L-5	60+71.00	N 1002334.970 E 829892.327	64+60.27	N 1002471.593 E 830256.835	389.27'	NA	N69°27'12"E



KEY MAP
SCALE: 1" = 1,000'

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

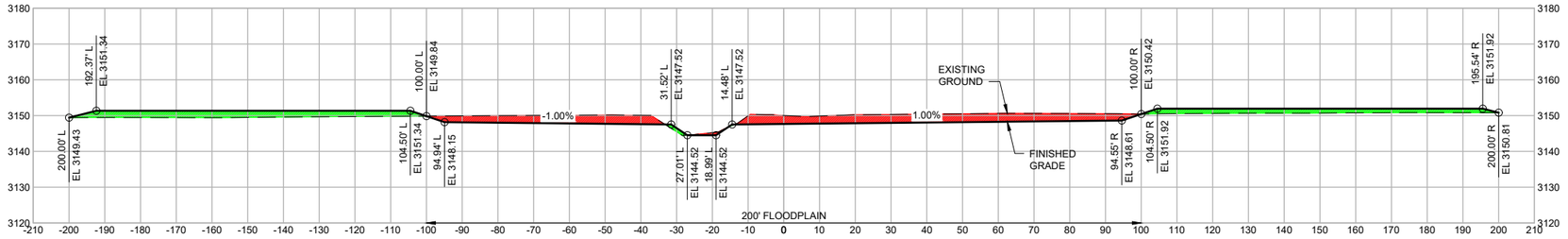
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
PLAN AND PROFILE
STA 51+00 TO STA 64+00

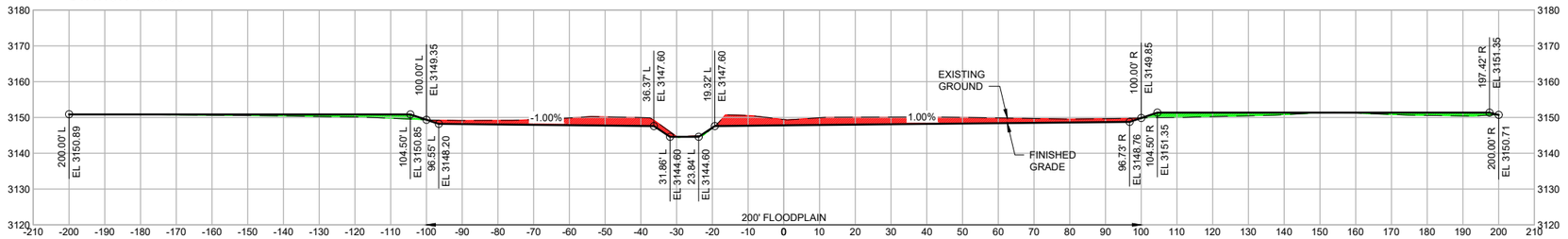
SHEET OF C.5 C.13

STATION 2+00.00



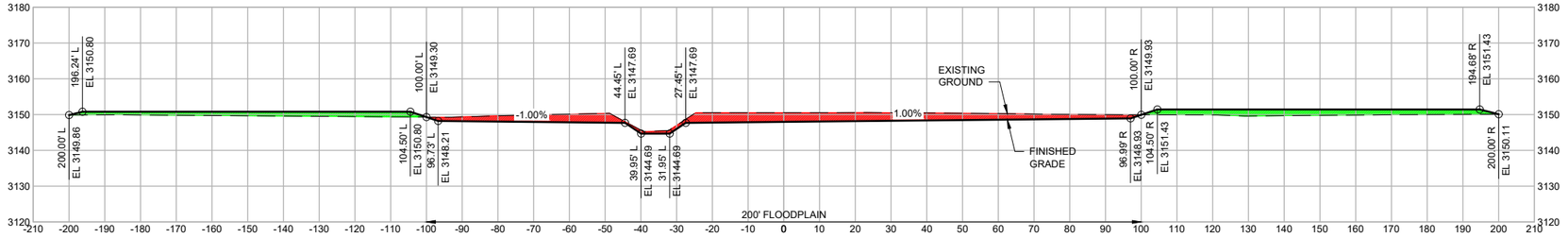
EARTHWORK AT STATION 2+00.00	
CUT AREA	387.01 SqFt
FILL AREA	290.55 SqFt
CUT VOLUME	1996.64 CuYd
FILL VOLUME	836.44 CuYd
CUMULATIVE CUT VOL	1996.64 CuYd
CUMULATIVE FILL VOL	836.44 CuYd
NET VOLUME	**1160.20 CuYd**

STATION 4+00.00



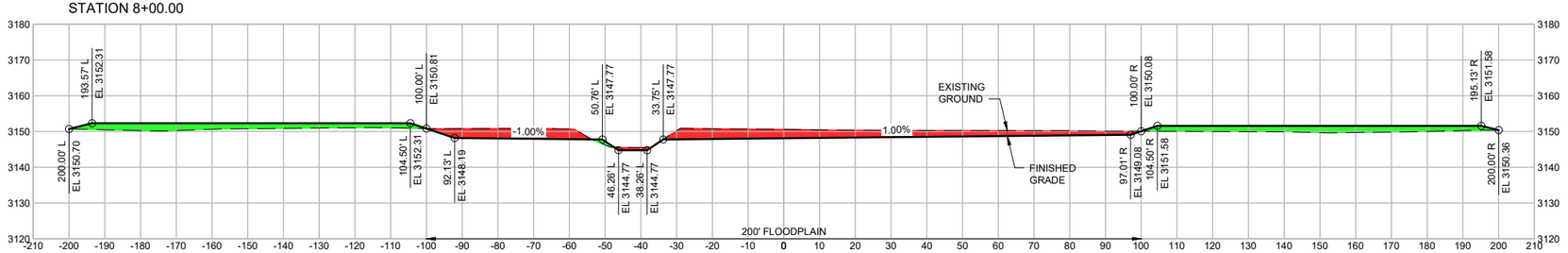
EARTHWORK AT STATION 4+00.00	
CUT AREA	316.02 SqFt
FILL AREA	112.93 SqFt
CUT VOLUME	2601.13 CuYd
FILL VOLUME	1492.85 CuYd
CUMULATIVE CUT VOL	4597.76 CuYd
CUMULATIVE FILL VOL	2329.28 CuYd
NET VOLUME	**2268.48 CuYd**

STATION 6+00.00



EARTHWORK AT STATION 6+00.00	
CUT AREA	366.48 SqFt
FILL AREA	260.72 SqFt
CUT VOLUME	2525.36 CuYd
FILL VOLUME	1382.59 CuYd
CUMULATIVE CUT VOL	7123.13 CuYd
CUMULATIVE FILL VOL	3711.87 CuYd
NET VOLUME	**3411.25 CuYd**

STATION 8+00.00



EARTHWORK AT STATION 8+00.00	
CUT AREA	372.66 SqFt
FILL AREA	313.07 SqFt
CUT VOLUME	2736.14 CuYd
FILL VOLUME	2124.08 CuYd
CUMULATIVE CUT VOL	9859.26 CuYd
CUMULATIVE FILL VOL	5835.95 CuYd
NET VOLUME	**4023.31 CuYd**

0 20 40

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

EXCESS EMBANKMENT (AVAILABLE FOR EXPORT)

1' - 2' HIGH SPOIL BANK (NOT AVAILABLE FOR EXPORT)

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

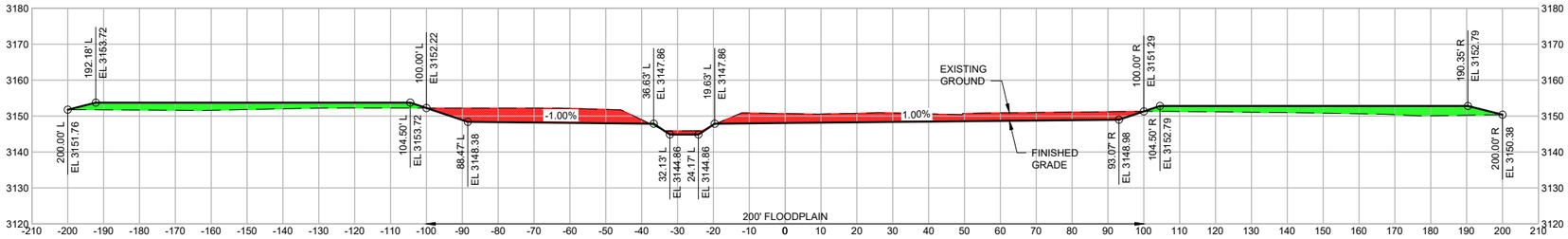
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 2+00 TO STA 8+00

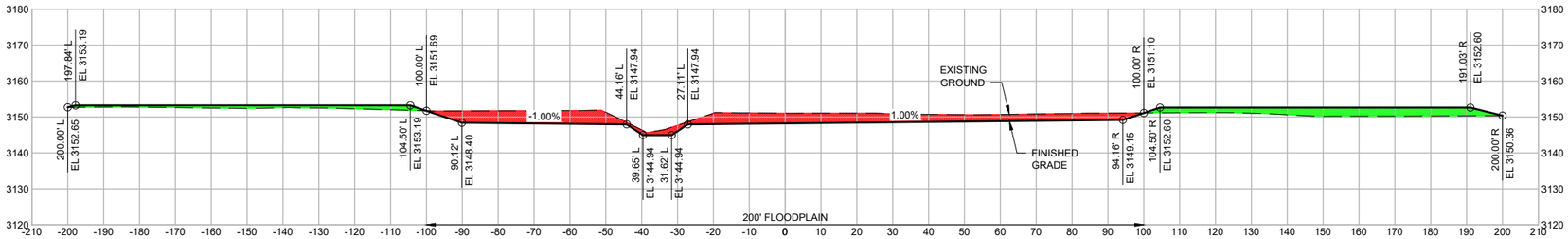
SHEET
OF
C.6 C.13

STATION 10+00.00



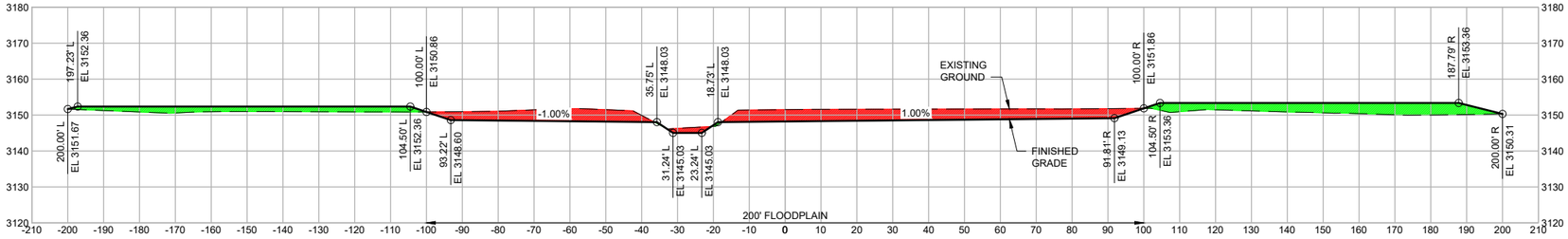
EARTHWORK AT STATION 10+00.00	
CUT AREA	484.66 SqFt
FILL AREA	362.01 SqFt
CUT VOLUME	3159.38 CuYd
FILL VOLUME	2487.79 CuYd
CUMULATIVE CUT VOL	13018.64 CuYd
CUMULATIVE FILL VOL	8323.74 CuYd
NET VOLUME	**4694.90 CuYd**

STATION 12+00.00



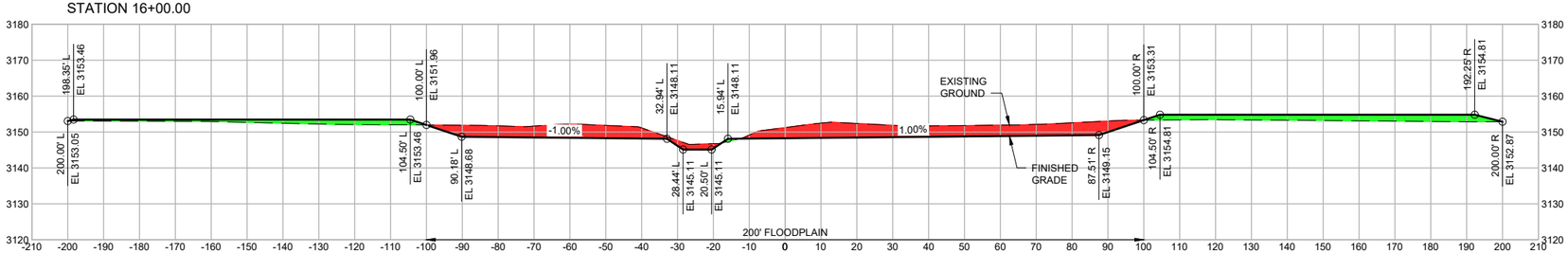
EARTHWORK AT STATION 12+00.00	
CUT AREA	477.01 SqFt
FILL AREA	259.27 SqFt
CUT VOLUME	3558.37 CuYd
FILL VOLUME	2298.86 CuYd
CUMULATIVE CUT VOL	16577.02 CuYd
CUMULATIVE FILL VOL	10622.60 CuYd
NET VOLUME	**5954.41 CuYd**

STATION 14+00.00



EARTHWORK AT STATION 14+00.00	
CUT AREA	521.66 SqFt
FILL AREA	387.21 SqFt
CUT VOLUME	4009.82 CuYd
FILL VOLUME	2947.33 CuYd
CUMULATIVE CUT VOL	20586.83 CuYd
CUMULATIVE FILL VOL	13569.94 CuYd
NET VOLUME	**7016.90 CuYd**

STATION 16+00.00



EARTHWORK AT STATION 16+00.00	
CUT AREA	562.51 SqFt
FILL AREA	240.23 SqFt
CUT VOLUME	3772.85 CuYd
FILL VOLUME	2043.98 CuYd
CUMULATIVE CUT VOL	24359.68 CuYd
CUMULATIVE FILL VOL	15613.92 CuYd
NET VOLUME	**8745.77 CuYd**

EXCESS EMBANKMENT (AVAILABLE FOR EXPORT)

1' - 2' HIGH SPOIL BANK (NOT AVAILABLE FOR EXPORT)

0 20 40

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -

DRAWN JW DATE 12/9/2022

CHECKED - SURVEYED DJ&A, P.C.

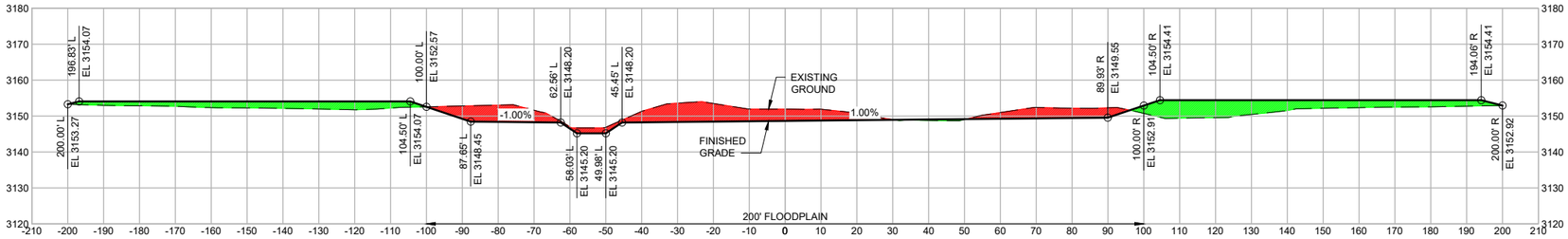
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 10+00 TO STA 16+00

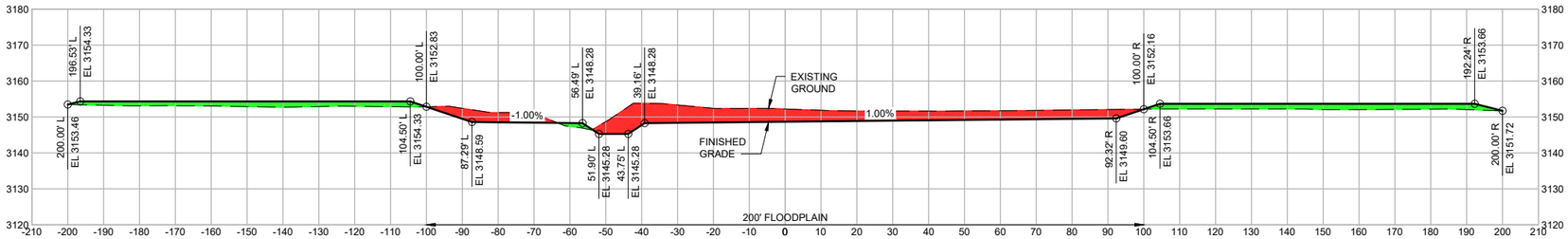
SHEET OF C.7 C.13

STATION 18+00.00



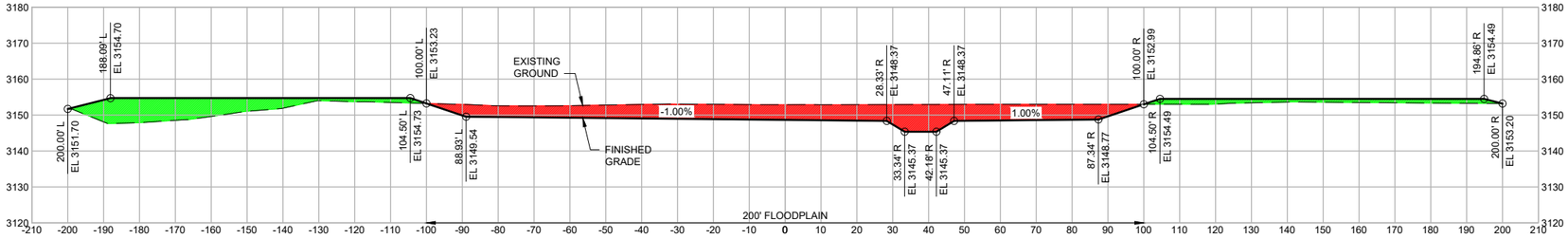
EARTHWORK AT STATION 18+00.00	
CUT AREA	491.95 SqFt
FILL AREA	457.42 SqFt
CUT VOLUME	3505.65 CuYd
FILL VOLUME	1997.98 CuYd
CUMULATIVE CUT VOL	27865.33 CuYd
CUMULATIVE FILL VOL	17611.90 CuYd
NET VOLUME	**10253.43 CuYd**

STATION 20+00.00



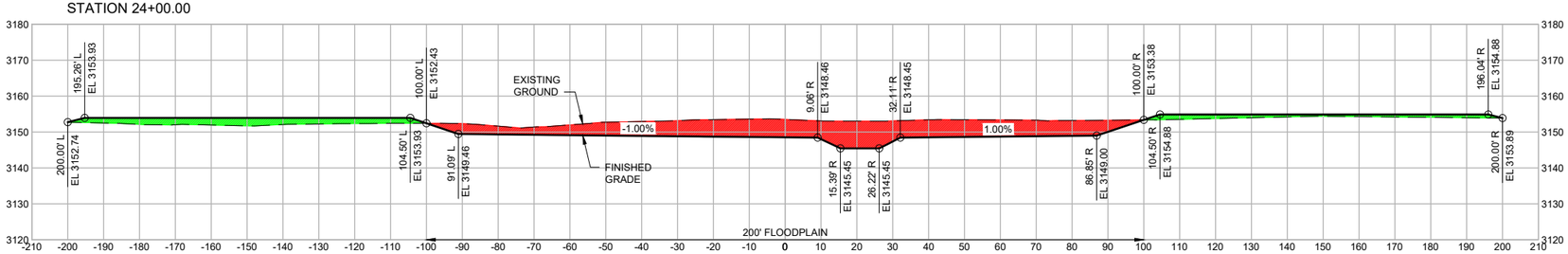
EARTHWORK AT STATION 20+00.00	
CUT AREA	580.55 SqFt
FILL AREA	279.41 SqFt
CUT VOLUME	3924.52 CuYd
FILL VOLUME	2696.21 CuYd
CUMULATIVE CUT VOL	31789.86 CuYd
CUMULATIVE FILL VOL	20308.11 CuYd
NET VOLUME	**11481.75 CuYd**

STATION 22+00.00



EARTHWORK AT STATION 22+00.00	
CUT AREA	804.47 SqFt
FILL AREA	454.51 SqFt
CUT VOLUME	4798.07 CuYd
FILL VOLUME	2051.78 CuYd
CUMULATIVE CUT VOL	36587.93 CuYd
CUMULATIVE FILL VOL	22359.89 CuYd
NET VOLUME	**14228.04 CuYd**

STATION 24+00.00



EARTHWORK AT STATION 24+00.00	
CUT AREA	827.67 SqFt
FILL AREA	249.05 SqFt
CUT VOLUME	5454.12 CuYd
FILL VOLUME	2180.18 CuYd
CUMULATIVE CUT VOL	42042.05 CuYd
CUMULATIVE FILL VOL	24540.06 CuYd
NET VOLUME	**17501.98 CuYd**

EXCESS EMBANKMENT
(AVAILABLE FOR EXPORT)

1' - 2' HIGH SPOIL BANK
(NOT AVAILABLE FOR EXPORT)

0 20 40

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -

DRAWN JW DATE 12/9/2022

CHECKED - SURVEYED DJ&A, P.C.

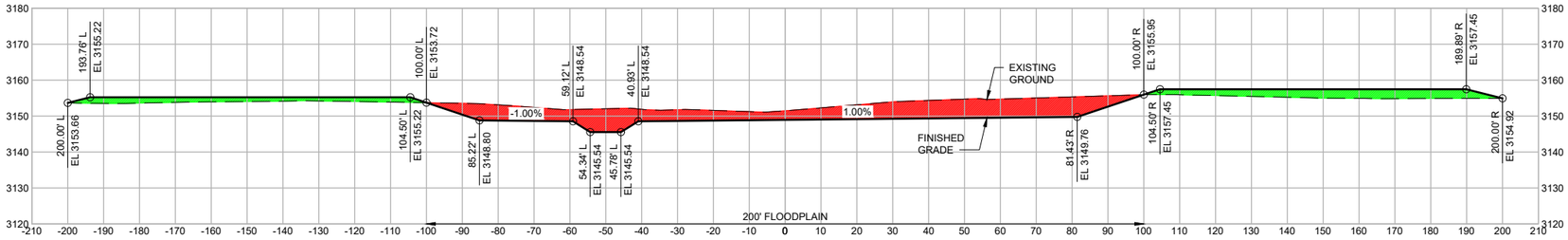
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 18+00 TO STA 24+00

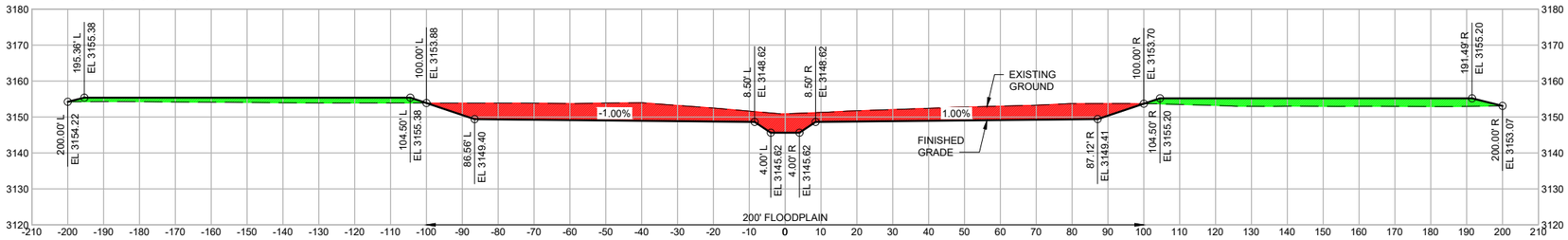
SHEET
OF
C.8 C.13

STATION 26+00.00



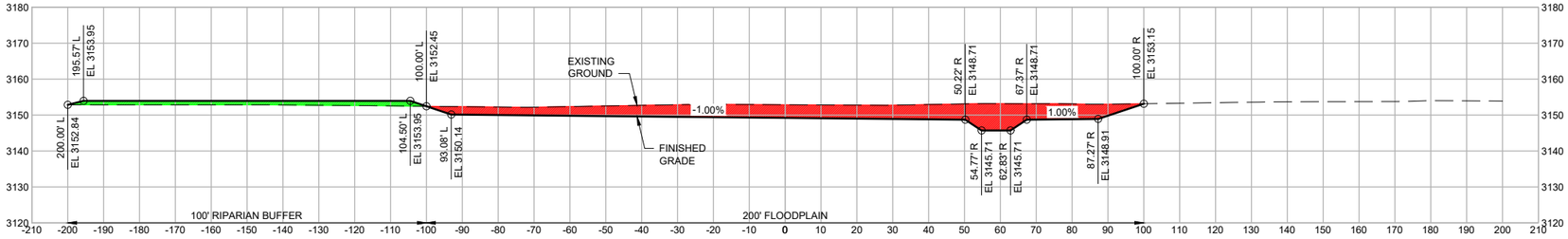
EARTHWORK AT STATION 26+00.00	
CUT AREA	784.16 SqFt
FILL AREA	331.47 SqFt
CUT VOLUME	5060.84 CuYd
FILL VOLUME	1822.71 CuYd
CUMULATIVE CUT VOL	47102.89 CuYd
CUMULATIVE FILL VOL	26362.77 CuYd
NET VOLUME	**20740.11 CuYd**

STATION 28+00.00



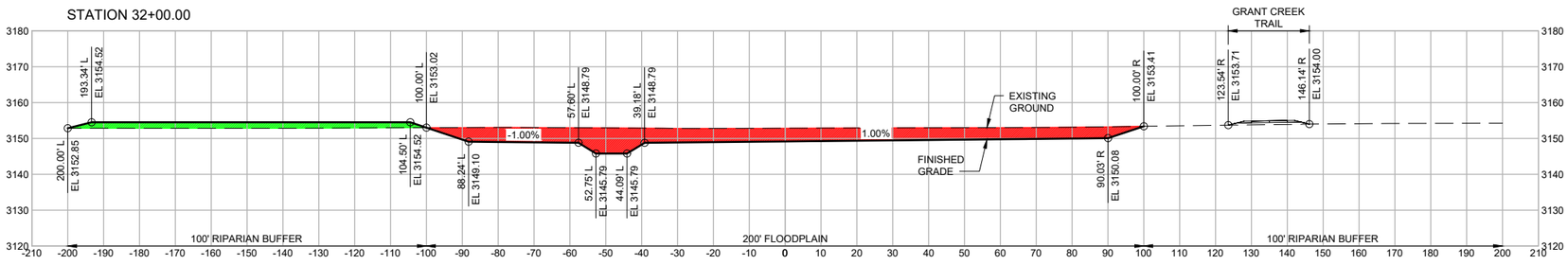
EARTHWORK AT STATION 28+00.00	
CUT AREA	766.49 SqFt
FILL AREA	328.92 SqFt
CUT VOLUME	5346.92 CuYd
FILL VOLUME	2299.36 CuYd
CUMULATIVE CUT VOL	52449.80 CuYd
CUMULATIVE FILL VOL	28662.13 CuYd
NET VOLUME	**23787.68 CuYd**

STATION 30+00.00



EARTHWORK AT STATION 30+00.00	
CUT AREA	701.67 SqFt
FILL AREA	114.48 SqFt
CUT VOLUME	5045.01 CuYd
FILL VOLUME	1523.65 CuYd
CUMULATIVE CUT VOL	57494.81 CuYd
CUMULATIVE FILL VOL	30185.78 CuYd
NET VOLUME	**27309.03 CuYd**

STATION 32+00.00



EARTHWORK AT STATION 32+00.00	
CUT AREA	738.90 SqFt
FILL AREA	154.93 SqFt
CUT VOLUME	4358.81 CuYd
FILL VOLUME	815.18 CuYd
CUMULATIVE CUT VOL	61853.61 CuYd
CUMULATIVE FILL VOL	31000.96 CuYd
NET VOLUME	**30852.65 CuYd**

EXCESS EMBANKMENT (AVAILABLE FOR EXPORT)

1' - 2' HIGH SPOIL BANK (NOT AVAILABLE FOR EXPORT)

0 20 40

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -

DRAWN JW DATE 12/9/2022

CHECKED - SURVEYED DJ&A, P.C.

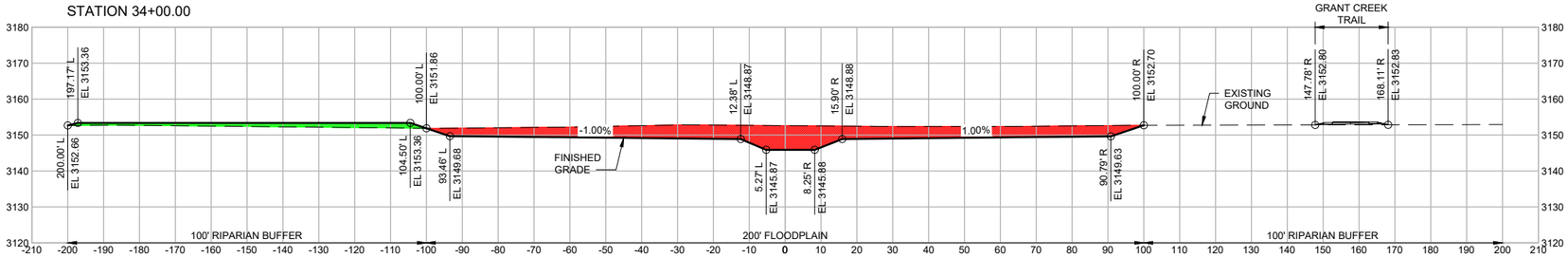
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 26+00 TO STA 32+00

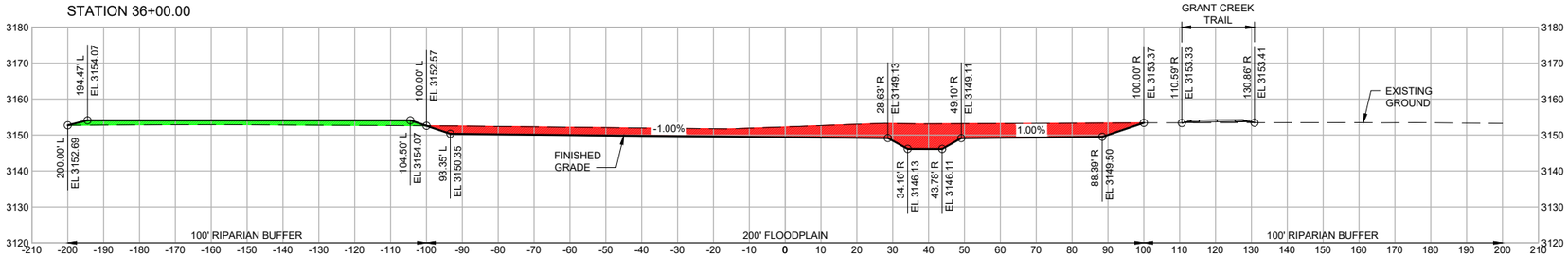
SHEET
OF
C.9 C.13

STATION 34+00.00



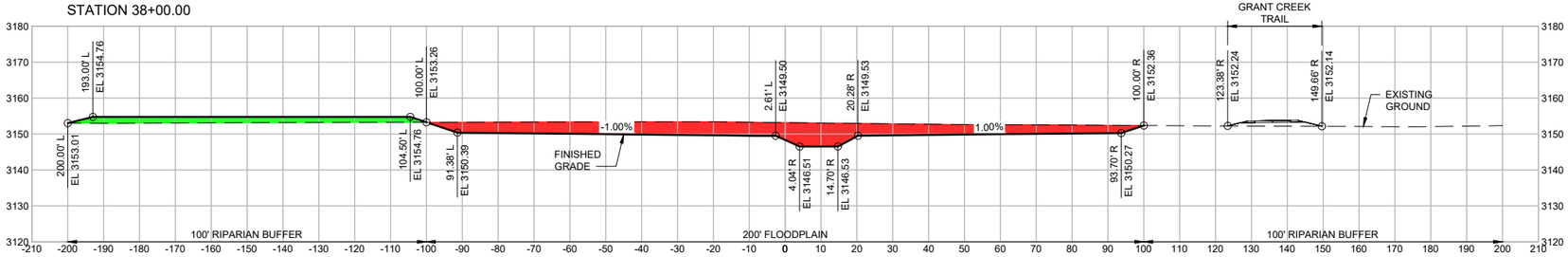
EARTHWORK AT STATION 34+00.00	
CUT AREA	676.65 SqFt
FILL AREA	96.16 SqFt
CUT VOLUME	4684.61 CuYd
FILL VOLUME	830.95 CuYd
CUMULATIVE CUT VOL	66538.23 CuYd
CUMULATIVE FILL VOL	31831.91 CuYd
NET VOLUME	**34706.31 CuYd**

STATION 36+00.00



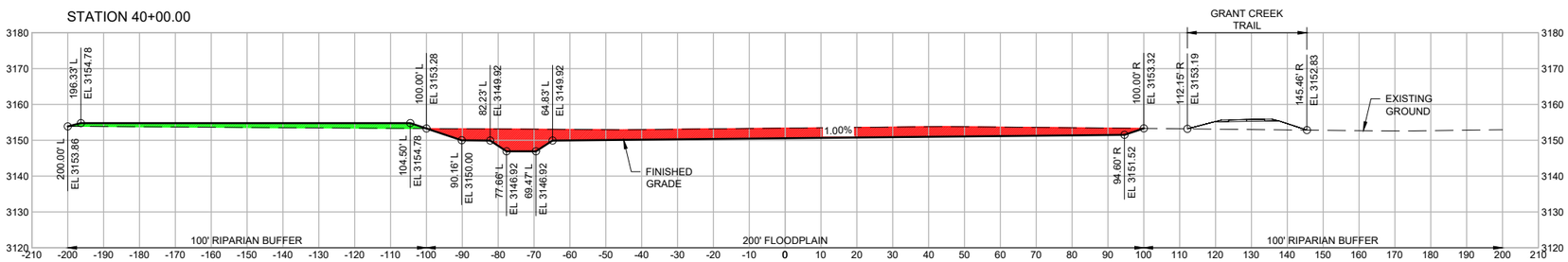
EARTHWORK AT STATION 36+00.00	
CUT AREA	621.02 SqFt
FILL AREA	125.12 SqFt
CUT VOLUME	4216.52 CuYd
FILL VOLUME	719.00 CuYd
CUMULATIVE CUT VOL	70754.75 CuYd
CUMULATIVE FILL VOL	32550.91 CuYd
NET VOLUME	**38203.83 CuYd**

STATION 38+00.00



EARTHWORK AT STATION 38+00.00	
CUT AREA	653.27 SqFt
FILL AREA	154.26 SqFt
CUT VOLUME	3621.09 CuYd
FILL VOLUME	1237.82 CuYd
CUMULATIVE CUT VOL	74375.83 CuYd
CUMULATIVE FILL VOL	33788.73 CuYd
NET VOLUME	**40587.10 CuYd**

STATION 40+00.00



EARTHWORK AT STATION 40+00.00	
CUT AREA	570.37 SqFt
FILL AREA	114.99 SqFt
CUT VOLUME	3435.81 CuYd
FILL VOLUME	838.30 CuYd
CUMULATIVE CUT VOL	77811.64 CuYd
CUMULATIVE FILL VOL	34627.04 CuYd
NET VOLUME	**43184.60 CuYd**

0 20 40

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

EXCESS EMBANKMENT (AVAILABLE FOR EXPORT)

1' - 2' HIGH SPOIL BANK (NOT AVAILABLE FOR EXPORT)

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -

DRAWN JW DATE 12/9/2022

CHECKED - SURVEYED DJ&A, P.C.

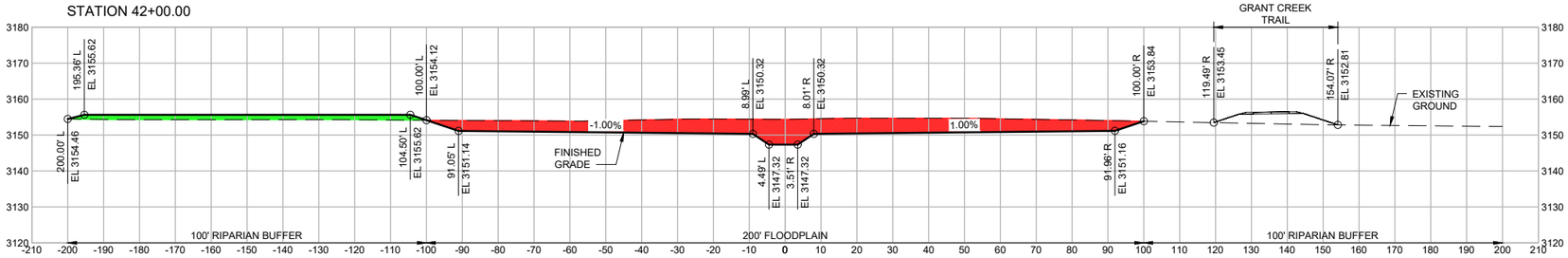
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 34+00 TO STA 40+00

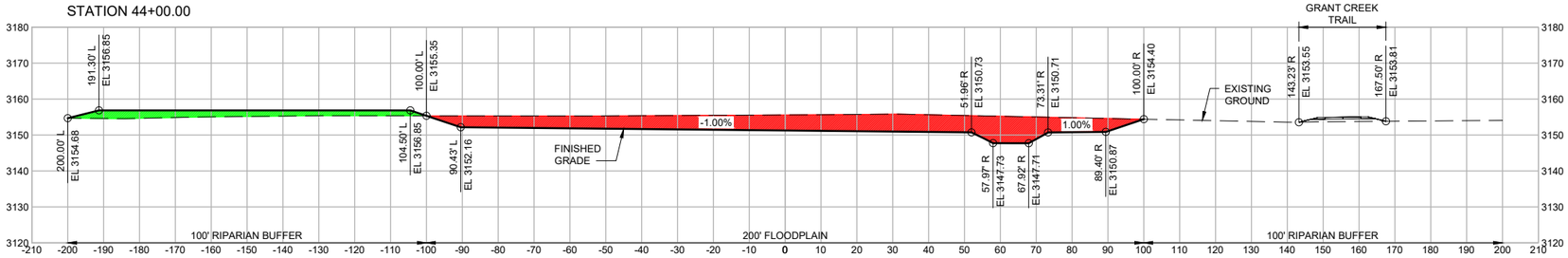
SHEET OF C.10 C.13

STATION 42+00.00



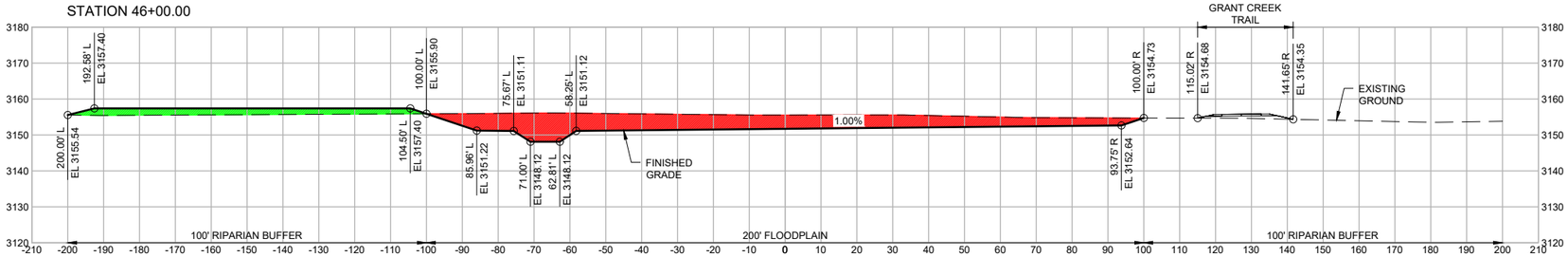
EARTHWORK AT STATION 42+00.00	
CUT AREA	728.86 SqFt
FILL AREA	130.06 SqFt
CUT VOLUME	3892.21 CuYd
FILL VOLUME	999.33 CuYd
CUMULATIVE CUT VOL	81703.85 CuYd
CUMULATIVE FILL VOL	35626.37 CuYd
NET VOLUME	**46077.48 CuYd**

STATION 44+00.00



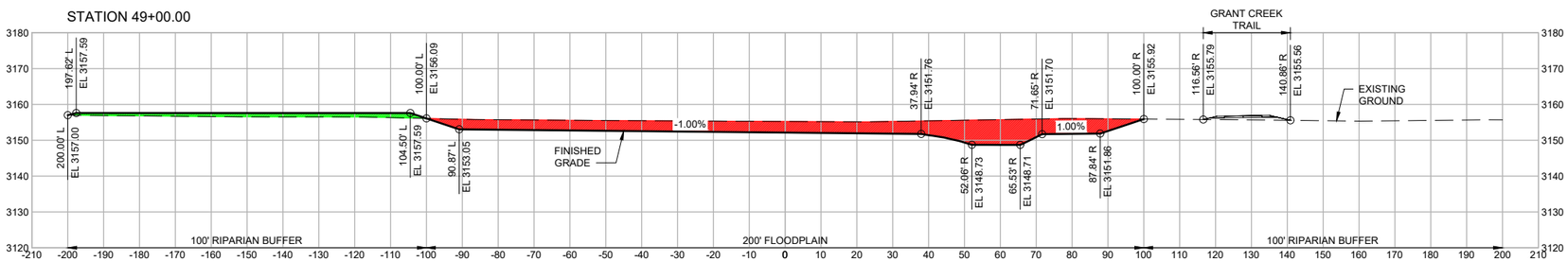
EARTHWORK AT STATION 44+00.00	
CUT AREA	819.06 SqFt
FILL AREA	165.94 SqFt
CUT VOLUME	4699.39 CuYd
FILL VOLUME	898.62 CuYd
CUMULATIVE CUT VOL	86403.24 CuYd
CUMULATIVE FILL VOL	36524.99 CuYd
NET VOLUME	**49878.25 CuYd**

STATION 46+00.00



EARTHWORK AT STATION 46+00.00	
CUT AREA	754.75 SqFt
FILL AREA	164.39 SqFt
CUT VOLUME	2242.08 CuYd
FILL VOLUME	470.59 CuYd
CUMULATIVE CUT VOL	88645.32 CuYd
CUMULATIVE FILL VOL	36995.58 CuYd
NET VOLUME	**51649.74 CuYd**

STATION 49+00.00



EARTHWORK AT STATION 49+00.00	
CUT AREA	696.13 SqFt
FILL AREA	95.55 SqFt
CUT VOLUME	2938.01 CuYd
FILL VOLUME	526.38 CuYd
CUMULATIVE CUT VOL	91583.33 CuYd
CUMULATIVE FILL VOL	37521.95 CuYd
NET VOLUME	**54061.38 CuYd**

EXCESS EMBANKMENT (AVAILABLE FOR EXPORT)

1' - 2' HIGH SPOIL BANK (NOT AVAILABLE FOR EXPORT)

0 20 40

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -

DRAWN JW DATE 12/9/2022

CHECKED - SURVEYED DJ&A, P.C.

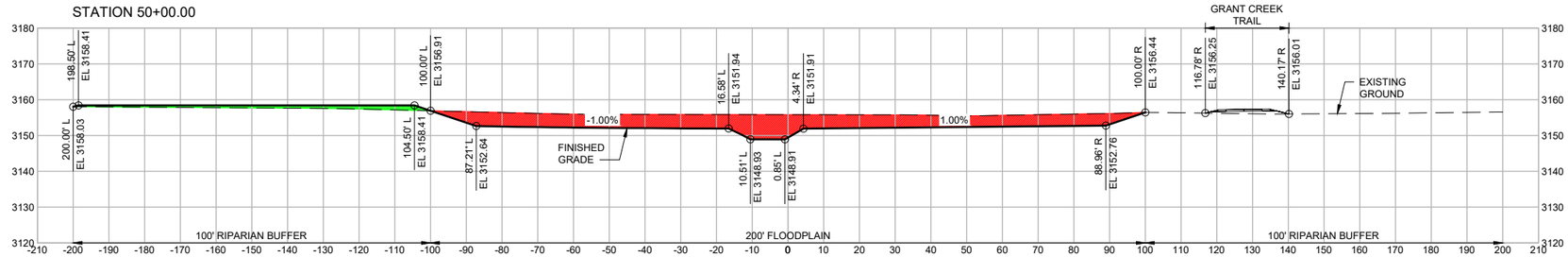
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 42+00 TO STA 49+00

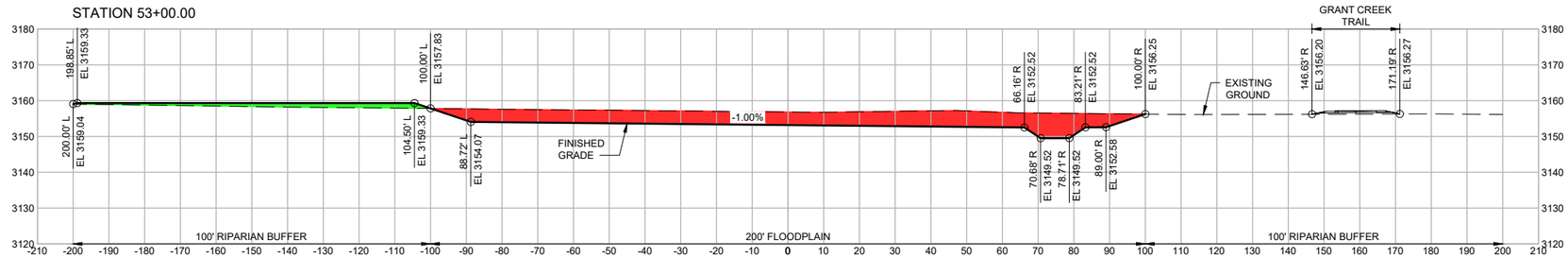
SHEET
OF
C.11 C.13

STATION 50+00.00



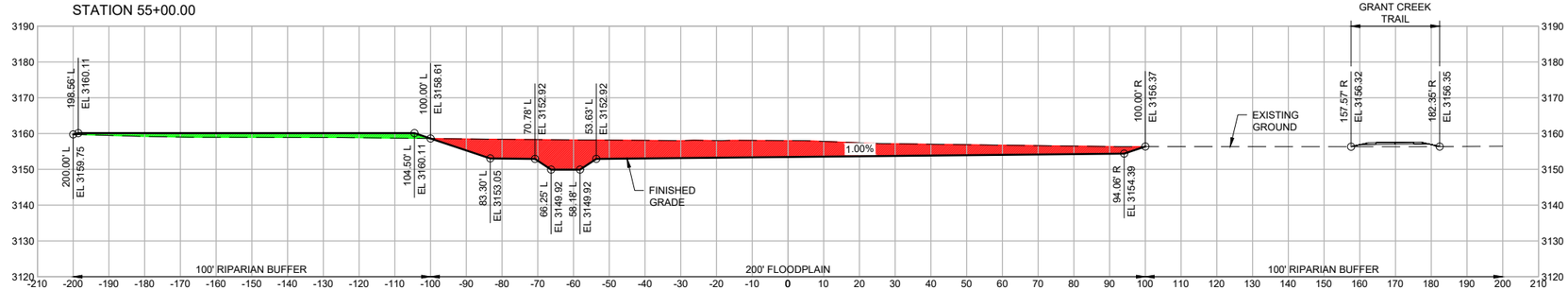
EARTHWORK AT STATION 50+00.00	
CUT AREA	732.55 SqFt
FILL AREA	72.49 SqFt
CUT VOLUME	1762.34 CuYd
FILL VOLUME	207.29 CuYd
CUMULATIVE CUT VOL	93345.67 CuYd
CUMULATIVE FILL VOL	37729.24 CuYd
NET VOLUME	**55616.43 CuYd**

STATION 53+00.00



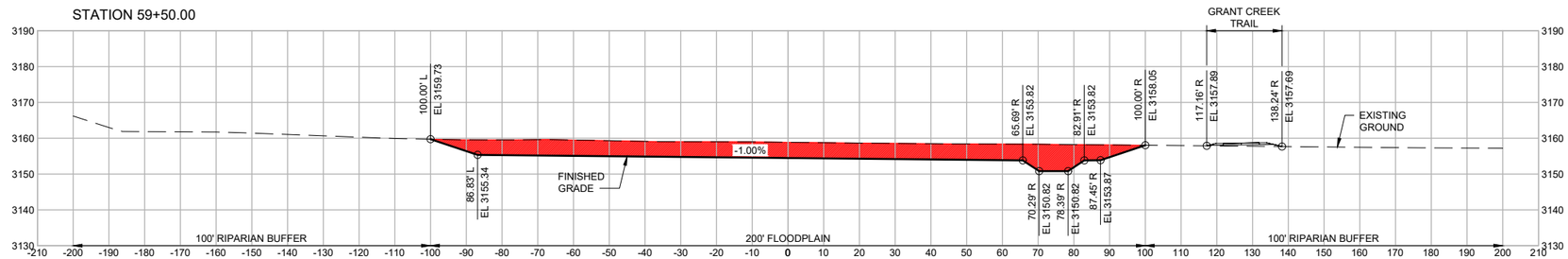
EARTHWORK AT STATION 53+00.00	
CUT AREA	763.68 SqFt
FILL AREA	91.07 SqFt
CUT VOLUME	3704.19 CuYd
FILL VOLUME	404.92 CuYd
CUMULATIVE CUT VOL	97049.86 CuYd
CUMULATIVE FILL VOL	38134.16 CuYd
NET VOLUME	**58915.70 CuYd**

STATION 55+00.00



EARTHWORK AT STATION 55+00.00	
CUT AREA	802.73 SqFt
FILL AREA	107.26 SqFt
CUT VOLUME	3003.94 CuYd
FILL VOLUME	380.35 CuYd
CUMULATIVE CUT VOL	100053.80 CuYd
CUMULATIVE FILL VOL	38514.52 CuYd
NET VOLUME	**61539.29 CuYd**

STATION 59+50.00



EARTHWORK AT STATION 59+50.00	
CUT AREA	856.81 SqFt
FILL AREA	0.00 SqFt
CUT VOLUME	4868.48 CuYd
FILL VOLUME	314.67 CuYd
CUMULATIVE CUT VOL	104922.28 CuYd
CUMULATIVE FILL VOL	38829.19 CuYd
NET VOLUME	**66093.09 CuYd**

0 20 40

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

EXCESS EMBANKMENT (AVAILABLE FOR EXPORT)

1' - 2' HIGH SPOIL BANK (NOT AVAILABLE FOR EXPORT)

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -

DRAWN JW DATE 12/9/2022

CHECKED - SURVEYED DJ&A, P.C.

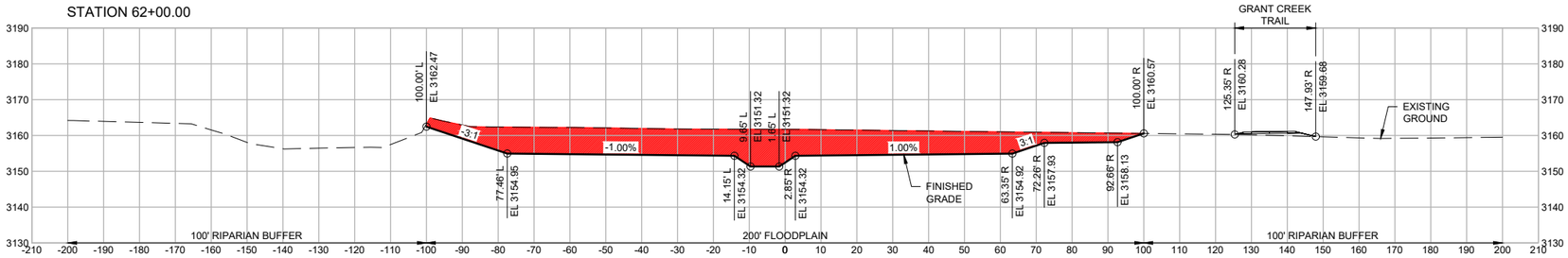
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 50+00 TO STA 60+00

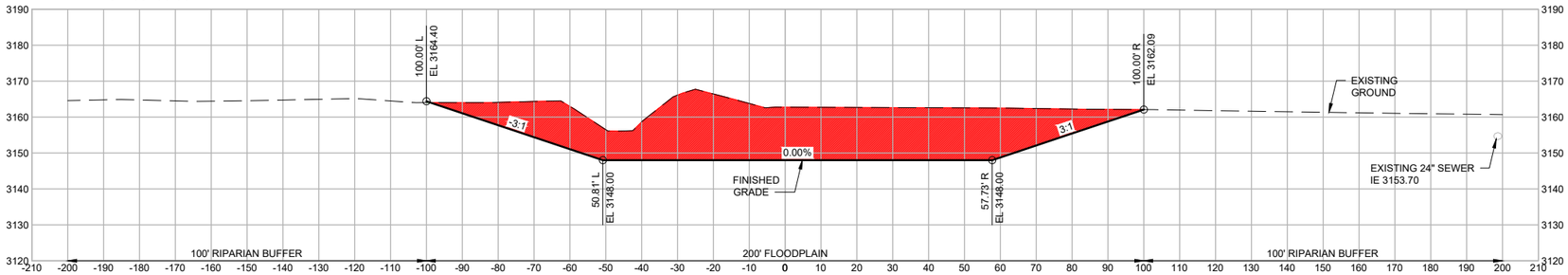
SHEET OF C.12 C.13

STATION 62+00.00



EARTHWORK AT STATION 62+00.00	
CUT AREA	1244.23 SqFt
FILL AREA	0.00 SqFt
CUT VOLUME	8023.85 CuYd
FILL VOLUME	0.00 CuYd
CUMULATIVE CUT VOL	112946.13 CuYd
CUMULATIVE FILL VOL	38829.19 CuYd
NET VOLUME	**74116.94 CuYd**

STATION 63+50.00



EARTHWORK AT STATION 63+50.00	
CUT AREA	2254.13 SqFt
FILL AREA	0.19 SqFt
CUT VOLUME	9717.66 CuYd
FILL VOLUME	0.53 CuYd
CUMULATIVE CUT VOL	122663.79 CuYd
CUMULATIVE FILL VOL	38829.72 CuYd
NET VOLUME	**83834.06 CuYd**

EXCESS EMBANKMENT (AVAILABLE FOR EXPORT)

0 20 40

SCALE IN FEET
CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

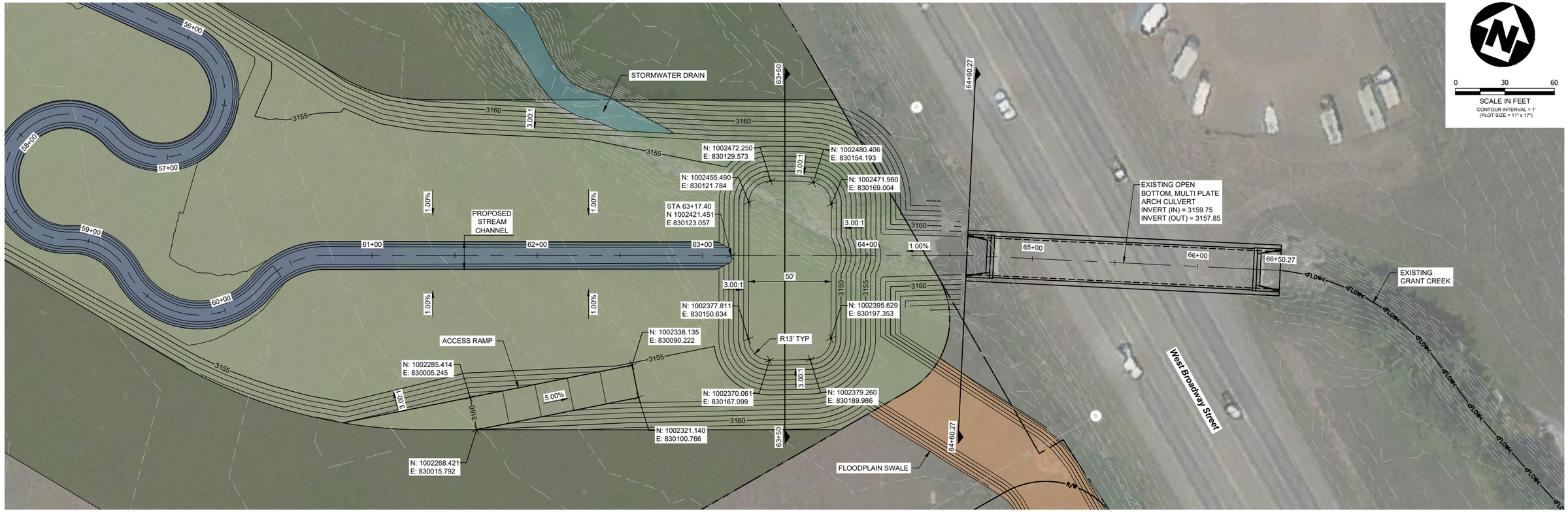
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED D.J&A. P.C.

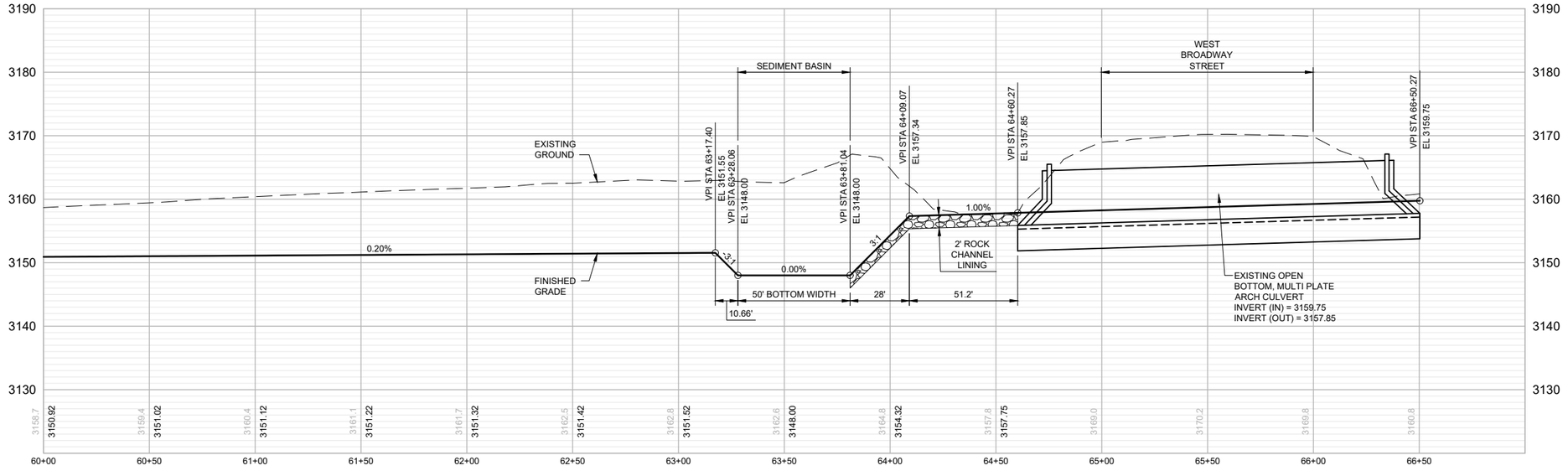
ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

C. GRANT CREEK
CROSS SECTIONS
STA 62+00 TO STA 64+00

SHEET OF C.13 C.13





REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

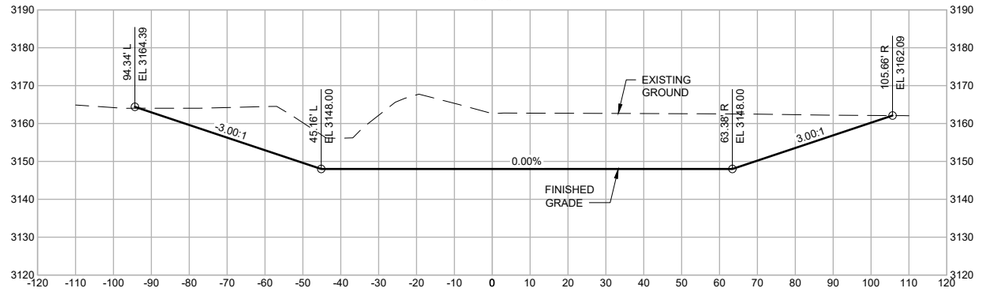
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

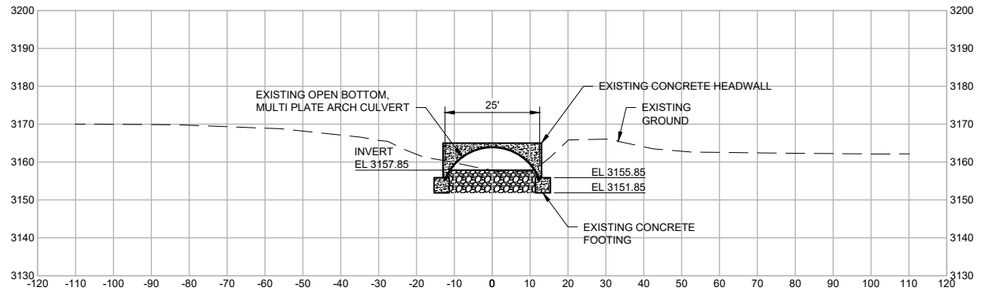
D. SEDIMENT BASIN
PLAN AND PROFILE
STA 60+00 TO STA 66+50.27

SHEET OF D.1 D.2

63+50



64+60.27



0 20 40

SCALE IN FEET
CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

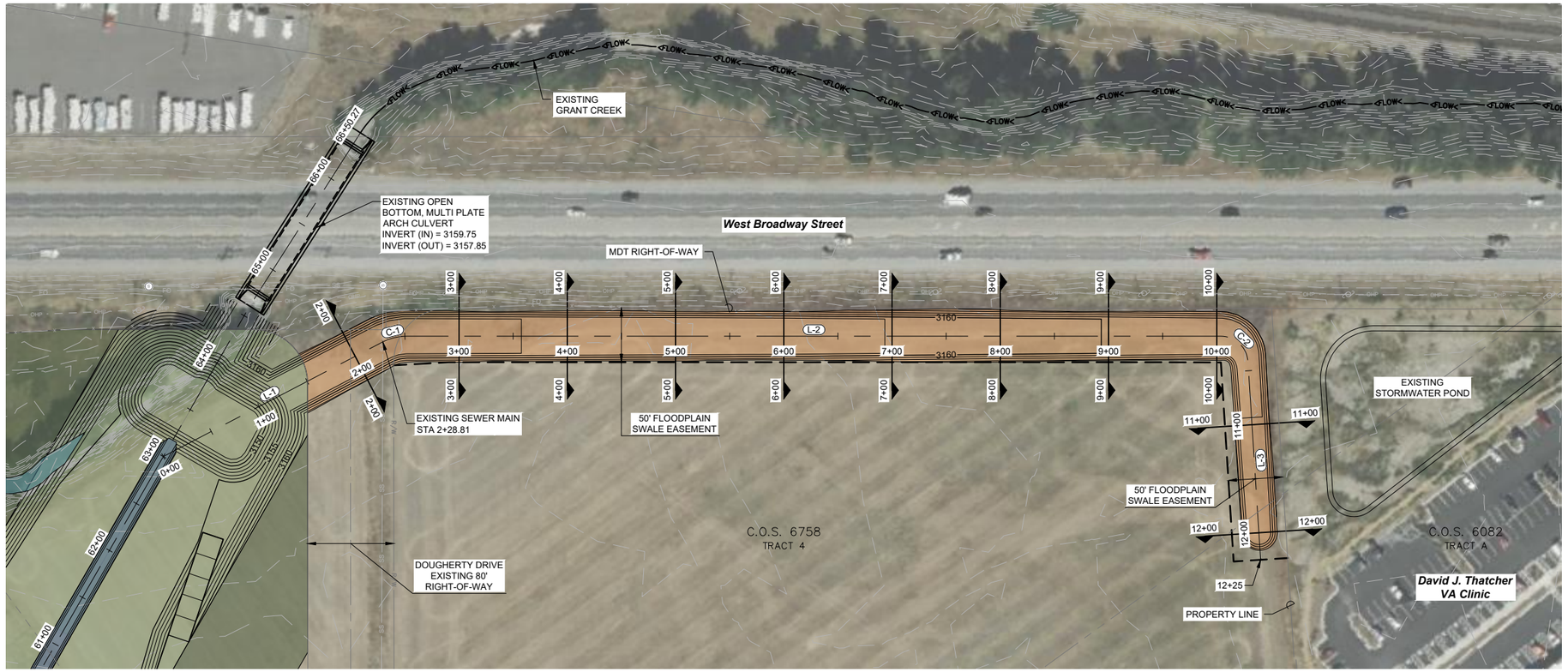
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

D. SEDIMENT BASIN
CROSS SECTIONS
STA 61+25 TO STA 64+60.27

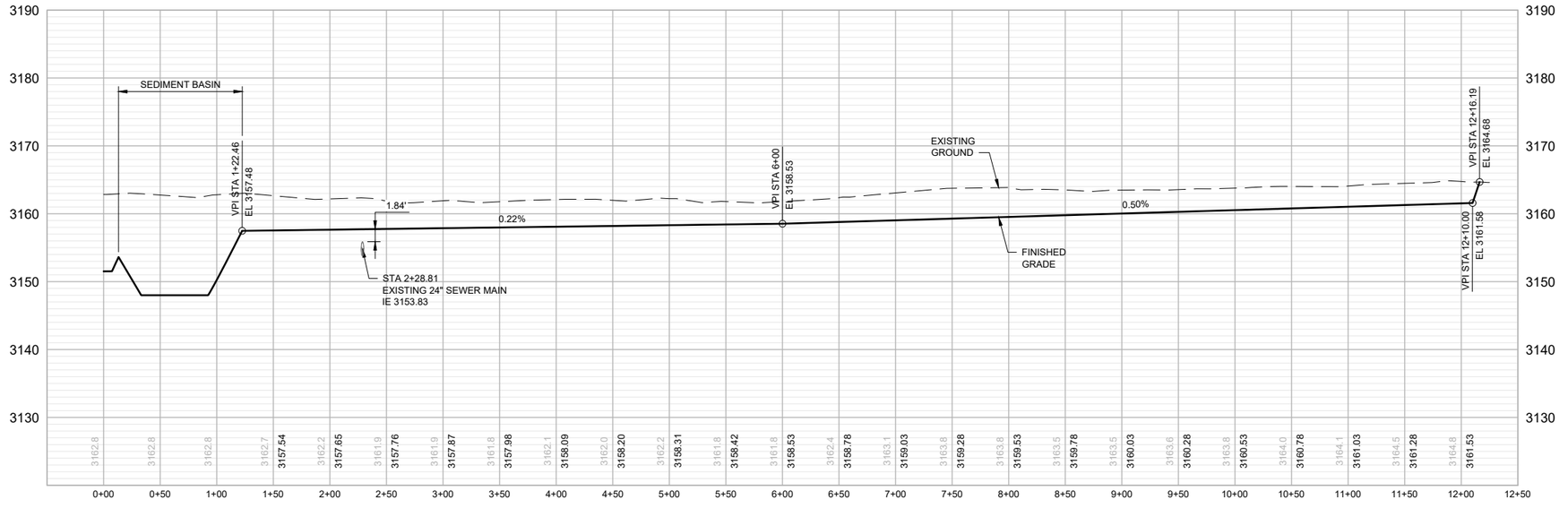
SHEET D.2 OF D.2



0 60 120

SCALE IN FEET

CONTOUR INTERVAL = 1'
(PLOT SIZE = 11" x 17")



FLOODPLAIN SWALE ALIGNMENT TABLE							
NO.	START STA.	START COORD.	END STA.	END COORD.	LEN.	RAD.	LINE/CHORD DIRECTION
L-1	0+00.00	N 1002415.344 E 830106.763	2+27.87	N 1002367.929 E 830329.643	227.87'	NA	S77°59'24"E
C-1	2+27.87	N 1002367.929 E 830329.643	2+51.94	N 1002357.552 E 830351.107	24.07'	50.00'	S64°11'51"E
L-2	2+51.94	N 1002357.552 E 830351.107	10+03.81	N 1001878.340 E 830930.474	751.87'	NA	S50°24'17"E
C-2	10+03.81	N 1001878.340 E 830930.474	10+41.48	N 1001844.406 E 830934.784	37.67'	25.00'	S07°14'15"E
L-3	10+41.48	N 1001844.406 E 830934.784	12+25.00	N 1001695.804 E 830827.097	183.52'	NA	S35°55'47"W

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

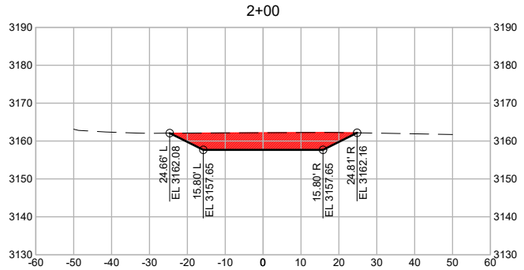
DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

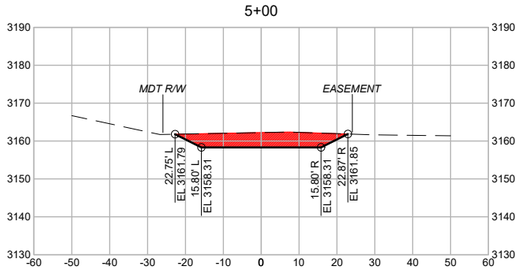
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

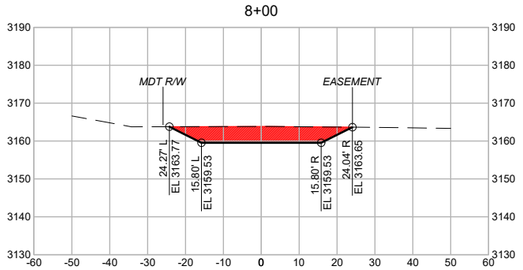
GRANT CREEK
90% PLANS

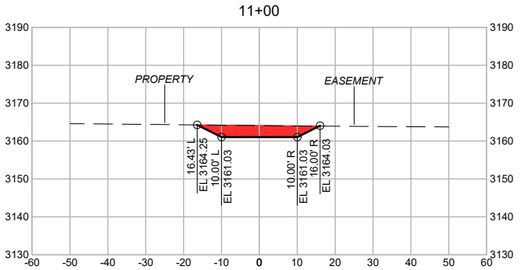
E. FLOODPLAIN SWALE
PLAN AND PROFILE
STA 0+00 TO STA 12+25

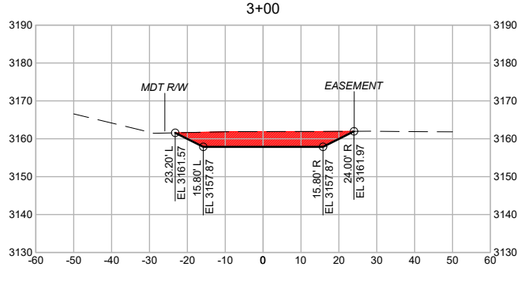
SHEET OF E.1 E.2

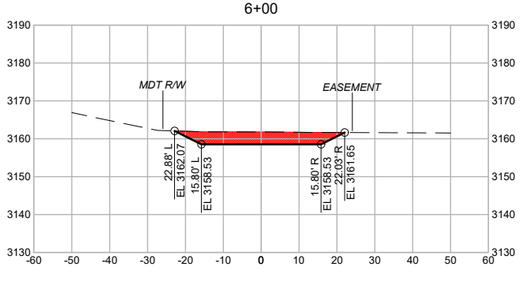


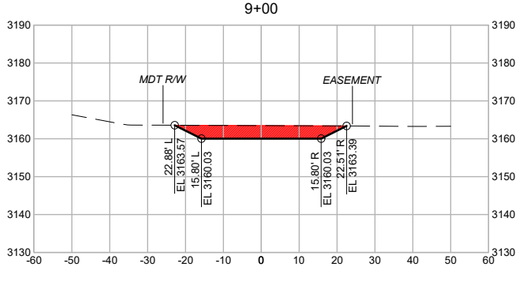


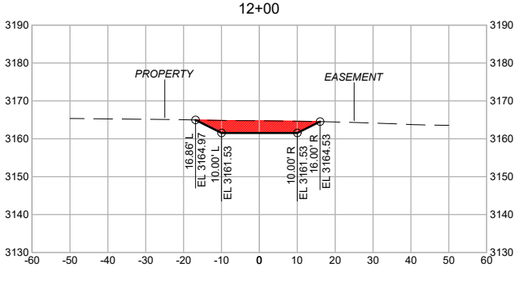


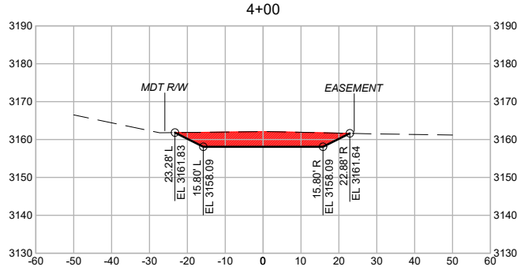


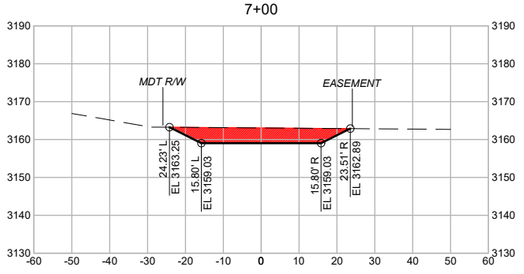


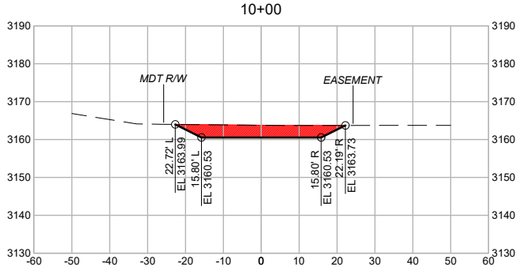


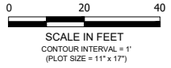












REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

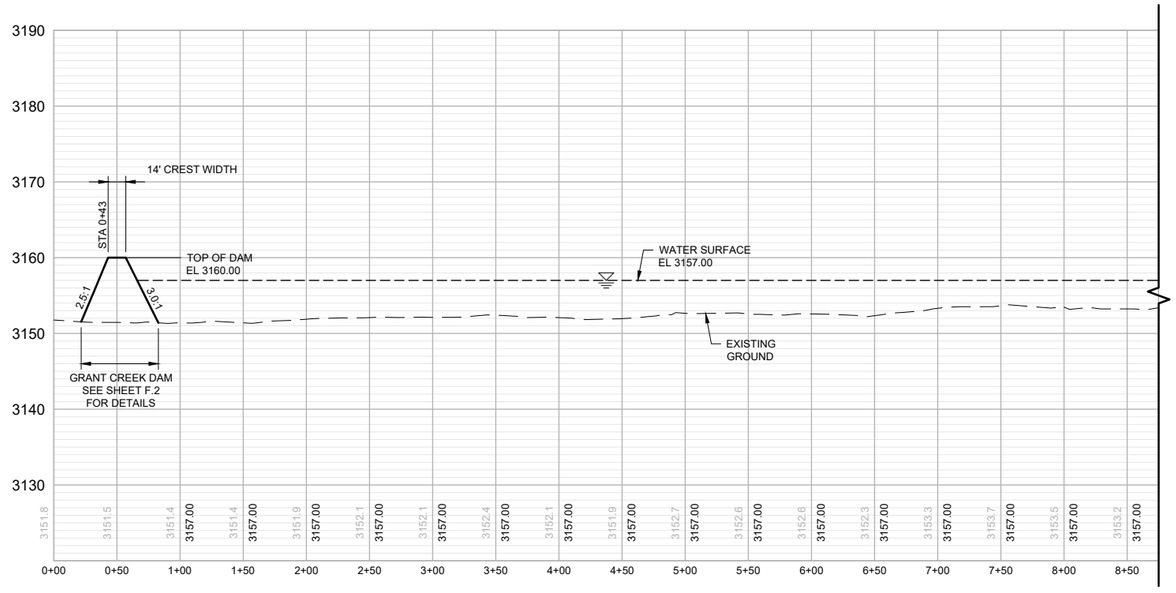
HDR DJ&A ENGINEERS PLANNERS SURVEYORS

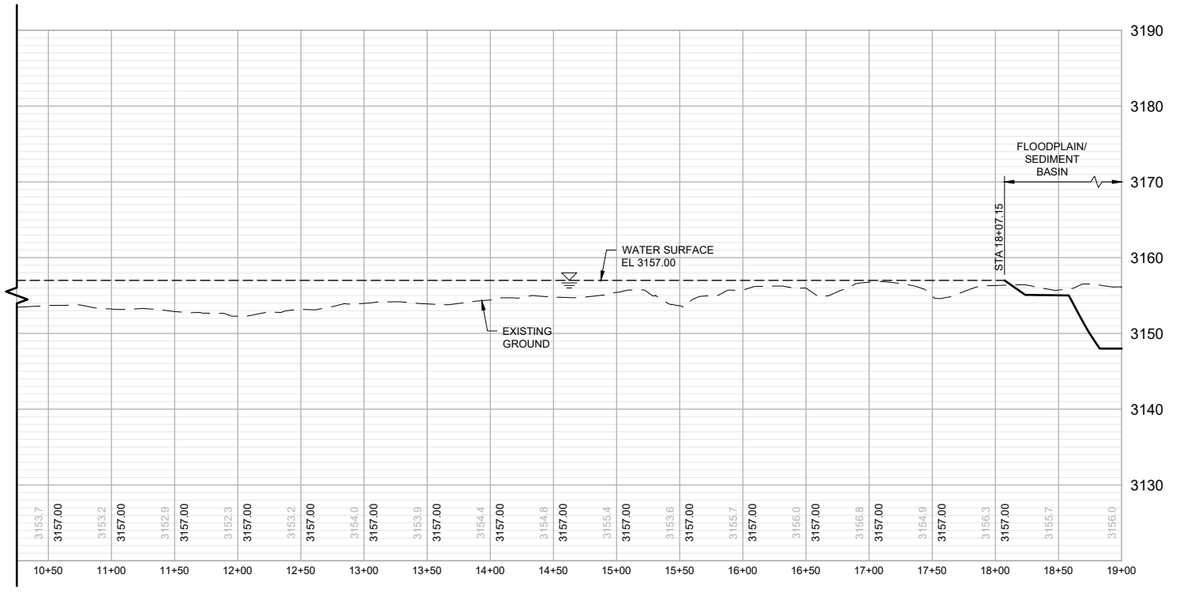
GRANT CREEK
90% PLANS

E. FLOODPLAIN SWALE
CROSS SECTIONS
STA 2+00 TO STA 12+00

SHEET
OF
E.2 E.2







REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

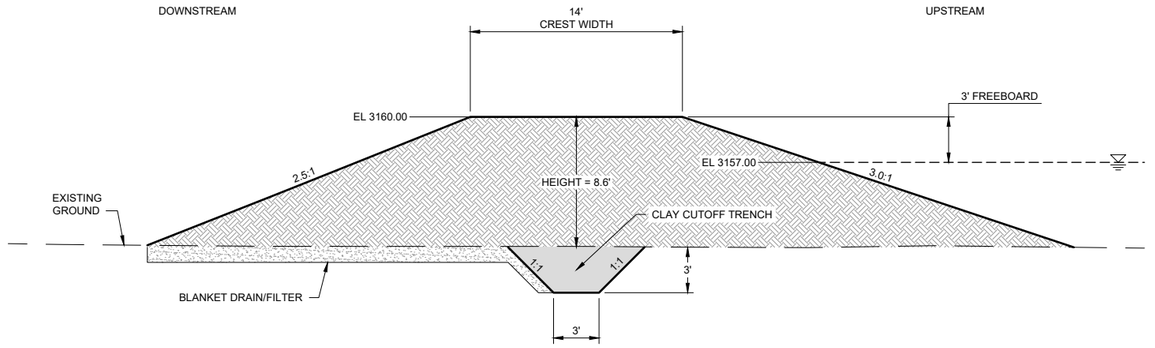
GRANT CREEK
90% PLANS

F. STORMWATER DRAIN
PLAN AND PROFILE
STA 0+00 TO STA 19+00

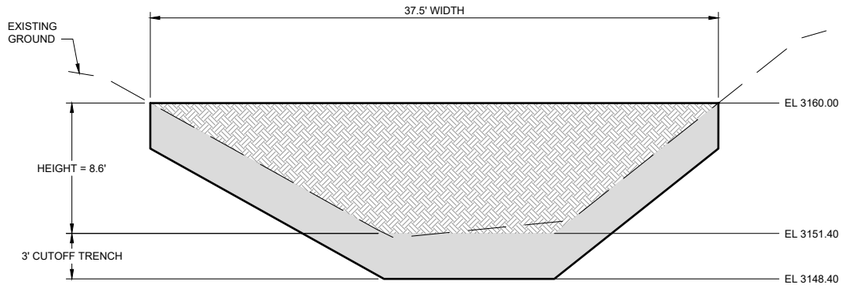
SHEET OF F.1 F.2



1 - GRANT CREEK DAM - PLAN VIEW
SCALE: 1" = 10'



2 - GRANT CREEK DAM - PROFILE VIEW
SCALE: 1" = 5'



A - GRANT CREEK DAM - SECTION VIEW
SCALE: 1" = 5'

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM | PROJ. NO. -
DRAWN JW | DATE 12/9/2022
CHECKED - | SURVEYED DJ&A, P.C.

HDR | DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

F. STORMWATER DRAIN
ENLARGED GRANT CREEK DAM
PLAN, PROFILE, AND SECTION VIEWS

SHEET
OF
F.2 | F.2

TBD

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

H. REVEGETATION PLAN
PLANTING PLAN

SHEET
OF
H.1 H.2

TBD

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

H. REVEGETATION PLAN
PLANTING SCHEDULE

SHEET
OF
H.2 H.2

TBD

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

I. SOIL EROSION AND SEDIMENT CONTROL
EROSION CONTROL DETAILS (1 OF 2)

SHEET
OF
I.1 I.2

TBD

REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

DESIGNER DM PROJ. NO. -
DRAWN JW DATE 12/9/2022
CHECKED - SURVEYED DJ&A, P.C.

HDR DJ&A ENGINEERS PLANNERS SURVEYORS

GRANT CREEK
90% PLANS

I. SOIL EROSION AND SEDIMENT CONTROL
EROSION CONTROL DETAILS (2 OF 2)

SHEET
OF
I.2 I.2

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION

GREG GIANFORTE, GOVERNOR
1539 ELEVENTH AVENUE

STATE OF MONTANA

DIRECTOR'S OFFICE: (406) 444-2074
FAX: (406) 444-2684
PO BOX 201601
HELENA, MONTANA 59620-1601

Conservation and Resource Development Division
Environmental Checklist Instructions

Purpose of This Document:

All applicants must consider the potential environmental impacts of their projects. Consideration of these impacts on the location, design, or construction actions may help avoid expensive costs. A project will not be eligible for funding if it results in significant environmental degradation.

DNRC requires compliance with the Montana Environmental Policy Act (MEPA) per state law and associated DNRC Administrative Rules (ARM 36.2.523). MEPA requires state agencies to prepare a detailed statement on any project, program, or activity directly undertaken by the agency; a project or activity supported through a contract, grant, subsidy, loan, or other form of funding assistance from the agency; and a project or activity involving the issuance of a lease, permit, license, certificate, or other entitlement for use or permission by the agency (MCA Title 75, Chapter 1). Thus, all project applications will be subject to MEPA review.

What Does This Mean for Applicants?

- ☐ All applicants must complete the Environmental Checklist in its entirety and provide sufficient documentation on public participation.
- ☐ Public participation, or scoping, of the project must include stakeholder, landowner, and community engagement. These efforts can be in the form of documented public meetings (e.g., meeting minutes, pdf presentations) or letters of support.
  - The public meeting must be properly noticed (advertised) and the public must be provided with an opportunity at the meeting to comment on the project.
  - Minutes of the meeting should reflect what was discussed about the project, including all comments received from the public.
  - Letters of support must be included from any identified or interested stakeholders.
- ☐ Agency Comment Letters (see instructions below)
- ☐ Please submit these items with your application.
- ☐ Provide Affidavit of Publication or Meeting Minutes for the public comment period notice on the draft EA

How Will DNRC Use the Information Provided?

The information provided within the Environmental Checklist will be subject to a MEPA review by DNRC. If this review should result in an Environmental Assessment, please be aware that DNRC will draft the Environmental Assessment. The drafted Environmental Assessment decision will be posted for a public comment period of up to 30 days dependent on the level of environmental impact.

When the draft EA is posted, we require the project proponent to post the notice in either one local newspaper outlet in the legal advertising section or provide the notice during a publicly held meeting. The applicant must then provide the affidavit of publication if posted in the newspaper or meeting minutes if discussed in a public meeting. Please note this public comment period does not suffice for the public participation component mentioned above. The MEPA document will then require a final decision by DNRC before funds are awarded.

It is also important to note for projects with no environmental impacts, or those that do not lead directly to construction or any other sort of environmental degradation, will not be subject to an environmental assessment and the checklist/public participation does not need to be completed. Examples of these sorts of activities include, but are not limited to, development of a PER (professional engineering report), planning, and education/informational outreach. Please let us know if there are additional questions on what other projects may fall under this category.

Instructions:

Complete the Environmental Checklist on the following pages after the instructions below. DNRC retains the ultimate decision-making authority on all MEPA decisions. If DNRC determines this section to be incomplete, additional information will be required before consideration for funding.

Example			
Impact Code	**Impact Type**	**Permits/ Mitigation Required?**	**Explanation of Impact to Resource**
1. Soil Suitability, Topographic and/or Geologic Constraints (example: soil slump, steep slopes, subsidence, seismic activity)			
☐ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☐ NA	*Current Conditions:* *Preferred Alternative Environmental Narrative:*

1. **Impact Code:** In the first column, identify the impact that the preferred alternative will have on each resource (e.g. 1. Soil Suitability, Topographic and/or Geologic Constraints) in the project area. Select from the following impact codes:
   - *No Impact*: No impact to the resource is anticipated or this is not applicable to this project.
   - *Beneficial*: Potentially beneficial impact to the resource.
   - *Adverse*: Potentially adverse impact to the resource.

   Please note that a resource may have more than one impact. Identify all possible impacts to the resource in the space provided. For example, the preferred alternative may have a short-term direct negative impact and a long-term direct and indirect positive impact on the resource. Check all boxes that apply and use the space provided in the final column "Explanation of Impact to Resource" to explain.

Example			
Impact Code	**Impact Type**	**Permits/ Mitigation Required?**	**Explanation of Impact to Resource**

1. Soil Suitability, Topographic and/or Geologic Constraints (example: soil slump, steep slopes, subsidence, seismic activity)			
☐ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☐ NA	*Current Conditions:* *Preferred Alternative Environmental Narrative:*

2. **Impact Type:** In the second column, identify the type(s) of impact to the resource from the preferred alternative. (Impacts may be direct, indirect or cumulative).
    - *Direct impacts*: Occur at the same time and place as the proposed project.
    - *Indirect or secondary impacts*: Occur at a different location or later time than the proposed project.
    - *Cumulative impacts*: Collective impacts on the environment when considered in conjunction with other past, present, and future actions related to the proposed project. Cumulative impact analysis includes a review of all state and nonstate activities that have occurred, are occurring, or may occur that have impacted or may impact the same resource as the proposed project.

    Just as above, please note that a resource may have more than one impact. Identify all possible impacts to the resource in the space provided. For example, the preferred alternative may have a short-term direct negative impact and a long-term direct and indirect positive impact on the resource. Check all boxes that apply and use the space provided in the final column "Explanation of Impact to Resource" to explain.

Example			
Impact Code	**Impact Type**	**Permits/ Mitigation Required?**	**Explanation of Impact to Resource**
1. Soil Suitability, Topographic and/or Geologic Constraints (example: soil slump, steep slopes, subsidence, seismic activity)			
☐ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☐ NA	*Current Conditions:* *Preferred Alternative Environmental Narrative:*

3. **Permits/Mitigation Required:** In the third column, please select if a permit and/or mitigation is required for the project (e.g., 310, USACE Section 404 Nationwide).
    - Please make sure to include which permits (if any) are required for the particular resource and what mitigation techniques will be used if impacts are to occur.

Example			
Impact Code	**Impact Type**	**Permits/ Mitigation Required?**	**Explanation of Impact to Resource**

1. Soil Suitability, Topographic and/or Geologic Constraints (example: soil slump, steep slopes, subsidence, seismic activity)			
☐ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☐ NA	Current Conditions: Click or tap here to enter text. Preferred Alternative Environmental Narrative: Click or tap here to enter text.

4. **Explanation of Impact to Resource:** In the final column, use the space provided on the Environmental Checklist to summarize the following information:
    - ***Current Conditions***
        - Describe the current environmental resources of the affected area including the impact of no action. Your description of the current natural resources will provide a baseline to compare all alternatives and their associated environmental impacts.
    - ***Preferred Alternative Environmental Narrative:***
        - Describe the impact of the preferred alternative or ***indicate why there is no impact*** from the project.
        - Identify any reasonable cumulative impacts that may result from implementing the preferred alternative. Cumulative impacts are the collective impacts on the environment when considered in conjunction with other past, present, and future actions related to the proposed project.
        - If a potentially adverse impact is identified for the preferred alternative, the applicant must provide the following:
            - An analysis of the severity, duration, extent, and frequency of the impact. Please specify and describe the following:
                - Severity: negligible, minor, or major.
                - Duration: short-term or long-term.
                - Extent: local, regional, or statewide.
                - Frequency: non-recurring or recurring.
            - An explanation of short- and/or long-term measures to mitigate the impact with a discussion on the effects of those mitigative measures on the proposed project.
        - Identify any required permits.

5. **Additional Information:** Underneath the table the following information must be provided:
    - Cultural Survey Acknowledgement
    - Sources of Information: Identify all sources consulted for the completion of the Environmental Checklist. Sources may include studies, plans, documents, or the persons, organizations, or agencies contacted for assistance.

Certain sections of this Environmental Checklist require specialized knowledge. Please contact the following agencies and attach comments provided by those agencies to your application. Below are contacts for certain sections that require additional review by other agencies:

- *Physical Environment,* ***Section #5*** **– Surface Water Quality** – Montana Department of Environmental Quality, (406) 444 - 3080.
- *Physical Environment,* ***Section #6*** **– Floodplains and Floodplain Management** – Contact the Local Floodplain Administrator for your County and/or Community

(http://dnrc.mt.gov/divisions/water/operations/floodplain-management/contacts/20210924FPAs2021.1.pdf) or visit the Department of Natural Resources Water Resources Division, (406) 444 – 0860, http://dnrc.mt.gov/divisions/water/operations/floodplain-management.

- *Physical Environment,* ***Section #7*** **– Wetlands** – U.S. Department of the Army Corps of Engineers, (406) 441 - 1375 or montana.reg@usace.army.mil.
- *Physical Environment,* ***Section #9*** **– Vegetation and Wildlife Species and Habitats** – Montana Fish, Wildlife and Parks, Wildlife Office (406) 444 - 2612 or find your Regional Office at https://fwp.mt.gov/aboutfwp/contact-us.
- *Physical Environment,* ***Section #10*** **– Unique, Endangered, Fragile or Limited Environmental Resources** – U.S. Fish and Wildlife Service for consultation on potential impacts to endangered or limited plants, fish, or other wildlife, (406) 449 - 5225.
- *Human Environment,* ***Section #4*** **– Historic Properties, Cultural or Archaeological Resources –** Montana State Historic Preservation Office (SHPO), (406) 444 - 7767 or dmurdo@mt.gov.

For assistance in preparing the Environmental Checklist, contact DNRC grant manager listed on grant application.

Environmental Checklist

Environmental Checklist Prepared by: On: Click or tap to enter a date.

Jon Schick, CEP	HDR Engineering, Inc.
Name of Person 1 406-532-2231	Organization jon.schick@hdrinc.com
Phone Number Click or tap here to enter text.	Email Click or tap here to enter text.
Name of Person 2 Click or tap here to enter text.	Organization Click or tap here to enter text.
Phone Number	Email

Click or tap here to enter text.

List additional people above. Include organization, phone number and email for all.

Physical Environment			
Impact Code	**Impact Type**	**Permits/ Mitigation Required?**	**Explanation of Impact to Resource**

1. Soil Suitability, Topographic and/or Geologic Constraints (example: soil slump, steep slopes, subsidence, seismic activity)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☒Permit ☒Mitigation ☐ NA	Current Conditions: The project area includes two primary soil types: Grassvalley silty clay loam, 0 to 4 percent slopes (MUSYM 45) and Desmet loam, 0 to 2 percent slopes (MUSYM 34). Both soil types are described as well drained and depth to water table is more than 80 inches (NRCS 2023). The topography of the project is relatively flat and does not include geologic constraints. The project area has historically been used for agriculture and has experienced extensive soil disturbance over the past several decades. Grant Creek has been historically realigned in the area of the "horseshoe bend," and has deeply incised eroding and unstable banks. Preferred Alternative Environmental Narrative: In general, the proposed project will have negligible impact on soil suitability or topographic/geologic constraints of the project area. The Preferred Alternative includes realigning Grant Creek to improve and enhance floodplain function. The immediate topography of the project area will be altered through construction of a new stream channel and floodplain bench, which will provide a beneficial impact on floodplain function. Once the creek realignment is completed, portions of the existing Grant Creek channel will be filled. Earthwork is anticipated to include stripping, clearing, and grubbing in the area of the creek realignment and floodplain swale. The total disturbance area is currently unknown but will exceed one acre. The disturbance area will be minimized to the extent possible to construct the project. The 90 percent plans for the project are provided as Attachment A. Due to the anticipated area of disturbance exceeding 1 acre, the contractor will be required to obtain permit coverage under the Montana Pollutant Discharge Elimination System (MPDES) through the Montana Department of Environmental Quality (DEQ). Compliance with the MPDES requires the contractor to develop, implement, and maintain a Storm Water Pollution Prevention Plan (SWPPP), which will include detailed information on best management practices (BMPs) that will be employed during construction to avoid and minimize any adverse effects related to potential erosion and sedimentation.
2. Hazardous Facilities (example: power lines, hazardous waste sites, acceptable distance from explosive and flammable hazards including chemical/petrochemical storage tanks, underground fuel storage tanks, and related facilities such as natural gas storage facilities and propane storage tanks)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☒Mitigation ☐ NA	Current Conditions: The DEQ web application "Discover DEQ Throughout Montana" (DEQ 2023a) was reviewed to identify any hazardous materials sites located in the project area. There

			are no known hazardous material sites or underground storage tanks located within the project limits. The EPA National Priorities List was reviewed and no sites of concern are located near the proposed project. Preferred Alternative Environmental Narrative: There are no known hazardous material sites located within the project limits. The presence of heavy machinery during construction poses a potential risk of fuel or oil accidently releasing on the project site, particularly when working within or near waterways. The contractor would follow their standard spill prevention protocols and have a spill kit on site to respond to any accidental release. Similarly, standard BMPs such as conducting daily startup inspection of all hydraulic lines and cylinder seals will reduce the potential for a release.
3. Surrounding Air Quality (example: dust, odors, emissions)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The project area is located adjacent to but outside of the Missoula Carbon Monoxide (CO) maintenance area. The project area is also adjacent to the Missoula International Airport and likely receives emissions from airplane traffic during operations. Preferred Alternative Environmental Narrative: Implementation of the project is anticipated to have negligible impact on the air quality of the surrounding area. Implementation of the Preferred Alternative would result in a minor and short-term increase of emissions from operation of construction equipment and fugitive dust due to grading activities. There would be a temporary increase in diesel exhaust and carbon monoxide from equipment used during construction. BMPs would be followed during all phases of construction to minimize emissions and reduce dust. These impacts are anticipated to occur over a relatively short timeframe during construction and have no long-term adverse effect on the local or regional air quality. Issues due to fugitive dust and/or airborne particulates would be managed through implementing BMPs as needed during construction, which may include dust suppression or altering construction activities due to weather conditions.

4. Groundwater Resources and Aquifers (example: quantity, quality, distribution, depth to groundwater, sole source aquifers)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: Several wells exist in the vicinity of the project area according to the Montana Bureau of Mines and Geology Ground Water Information Center (MBMG 2023). Based on available data for nearby wells, ground water levels (static water levels) range from approximately 20-30 feet below ground surface (bgs). The general direction of groundwater flow slopes to the southwest towards the Clark Fork River. The project overlies Missoula Valley's sole source aquifer. The depth to the aquifer is unknown at the project location, but is likey greater than 50 feet bgs. Preferred Alternative Environmental Narrative: The proposed project will have negligible effect on groundwater quantity, quality, distribution, or depth to groundwater. Excavation depths vary across the project depending on existing topography, but impact on the aquifer is not anticipated. Groundwater is likely to be encountered during construction and dewatering will occur in accordance with the DEQ General Permit regulations. Grant Creek likely influences local groundwater conditions currently, and the relocation and realignment of the creek in a location approximately 1,000 feet to the southeast will have negligible effect on groundwater resources.

5. Surface Water/Water Quality, Quantity and Distribution (example: streams, lakes, storm runoff, irrigation systems, canals)			
☐ No Impact ☒ Beneficial ☐ Adverse	☒ Direct ☒ Indirect ☐ Cumulative	☒Permit ☒Mitigation ☐ NA	Current Conditions: The project area includes approximately 1.5 miles of Grant Creek between West Broadway Street to Hiawatha Road. Grant Creek is a tributary to the Clark Fork River. It should be noted that the USGS National Hydrography Dataset incorrectly identifies the location of Grant Creek. Grant Creek has been significantly altered and channelized downstream of I-90. The creek has been impacted by channelization, construction of I-90, past gravel mining activities, flow diversion for irrigation, and other land use and development activities. Most notable within the project area, Grant Creek has been historically realigned in the area of the "horseshoe bend," and has deeply incised eroding and unstable banks. Grant Creek is an impaired waterbody due to multiple factors including total nitrogen, nitrate/nitrite, sediment, temperature, alteration in streamside or littoral vegetative covers, and flow regime modification (DEQ 2023b). Channel incision and the subsequent erosion of Grant Creek above Mullan Road are contributing significant amounts of sediment to downstream reaches of the creek, which is reducing the hydraulic conveyance of the creek, degrading the creek ecosystem and contributing to its impairment due to sediment and total nitrogen. An additional problem relates to a Montana Department of Transportation (MDT) storm water outfall that drains portions of I-90, Airway Boulevard, Expressway Drive and West Broadway into Grant Creek, where a significant erosion problem exists at the outfall. Preferred Alternative Environmental Narrative: Restoration of Grant Creek will result in realignment of approximately 5,200 lineal feet of Grant Creek, establishment of a 1,645 foot flood control swale with berm that is located on the southwest right-of-way of West Broadway that discharges to the Grant Creek channel, establishment of a 150 foot riparian area and setback from the Grant Creek channel, development of a natural stream channel capable of conveying the 2-year storm and with sinuosity and stable channel design, design of a roadway crossing of the Grant Creek channel at the extension of George Elmer Drive, and design of storm water facilities to assure the developed runoff from the area will discharge to Grant Creek at pre-developed conditions. Overall the project is intended to have a beneficial impact on surface water resources and water quality by constructing an enhanced floodplain and stream channel that will reduce erosion and sedimentation by promoting natural streambank

			and sediment management conditions. The MDT stormwater outfall will also be improved to eliminate another ongoing source of sediment. The proposed riparian corridor will also provide a vegetated buffer that will provide water quality enhancement by allowing for infiltration of future stormwater from adjacent development as it occurs. Water quality impacts during construction will be substantially avoided and minimized by the use of standard BMPs that include erosion and sediment control(s) to minimize temporary impacts on adjacent properties and abate pollution of surface and ground water resources. Construction sequencing will be an important BMP. The new channel and the vast majority of the project will be constructed in the dry. The connections to Grant Creek will be constructed late in the fall when Grant Creek has typically run dry for the season. Other standard BMPs (e.g., silt fence, straw wattles) would be installed and maintained during construction in accordance with the MPDES General Permit and other applicable environmental permits to prevent erosion and sediment transport in the event of a runoff event. The contractor would be responsible for conducting routine site monitoring to ensure all pollution control measures are installed, maintained, and functioning correctly. A Clean Water Act (CWA) Section 404 permit will be required due to instream work occurring within Grant Creek, which is a Waters of the U.S. Additional permits that will be required include a 318 Authorization for Turbidity, Stream Protection Act (SPA) 124, CWA Section 401 Water Quality Certification, and a Floodplain Development Permit.

6. Floodplains and Floodplain Management (Identify any floodplains within one mile of the boundary of the project.)

☐ No Impact ☒ Beneficial ☐ Adverse	☒ Direct ☒ Indirect ☒ Cumulative	☒Permit ☒Mitigation ☐ NA	Current Conditions: Floodplains within one mile of the project include only Grant Creek and associated floodplain. The project area is located within a FEMA Zone A floodplain (FEMA FIRM panels 30063C1190E and 30063C1195E) (FEMA 2023). Grant Creek experienced a significant flooding event of residential developments in the Mullan Road area in 1997. These floods prompted a re-examination of the Grant Creek floodplain. The investigation discovered that the floodplain was within an entirely different location than was originally published in the Federal Environmental Management Agency (FEMA) Flood Insurance Rate Map. Modifications to Grant Creek downstream from the project area corrected flooding issues with downstream properties and improved fish passage; however, the reach of Grant Creek between West Broadway and immediately upstream from the Old Milwaukee Railroad Grade (Horseshoe Bend) were not addressed and the properties within this reach remain vulnerable to erosion, is subject to flooding, and provides poor fish habitat and fish passage conditions. Preferred Alternative Environmental Narrative: The purpose and need for the project is to realign Grant Creek to restore and enhance floodplain function and promote water quality. The realignment covers a length of 5,200 feet. The proposed project will develop a new channel for Grant Creek with an established thalweg capable of passing a 2-year flood event and a floodplain that provides a minimum 150 foot riparian area that is capable of passing a 100-year storm event. The realigned channel and riparian zone will extend from West Broadway to the previously constructed Hiawatha Lake floodplain and riparian area that was completed in 2010. There will also be modifications to the existing MDT stormwater outfall draining portions of I-90, Airway Boulevard, Expressway Drive and West Broadway into Grant Creek to eliminate the severe erosion occurring at the outfall. The project design includes a floodplain swale to the east of Grant Creek parallel and south of West Broadway Street, sized to capture the overtopping flood flows of the 100-year event to mitigate the issue of the overland flooding downstream of West Broadway. The geometry of the swale parallels the southwest edge of the roadway at slopes ranging from 0.0026 ft/ft to 0.01 ft/ft, which approximates the existing ground. Assuming a trapezoidal channel with 2:1 side slopes and a depth of 3 feet, results in top widths ranging from 15 to 21 feet. The overtopping discharge would be directed to the proposed Grant Creek floodplain at the downstream end of the West Broadway crossing of Grant Creek with a 0.5 feet freeboard. The swale will cover 1,645 feet. The channel modifications will complete the restoration work that was originally identified in the Grant Creek Environmental

			Restoration and Floodplain Project in 2005. The project will also result in creating additional developable property by eliminating a wide swath of shallow Zone A/AE floodplain that has no ecological value and replacing it with a 150-foot wide floodplain that is a functioning riparian area. The final restoration recommendations will ultimately result in the completion of a CLOMR and LOMR process with FEMA. The project will require a floodplain development permit from the City of Missoula.
7. Wetlands (Identify any wetlands within one mile of the boundary of the project and state potential impacts.)			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	<u>Current Conditions:</u> A wetland survey of the project area was initially conducted on July 20 and October 20, 2004, as part of the Grant Creek Environmental Restoration and Floodplain Project completed in 2005 (Maxim Technologies 2005). No wetlands were identified in the project area, including along Grant Creek. The project area including Grant Creek were surveyed for wetlands again on May 26-27, 2020, as part of the federal Mullan BUILD project (HDR 2020). Again, no wetlands were identified within or adjacent to Grant Creek. Areas identified as potential wetland by public data sources (i.e., MT Natural Heritage Program and US Fish and Wildlife Service) in the project area were also investigated during the 2020 survey where it was determined these areas did not meet the criteria for wetland. As such, the project area does not include any wetlands. <u>Preferred Alternative Environmental Narrative:</u> No wetland impacts will occur as a result of the proposed project. The creation of a functioning floodplain and revegetation of riparian species will likely create conditions suitable for wetland habitat to form over time.

8. Agricultural Lands, Production, and Farmland Protection (example: grazing, forestry, cropland, prime or unique agricultural lands) Identify any prime or important farm ground or forest lands within one mile of the boundary of the project.			
☐ No Impact ☐ Beneficial ☒ Adverse	☒ Direct ☒ Indirect ☒ Cumulative	☐Permit ☒Mitigation ☒ NA	Current Conditions: The project area includes soils that are classified as "Prime farmland if irrigated" and "Farmland of local importance" (NRCS 2023). Agricultural and hay (primarily alfalfa) production in the project area has waned over the years as urbanization has steadily replaced agricultural lands in the vicinity of the project. There are no conservation easements protecting farmland in the project area. The project area is within the greater Mullan Area Neighborhoods Master Plan area, later renamed the Sxwtpqyen Area, which has recently completed a regional master plan outlining the development of the project area vicinity. Preferred Alternative Environmental Narrative: The Preferred Alternative will impact a swath of area currently vacant and formerly used for agriculture. The proposed project also has indirect effects on farmland because it is a component of the overall master plan for the area to be developed with a mix of land uses. Completion of the Grant Creek realignment will remove a portion of land from the floodplain, thus allowing the area to be developed as envisioned under the adopted Sxwtpqyen Area Master Plan. This Sxwtpqyen Area Master Plan acknowledges the historical significance of this agricultural area, as well as the loss of potential agricultural production, and recommends mitigation by setting aside certain areas for future agricultural uses. Within the plan is a vision of incorporating a portion of agricultural land that will complement and enhance the neighborhoods within the master planning area. Within this area are two areas specifically allocated for farms, along with a provision for community gardens spread throughout the different neighborhoods. In total, nearly 230 acres will be potential areas of agricultural production, and/or community garden space (DK&P 2020).

9. Vegetation and Wildlife Species and Habitats, Including Fish (example: terrestrial, avian and aquatic life and habitats)			
☐ No Impact ☒ Beneficial ☐ Adverse	☒ Direct ☒ Indirect ☐ Cumulative	☐Permit ☒Mitigation ☐ NA	Current Conditions: The project area is currently vacant field containing grasses and weedy species. The existing Grant Creek corridor has minimal riparian vegetation along its fringe, primarily due to the steep, incised bank and lack of floodplain. Intermittent cottonwoods (Populus balsamifera) exist along the stream channel. The project area provides marginal wildlife habitat. According to the Montana Natural Heritage Program (MTNHP) Generalized Observations database, species likely to occur in the project area vicinity include deer mouse (Peromyscus maniculatus), coyote (Canis latrans), striped skunk (Mephitis mephitis), mountain cottontail (Sylvilagus nuttallii), eastern fox squirrel (Sciurus niger), and raccoon (Procyon lotor), among other species (MTNHP 2023). Columbian ground squirrels (Urocitellus columbianus) and white-tailed deer (Odocoileus virginianus) were observed in the project area during the May 2020 field investigations. The population of Columbian ground squirrels is a prey source for various raptor species in the vicinity of the project area. According to the Montana Fish, Wildlife and Parks (FWP) MFISH Mapper, Grant Creek has been documented to contain several fish species, including rainbow trout (Oncorhynchus mykiss), brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), bull trout (Salvelinus confluentus), westslope cutthroat trout (Oncorhynchus clarkii lewisi), and mountain whitefish (Prosopium williamsoni) (FWP 2023). The project area does not intersect any sage grouse habitat (MSGHCP 2023). Preferred Alternative Environmental Narrative: Vegetation availability and wildlife habitat is anticipated to improve under the Preferred Alternative. The project will construct a 200-foot-wide floodplain and abutting 100-foot-wide riparian buffers on either side of the realigned creek channel that will be planted with native riparian species. This 400-foot wide buffer will provide new habitat for a multitude of wildlife. Aquatic habitat is anticipated to improve as well under the Preferred Alternative. The project will create a more sinuous and natural stream channel that will provide more stable banks, channel complexity, and functioning floodplain. The stream channel will be vegetated with riparian species, which will improve upon current conditions by allowing for woody debris recruitment and shading.

10. Unique, Endangered, Fragile, or Limited Environmental Resources, Including Endangered Species (example: plants, fish or wildlife)			
☐ No Impact ☒ Beneficial ☒ Adverse	☒ Direct ☐ Indirect ☐ Cumulative	☐Permit ☒Mitigation ☒ NA	Current Conditions: According to the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) application, several species listed as federally threatened or proposed threatened have potential to occur in the project area and vicinity. The species include Canada lynx (Lynx canadensis), grizzly bear (Ursus arctos horriblis), North American wolverine (Gulo gulo luscus), bull trout, and monarch butterfly (Danaus plexippus) (USFWS 2023). Grant Creek is designated as bull trout critical habitat. No plant species listed as either threatened or endangered exist in the project area or vicinity. Preferred Alternative Environmental Narrative: The Preferred Alternative would have no effect on Canada Lynx or Wolverine because suitable habitat for these species does not exist in the project area. Grizzly bear are known to occur in the higher elevation national forest to the north of the project area; however, the project area does not provide suitable habitat and grizzly bear are not likely to be adversely affected by the Preferred Alternative. The Preferred Alternative will require instream work within Grant Creek, which has potential to adversely affect bull trout due to minor, short-term effects to water quality resulting from construction. It is anticipated that instream work will occur during a work window as specified by the USFWS and/or FWP when bull trout are not likely to be present. It is anticipated that the aquatic habitat improvements resulting from the project will have a long-term direct beneficial impact on bull trout by providing more quality habitat throughout the project reach, as well as by reducing erosion potential and sediment loads within Grant Creek. The project will require compliance with the Endangered Species Acta that includes preparation of a Biological Assessment (BA) and consultation with the USFWS. The BA will include mitigation measures to avoid and minimize impacts to bull trout and critical habitat.
11. Unique Natural Features (example: geologic features)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: There are no identified unique natural features located within the project area. Preferred Alternative Environmental Narrative: No impact to any unique natural features will occur as a result of the proposed project.

12. Access to, and Quality of, Recreational and Wilderness Activities, Public Lands and Waterways (including Federally Designated Wild & Scenic Rivers), and Public Open Space			
☐ No Impact ☒ Beneficial ☐ Adverse	☒ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: There are no recreational areas, wilderness, public lands or open space located within the project area. Preferred Alternative Environmental Narrative: The Preferred Alternative includes constructing a shared-use path adjacent to the realigned Grant Creek, which will create a new city-owned recreational amenity for area residents. This will improve access to and quality of recreational opportunities and public land in the west end of Missoula.
Human Environment			
Impact Code	**Impact Type**	**Resource**	
1. Visual Quality – Coherence, Diversity, Compatibility of Use and Scale, Aesthetics			
☐ No Impact ☒ Beneficial ☐ Adverse	☒ Direct ☐ Indirect ☒ Cumulative	☐Permit ☒Mitigation ☐ NA	Current Conditions: The existing visual environmental includes vacant agricultural fields surrounded by industrial and residential development. Preferred Alternative Environmental Narrative: Implementation of the Preferred Alternative will result in a beneficial impact on the visual quality of the project area and surrounding environment. The proposed design includes constructing a new floodplain and riparian corridor, in an area where there were none before, which will enhance the visual quality of the project vicinity. The Preferred Alternative is a planned component of the Sxwtpqyen Area Master Plan and will provide a cumulative beneficial impact on the surrounding environment once the master plan area has been built out.
2. Nuisances (example: glare, fumes)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☒Mitigation ☐ NA	Current Conditions: The current project area experiences nuisances from the nearby Missoula International Airport and adjacent West Broadway Street. Preferred Alternative Environmental Narrative: No long-term nuisance will be created by the Preferred Alternative. Minor disruption of local residents due to construction noise, fumes, dust, etc., is unavoidable. Such effects will be mitigated wherever possible by implementing BMPs and control measures, such as minimizing emissions and fugitive dust during construction. All such nuisances will be temporary in duration and will cease once construction is completed.

3. Noise – Suitable Separation Between Housing and Other Noise Sensitive Activities and Major Noise Sources (example: aircraft, highways and railroads.)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The project area currently experiences noise from traffic on West Broadway Street as well as airplane traffic from the adjacent Missoula International Airport. Preferred Alternative Environmental Narrative: The long-term operation of the proposed project is not anticipated to affect or increase noise in the project area. Operation of construction equipment would cause a temporary, minor increase in noise levels at the location where construction is occurring. Any increase in noise level at the construction site would be short-term and minor. Construction would occur during daylight hours only.
4. Historic Properties, Cultural, and Archaeological Resources ***(Please see end of Environmental Checklist for details if Cultural Survey has not been performed per SHPO Section 106)***			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☒Mitigation ☐ NA	Current Conditions: The project area was surveyed for cultural resources during the preliminary design phase of the federal Mullan BUILD project. The Class III cultural resources inventory was completed by Rabbitbrush Archaeological Services, LLC and the report was completed in June 2020 (Rabbitbrush 2020). The report can be downloaded at the following link: https://www.mullanbuild.com/_files/ugd/570f64_3ff2c26995364314ba749632e78fdb40.pdf There is one historic irrigation ditch, the Field Dougherty ditch, within the project area. The Field Dougherty ditch (24MO902) was first recorded in 2003 and updated in 2005 as part of the Grant Creek Corridor Environmental Restoration and Flood Control Project. As a result of post 1960s realignments and the Grant Creek restoration project, the ditch is essentially the path of Grant Creek and no longer serves as an irrigation resource but rather as the creek itself. The resource is considered to be not eligible for inclusion the National Register of Historic Places (NRHP). The State Historic Preservation Office (SHPO) previously determined Site 24MO0902 as not eligible for inclusion on the NRHP on June 20, 2006. In addition, there are a two lateral segments of another historic ditch, the Flynn-Lowney ditch (24MO0550), that cross the project area. The main ditch is located outside of the project area and was recommended eligible for the NRHP in the June 2020 report. The primary laterals, however, have been reconfigured and their integrity has been compromised

			and thus were recommended as non-contributing to the site's recommended eligibility. The Dougherty Ranch (24MO1781) is located approximately one half-mile to the southeast of the project area. As mitigation to avoid impacting any undiscovered cultural resources, should evidence of historic or pre-historic sites be discovered during construction, the contractor would be required to immediately stop work in the area until the significance of the site is determined and appropriate measures implemented. <u>Preferred Alternative Environmental Narrative:</u> The Preferred Alternative will have no adverse effect on any cultural/historic resources that are either listed on or recommended eligible for the NRHP. As mitigation to avoid impacting any undiscovered cultural resources, should evidence of historic or pre-historic sites be discovered during construction, the contractor would be required to immediately stop work in the area until the significance of the site is determined and appropriate measures implemented.
5. Changes in Demographic (Population) Characteristics (example: quantity, distribution, density)			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	<u>Current Conditions:</u> The proposed project site is currently vacant. Surrounding properties include some rural residential uses and generally low population densities. There is currently substantial development of new residential units occurring near the immediate project area. <u>Preferred Alternative Environmental Narrative:</u> The Preferred Alternative will have no direct impact on changes in demographic characteristics. The Preferred Alternative may have indirect effects on population by removing an area from the floodplain to allow for it to be developed, some of which may include residential development. The potential indirect impacts are beneficial for the urban area, which, per growth policy, is attempting to consolidate growth to keep development near existing infrastructure and reduce the potential for sprawl. In addition, the area to be developed following the remapping of the floodplain will attract new businesses and foster economic development.

6. General Housing Conditions – Quality, Quantity, Affordability			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☒ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The immediate project area is vacant land with no businesses or residences present. Adjacent developments outside of the immediate project area include the airport and other industrial land uses. Preferred Alternative Environmental Narrative: The quality and quantity of housing conditions will not be directly affected by the proposed project. The Preferred Alternative may have indirect effects on general housing conditions by removing an area from the floodplain to allow for it to be developed, some of which may include residential development. In conjunction with the planned growth occurring in accordance with the Sxwtpqyen Master Plan, the Preferred Alternative may have cumulative beneficial impacts on the quantity and affordability of general housing conditions.
7. Businesses or Residents (example: loss of, displacement, or relocation)			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☒ Cumulative	☐Permit ☐Mitigation ☐ NA	Current Conditions: The immediate project area is vacant land with no businesses or residences present. Adjacent developments outside of the immediate project area include the airport and other industrial and commercial land uses. Preferred Alternative Environmental Narrative: The proposed project will not result in the displacement or relocation of any residences or businesses. As noted above, the proposed project is anticipated to have a beneficial indirect effect on both businesses and population/housing as the vicinity develops in accordance with the Sxwtpqyen Master Plan.
8. Public Health and Safety			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site consists of privately owned land that is currently vacant and there are no existing public health or safety issues present. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no adverse impacts on public health and safety. The project includes constructing a portion of the Grant Creek Trail, which is anticipated to result in indirect health benefits to area residents by providing active transportation opportunities.

9. Local Employment – Quantity or Distribution of Employment, Economic Impact			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☒ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site is vacant and there is no employment associated with the current conditions. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no direct effect on local employment because the project is an environmental restoration project. The project may indirectly benefit local employment due to the creation of temporary construction jobs. Also, construction workers will likely support local businesses during the period of construction. Cumulatively, the project is a part of the larger Sxwtpqyen Master Plan, which will result in substantial new positive economic impacts.
10. Income Patterns – Economic Impact			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☒ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site is vacant and there is no employment associated with the current conditions. Preferred Alternative Environmental Narrative: Implementation of the Preferred Alternative will have no direct impact on the economic environment. The Preferred Alternative may indirectly result in beneficial economic impacts by allowing an area currently undevelopable within a floodplain to be removed from the floodplain to allow for a diversity of planned development. The project may have an indirect beneficial economic impact due to the creation of temporary construction jobs and temporary increase in local spending. Cumulatively, the project is a part of the larger Sxwtpqyen Master Plan, which will result in substantial new positive economic impacts.
11. Local and State Tax Base and Revenues			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site consists of several privately-owned, unimproved parcels that are categorized as agricultural land in the tax assessment database. These properties likely contribute a minimal amount of revenue to the local tax base due to their relatively low assessed value. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no direct impact to the local and state tax base. The Preferred Alternative may indirectly result in beneficial economic impacts on the local tax base by allowing an area currently undevelopable within a floodplain to be removed from the floodplain to allow for planned development. Cumulatively, the project is a part of the larger Sxwtpqyen Master Plan, which will result in substantial new positive economic impacts through land

			subdivision and construction of new commercial, industrial, and residential areas.
12. Community and Government Services and Facilities (example: educational facilities; health and medical services and facilities; police; emergency medical services; and parks, playgrounds and open space)			
☐ No Impact ☒ Beneficial ☐ Adverse	☒ Direct ☒ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site is vacant and there are no community or government services or facilities available. Preferred Alternative Environmental Narrative: The Preferred Alternative will have direct positive effect on the availability of parks and open space due to the creation of a new Grant Creek riparian corridor. The new riparian corridor would be usable as open space as well as accessible via the proposed Grant Creek Trail that will parallel the realigned creek. Because the project is a part of the larger master planning area, the project may indirectly and cumulatively affect community and government services and facilities by indirectly putting more pressure on these facilities as the population of the planning area grows. These potential effects are anticipated to be negligible and have no adverse long-term effect on community or government services.
13. Commercial and Industrial Facilities – Production and Activity, Growth or Decline			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☒ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site is vacant and there are no commercial or industrial facilities within the project area. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no direct impact on commercial or industrial activities. The project may result in indirect and cumulative beneficial impact on commercial and industrial facilities due to the planned development that will occur in the area that will be removed from the floodplain.
14. Social Structures and Mores (example: standards of social conduct/social conventions)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: Not applicable for the project. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on social structures and mores.
15. Land Use Compatibility (example: growth, land use change, development activity, adjacent land uses and potential conflicts)			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project area land use includes vacant agricultural land. The project area is a part of the larger Sxwtpqyen Master

			Plan area, which is slated to be developed into new neighborhoods and commercial uses. Preferred Alternative Environmental Narrative: The Preferred Alternative is an integral and necessary component of the overall Sxwtpqyen Master Plan and will provide for environmental restoration of Grant Creek while simultaneously removing land out of the floodplain and allowing for new development to occur in accordance with locally adopted land use plans and growth policy.
16. Energy Resources – Consumption and Conservation			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site is vacant and does not require energy resources. Preferred Alternative Environmental Narrative: No direct impacts are anticipated in relation to energy resources except for the energy expended to construct the project. Indirect impacts on energy demands may occur as the area develops; however, it is anticipated that this will have no impact on future energy resources.
17. Solid Waste Management			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site does not have any solid waste management facilities or requirements. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on solid waste management. The demand for solid waste management will increase as the area develops; however, the existing landfill is anticipated to be able to handle the stream of solid waste increase as the project area vicinity develops and Missoula's population grows.
18. Wastewater Treatment – Sewage System			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site does not have any wastewater treatment facilities. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on wastewater treatment. The demand for wastewater treatment will increase as the area develops; however, the backbone sewer infrastructure for the area has been installed as a result of the federal Mullan BUILD grant project.

19. Storm Water – Surface Drainage			
☐ No Impact ☒ Beneficial ☐ Adverse	☐ Direct ☒ Indirect ☒ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The project site is currently undeveloped, vacant agricultural land with no existing storm water facilities. The site includes existing abandoned irrigation ditches that flow towards Grant Creek that likely function as storm drains in the event of substantional rainfall. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on existing storm water facilities because none are currently present at the project site. Subsequent development within the project area will create areas of impervious surfaces and storm water runoff is anticipated to increase over the existing condition. Storm water management will occur in accordance to local requirements. The creation of a riparian corridor and floodplain will indirectly benefit future storm water facilities and improve water quality because future development will be able to outfall into the riparian vegetative buffer allowing for infiltration treatment of storm water. New development occurring in the project area will be designed in accordance with local storm water requirements, which, in conjunction with the enhanced riparian corridor, will provide cumulative benefits to the water quality of Grant Creek. The project will include permanent storm water management considerations that will be accomplished through site design and grading. Storm water during construction will be managed in accordance with the MPDES permit and SWPPP.
20. Community Water Supply			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site does not have a community water supply. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on community water supply. The demand for a water supply will increase as the area develops; however, no impact on Missoula aquifer is anticipated and no indirect or cumulative impacts to community water supply are anticipated as a result of the proposed project.

21. Fire Protection – Hazards			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The project area vicinity is is currently serviced by the Missoula Fire Department. Station #4 is specifically the station that services the project area vicinity. Preferred Alternative Environmental Narrative: The proposed project will have no effect on fire protection. Future development in the greater project area will continue to be serviced by the City fire department.
22. Cultural Facilities, Cultural Uniqueness and Diversity			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The project site is currently undeveloped, vacant agricultural land. There are no cultural facitilites in the project area. As previously noted, the project area is a part of the larger Sxwtpqyen master planning area. Because of the cultural uniqueness of the project vicinity and historical use of the area by the Native Americans, the planning area, which was formerly called the Mullan Neighborhoods Master Plan, was renamed the Sxwtpqyen (S-wh-tip-KAYN). Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on cultural facilities, cultural uniqueness, or diversity.
23. Transportation Networks and Traffic Flow Conflicts (example: rail; auto including local traffic; airport runway clear zones – avoidance of incompatible land use in airport runway clear zones)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The immediate project area is currently vacant land and no transportation networks exist. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on the existing or planned transportation network. The future extension of George Elmer Drive will cross the realigned Grant Creek. Additional new roads are planned to eventually be built within the project area and vicinity.

24. Consistency with Local Ordinances, Resolutions, or Plans (example: conformance with local comprehensive plans, zoning, or capital improvement plans.)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The project area is a part of the larger Sxwtpqyen Area Master Plan. The adopted master plan can be downloaded here: https://www.engagemissoula.com/5664/widgets/20500/documents/16169/download. Preferred Alternative Environmental Narrative: The Preferred Alternative is included in the Sxwtpqyen Area Master Plan (DK&P 2020) and is therefore consistent with existing planning documents and local growth policy.
25. Private Property Rights (example: a regulatory action or project activity that reduces, minimizes, or eliminates the use of private property.)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project area is comprised of three separate privately owned parcels owned by the same entity. Preferred Alternative Environmental Narrative: The City of Missoula is obtaining an easement from the landowner to construct the Grant Creek realignment. The proposed project will have no impact on private property rights.
26. Environmental Justice (example: does the project avoid placing lower income households in areas where environmental degradation has occurred, such as adjacent to brownfield sites?)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: The current project site is vacant and there are no environmental justice populations within the project area. Preferred Alternative Environmental Narrative: The Preferred Alternative will have no impact on any environmental justice populations. The proposed project is not anticipated to result in disproportionately high or adverse human health and environmental effects on low-income or minority populations. Due to the nature of the proposed project, no impact on any low-income or minority population is anticipated.

27. Lead Based Paint and/or Asbestos (example: does the project replace asbestos-lined pipes? Do any structures qualify as containing lead-based paint?)			
☒ No Impact ☐ Beneficial ☐ Adverse	☐ Direct ☐ Indirect ☐ Cumulative	☐Permit ☐Mitigation ☒ NA	Current Conditions: There is currently no infrastructure in the project area that would contain lead or asbestos. Preferred Alternative Environmental Narrative: The Preferred Alternative does not involve work affecting any facility or infrastructure contiaining lead or asbestos. The project does not involve any areas of known hazardous materials.

Additional Information

****If no cultural survey has been performed, or is not expected to be needed, applicant must agree to the following statement:**

☐ I hereby agree that, to my knowledge, there are no cultural or paleontological materials in the proposed project site. If previously unknown cultural or paleontological materials are identified during project related activities, the DNRC grant manager will be notified, and all work will cease until a professional assessment of such resources can be made.

List all sources of information used to complete the Environmental Checklist. Sources may include studies, plans, documents, or the individuals, organizations, or agencies contacted for assistance. For individuals, groups, or agencies, please include a contact person and phone number. List any scoping documents or meetings and/or public meetings during project development.

REFERENCES CITED:

DEQ (Montana Department of Environmental Quality). 2023a. Discover DEQ Throughout Montana. Web Application. Accessed at <Discover DEQ Throughout Montana (mtdeq.us)>. Accessed on October 9, 2023.

DEQ. 2023b. Clean Water Act Information Center. 2020 Assessment Map. Accessed at <ArcGIS Web Application (mtdeq.us)>. Accessed on October 10, 2023.

DK&P (Dover, Kohl & Partners). 2020. Mullan Area Neighborhoods Master Plan. December 10, 2020. Accessed at <https://www.engagemissoula.com/5664/widgets/20500/documents/16169/download>.

FEMA (Federal Emergency Management Agency). 2023. FEMA National Flood Hazard Layer Web Application. Accessed at <FEMA's National Flood Hazard Layer (NFHL) Viewer (arcgis.com)>. Accessed on October 10, 2023.

FWP (MT Fish, Wildlife & Parks). 2023. MFISH Mapper. Accessed at < https://fwp.mt.gov/gis/maps/mFish/?zoomFeatures=%7BlayerName:%22STREAMS%22,features:%5B%7BLLID:%221123386455677%22%7D%5D,fadeOutTimer:4%7D>. Accessed on October 24, 2023.

HDR Engineering. 2020. Aquatic Resources Report for the Mullan BUILD Project. Prepared for DJ&A. October 8, 2020.

Maxim Technologies. 2005. Wetland Assessment Grant Creek Environmental Restoration/Flood Control. Report prepared for HDR and Missoula County. February 2005.

MBMG (Montana Bureau of Mines and Geology). 2023. Well Mapping Application. Accessed at <MBMG - Mapper (mtech.edu)>. Accessed on October 10, 2023.

MSGHCP (Montana Sage Grouse Habitat Conservation Program). 2023. Montana Sage Grouse Habitat Conservation Map. Accessed at <https://sagegrouse.mt.gov/ProgramMap>. Accessed on Octobler 26, 2023.

MTNHP (Montana Natural Heritage Program). 2023. Natural Heritage Map Viewer. Generalized Observations web tool. Accessed at <NHP Generalized Observations (mtnhp.org)>. Accessed on October 18, 2023.

NRCS (Natural Resource Conservation Service). 2023. Web Soil Survey. Custom Report for the Grant Creek Realignment Project. Accessed at <Web Soil Survey - Home (usda.gov)>. Accessed October 18, 2023.

Rabbitbrush Archaeological Services, LLC. 2020. Cultural Resource Inventory for the Proposed Mullan BUILD Project, Missoula County, Montana. June 2020. Available at <https://www.mullanbuild.com/_files/ugd/570f64_3ff2c26995364314ba749632e78fdb40.pdf>.

USFWS (US Fish and Wildlife Service). 2023. Environmental Conservation Online System (ECOS). Information for Planning and Conservation (IPaC) Custom Report for the Grant Creek Realignment project area. Accessed at <IPaC: Home (fws.gov)>. Accessed on October 24, 2023.

Below is a list of electronic resources available for data gathering to aid in the development of the Environmental Checklist:

Abandoned Mines (DEQ): https://deq.mt.gov/cleanupandrec/Programs/aml

Agricultural Statistics (USDA): USDA - National Agricultural Statistics Service - Data and Statistics

Air Quality

- Nonattainment Areas: Plan and Rule Development | Montana DEQ (mt.gov)
- Opening Burning Guidelines: Open Burning | Montana DEQ (mt.gov)

Army Corps of Engineers: http://www.usace.army.mil/Home.aspx

Bureau of Business and Economic Research, UM: http://www.bber.umt.edu/

Cadastral (for property ownership info): http://svc.mt.gov/msl/mtcadastral

Census Information, MT Dept. of Commerce: http://ceic.mt.gov

Conservation Districts, MT: http://macdnet.org/

Cultural Records

- Montana Historical Society: https://mhs.mt.gov/Shpo/CulturalRecords

DEQ data search tools: Montana DEQ's GIS Portal (mt.gov)

- Including Clean Water Act Info Center, Hazardous Waste Handlers, Petroleum Release Fund Claims, Unpermitted Releases, Underground Storage Tanks, Source Water Protection

EPA Enforcement and Compliance History Online http://echo.epa.gov/

Farmland Classification: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Fish (Also See Wildlife)

- Montana Fisheries Information System: Montana Fish, Wildlife & Parks GIS Data (arcgis.com)
- Aquatic Invasive Species: Montana FWP AIS Surveys Dashboard 2021 (arcgis.com)

Floodplain Maps, FEMA: https://msc.fema.gov/portal

Geographic Information, Natural Resources Information System: http://nris.mt.gov/gis

Geologic Information - MBMG - Publications - Download Geologic Maps (mtech.edu)

Maps of Montana for species observations, land cover, wetland and riparian areas, land management: Montana Natural Heritage Program (mtnhp.org); http://mtnhp.org/mapviewer/?t=6

Montana Department of Transportation: https://www.mdt.mt.gov/

- Environmental Manual: http://www.mdt.mt.gov/publications/docs/manuals/env/preface.pdf
- Environmental Manual - Chapter 29, Permits Required: https://www.mdt.mt.gov/publications/docs/manuals/env/Chapter%2029%20PERMITS%20REQUIRED.pdf

Montana Board of Oil and Gas Conservation Information System:

- http://bogc.dnrc.mt.gov/webApps/DataMiner/

Plants

- Plant database, USDA Natural Resources Conservation Service: http://plants.usda.gov/java
- Plant Species, MT Field Guide: http://fieldguide.mt.gov/default.aspx
- Plant Species of Concern: http://mtnhp.org/SpeciesOfConcern/Default.aspx?AorP=p
- Threatened, Endangered and Rare Plants, USDA: https://plants.usda.gov/home/raritySearch

Soils

- USDA Natural Resource Conservation Service database: https://websoilsurvey.nrcs.usda.gov/app/
- Montana soil and water conservation districts: http://swcdmi.org/

State Historic Preservation Office: http://mhs.mt.gov/Shpo

Tourism, UM – Institute of Tourism & Recreation Research: http://www.itrr.umt.edu

Tribal Resources:

- Blackfeet Tribal Environmental Permits: http://www.blackfeetenvironmental.com
- CSKT Natural Resources Department: http://nrd.csktribes.org/
- Montana Office of Indian Affairs: http://tribalnations.mt.gov/
- Tribal Historic Preservation Officer List: Search - NATHPO
- Tribal Directory Assessment Tool (TDAT): https://egis.hud.gov/tdat/

Vehicle Traffic Count (MDT): http://www.mdt.mt.gov/publications/datastats/traffic.shtml

Water

- Stream Record Extension Facilitator, USGS: USGS | National Water Dashboard
- Streamstats basin characteristics, USGS: http://water.usgs.gov/osw/streamstats/
- Water Resources Division, DNRC: http://dnrc.mt.gov/divisions/water ; ArcGIS Web Application (mt.gov)
- Water Rights Bureau, DNRC: http://dnrc.mt.gov/divisions/water/water-rights
- Water Right Query System, DNRC: DNRC Water Right Query System (mt.gov)
- Wetlands database, USFWS: http://www.fws.gov/wetlands/Data/mapper.html

Wild and Scenic Rivers: http://www.rivers.gov/montana.php

Wildlife

- Animal Species, MT Field Guide: http://fieldguide.mt.gov/default.aspx
- Animal Species of Concern: http://mtnhp.org/SpeciesOfConcern/Default.aspx?AorP=a
- Aquatic Invasive Species: Montana FWP AIS Surveys Dashboard 2021 (arcgis.com)
- Critical Habitat Mapper, USFWS: http://ecos.fws.gov/crithab/
- Crucial Areas Planning System/Habitat Assessment Tool: Habitat MT (HB 526) Funded Lands (arcgis.com)
- FWP Contact Map: http://fwp.mt.gov/gis/maps/contactUs/ (includes biologist responsibility areas)
- Maps and GIS Data, FWP: Montana Fish, Wildlife & Parks GIS Data (arcgis.com)
- Sage grouse management, FWP: Montana Fish, Wildlife & Parks GIS Data : Sage-grouse Habitat/Current Distribution (Montana) : Sage-grouse Habitat/Current Distribution (Montana) (arcgis.com)
- Sage grouse habitat conservation program, DNRC: http://sagegrouse.mt.gov/
- Sage grouse habitat map: https://sagegrouse.mt.gov/ProgramMap

Design Report

Grant Creek Environmental Restoration / Flood Control

Prepared for

Missoula County, Montana

and

United States Army Corps of Engineers

Seattle District

Prepared by

HDR Engineering, Inc.

In association with MAXIM Technologies, Inc.

MAXIM TECHNOLOGIES

A DIVISION OF TETRA TECH, INC.

FEBRUARY 2005

TABLE OF CONTENTS

1. INTRODUCTION 4

1. INTRODUCTION 4

1.1. SUMMARY 4
1.2. AUTHORITY AND FUNDING 4

2. PURPOSE OF AND NEED FOR THE PROPOSED ACTION 6

2.1. PROJECT LOCATION 6
2.1.1. Scope of Work 8
2.1.2. Reach Descriptions 9
2.1.3. Historical Changes 13
2.1.4. Prior Studies, Reports and Actions 14
2.1.5. Problem Description 16
2.2. PROJECT GOALS AND OBJECTIVES 19
2.2.1. Environmental Restoration Goal and Objectives 19
2.2.2. Flood Management Goal and Objectives 20

3. ALTERNATIVES DEVELOPMENT 21

3.1. APPROACH 21
3.2. DESIGN CRITERIA 25

4. ASSESSMENT OF ALTERNATIVES 29

4.1. DEVELOPMENT OF ALTERNATIVES 29
4.2. DEVELOPMENT OF SYSTEM-WIDE ALTERNATIVES 60
4.2.1. System-Wide Alternative No. 1 – No-Action 60
4.2.2. Alternative No. 2 – Maintain Existing Channel 60
4.2.3. System-Wide Alternative No. 3 – Relocate Existing Channel and Terrace Channel with Levees 61
4.2.4. System-Wide Alternative No. 4 – Peak Flow Bypass with Channel Terracing 62
4.2.5. System-Wide Alternative No. 5 – Deep Channel Excavation 62
4.3. SELECTION OF THE RECOMMENDED PLAN 63

5. RECOMMENDED PLAN 67

5.1. DESCRIPTION OF RECOMMENDED PLAN 67
5.2. ENVIRONMENTAL COMPLIANCE 69
5.2.1. National Environmental Policy Act (NEPA) 69
5.3. PREFERRED SYSTEM-WIDE ALTERNATIVE IMPLEMENTATION 70
5.3.1. Project Cost Estimate 70
5.3.2. Construction Contingency Costs 71
5.3.3. Design and Construction Schedule 71
5.3.4. Sponsor's Financial Plan and Potential Construction Phasing 71
5.3.5. Operation and Maintenance Consideration 73

6. TECHNICAL ANALYSIS 74

6.1.1. Task 106 Public Meetings (Appendix A) 74
6.1.2. Task 108: Long-Term Monitoring Plan (Appendix B) 75
6.1.3. Task 300: Surface Water Hydrologic Analyses (Appendix C) 75

6.1.4. Task 400: Hydraulics Report (Appendix D) 77
6.1.5. Task 500: Groundwater Studies (Appendix E) 77
6.1.6. Task 600: Economic Analysis (Appendix F) 79
6.1.7. Task 701: Fisheries Study (Appendix G) 80
6.1.8. Task 703: Cultural Resources (Appendix H) 81
6.1.9. Task 704: Wetland Assessment (Appendix I) 82
6.1.10. Task 705: Riparian Restoration Plan (Appendix J) 82
6.1.11. Task 707: Biological Assessment (Appendix K) 83
6.1.12. Task 800: Real Estate Plan (Appendix L) 83
6.1.13. Task 900: Water Rights Analysis (Appendix M) 84
6.1.14. Task 1100: Survey (Appendix N) 84
6.1.15. Task 1100: Design Drawings (Appendix O) 84
6.1.16. Task 100: Project Elements Summary (Appendix P) 84

7. REFERENCES 85

8. LIST OF PREPARERS 86

LIST OF FIGURES

FIGURE 2.1 LOCATION AND PLANNING AREA 7
FIGURE 2.2 STUDY AREA 8
FIGURE 2.3 GRANT CREEK PLANNING REACHES 10
FIGURE 2.4 WEST BROADWAY CULVERTS 10
FIGURE 2.5 HORSESHOE BEND BANK 11
FIGURE 2.6 PRUYN CHECK DAM 12
FIGURE 2.7 FIRM 1988 17
FIGURE 2.8 PRE-PROJECT 100-YEAR FLOOD CONDITION 19
FIGURE 3.1 PROPOSED PROJECT MITIGATION MEASURES 24
FIGURE 5.1 RECOMMENDED PLAN 68
FIGURE 5.2 PROJECT IMPLEMENTATION SCHEDULE 72
FIGURE 6.1 WATERSHED LOCATION 76

LIST OF TABLES

TABLE 3.0 PROJECT MITIGATION MEASURES CONSIDERED 23
TABLE 4.1 SYSTEM-WIDE ALTERNATIVES NON-MONETARY EVALUATION 64
TABLE 4.2 COMPARISON OF SYSTEM-WIDE MITIGATION ALTERNATIVE COSTS 66
TABLE 5.1 RECOMMENDED PLAN PROJECT ELEMENTS 69
TABLE 6.1 COST COMPARISON 79
TABLE 6.2 SUMMARY OF NATIONAL REGISTER RECOMMENDATIONS FOR RECORDED SITES 81

1. INTRODUCTION

The purpose of this report is to provide sufficient information for the U.S. Army Corps of Engineers (Corps) to complete an Environmental Assessment (EA) or other appropriate environmental documentation for the Grant Creek Environmental Restoration and Flood Control Project (Grant Creek) in compliance with the National Environmental Policy Act (NEPA). This report provides succinct documentation to support the extensive work completed for the Grant Creek Project including the project background, goals and objectives, development and analysis of the alternatives, public involvement, and the recommended plan. If appropriate, supporting technical analysis has been included as an appendix.

1.1. Summary

In 1997, floods in a local subdivision prompted Missoula County and others to re-examine Grant Creek. In September 2001, the Montana Department of Natural Resources and Conservation (DNRC) released the draft of a detailed flood study for lower Grant Creek. The draft showed the floodplain in an entirely different location than was previously published in the Federal Emergency Management Act (FEMA) Flood Insurance Rate Map (FIRM). Recognizing the need to better define the impacts of this flood study and the potential actions the County could take to address any flood conditions, the Missoula County Commission elected to delay any formal action on the study results until additional study could be performed to develop potential mitigation measures to address flooding and provide for restoration of degraded portions of Grant Creek. In addition to the re-examining of the creek for flood purposes, the County recognized a need and an opportunity to enhance the value of Grant Creek by improving fish habitat, fish passage, and the overall stream ecosystem. The proposed project includes solutions to an array of existing problems and future needs including hydraulic capacity, flood control, sediment management, maintenance, new development, airport expansion impacts, aesthetics, aquatic management and public access.

The ecosystem restoration envisioned by the project would result in maximizing available habitat for a wider variety of wildlife and vegetation, improve fish passage for several species of trout, and create a natural stream system requiring less long-term maintenance. Information obtained through site reconnaissance and discussions with current and former landowners indicates that the stream has been heavily impacted by agricultural practices in the area, placement of irrigation ditches directly into the stream, dredging and land development.

1.2. Authority and Funding

Authority. In 2000, Missoula County developed a Project Management Plan (PMP) in coordination with the Corps' Seattle District under the authority of Section 595 of the 1999 Water Resources Development Act (WRDA). Section 595, entitled "Rural Nevada and Montana Environmental Infrastructure Resource Protection and Development Program," provides

authority to the Corps to participate in environmental infrastructure projects in rural Nevada and Montana.

Funding. Section 595 of the WRDA provides for a federal grant of up to 75% to cover the cost of the environmental infrastructure project design. Missoula County is responsible for 25% of the project design costs and is responsible for working with the U.S. Army Corps of Engineers in acquiring the funding for the design, acquisition of real estate, project construction, and operation and maintenance of the project. The following two grants were applied for to help procure funding for the Grant Creek project:

- On September 30, 2003 Missoula County filed a FEMA Pre-Disaster Mitigation Grant Application (No. MT-2003-001). The application was denied due to "…a lack of supporting documentation regarding the Benefit-Cost Analysis." The project team is in the process of appealing this application and plans to resubmit it on March 4, 2005.
- On May 15, 2004, Missoula County submitted a Renewable Resource Grant and Loan Program application to the Montana Department of Natural Resources and appeared at a hearing before the Long-Range Planning Subcommittee in January 2004. The grant application was elevated to the Recommended for Funding status and a decision is anticipated in 2005.

The design phase of the Grant Creek project has been completed. If funding is available, construction could occur as early as fall 2005.

2. Purpose of and Need for the Proposed Action

The Grant Creek project is needed for two primary reasons. First, Grant Creek is in generally poor ecological condition due to environmental degradation and barriers to fish passage. Second, there are severe flood hazards in the study area, which were previously unknown due to outdated and inaccurate FEMA floodplain mapping. Grant Creek is located in the western Missoula Valley, and currently there are about 70 single-family homes within the 100-year floodplain. The purpose of the Grant Creek project is to evaluate and alleviate the flood hazards and reduce environmental degradation. The project goals are to 1) reduce flooding hazards; 2) improve fish passage; 3) improve fish habitat; and 4) improve recreation opportunities and the aesthetic value of the creek.

2.1. Project Location

The project study area includes western Missoula Valley in Missoula County, Montana. Grant Creek is located west of the Missoula city center, east of the Missoula International Airport, and is a tributary to the Clark Fork River. It originates in the steep headwater reaches between the Rattlesnake Wilderness and the Flathead Indian Reservation and then flows in a southwesterly direction from the Grant Creek watershed. The upstream boundary of the project is Schramm Road. The downstream boundary is the confluence of Grant Creek with the Clark Fork Floodplain. The historic Grant Creek channel forms a large alluvial fan prior to its confluence with the Clark Fork River. The flows from Grant Creek are intermittent below I-90 for much of the year due to infiltration. Flows from the upper reaches of Grant Creek transport sediment to the Missoula Valley, where stream gradient and velocities are reduced and sediment is deposited. South of Schramm Road, most of the Grant Creek channel has been modified. Between Schramm Road and I-90, the channel and a flood-control levy is maintained by the City of Missoula. At I-90, a 12-foot by 12-foot concrete box culvert carries flows under I-90. From I-90 to West Broadway, the stream generally follows the alignment of the historic channel, but has been straightened and channelized. It continues under West Broadway (State Highway 10) in three 60-inch pipe culverts. Downstream of West Broadway, Grant Creek meanders through generally undeveloped/agricultural land southeast of the Missoula International Airport. The West Broadway culvert is a known fish passage barrier. Grant Creek passes under the abandoned Chicago, Milwaukee, St. Paul & Pacific Railroad (Hiawatha Railroad) Bridge embankment and turns 45 degrees to the east adjacent to the Mullan Trail Subdivision. This is an area undergoing rapid development where existing flooding and groundwater problems have been experienced. The creek then crosses under Mullan Road in a 7-foot-by-10-foot corrugated metal arch culvert and continues to its confluence with the Clark Fork River. The Mullan Road culvert is identified as a hydraulic barrier and potential fish barrier at high flow conditions. See Figure 2.1, Location and Planning Area. The project study area comprises the existing Grant Creek corridor from

Schramm Road to the vicinity of I-90 downstream to the Grant Creek confluence with the Clark Fork River.

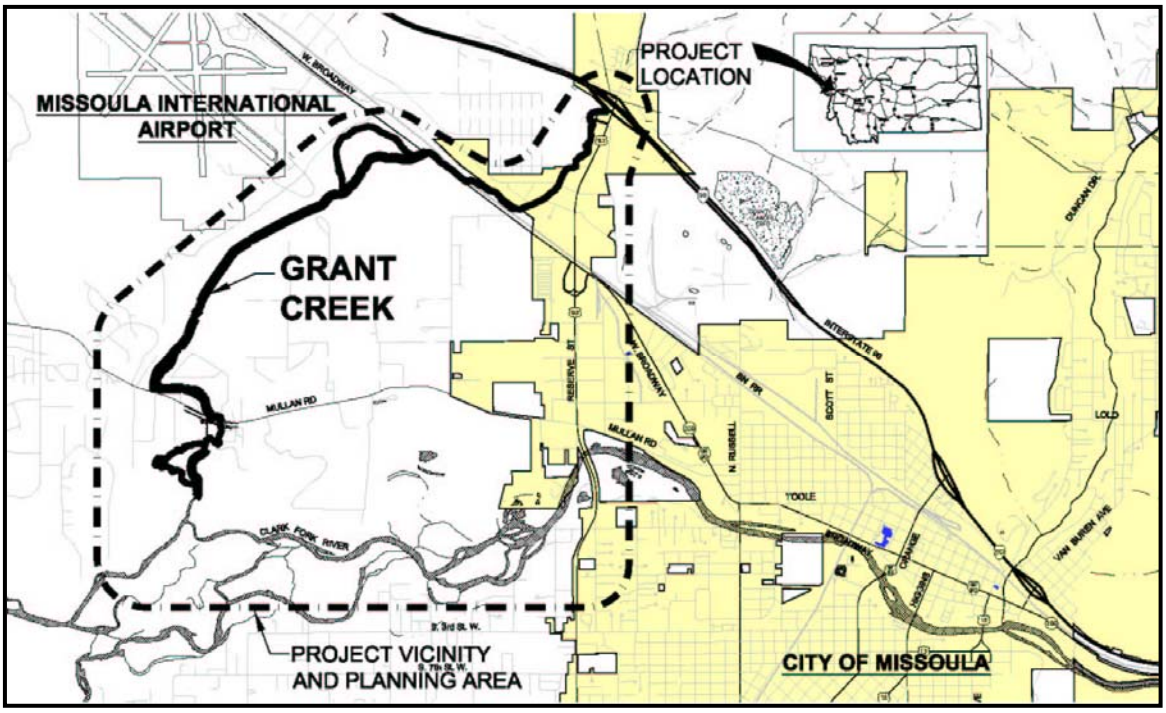


Figure 2.1 Location and Planning Area

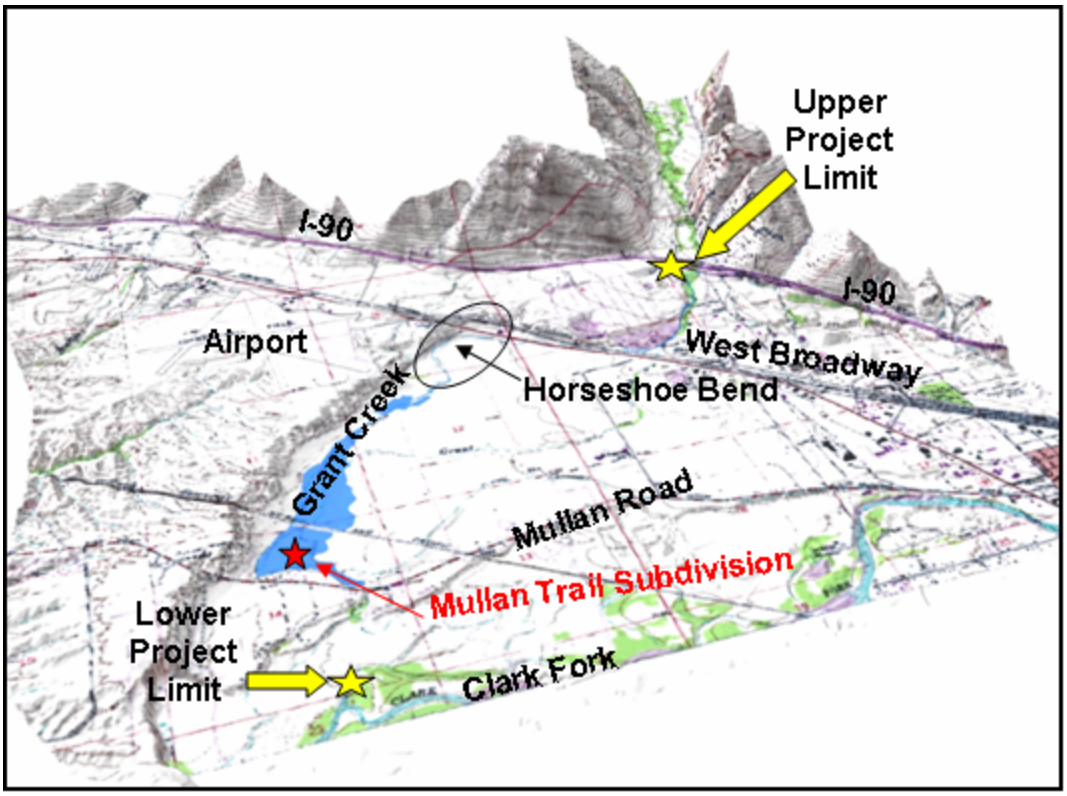


Figure 2.2 Study Area

2.1.1. Scope of Work

The goals of this project, as stated above, include development of a healthy riparian ecosystem that has the capability to adapt to a range of flows and that reduces flooding. The study reviewed both "active" and "passive" approaches to achieve this. Passive approaches include:

- Allowing natural erosion and sedimentation processes to gradually restore geomorphic form and function,
- Undoing prior interventions, such as areas that have been through past agricultural practices, and
- Weed control.

More active approaches and interventions considered include:

Part 1 - Re-grading and realignment of the creek,

Part 2 - Floodplain terracing excavation and creation of riparian areas,

Part 3 - Recreating geomorphic features,

Part 4 - Removing culverts and other flow restrictions,

Part 5 - Removing fish passage barriers, and

Part 6 - Constructing peak flow bypass structures.

The general approach for this study and design was as follows:

I Identify Problems

A. Assess the stability of Grant Creek and its ecological functions.

B. Assess the hydraulic capacity of Grant Creek and its hydraulic barriers.

II Collect and Analyze Data

III Identify and Evaluate Design Options

A. Examine suitable and practical range of flow conditions.

B. Study the most probable “stable” stream type based on stable reference reach.

C. Determine hydraulic elements and alternatives and cost estimates for each element.

D. Determine the most appropriate restoration alternatives and cost estimates for each.

E. Conduct Plan Formulation and selection.

F. Assess the project footprint and real estate needs for the project.

G. Prepare environmental compliance studies for the U.S. Army Corps of Engineers’ use in preparing a project Environmental Assessment.

H. Complete design development and environmental compliance.

2.1.2. Reach Descriptions

During the initial phases of assessment and planning, existing baseline conditions were evaluated, includng: Geology and Geomorphology, Hydrology and Hydraulics, Environmental Resources and the Human Environment. It was identified very early that, within the study area, Grant Creek was made up of separate and distinct reaches, with each reach having very different physical conditions and issues. Because of the variation between project areas, the project study area was partitioned into six reaches, each with similar physical, hydraulic, or geomorphic characteristics and segredated by a defined physical feature (i.e. culvert crossing). See Figure 2.3 Grant Creek Planning Reaches.

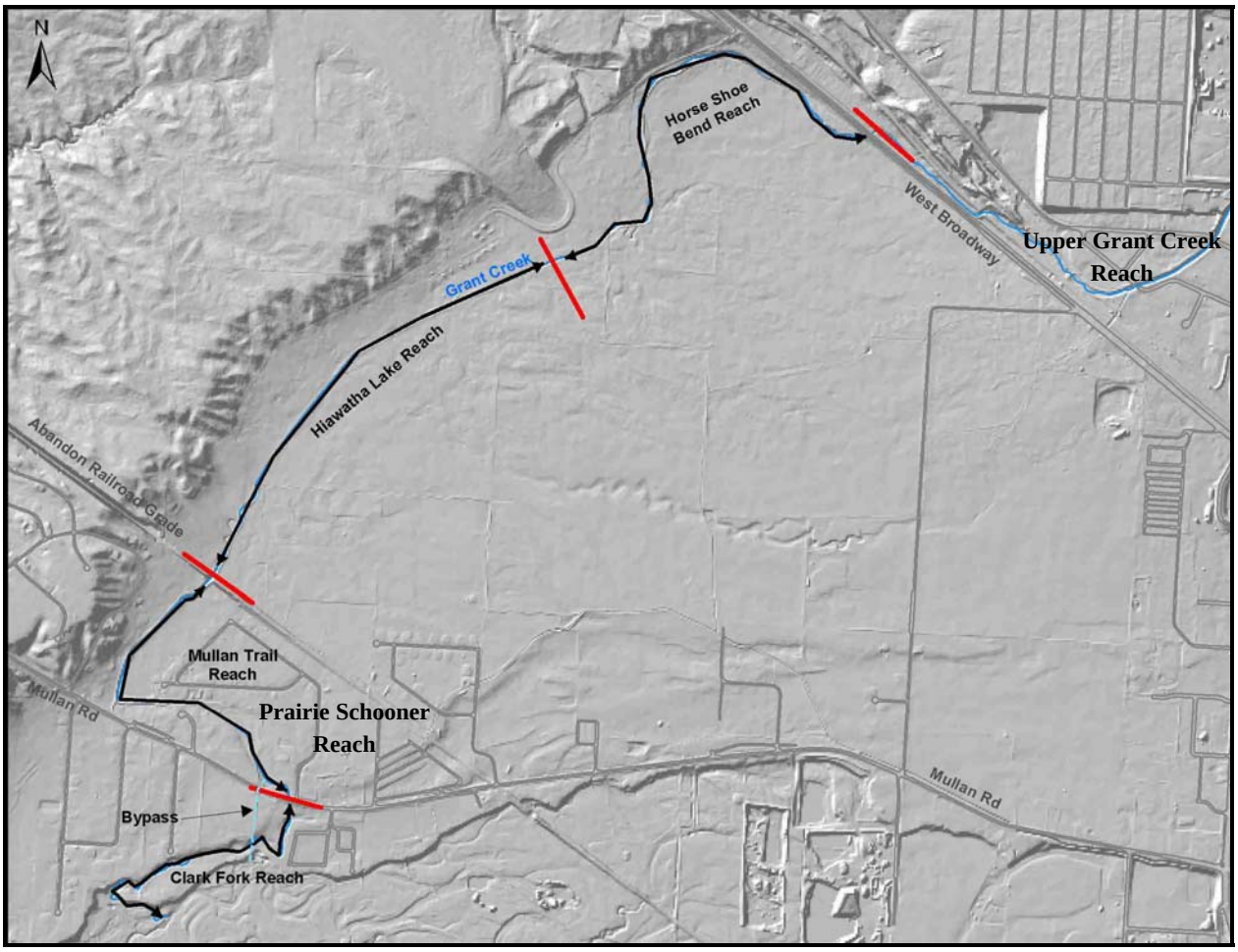


Figure 2.3 Grant Creek Planning Reaches

The reaches, named by the Missoula County project leadership team to streamline discussions and enhance project familiarity, are described below.

Upper Grant Creek Reach: I-90 to West Broadway. The Upper Grant Creek Reach starts at the project study area boundary downstream from I-90, at approximately Schramm Road. The main channel in this reach is steeper, with generally well-established riparian zones on each side. Some development does encroach into the riparian zones to within 50 feet of the stream banks. The creek is in generally good condition except for an obsolete irrigation structure and undersized culverts near the West Broadway and the railroad right of way. Grant Creek flows under the Montana Rail Link Bridge in this reach and parallel to and



Figure 2.4 West Broadway Culverts

between West Broadway and the Montana Rail Link railroad right of way until it crosses under West Broadway. West Broadway is the point where the Upper Grant Creek Reach ends. The existing West Broadway crossing is comprised of three 60-inch concrete pipe culverts. These culverts are under-sized and are showing signs of scour at both inlet and outlet locations. Missoula County, as part of a recent sanitary sewer project, completed temporary repairs of the culvert outlets, installing end flare support and bank stabilization.

Horseshoe Bend Reach. The Horseshoe Bend Channel Reach begins at the West Broadway crossing and extends downstream to the western edge of the current Missoula Airport Authority's ownership. Historically, this channel reach was realigned to the west in a horseshoe shape to accommodate agricultural land uses.



Figure 2.5 Horseshoe Bend Bank Erosion

The realignment utilized steep clay banks for the main channel. The clay banks are unstable, erodible, and are a major source of aggradations in downstream reaches. The environmental degradation created by the scouring of the unstable banks in this region has also created maintenance problems downstream. Dredging and channel cleaning have been required to maintain hydraulic conveyance capacity. The channel grade is flatter in this reach; however, instability problems still promote erosion in this area. The Horseshoe Bend reach ends at the property line between Airport and Pruyn holdings at the southern end of the existing Missoula City/County Airport runway.

Upper and Middle Hiawatha Lake Reach. The Upper Hiawatha Lake Reach and Middle Hiawatha Lake Reach are within an existing trapezoidal channel, developed over time for use in agricultural activities in the area. Water rights from Grant Creek (See Appendix M) allow diversion of Grant Creek flows from the system and introduction of Clark Fork River flows during the irrigating season into the area.

The irrigation system is owned by the Hellgate Valley Irrigation Company (HVIC), and water flows from the Clark Fork through the Flynn/Lowney Ditch to north and south lateral ditches and a waste ditch that discharge into Grant Creek in this reach. Many of the agricultural uses have been abandoned as the area has urbanized; however, the HVIC system is still operational to serve several large agricultural uses near the Airport. Flows from the HVIC system are introduced into Grant Creek from the end of June through

November each year. The flows are stored in the Upper and Middle Grant Creek reaches using a check dam at the lower limit of the Middle Hiawatha Lake Reach.

The Pruyn Check Dam[1] functions by ponding flow in Grant Creek to about 3 feet deep. The flow is then pumped onto adjacent land using three large-capacity (total capacity of approximately 3,000 gpm) pumping stations. The check dam shows signs of localized scour damage and acts as a fish barrier during low-flow periods.



Figure 2.6 Pruyn Check Dam

Lower Hiawatha Lake Reach. The Lower Hiawatha Lake Reach extends from the Pruyn Check Dam downstream to the existing Hiawatha Railroad Grade. The channel in this reach is still a trapezoidal in shape, yet there are exiting cottonwoods and riparian zones that are acting more closely like a natural system. The riparian zones are generally located to the west of the channel in this reach, on the opposite side of the adjacent agricultural uses.

The railroad grade overpass serves as a flow restriction at the lower end of this reach. Historically, when Grant Creek reaches flood stage, the narrows at the railroad grade create a backwater that at times has flooded the area outside of the channel banks. Irrigation flows from the HVIC system are also allowed to waste into Grant Creek at this location, which have the potential to increase the amount of flooding in this area. The Groundwater Studies (Appendix E) also define impacts to the upper aquifer in this region due to irrigation inputs and flooding during peak flow events.

Mullan Trail Reach. The Mullan Trail Reach extends downstream from the Hiawatha Railroad Grade south, adjacent to the Mullan Trail Estates subdivision. The channel slope in this area is less than 1% and the channel is confined to a trapezoidal man-made channel, approximately 9 feet in width at the channel base. During recent high flow events, the Mullan Trail reach flooded homes in the Mullan Trail subdivision. Current condition hydraulic analysis (Appendix D) indicates that a significant portion of the Mullan Trail Estates subdivision is within the existing 100-year floodplain (prior to mitigation). The Mullan Trail Reach turns in a dogleg fashion near Mullan Road, and

[1] The Pruyn Check Dam was originally installed through an assistance grant with the Soil Conservation Service to enable an impoundment of Grant Creek flows and flows from the HVIC system.

extends to the east into a narrow right-of-way. This narrow condition begins the Prairie Schooner Reach.

Prairie Schooner. The Prairie Schooner Reach extends through the "Prairie Schooner Narrows," east along the southern edge of the Mullan Trail Estates subdivision, to Mullan Road. The channel continues at an extremely flat slope through this zone and channel inslopes are steep. Eroded solids and sediments, originating from upstream reaches, has tended to deposit in this reach, requiring significant channel cleaning and maintenance.

A groundwater pumping system was installed to control groundwater impacts at existing homes within the Mullan Trail Estates subdivision. This pumping system discharges approximately 7.8 cfs (3,500 gpm) into the Grant Creek channel along this reach when operating at full capacity. At the end of this reach is the culvert crossing at Mullan Road. The culvert is a 7 foot high by 10 foot wide corrugated arch culvert. Hydraulic analysis of this culvert (Appendix D) indicates this culvert is under-sized for 100-year peak flows and is a major contributor to the flooding potential in the Mullan Trail Estates subdivision.

Clark Fork Confluence Reach. Grant Creek flows under Mullan Road and meanders to the Clark Fork in a much steeper trapezoidal channel. This channel was reportedly constructed by the Montana Department of Transportation (MDT) when grade improvements were made to Mullan Road. The defined trapezoidal channel is flanked by a well established riparian zone on each side for the majority of the reach. Some bank erosion has occurred at a location where the channel turns from a southerly to a westerly direction. The existing channel in this reach is in generally good condition to the Clark Fork River floodplain. Some minor flooding conditions were identified in the Hydraulics Report (Appendix D) for the existing condition 100-year storm event.

2.1.3. Historical Changes

Historically, Grant Creek flowed down from its steep headwaters in the Grant Creek watershed and spread out into numerous channels over an alluvial fan in the western Missoula Valley. As the population of Missoula has grown, development has increased significantly along the lower reaches of Grant Creek. To accommodate this growth and to maintain agricultural land use, the creek has been significantly modified from its historic characteristics by the following actions:

- Rerouting the channel alignment to accommodate the development of I-90
- Introducing unstable, erodible stream bank materials from development downstream of I-90 and from past gravel mining
- Diverting flows for irrigation (particularly at Dougherty and Pruyn/Dougherty)

- Constructing irrigation features including an irrigation check dam in the Grant Creek channel
- Installation of culvert crossings at West Broadway and Mullan Road
- Changes in land use and development

2.1.4. Prior Studies, Reports and Actions

The Grant Creek study area has been the subject of many recent water resource and environmental resource studies. Many of these reports were a result of recent flooding of the Mullan Trail Estates subdivision in 1997. These studies have focused on issues ranging from surface water flood protection, channel maintenance and associated Operation and Maintenance (O & M), and groundwater flooding and control. The following paragraphs describe pertinent prior studies and reports.

- The *Grant Creek Area Plan* (Missoula Planning Office, 1980) was initiated in 1980. The plan updated a comprehensive planning effort for the Grant Creek Valley that was first initiated in 1967 and later updated in 1975. Problems and opportunities for the Grant Creek Valley were identified. The report indicated excavation of gravels from the lower portion of the Grant Creek Valley started in 1968.
- *FEMA Flood Insurance Study* (FEMA, 1988). Flood mapping downstream of I-90 was performed using approximate methods. USGS regional flood flow frequency equations (USGS, 1981) were reported.
- A Montana Department of Transportation (MDT) *Hydrology Report*, 1990, was completed for the Mullan Road crossing culvert.
- A letter of map revision (LOMR) was submitted to FEMA in 1991 (Morrison-Maierle/CSSA, July 17, 1991). The purpose of the study was to provide detailed floodplain analysis of the proposed Grant Creek Village site.
- *The Hydrological Investigation for Mullan Trail Estates Subdivision* (Land & Water, August 1997) was completed following flooding of the Mullan Trail subdivision. Regional regression equations were used to develop flow estimates and determine flooding sources and locations.
- I-90 Grant Creek culvert design in 1997 (Project NH-CM-STRE 0002 (266)) was completed for MDT.
- The *Review of Hydrological Investigation Technical Findings and Comments* (Curry Consulting Service) was completed in 1998. Curry performed an undocumented, independent analysis of the Land and Water Consulting findings in 1997.

- The *Phase II Hydrological Investigation for the Mullan Trail Estates Subdivision* (Land & Water Consulting) was completed in 1998. The investigation assessed water problems at the Mullan Trail Estates subdivision. The report evaluated the feasibility of increasing channel capacity of Grant Creek and lining the channel.
- The *Interim Channel Maintenance Recommendations for the Grant Creek/Field-Dougherty Ditch Rehabilitation* (Land & Water Consulting, February 1999) was completed in 1999. The report provided contingency channel maintenance recommendations for the Mullan Trail Estates subdivision reach of Grant Creek. The report also recommended lining sections of Grant Creek and the Flynn overflow ditches.
- During 1999, RLK Hydro performed a study to develop recommendations for methods to protect residents of Mullan Trail Estates from further flooding. This report references earlier work completed by Land & Water Consulting (1997) and Curry Consulting Service (1998).
- The *Summary Report Mullan Trail Estates* (Land & Water Consulting) was completed in July 1999. This report provided additional updates to previous hydrological investigations and updated conclusions and recommendations.
- The *Groundwater Modeling Mullan Trail Estates Subdivision* (Land & Water Consulting) was completed in July 1999. The study performed a review of the RLK Hydro study. Groundwater modeling code known as MODFLOW was used to simulate base flow and high flow conditions below Mullan Trail Estates.
- The *Effects of a 100-Year Flood on the Development Potential of Pleasant View Homes* (Howard Newman) was completed in December 1999.
- The *Grant Creek Hydrologic Analysis* (RLK Hydro) was published in June 2000. This report recommended chance flood flows for Mullan Trail Estates subdivision.
- The *Joint Application Submittal for Grant Creek Set-Back Levee Embankment System* (RLK Hydro) was submitted on behalf of the Mullan Trail Estates subdivision. This report provided conclusions and recommendations regarding leakage from Grant Creek.
- The *Groundwater Dewatering System Summary Report for Mullan Trail Estates* (RLK Hydro, December 2001) was published for the Mullan Trail Estates Homeowners Association. This report planned the groundwater removal system to serve 47 homes within the Mullan Trail Estates subdivision. This system was installed in 2002.
- The *Grant Creek, Missoula, Montana, Project Management Plan (PMP)* (HDR, June 2002) was developed for the U.S. Army Corps of Engineers, Seattle District. This PMP formed the basis of the current *Grant Creek Design Report and Environmental Analysis.*

2.1.5. Problem Description

Investigations have uncovered several problems that contribute to both flooding and ecological deterioration in the study area. These problems have been categorized as either environmental conditions or flood hazards.

Environmental Conditions.

- Near the confluence of Grant Creek and the Clark Fork, the creek crosses under Mullan Road in a 7-foot-high-by-10-foot-wide corrugated metal arch culvert. This culvert is a known fish passage barrier, and hydraulic modeling has shown that it is a significant source of backwater flooding.
- Channel incision and the subsequent erosion upstream of the Mullan Trail Subdivision are contributing significant amounts of sediment to downstream reaches of the creek, which is reducing the hydraulic conveyance of the creek and degrading the creek ecosystem.
- The creek crosses West Broadway Street (State Highway 10), a major state arterial, in three 60-inch culverts. These culverts are known fish passage barriers and significantly restrict the creek flow. The culverts have caused severe erosion at the culvert outlets.
- The Mullan Road Corridor Sanitary Sewer Project was completed in 2004. Although this project will ensure sanitary sewer impacts to the area will be minimized, the sanitary sewer has promoted additional development pressure to the area. Unless riparian corridor planning and acquisition of corridor right-of-way is implemented, the development will result in impacts to riparian habitat along Grant Creek.

Flood Hazards. The Mullan Trail Subdivision was approved in 1992 and was built immediately adjacent to lower Grant Creek using an outdated FEMA FIRM that provided only approximate Zone A flood hazard boundaries (see Figure 2.7 FIRM 1988). This FEMA map was over 20 years old and did not reflect existing conditions. Unfortunately, many land use decisions accommodating population growth have been guided by this map.

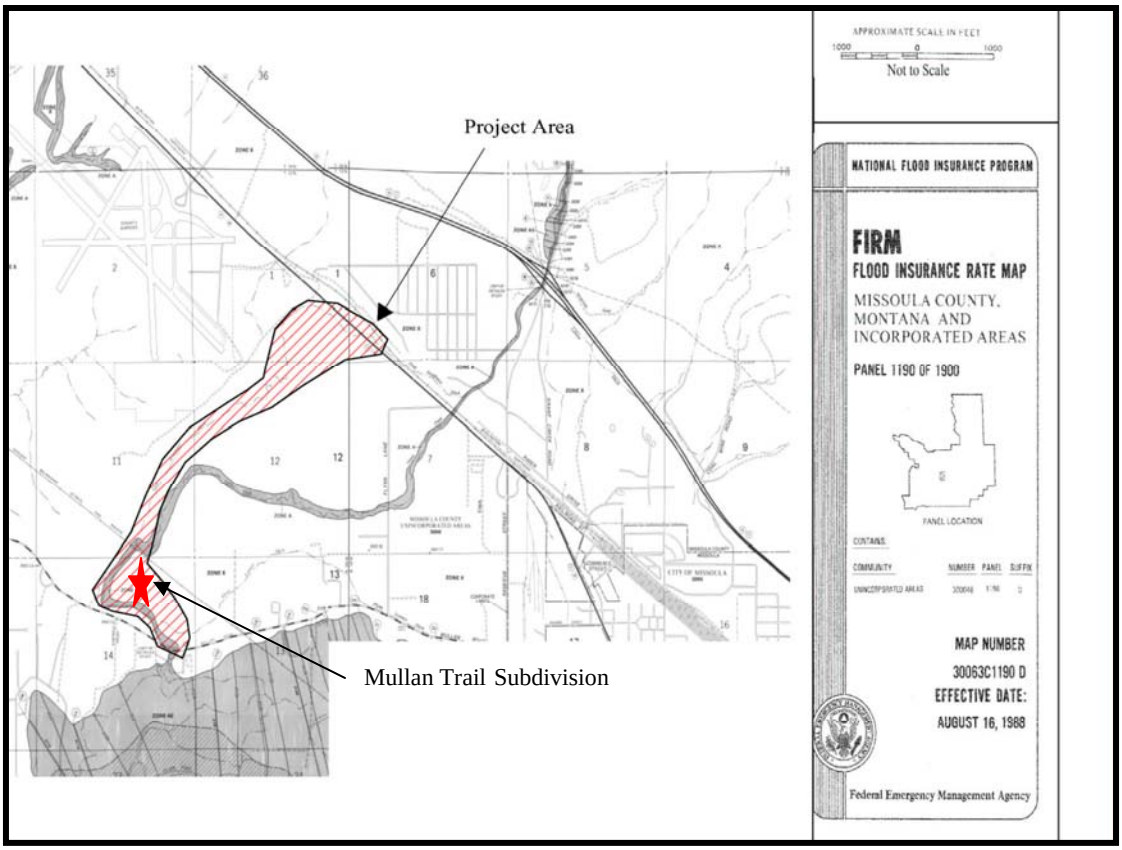


Figure 2.7 FIRM 1988

In 1997, an estimated 10-year recurrence flow produced an estimated $6.2 million of damage to the Mullan Trail Subdivision. About 40 homes were damaged and several lawsuits were filed. This flood triggered the need for a re-evaluation of Grant Creek. The State of Montana performed a detailed analysis of the floodplain and found it to be located in an entirely different location than what was shown on the FEMA map. In fact,

the 100-year floodway[2] encompasses about 70-single family homes that were previously not considered to be in the floodplain[3] (see Figure 2.8, Pre-Project 100-year Flood).

Several causes of flooding were identified, including water that overflowed from Grant Creek and nearby unlined irrigation ditches and groundwater that seeped into daylight basements in the subdivision. In addition to the known flooding hazards at Mullan Trail subdivision, other identified flood hazards include:

- Part of the creek parallels West Broadway Street and, in some locations, the elevation of the creek bed is nearly the same as that of the roadway with only a small earthen berm separating the creek from the roadway. During a severe flood, the berm could fail, releasing creek flow and sediment across the roadway and damaging the road surface and subgrade.
- The mainline tracks for Montana Rail Link Bridge cross over Grant Creek. The creek alignment underneath the bridge consists of sharp turns, which can result in pier scour and trapped debris at the crossing. These conditions could cause the railroad bridge to fail.
- The creek channel decreases in steepness and bed material size downstream of I-90. This reach of the creek, from I-90 to West Broadway Street, is aligned along an ancient alluvial fan. The sediment load is high, but there are limited opportunities for sediments to be deposited over the creek banks due to development on both sides of the creek.
- The Hiawatha Railroad Grade channel narrowing restricts peak flows and creates flooding of the Hiawatha Lake Reach. Known sand spans (Appendix E – Groundwater Studies) creates a direct conduit of surface waters to the upper aquifer below the Mullan Trail subdivision.

[2] Floodway: FEMA defines a floodway as the area of a river or stream where water is likely to be the deepest and fastest. It is the area of the floodplain that should be reserved (kept free of obstructions) to allow floodwaters to move downstream. Placing fill or buildings in a floodway can block the flow of water and increase flood heights.

[3] Floodplain: FEMA defines a floodplain as the area of a river or stream that would be inundated by a 100-year flood.

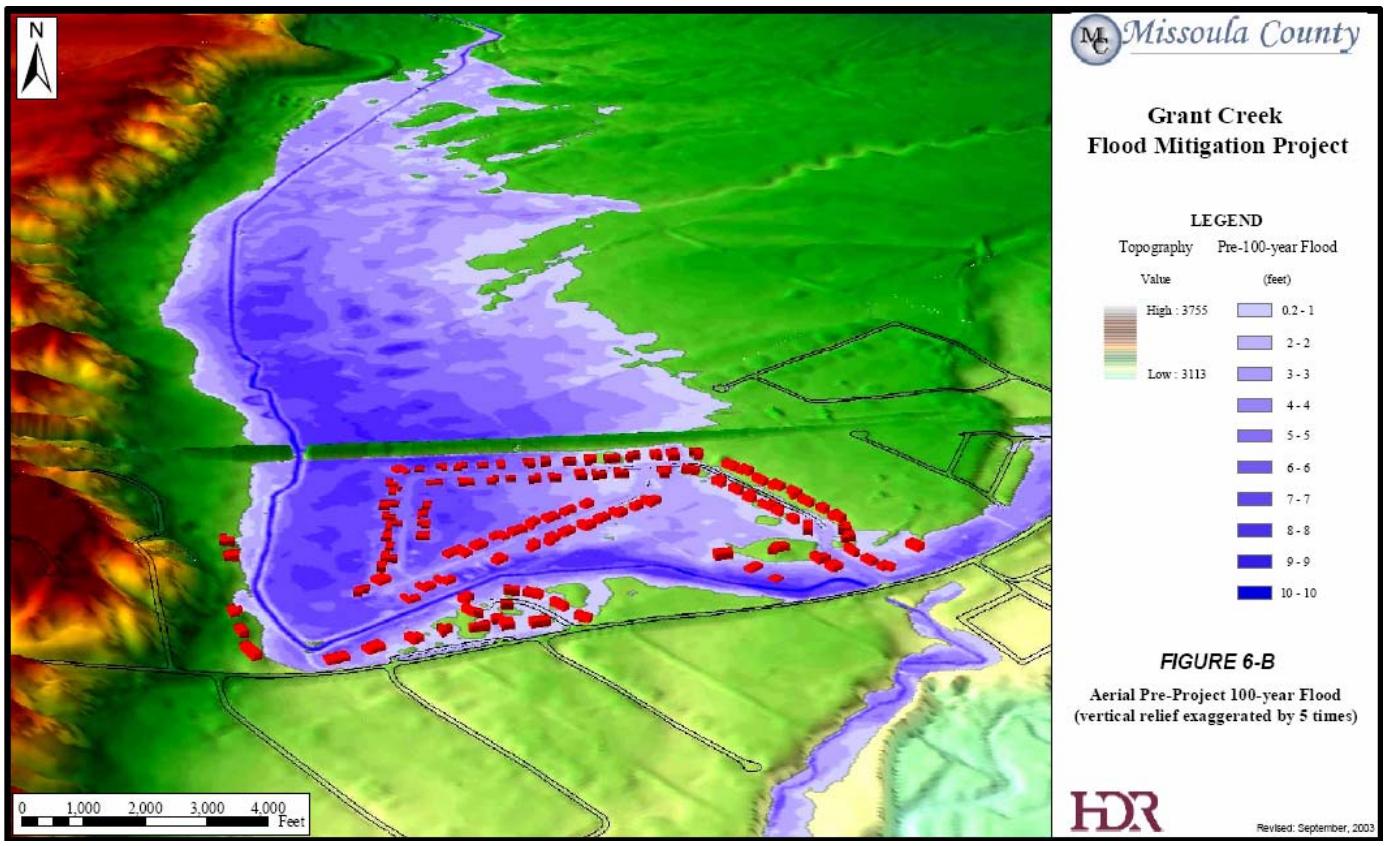


Figure 2.8 Pre-Project 100-year Flood Condition

2.2. PROJECT GOALS AND OBJECTIVES

This section describes the goals of the Grant Creek project, the objectives that must be achieved to meet those goals and project opportunities. The overall goal of this project is to evaluate the Grant Creek system and create a design that achieves multiple objectives for flood management and environmental restoration.

2.2.1. Environmental Restoration Goal and Objectives

The ultimate goal of this project is to perform a methodical evaluation of the Grant Creek system, resulting in a design that achieves multiple objectives for flood hazard reduction and environmental restoration.

The following environmental restoration objectives are intended to support the goal:

- Increase opportunities for seasonal fish passage roadway crossings;
- Improve fish and wildlife habitat within the creek channel and floodplain and improve fish passage;
- Create a sustainable riparian corridor;

- Integrate a public trail and/or open space system into the restoration design;
- Improve recreational opportunities and aesthetic appeal of the creek system;
- Reduce the potential for chronic creek bank erosion and riparian damages and minimize long-term maintenance of the corridor;
- Promote stakeholder involvement to achieve the community and local landowners' vision;
- Satisfy NEPA documentation and environmental compliance requirements and meet minimum objectives outlined in the U.S. Army Corps of Engineers' Project Management Plan (HDR, 2000).

2.2.2. Flood Management Goal and Objectives

The flood management goal of the project is to reduce the risk of flood hazards to protect existing property owners and public/private infrastructure.

- Manage existing conditions flooding up to the 100-year (one percent annual chance) flood event;
- Manage sediment conditions along the creek system;
- Acknowledge and define hazards from increased flooding due to future land conditions or burns;
- Reduce the potential for nuisance flooding of Mullan Trail Subdivision homes from groundwater seepage;
- Improve the management of irrigation flows and reduce their contributions to seasonal flooding;
- Define the characteristics of seasonal surface and groundwater interactions;
- Reduce the risk of flood damage to roadway and railroad infrastructure;
- Establish a long-term monitoring program to define surface and groundwater hydrologic conditions;
- Perform flood investigations meeting FEMA standards to support eventual flood insurance map revisions;
- Support County and City emergency planning objectives;
- Accommodate City and County long-range planning goals, including the ongoing Mullan and Wye Area Comprehensive Land Use Planning and Wye-Mullan Transportation Plan.

3. ALTERNATIVES DEVELOPMENT

This section describes the approach to the alternatives development, gives an overview of design elements considered, and includes the design criteria used for various resources.

3.1. Approach

The main impetus for the Grant Creek project was the severe flood damage experienced by homeowners in the Mullan Trail Subdivision in 1997. However, the approach to this project and the alternatives development was to initially "step back" from the flooding situation and identify the broad hydrologic, hydraulic, geomorphic, and biological processes at work in the creek.

Flood hazards have typically been reduced through traditional engineering practices to control floods—practices such as dredging, constructing levees, and lining channel banks. However, these engineered fixes can require significant time and cost to maintain and can exacerbate other natural processes and affect biological resources. For these reasons, the project team sought solutions that consider the creek and its floodplain as a dynamic system with localized flooding that is influenced by conditions both upstream and downstream of the subdivision. One objective was to identify solutions that will be sustainable in the long term. Sustainability often depends on solutions that acknowledge and complement the natural processes at work in a fluvial system. These solutions also result in better long-term maintenance situations.

Flood and fish management share a common strategy for achieving their respective goals, which are to restore natural processes and floodplain functions. Consequently, the overriding issue for this project is integrating engineering concepts for flood management and biological concepts for fisheries protection into a unified creek-management strategy. Managing flood *sources* is a more cost-effective and sustainable solution than controlling the flooding itself.

The following flow chart shows the general process for screening alternatives.

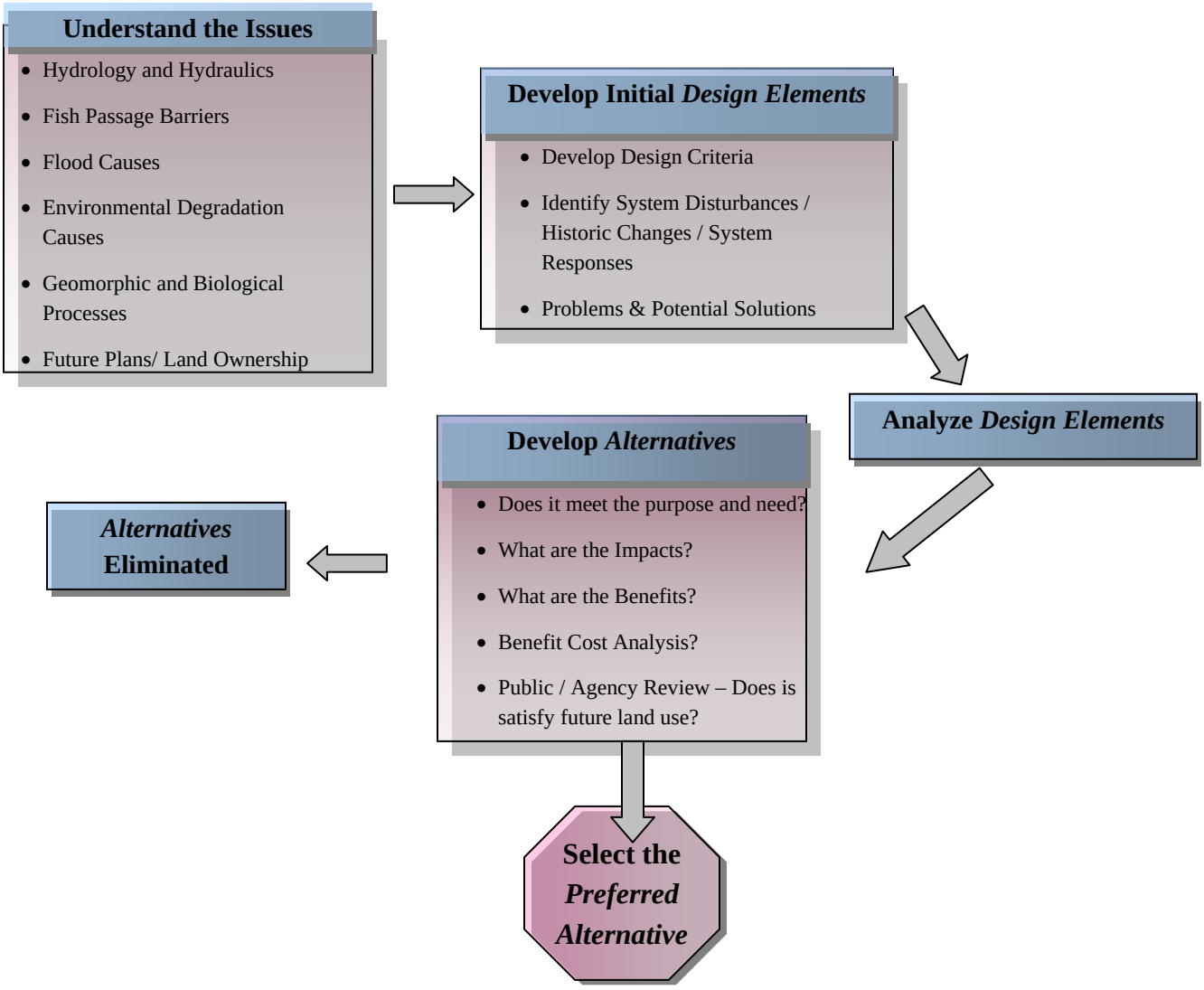


Table 3.0 provides the conceptual framework for planning and design used for identification of the problems (System Disturbances) and opportunities (Potential Design & Management Elements). From this analysis, the design elements were identified for various channel reaches and specific problems. Design elements considered included a range of options involving construction, mitigation, management, etc. The initial listing of potential design elements identified for the Grant Creek project is shown on Figure 3.1. The potential list of design elements was then narrowed further to a group of viable design elements that were determined to be applicable to the various reaches of the system. These design elements are shown on Figure 3.2 Proposed Project Mitigation Measures Considered, and are associated with the system disturbances and opportunities outlined in Table 3.0.

Table 3.0 Project Mitigation Measures Considered

System Disturbances	Upper reaches of creek watershed are being developed with residential housing.	Numerous culverts and bridges cross the creek upstream of I-90.	The creek channel has been constricted between the Montana Mainline Railroad and Hwy 93.	The creek channel below Hwy 93 has been realigned and channelized.	The creek floodplain below Hwy 93 is being developed.	The creek floodplain and banks below Hwy 93 are being grazed and farmed.	Riparian habitat along the lower reaches of the creek has been removed or is eroding.	Fence lines cross the creek in several locations to mark property lines.	Fence lines and dikes have been constructed at the edge of the existing creek channel.	Native soils are unstable and prone to rodent burrows.	The abandoned Hiawatha Railroad embankment constricts flood flows.	The Flynn Lowney Ditch transfers additional water to the creek system during the seasonal flood period.	Septic tanks have been placed below the water table.	Basements and crawl spaces have been built below the water table in the Mullan Trail Subdivision.
System Responses :Changes from Historic Conditions	Increased suspended sediment, urban pollution, and higher flows are discharged to the creek system.	The natural movement of creek sediments is impeded and creek channel flood capacity is decreased where deposition occurs at crossings.	Stream is channelized, decreasing flood capacity and storage, and increased sediment deposition occurs upstream of the Hwy 93 culverts crossing.	Down-cutting in the northern portion of the channel has occurred. Natural sediment movement is restricted, causing degradation of channel and predominantly finer-grained bed material.	Encroachment on floodplain restricts flood storage capacity and requires artificial flood control measures.	Bank erosion and increased sediment into the stream.	Reduced groundwater uptake by trees and shrubs, flood flow impediment is reduced, wildlife and fish habitat are reduced.	Potential debris collectors during floods.	Reduced flood storage and adverse riparian impacts from grazing.	Soil loss and vegetation damage from rodents.	Higher flood depths upstream of abandoned embankment causes increased flooding upstream, which allows increased infiltration to groundwater.	Increased groundwater elevations during irrigation season cause increased flood risk to local residents and allow additional recharge to shallow groundwater.	Water quality degradation.	Flood damage to homes.
	Implement pollution source control measures in upstream developments and storm water detention.	Replace Hwy 93 culverts with larger opening structure and build higher berms to protect infrastructure, or lower the stream grade	Implement a monitoring and gravel management plan.	Realign channel with appropriate sinuosity and grade to account for anticipated sediment load and establish naturally functioning riparian zone.	Establish a reasonable corridor for floodplain and floodway that is designed to allow the stream to meander within the corridor.	Establish grazing and farming restrictions in the riparian zone.	Establish a riparian zone with development restrictions.	Construct fences up to stream banks but do not fence across the creek or fence out the riparian zone.	Remove dikes or move them dikes back for wider floodplain and greater flood storage; re-fence the riparian zone.	Reconstruct floodplain corridor and develop diverse riparian vegetative community to allow denser plant growth and habitat cover.	Reconstruct bridge with wider opening, designed in conjunction with downstream residential flood protection. Decrease flood area to decrease infiltration to groundwater.	Restrict or eliminate flood irrigation and replace with sprinkler systems. Replace water source with wells. Eliminate ditch seepage before and during spring runoff.	Replace with alternative on-site treatment systems or connect to municipal sewer system	Reduce water table through irrigation practices and flood control measures in the area of homes or install individual sump systems
Design Element Identifiers [1]		**AA A M Q**	**N O P**	**AA K L**	**I L**	**I J L**	**E I**	**E I**	**C E I**	**C I**	**G**	**H**		**F**

[1] See Figure 3.1 for associated locations of elements identified

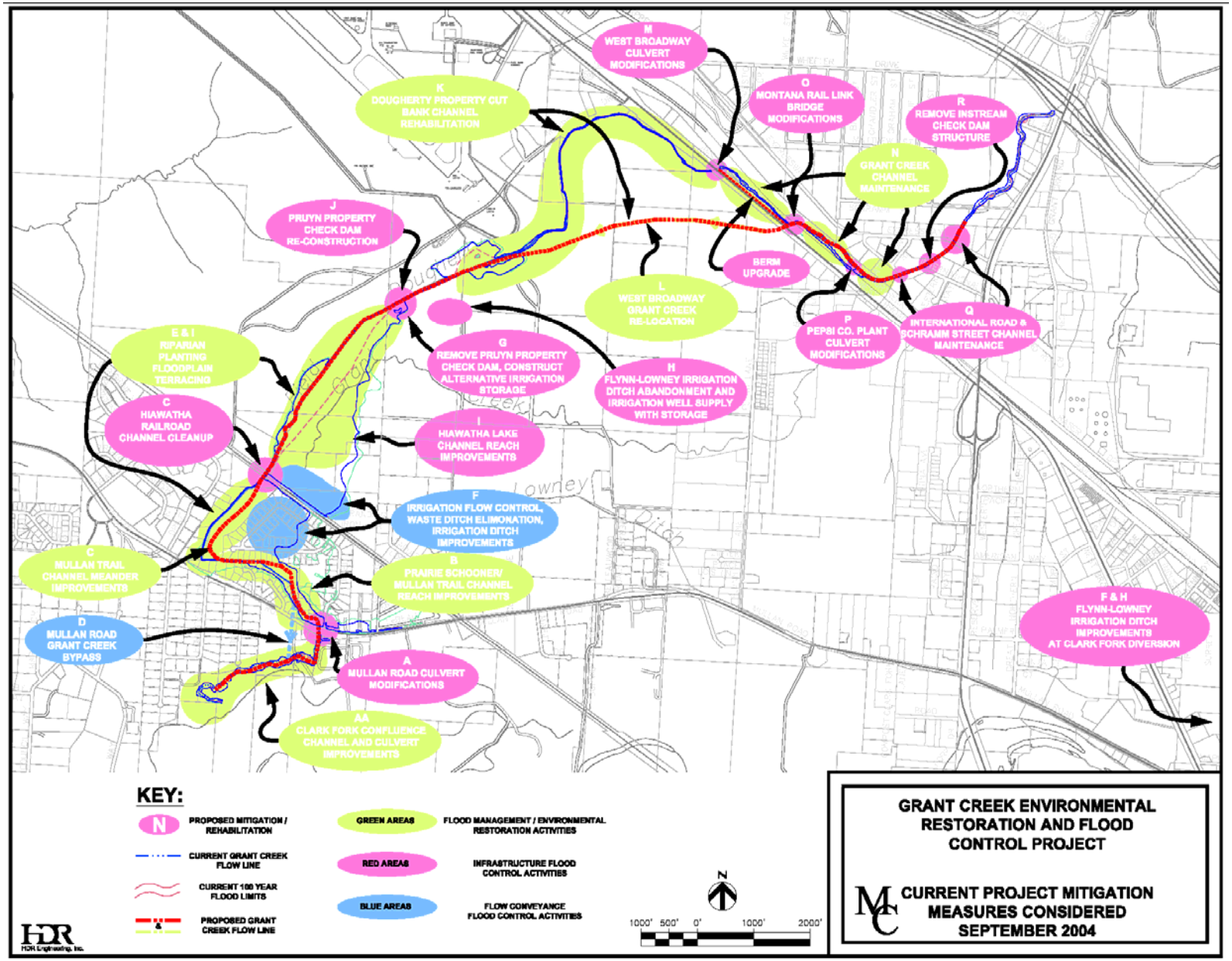


Figure 3.1 Proposed Project Mitigation Measures

Each of the design elements shown on Figure 3.1, Proposed Project Mitigation Measures, was evaluated and impacts were analyzed for surface water, ground water, fisheries, riparian habitat, geomorphology, land use, and water rights. For a complete description of these design elements and the opportunities and constraints associated with various resource areas, see *Appendix P - Task 1100: Preliminary Design, Grant Creek Environmental Restoration/Flood Control, Design Elements Summary*.

3.2. Design Criteria

The Grant Creek project design criteria were developed in conjunction with project stakeholders. The design criteria were used as a guide during the alternatives development and analysis.

Surface Water Hydrologic and Hydraulic Design Criteria

- Convey floods up to the 100-year event through roadway structures without pressure flow
- Control floods up to the 100-year event in the vicinity of the Mullan Trail Subdivision
- Manage flooding elsewhere using enlarged hydraulic structures, terraces, and setback berms
- Optimize roadway hydraulic openings for fish passage
- Establish channel geometry for stability at the 2-year flood event
- Accommodate creek inflows from storm drainage outfalls
- Reduce potential for failure of earthwork structures due to rodent burrowing
- Provide a functioning floodplain where feasible

Groundwater Design Criteria

- Reduce the amount of ponded/standing water, especially during flooding
- Eliminate irrigation ditch leaking (main, waste, north laterals)
- Reduce or eliminate spring irrigation before runoff
- Decrease permeability of floodplain surfaces where possible
- Prevent ponding of flood waters against the railroad embankment to reduce seepage toward subdivision basements

Fisheries Management Design Criteria

- Design for species of concern – bull trout and westslope cutthroat trout
- Juvenile fish are not a design priority
- Maximize removal of barrier structures; native gene pool is already impacted
- Maximum jump height – 10 inches
- Minimum flow depth – 6 to 8 inches
- Burst speed – 8 feet per second for 5 seconds
- Passage conveyance period – May 15 to July 30
- Provide increased channel complexity

NON-STRUCTURAL ACTIONS	Direct Fish Benefits	Direct Wildlife Benefits	Direct Human Benefits
Mapping and Regulatory Actions			
Update and Enforce Planning and Zoning	✓	✓	✓
Preserve Open Space		✓	✓
More Stringent Floodplain Regulations	✓	✓	✓
Develop Stormwater Management Plans	✓	✓	✓
Acquire Additional Flood Data			✓
Obtain and Maintain Flood Data			✓
Develop a Hydrodynamic Flood/Sediment Model			✓
Maintenance Actions			
Perform Drainage System Maintenance			✓
Flood Damage Reduction Actions			
Relocate Flood-Prone Structures		✓	✓
Acquire Flood-Prone Property		✓	✓
Elevate Flood-Prone Structures			✓
Floodproof Structures at Risk			✓
Provide Sewer Backup Protection			✓
Promote Flood Insurance			✓
Natural Resource Protection Actions			
Enforce Wetlands Protection	✓	✓	✓
Enforce Erosion and Sediment Control Practices	✓	✓	✓
Employ Best Management Practices	✓	✓	✓
Flood Preparedness Actions			
Establish a Flood Warning Program			✓
Establish Flood Response Protocol			✓
Identify Critical Facilities Protection			✓
Develop Flood Health and Safety Maintenance Plans			✓
Develop Levee and Dam Safety Standards			✓
NOAA Weather Radio			✓
Develop Flood Warning Call Lists			✓
Public Information Actions			
Prepare Detailed Flood Map Information			✓
Develop Outreach Projects			✓
Disclose Real Estate Hazards			✓
Establish Flood Protection Library			✓
Offer Flood Protection Assistance			✓
Offer Environmental Education			✓
Issue Flood Elevation Certificates			✓
Watershed Management Actions			
Develop Watershed Analyses Data			✓
Decommission Forest Roads - Upper Reaches	✓	✓	✓
Upgrade Forest Roads and Culverts - Upper Reaches	✓	✓	✓
Adopt System-Based Forest Management Practices	✓	✓	✓
Install Additional Precipitation, Stream Gauges			✓
Develop Regional Geomorphic Reference Sites			✓

STRUCTURAL ACTIONS	Direct Fish Benefits	Direct Wildlife Benefits	Direct Human Benefits
Levee/Dike Modification Actions			
Adopt New Levee Design Guidelines			✓
Improve Existing Levee Freeboard			✓
Selectively Lower Levee/Dike Crest Elevations	✓	✓	✓
Selectively Setback Levee/Dikes	✓	✓	
Selectively Breach Levee/Dikes	✓	✓	
Oversize Levee Section for Recreation	✓	✓	✓
Construct Floodgates/Pumping Stations			✓
Construct Vegetated Levees	✓	✓	✓
Stream Bank Stabilization Actions			
Repair Existing Revetment In-Kind			✓
Modify Existing Revetment with Vegetation	✓	✓	✓
Construct Biotechnical Bank Stabilization	✓	✓	✓
Remove Damaged Revetment	✓	✓	✓
Perform Regular Vegetation Management			✓
Roadway Improvement Actions			
Reconstruct Restrictive Bridges and Approaches	✓		✓
Modify Floodplain Fill Encroachments	✓		✓
Modify Culverts for Fish Passage	✓	✓	
Construct Flood Relief and Flood Bypass Routes	✓	✓	✓
Drainage Modification Actions			
Modify/Relocate In-Stream Flow Diversions	✓		
Construct Storm Sewers			✓
Construct Sedimentation Basins	✓		✓
Construct Storm Water Detention Basins			✓
Construct Control Structure on Ag Diversion			✓
Modify Groundwater Withdrawals	✓	✓	
Line Agricultural Ditches to Reduce Seepage			✓
Channel/Floodplain Modification Actions			
Construct Overbank Conveyance Channels	✓	✓	✓
Perform Repetitive Maintenance Dredging			✓
Remove/Deflect/Trap Floating Debris			✓
Construct Vegetated Bridge Guide Banks			✓
Construct Grade Control Structures			✓
Remove/Modify Fencing		✓	
Construct Flood Defense Hedgerows		✓	✓
Floodplain Restoration Actions			
Construct Floodplain Terraces	✓	✓	✓
Revegetate Channel Banks	✓	✓	✓
Restore Cutoff Channels	✓	✓	✓
Construct Livestock Fencing	✓	✓	
Establish Riparian Shelterbelts	✓	✓	✓
Implement Rotational Grazing Practices	✓	✓	✓

Italicized text refers to FEMA Community Rating System mitigation elements that can be used to reduce flood insurance premium rates.

Figure 3.2 Listing of Potential Design Elements Considered in Alternatives Analysis

- Decrease channel slack water areas
- Maximize emergent wetland habitat in stream channel(s)
- Use stepped and/or vortex weirs for structures
- Use woody material for stabilization wherever possible
- Design natural plan and profile where possible
- Plant trees where possible for diversity, shade, and improved habitat (food sources)

Water Quality Design Criteria

- Reduce nutrient loadings from agricultural operations
- Increase plant growth to reduce sediment suspension
- Implement roadway spill prevention measures for creek protection
- Maximize creek shading and minimize channel widths to reduce water temperatures

Biological and Riparian Diversity Design Criteria

- Plant appropriate and locally adapted native plant species
- Provide a sustainable plant community within the hydrologic context
- Implement deer grazing/herbivore where not impacted by airport runway corridor
- Improve waterfowl habitat where not impacted by airport runway corridor
- Minimize opportunities for colonization by exotic plants
- Minimize impacts to lower Clark Fork River trout habitat
- Use native plant species where possible
- Use woody material where possible

Water Management Design Criteria

- Comply with water rights issues
- Transition irrigation/drainage from agricultural in-holdings
- Use groundwater resources to replace surface water sources for agricultural practices
- Maintain access/flood protection for residential in-holdings
- Maintain access/flood protection for agricultural in-holdings

Engineering/Construction/Permitting/Environmental Design Criteria

- Use natural and native construction materials where possible
- Use local construction labor
- Lower the risk of catastrophic failure
- Minimize the discharge of sediments to the Clark Fork River basin and Hiawatha Lake region of project
- Reduce FEMA 100-year flood hazards to associated properties along corridor
- Use dry construction techniques when possible
- Use natural designs to limit long-term maintenance

- Ensure cultural resource sites are identified and avoided; use Mullan Road study as initial basis
- Satisfy all NEPA/MEPA[4] requirements

Geomorphic Design Criteria

- Restore an annual flood cycle to the alluvial reach
- Accommodate the unknown (ice and debris jams)
- Manage sediment deposition in alluvial reach or immediately downstream in upper horseshoe bend area
- Restore natural frequency of channel change/evolution
- Restore natural frequency of channel and restore channel gradient in horseshoe bend area
- Reduce aggradations of sediments in Hiawatha Lake region where possible
- Design channels consistent with existing bed material

Land Use and Water Rights Design Criteria

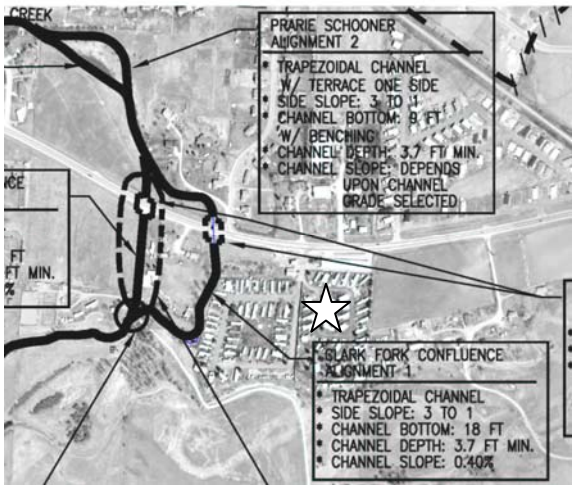
- Comply with Wye-Mullan Area draft comprehensive land use plan
- Coordinate with adopted Wye-Mullan Area transportation corridor plan
- Eliminate use of stream channel for irrigation storage
- Limit Clark Fork diversion into Grant Creek drainage to legal right (62.5 cubic feet per second) or less
- Reduce Grant Creek diversions for agricultural practices in lower reaches
- Maximize public access/use for floodplain corridor

[4] MEPA is the Montana Environmental Policy Act of 1971.

4. ASSESSMENT OF ALTERNATIVES

4.1. Development of Alternatives

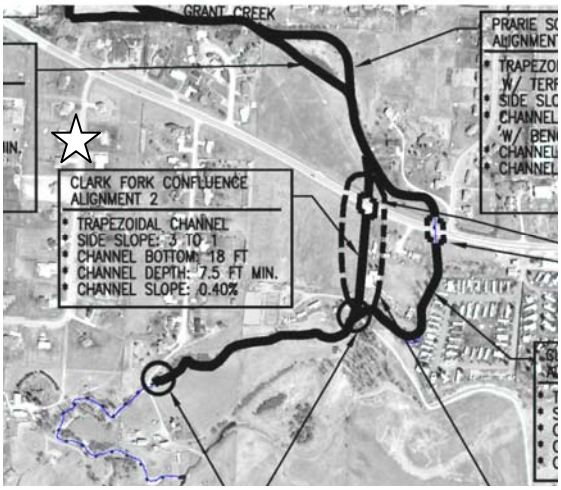
Using the design criteria and impacts assessment, the design elements were narrowed down to several alternatives for each reach of the planning area that were considered viable. The following pages provide detailed descriptions of the alternatives analyzed for each reach and provide advantages and disadvantages of each of the alternatives considered.

Clark Fork Confluence Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:** **Modify Existing Channel**
Key Alternative Elements	
• Maintain existing channel alignment. • Revise channel crossection. Set channel bottom elevation at 18 FT with 3:1 sideslopes. • Modify south channel alignment at Greenfield Mobile home Park to fortify existing channel. • Replace existing access road culverts at Miller and Frey properties. • Revise channel grade: o Alt.1 – Deep excavation (5-8 FT), no berms o Alt. 2 – Current channel grade, retain berms o Alt 3 – Moderate excavation (3 FT), terracing and slight berms	
Advantages	***Disadvantages***
• Keeps existing channel in same location. Less need for construction easements. • Reduces flood level in Mullan Trail subdivision area. • Can address lower channel restrictions without eliminating an existing riparian area. Better opportunity to meet the needs of affected landowners along the reach.	• Deep excavation lowers channel to avoid berms, requires moving Mullan Road Corridor Sanitary Sewer with siphon. • Deep excavation will generate extensive material quantity. • Requires excavation of existing riparian area below Mullan road. Landowner does not prefer option. • Will require removal of existing cottonwood trees, extent depending upon channel grade selected.
Notes:	
The deep excavation alternative will result in the greatest capital cost and will require removal of existing riparian area or re-location of channel in new easement. Existing landowner not interested in granting easement for revised grades or tree removal.	

Clark Fork Confluence Alternative 2

Grant Creek Environmental Restoration and Flood Control

Description: **Move Existing Channel**

Key Alternative Elements	
• Re-locate existing channel to location that requires less tree removal and less protection of adjacent trailer park. • Revise channel crossection. Set channel bottom elevation at 18 FT with 3:1 sideslopes. • Replace existing access road culverts at Miller and Frey properties. • Revise channel grade: o Alt.1 – Deep excavation (5-8 FT), no berms. o Alt. 2 – Current channel grade, retain and widen berms. o Alt 3 – Moderate excavation (3 FT), terracing and slight berms. • Acquire necessary easements for re-alignment.	
Advantages	***Disadvantages***
• Addresses lower channel restrictions without full elimination an existing riparian area. • Moves channel away from known embankment problems at existing adjacent mobile home park. • Provides for better constructability since new construction is separate from existing channel. • Reduces flood level in Mullan Trail subdivision area.	• Deep excavation lowers channel to avoid berms, requires moving Mullan Road Corridor Sanitary Sewer with siphon. • Deep excavation will generate extensive material quantity. • Requires restoration and/or removal of existing riparian area below Mullan road. Landowner does not prefer option. • Easement acquisition will be difficult for revised alignment.

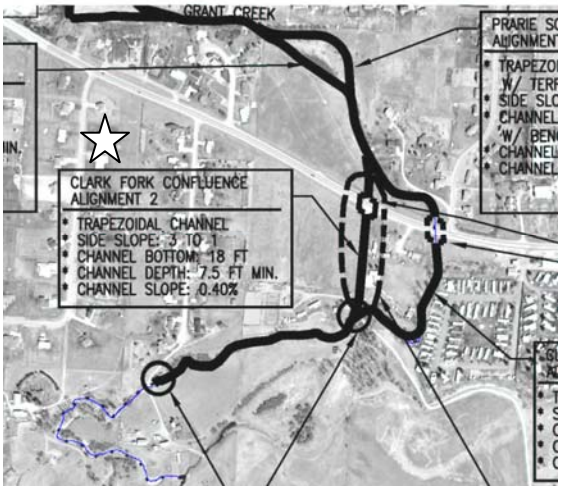
Cost Summary:

The estimated capital costs for this alternative, including channel grade alternatives, are to be completed.

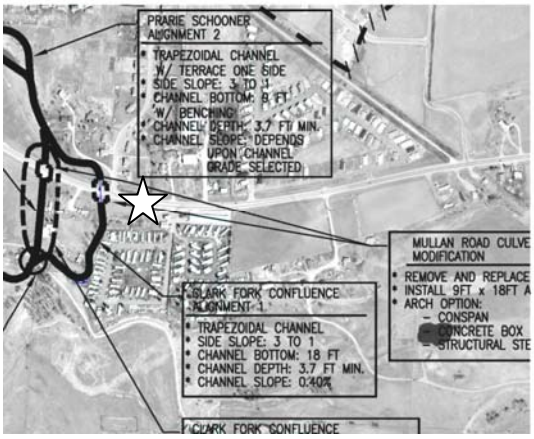
Notes:

The deep excavation alternative will result in the greatest capital cost and will require removal of existing riparian area or re-location of channel in new easement. Existing landowner not interested in granting easement for revise alignment with open channel.

Clark Fork Confluence Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Deepen Channel On Existing Alignment**

Key Alternative Elements	
• Maintain existing channel alignment. • Revise channel crossection. Set channel bottom elevation at 18 FT with 3:1 sideslopes. • Replace existing access road culverts at Miller and Frey properties. • Revise channel grade: o Alt.1 – Deep excavation (5-8 FT), no berms. o Alt. 2 – Current channel grade, retain and widen berms. o Alt 3 – Moderate excavation (3 FT), terracing and slight berms. • Acquire necessary easements for deep excavation sideslopes.	
Advantages	***Disadvantages***
• Addresses lower channel restrictions without full elimination an existing riparian area. • Corrects channel problems at existing adjacent mobile home park. • Reduces flood level in Mullan Trail subdivision area.	• Deep excavation lowers channel to avoid berms, requires moving Mullan Road Corridor Sanitary Sewer with siphon. • Deep excavation will generate extensive material quantity. • Requires restoration and/or removal of existing riparian area below Mullan road. Landowner does not prefer option. • Easement acquisition will be difficult for revised alignment.
Notes:	
The deep excavation alternative will result in the greatest capital cost and will require removal of existing riparian area in new easement. Existing landowner not interested in granting easement for revise alignment with open channel.	

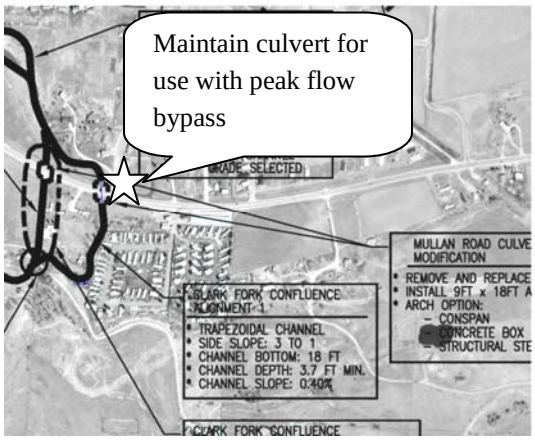
Mullan Road Culvert Alternative 1	**Description:**	**Maintain Existing Culvert, Install Parallel Culvert**
Grant Creek Environmental Restoration and Flood Control		

Key Alternative Elements	
• Maintain existing culvert and install new culvert adjacent to existing culvert. • Requires use of existing channel grades and enhancement of existing flood control berms in the Mullan Trail subdivision area.	

Advantages	***Disadvantages***
• Less impact to the existing channel configuration. • Results in smaller size new culvert installation (estimated at 8 FT x 14 FT) • Reduces peak flow velocities and will enhance fish passage. • Less channel disruption with existing channel grades maintained • Reduces flood level in Mullan Trail subdivision area.	• Involves retaining flood control berms in Mullan Trail area. • Does not allow reduction in channel depth upstream from Mullan Road • Will require additional protection of existing Mullan Road Corridor sewer for installation. • Does not work with the majority of alignment options for the Clark Fork confluence and Prairie Schooner reaches. • Develops fish passage problem for minimum flow levels as flows reside. Will shorten fish passage time window.

Notes:

The parallel culvert alternative was added to test whether it is cost effective to keep the existing culvert in place.

Mullan Road Culvert Alternative 2 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Maintain Existing Culvert**
Key Alternative Elements	
• Maintain existing culvert and install with peak flow bypass. • Requires use of existing channel grades and installation of the peak flow bypass system to resolve flooding problems in Mullan Trail.	
Advantages	***Disadvantages***
• Less impact to the existing channel configuration. • Allows reduction of peak flow velocities and will enhance fish passage. • Less channel disruption with existing channel grades maintained • Reduces flood level in Mullan Trail subdivision area.	• Requires coordination with peak flow bypass alternative for Clark Fork Confluence reach.
Notes:	
The maintain existing culvert alternative was added to enable the peak flow bypass alternative to be worked with the Clark Fork Confluence reach.	

Mullan Road Culvert Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Replace Culvert with Arch Culvert**

Key Alternative Elements	
• Remove existing arch culvert and install with larger 9 FT x 18 FT arch or box culvert. • Install culvert at any of the proposed channel elevations. • Re-locate existing flow measurement staff gauge. • Culvert Options: o Conspan o Concrete Box o Structural Steel Plate Arch	

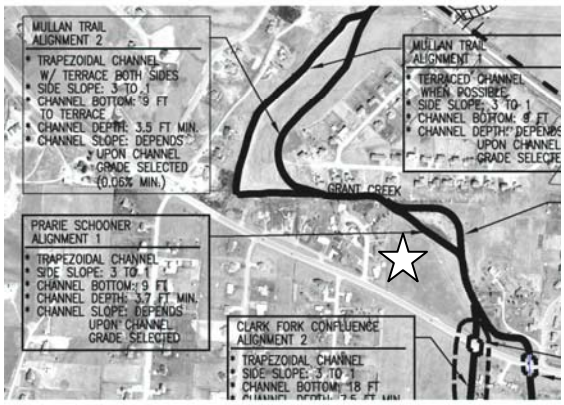
Advantages	***Disadvantages***
• Can be coordinated with more upstream and downstream channel grade alternatives. • Reduces peak flow velocities and enhances fish passage. • Reduces flood level in Mullan Trail subdivision area. 	• Greater impact to Mullan road during construction. • May require modification of the existing Mullan Road Corridor Sewer Pipelines including installation of siphon structure, depending upon channel grade selected for area. • Wider channel opening will reduce low flow depths. Will reduce fish passage window.

Notes:

Installation of a larger culvert at Mullan Road is required, unless peak flows are diverted upgradient. The existing culvert is adequate for fish passage; however, reduction in peak velocities is preferred. Culvert options will require review by MDT before final selection is made.

Prairie Schooner Reach Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Maintain Existing Channel Alignment**

Key Alternative Elements	

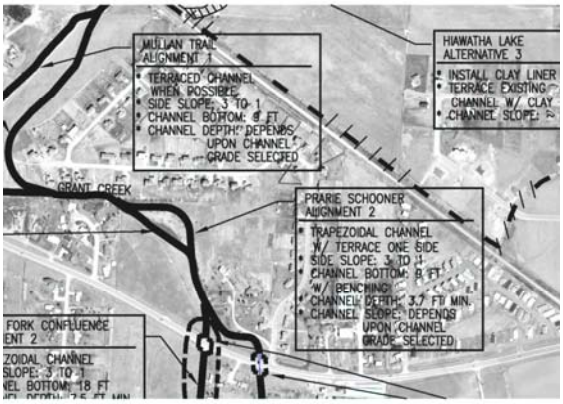
• Maintain existing channel alignment.
• Construct trapezoidal channel with minimum channel bottom width of 9 FT, include 3:1 sideslopes.
• Construct terraced riparian zone along north side where right of way is available within common area.
• Channel depth and slope dependent upon channel grade selected. Alternatives include:
  o Alt.1 – Deep excavation (5-8 FT), no berms.
  o Alt. 2 – Current channel grade, retain berms and terrace where possible.
  o Alt 3 – Moderate excavation (3 FT), terracing and slight berms.
	

Advantages	***Disadvantages***
• Less excavation involved when compared to Prairie Schooner alignment alternative 2. • Less disruption to existing channel configuration. • Can be coordinated with all channel grade alternatives. • Retains flood level at acceptable elevation in Mullan Trail area.	• Not as easy to provide terraced riparian zone. • Not as easy to construct within available right of way and flood way. • Does not have as much potential for creation of more natural channel crossection.

Notes:

The three channel grade alternatives have varied impact on constructibility within this reach of the project. The deep excavation, where the channel elevation would be lowered approximately 5 FT, would result in the same footprint as the existing channel width. However, there will be less opportunity for channel terracing resulting in a more "engineered channel" in the narrow area adjacent to the Dino Estates subdivision.

Prairie Schooner Channel Alternative 2 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Revise Channel Alignment and Construct Terrace**

Key Alternative Elements	
• Modify existing channel alignment to enable construction of floodplain and riparian corridor. • Construct trapezoidal channel with minimum channel bottom width of 9 FT, include 3:1 sideslopes and variable floodway terrace. • Construct terraced riparian zone along both sides where right of way is available within common area. • Channel depth and slope dependent upon channel grade selected. Alternatives include: o Alt.1 – Deep excavation (5-8 FT), no berms. o Alt. 2 – Current channel grade, retain berms and terrace where possible. o Alt 3 – Moderate excavation (3 FT), terracing and slight berms.	

Advantages	***Disadvantages***
• Greater opportunity for terracing for floodplain and riparian area. • Easier to construct preferred crossection within right of way available in area. • Enables removal of existing levees and better flood routing for MDT storm water. • Retains flood level at acceptable elevation in Mullan Trail area. • Provides greater opportunity for more natural stream crossection.	• Greater excavation than Prairie Schooner Alignment 1. • Greater disruption to existing channel area.

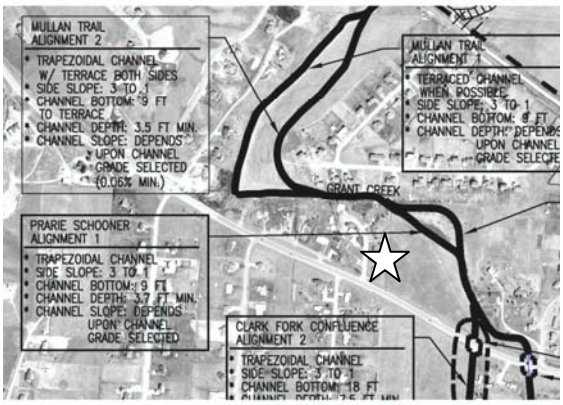
Cost Summary:

The estimated capital costs for this alternative, including channel grade alternatives, are to be completed.

Notes:

This alternative has a greater potential for constructability for all channel grading alternatives. Provides better capability for flood control using amore natural channel section.

Prairie Schooner Reach Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Deepen Channel on Existing Alignment**

Key Alternative Elements	
• Maintain existing channel alignment. • Construct trapezoidal channel with minimum channel bottom width of 9 FT, include 3:1 sideslopes. • Channel depth and slope dependent upon channel grade selected. Alternatives include: o Alt.1 – Deep excavation (5-8 FT), no berms. o Alt 2 – Moderate excavation (3 FT), terracing and slight berms.	

Advantages	***Disadvantages***
• Retains flood level at acceptable elevation in Mullan Trail area.	• Not as easy to construct within available right of way and flood way. • Greater excavation involved. • Higher cost. • Right-of-way not available.

Notes:

The deep excavation channel grade alternatives have varied impact on constructibility within this reach of the project. The deep excavation, where the channel elevation would be lowered approximately 5 FT, would result in the same footprint as the existing channel width. However, there will be less opportunity for channel terracing resulting in a more "engineered channel" in the narrow area adjacent to the Dino Estates subdivision. This alternative also has less opportunity to fit within available right-of-way.

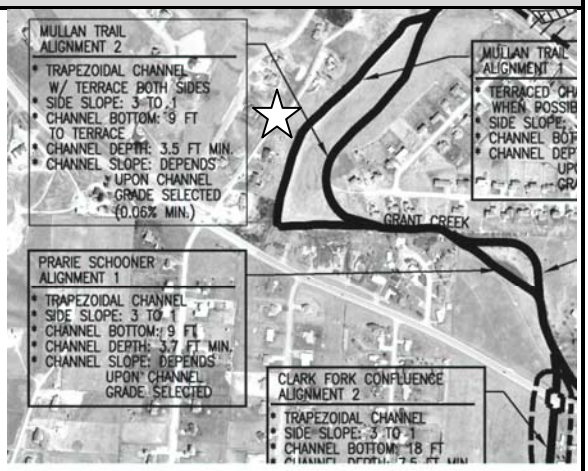
Mullan Trail Channel Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Maintain Existing Channel Alignment**

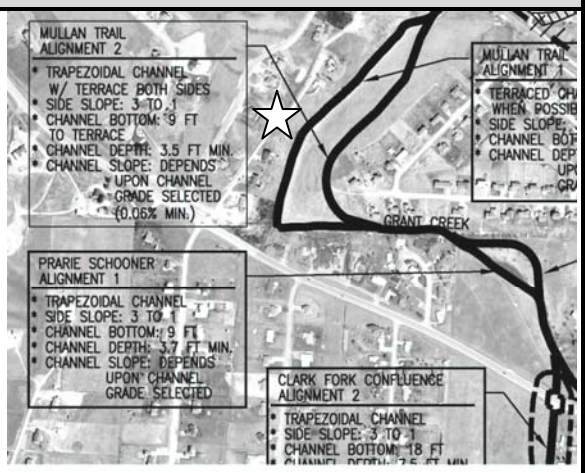
Key Alternative Elements	
• Maintain existing channel alignment. • Construct trapezoidal channel with minimum channel bottom width of 9 FT, include 3:1 sideslopes. • Construct terraced riparian zone along east side where right of way is available within common area. • Channel depth and slope dependent upon channel grade selected. Alternatives include: o Alt.1 – Deep excavation (0-8 FT), no berms. o Alt. 2 – Current channel grade, retain berms and terrace where possible. o Alt 3 – Moderate excavation (0-3 FT) and terracing.	

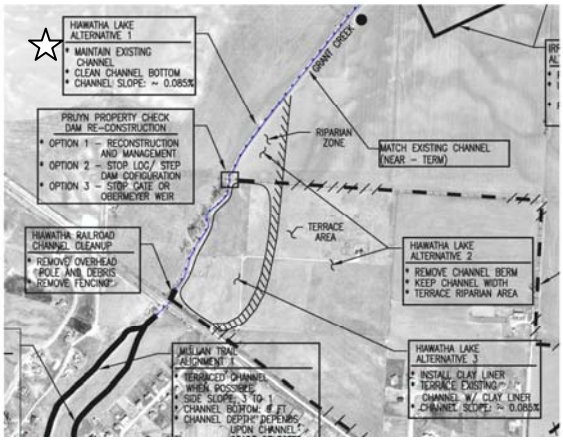
Advantages	***Disadvantages***
• Less excavation involved when compared to alignment Mullan Trail Alternative 2. • Less disruption to existing channel configuration. • Can be coordinated with all channel grade alternatives. • Retains flood level at acceptable elevation in Mullan Trail area.	• Does not remove the existing dog-leg channel alignment near Mullan Road. • Not as easy to provide terraced flood way and riparian zone. • Not as easy to construct within available right of way. • Does not have as much potential for creation of more natural channel crossection. • Does not enable as easy of construction sequencing. • Does not move existing channel away from properties to the west.

Notes:

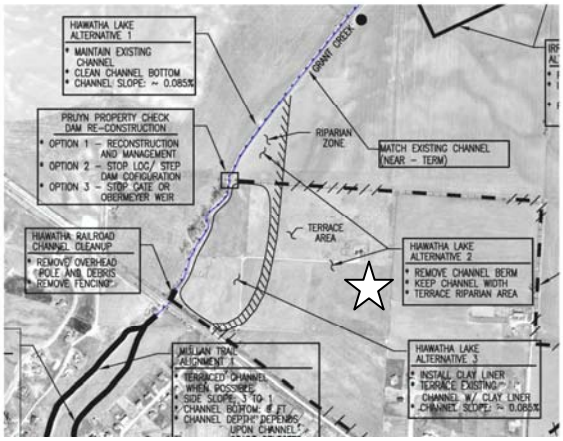
This alternative has less potential for constructability for all channel grading alternatives. Not as flexible for providing for flood control using a more natural channel section.

Mullan Trail Channel Alternative 2 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Revise Channel Alignment and Construct Terrace**
Key Alternative Elements	
• Modify existing channel alignment to enable construction of floodplain and riparian corridor along both sides. • Construct trapezoidal channel with minimum channel bottom width of 9 FT, include 3:1 sideslopes and variable floodway terrace. • Allows removal of channel dog-leg at Mullan Road. • Channel depth and slope dependent upon channel grade selected. Alternatives include: o Alt.1 – Deep excavation (5-8 FT), no berms. o Alt. 2 – Current channel grade, retain berms and terrace where possible. o Alt 3 – Moderate excavation (3 FT), terracing.		
Advantages		***Disadvantages***
• Greater opportunity for terracing for floodplain and riparian area. • Easier to construct preferred crossection within right of way available in area. • Enables removal of existing levees and better flood routing for MDT storm water. • Provides greater opportunity for more natural stream crossection.		• Greater excavation than Mullan Trail Alignment 1. • Greater disruption to existing channel area.
Notes:		
This alternative has a greater potential for constructability for all channel grading alternatives. Provides better capability for flood control using a more natural channel section. Enables removal of the channel dog-leg bend at Mullan Road, enhancing hydraulic capacity.		

Mullan Trail Channel Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Deepen Channel on Existing Alignment**
Key Alternative Elements	
• Modify existing channel grades to deeper section with greater hydraulic capacity. • Construct trapezoidal channel with minimum channel bottom width of 9 FT, include 3:1 sideslopes. • Channel depth and slope dependent upon channel grade selected. Alternatives include: o Alt.1 – Deep excavation (5-8 FT), no berms. o Alt 2 – Moderate excavation (3 FT), terracing.		
Advantages		***Disadvantages***
• Enables removal of existing levees and better flood routing for MDT storm water.		• Much Greater excavation than Mullan Trail Alternatives 1 and 2. • Greater disruption to existing channel area, greater cost. • Available right-of-way questionable. • Less opportunity for terracing floodplain and riparian area. • Less opportunity for more natural stream crossection.
Notes:		
This alternative has less potential for constructability for all channel grading alternatives. Provides less capability for flood control and uses un-natural channel section that would require more long-term maintenance. Does not enable removal of the channel dog-leg bend at Mullan Road.		

Hiawatha Lake Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Maintain Existing Channel**
Key Alternative Elements		
• Maintain existing channel. • Maintain existing irrigation impoundment in summer months. • Clean channel bottom and maintain 0.085% slope. • Provide flood protection around residence. • Includes Hiawatha Railroad Channel area cleanup	
Advantages		***Disadvantages***
• Maintenance of existing stream vegetation. • Maintenance of existing level of downstream flood protection. • Protection of existing residence from flood damage.		• No decrease in downstream flooding impacts. • No riparian corridor established.
Notes:		
Because this alternative does not mitigate downstream flooding impacts, it relies on other downstream alternatives to mitigate these impacts. Residence flood protection assumes elevation of first story of house is above the 100-year flood elevation and filling the lot up to the 100-year flood elevation is feasible.		

Hiawatha Lake Alternative 2 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Construct Riparian Zone and Terrace**

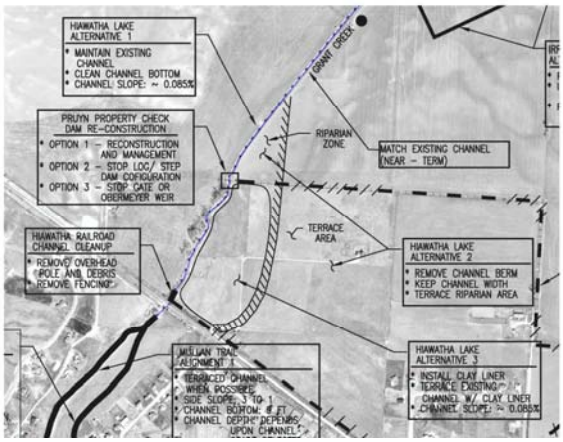
Key Alternative Elements	
• Reconfigure floodplain to create a riparian corridor and reduce extent of 100-year flooding. • Construct terrace above 100-year flood elevation in existing floodplain. • Maintain existing channel alignment and banks. • Remove existing berms along channel. • Remove debris at Hiawatha Railroad Channel and clean channel.	

Advantages	***Disadvantages***
• Maintains most existing riparian vegetation. • Creates a riparian corridor. • Reduces existing level of surface water downstream flooding impacts for minor floods. • Limits extent of 100-year flood without increasing downstream impacts. • Limits flooding potential at residence.	• Limited mitigation of downstream flooding effects. • Minor floods may increase groundwater migration to Mullan Trails Subdivision through increased ponding in "lake" area. • Does not address infiltration of surface water into the upper groundwater aquifer from Hiawatha Lake during peak flow events.

Notes:

The floodplain is reconfigured only in un-irrigated areas east of the stream. The terrace will be constructed to maintain drainage towards the stream. Riparian vegetation may be restricted to drought tolerant species due to seasonal loss of flow in the stream, particularly if irrigation ditches are abandoned.

Hiawatha Lake Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Construct Floodplain Terrace and Install Clay Liner**

Key Alternative Elements	
• Reconfigure floodplain to create a riparian corridor and reduce extent of 100-year flooding. • Construct terrace above 100-year flood elevation in existing floodplain. • Maintain existing channel alignment and banks. • Remove existing berms along channel. • Place one-foot layer of compacted clay one foot beneath surface of portion of riparian zone. • Remove debris at Hiawatha Railroad Channel and clean channel.	

Advantages	***Disadvantages***
• Adds to advantages of Hiawatha Lake Alternative 2. • Reduces damage in Mullan Trail Subdivision from groundwater rise.	• None.

Notes:

The liner will be placed by overexcavating the designated portion of the riparian zone by two feet beyond the depth proposed in Alterntive 2, stockpiling one foot of material for topsoil, placing the other foot of the material in the terrace, placing and compacting one-foot of clay, replacing the topsoil, and seeding and planting.

Irrigation System Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Eliminate Clark Fork River Diversion**
Key Alternative Elements		
• Permanently shut off flow at Clark Fork River diversion.		
Advantages	***Disadvantages***	
• Eliminates waste water reaching Grant Creek near the railroad right-of-way. • Eliminates Clark Fork River water flow during flooding.	• Requires agreement with Hellgate Valley Irrigation Company. • Company shareholders have indicated they will not relinquish their water rights at this time.	
Notes:		
This alternative eliminates the allotted water right (approx. 7 cfs) from the western irrigated property to reach Grant Creek. This alternative eliminates irrigation waters prior to peak flow events that would contribute water to the shallow aquifer but is not likely feasible as Shareholders are not interested in relinquishing their water rights.		

Irrigation System Alternative 2 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Flow Control at Clark Fork River Diversion**
Key Alternative Elements		
• Install sharp-crested weir. • Install constant-level downstream control gate. • Manually shut off flow at Clark Fork River as flow nears flood stage in Grant Creek.		
Advantages		***Disadvantages***
• Limits flow in the Flynn-Lowney Ditch to approved water right (62.5 cfs) during periods of high flow. • Eliminates waste water reaching Grant Creek near the railroad right-of-way. • Eliminates Clark Fork River water flow during flooding.		• Requires agreement with Hellgate Valley Irrigation Company. • Requires continued monitoring and maintenance.
Notes:		
This alternative results in no more than the allotted water right (approx. 7 cfs) from the western irrigated property to reach Grant Creek during the high water period. This alternative does not eliminate irrigation waters prior to peak flow events that would contribute water to the shallow aquifer.		

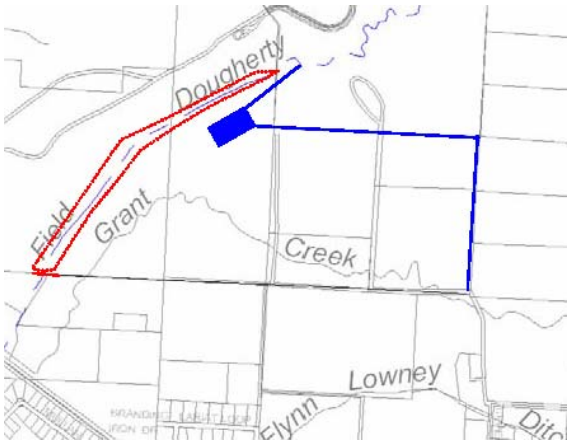
Irrigation System Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Eliminate Waste and South Irrigation Ditches and Improve North Ditch**

Key Alternative Elements	
• Abandon the waste and south irrigation ditches by building a berm in the HVIC ditch system. • Improve the north ditch lateral to handle peak flows. • Line the north ditch lateral to prevent leakage to groundwater. • Manually close the ditch system during high flow periods in Grant Creek.	

Advantages	***Disadvantages***
• Eliminates flow into Grant Creek and Hiawatha Lake during flood stage events. • Eliminates seepage into the shallow aquifer during early runoff so that water table elevations are lower prior to flood stage.	• Requires agreement with the Hellgate Valley Irrigation Company and landowner. • Requires flow monitoring and responsibility for shutting off flow from the Clark Fork River during high flow periods.

Notes:

This alternative diverts all ditch flow into the north lateral and subsequently into Grant Creek via a waste ditch control structure.

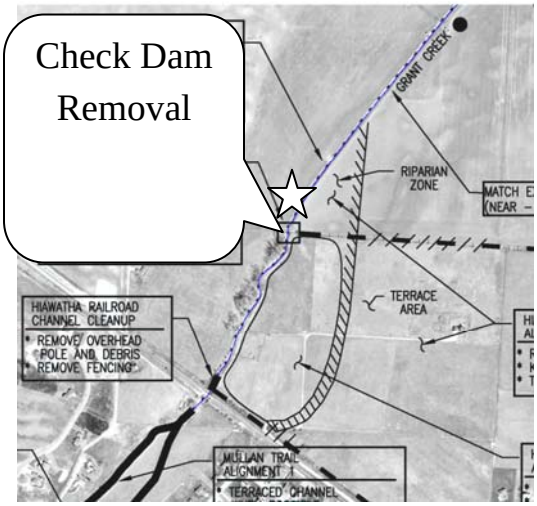
Irrigation System Alternative 4 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Remove Check Dam and Replace with Lined Storage Structure**
Key Alternative Elements		
• Remove check dam on Pruyn property and repair channel. • Construct lined basin for alternative storage of irrigation water		
Advantages		***Disadvantages***
• Eliminates need for check dam. • Allows for much better fish passage. • Reduces recharge to shallow aquifer prior to flood in creek.		• Requires agreement with landowner. • Higher capital costs than leaving existing storage structure in place.
Notes:		
This alternative would be associated with the Pruyn Check Dam removal alternatives.		

Irrigation System Alternative 5 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Abandon Hellgate Valley Irrigation and Develop Groundwater Supply**

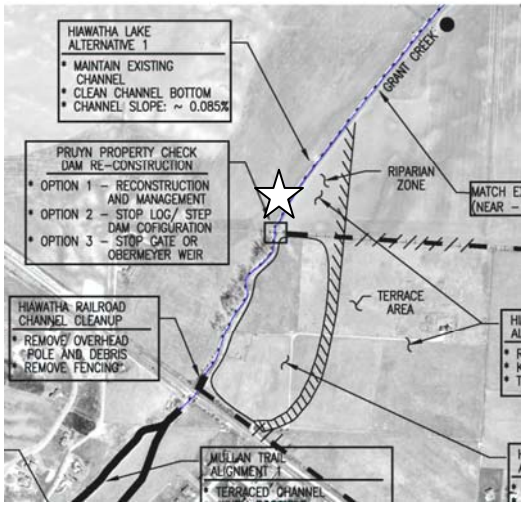
Key Alternative Elements	
• Drill and install 3 to 4 wells capable of producing a total of 3,300 gpm. • Install turbine pumps in each well. • Pipe water from wells to either the existing storage structure in Grant Creek or to lined basin.	
Advantages	***Disadvantages***
• Eliminates the import of Clark Fork river water into the study area. • Greatly reduces flow in Grant Creek during flood. • Eliminates seepage from ditch system to groundwater.	• Requires agreement with land owners and Hellgate Valley Irrigation District. • Relatively high capital costs.

Notes:

Preliminary investigations have been conducted on installation of water supply wells for irrigation supply. Well capacities of 700 to 1200 gpm are possible and could potentially address needs. It is estimated that 3 or 4 wells would be rrequired. Potential for future transition of well to local water purveyor for public potable source.

Pruyn Property Check Dam Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:** **Check Dam Removal**
Key Alternative Elements • Eliminate existing structure.	
Advantages	***Disadvantages***
• Lowest cost alternative that can provide easiest removal of check dam. • Results in least modifications to existing channel. • Provides permanent solution to fish passage concerns.	• Requires agreement with the Airport and landowner that is utilizing creek channel for irrigation storage.
Notes:	
This alternative is recommended as an eventual goal for elimination of the Clark Fork River flows from the Grant Creek system in the future. This alternative is not currently feasible because existing irrigators are not interested in losing their ability to pump from Grant creek at this time.	

Pruyn Property Check Dam Alternative 2 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Check Dam Re-Construction With Fish Ladder**

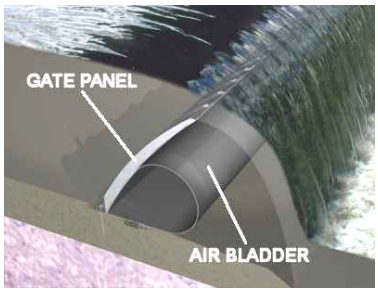
Key Alternative Elements	
• Maintain existing structure. • Re-build structure for temporary operation for near-term operation. • Replace downstream channel to eliminate fish passage barrier. • Replace stop planks and clean channel upstream from check structure. • Provide for management of structure where check dam planks are not installed until after the Grant Creek flood stage period is over.	

Advantages	***Disadvantages***
• Lowest cost alternative that can provide easiest removal of check dam system when associated land is no longer used for agricultural practice. • Results in least modifications to existing channel.	• Requires agreement with the Airport and landowner that is utilizing creek channel for irrigation storage. • Requires flow monitoring and responsibility for removal of check dam planks during flood stage. • Does not provide permanent solution to fish passage concerns.

Notes:

This alternative is provided because of the need for maintaining current irrigation practices, with eventual goal of elimination of the check dam from the Grant Creek system in the future.

Pruyn Property Check Dam Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Check Dam Removal and Replacement With StopGate or Obermeyer Weir**

Key Alternative Elements	
• Demolish existing check dam structure and clean channel. • Construct concrete structure with Stop gate or Obermeyer Weir that will maintain a minimum of 3 FT backwater in grant Creek channel. • Weir or stop gate easily operated to allow for check dam during irrigations season. • Operate structure during peak events to eliminate need for manual removal of barrier for fish passage. • Reduces upstream maintenance of channel since channel is allowed to flush during peak events.	 

Advantages	***Disadvantages***
• Provides mechanical control of water levels upstream from gate panel that allows for irrigation. • Enhances fish passage for peak flow events. • Maintains higher water levels in channel for longer time periods enabling more diversity in habitat. • Requires less additional upstream channel maintenance.	• Requires more costly construction of structure that may eventually also be eliminated. • Decreases channel gradient while increases hydraulic gradient of channel upstream. • Requires agreement with the Airport and landowner that is utilizing creek channel for irrigation storage. • Requires annual operation of check dam gate panels.

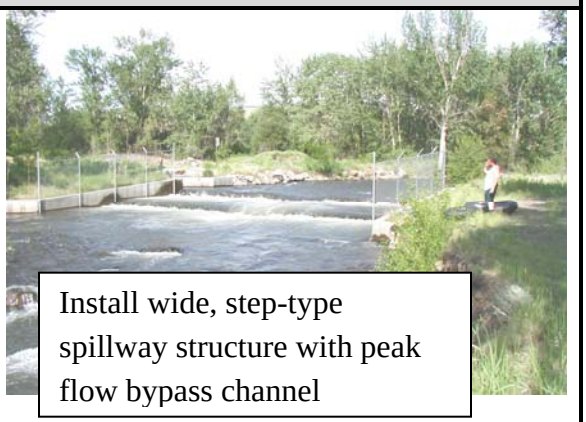
Cost Summary:

The estimated capital cost for this alternative to be completed.

Notes:

This alternative is a lower cost alternative than the step spillway but results in less flexibility and automation of the irrigation practices. This alternative also installs infrastructure that may be removed in the near future if agricultural practices are eliminated for the subject property.

Pruyn Property Check Dam Alternative 4 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Check Dam Removal and Replacement**

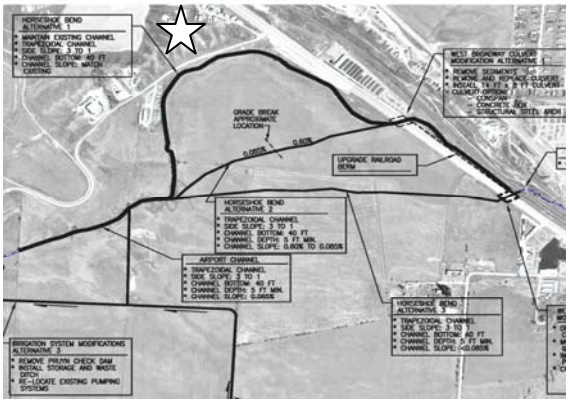
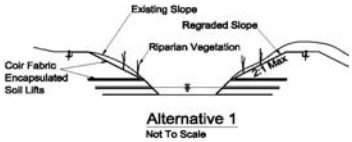
Key Alternative Elements	
• Demolish existing check dam structure and clean channel. • Construct concrete step structure that will maintain a minimum of 3 FT backwater in grant Creek channel. Step structure to allow for fish passage. • Construct bypass peak flow channel to minimize size of spillway and improve flow velocities during peak events for enhancement of fish passage. • Continue upstream maintenance of channel.	 Install wide, step-type spillway structure with peak flow bypass channel

Advantages	***Disadvantages***
• Provides automatic control of water levels upstream from step spillway to allow for irrigation without making annual modifications to the structure (planks or other diversion structures). • Enhances fish passage for both low flow and peak flow events. • Maintains higher water levels in channel for longer time periods enabling more diversity in habitat.	• Requires more costly construction of structure that may eventually also be eliminated. • Decreases channel gradient while increases hydraulic gradient of channel upstream. • Requires upstream channel maintenance in future. • Requires agreement with the Airport and landowner that is utilizing creek channel for irrigation storage.

Notes:

This alternative results in greater flexibility and automation of the irrigation practices but is more expensive. This alternative also installs infrastructure that may be removed in the near future if agricultural practices are eliminated for the subject property.

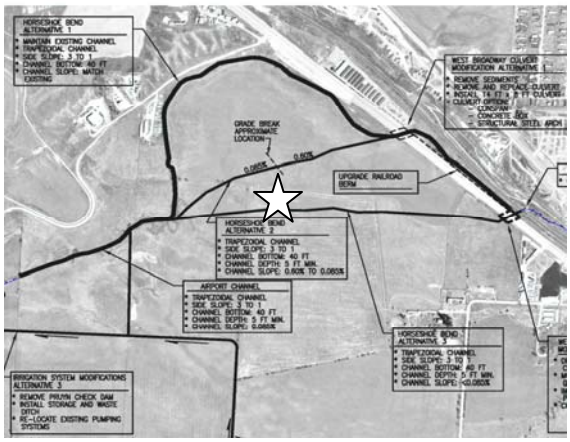
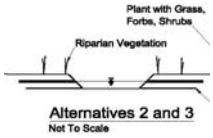
Horseshoe Bend Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Rebuild Existing Channel**

Key Alternative Elements	
• Maintain the existing alignment and improve stability of the banks by reducing slopes and vegetating. • Construct channel with terraced section to 40 FT wide, side slopes 3:1. Eliminate berms. • Fill channel to match upper and lower grades • Replace culverts under West Broadway to improve fish passage and mitigate erosion potential at current culvert outfall. • Includes channel cleanup at Airport property area.	  Alternative 1 Not To Scale

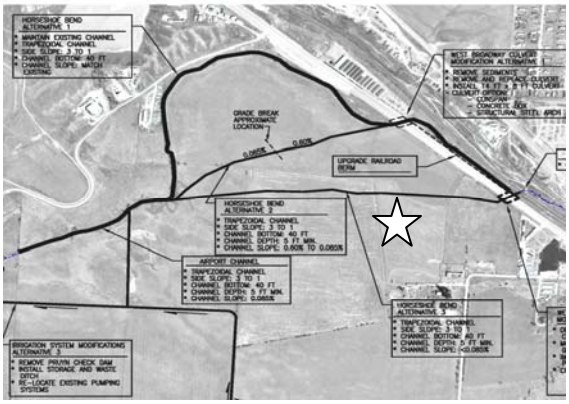
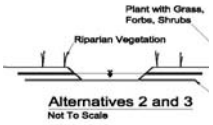
Advantages	***Disadvantages***
• Reduce sediment discharge to stream. • Maintain existing land uses. • Allows fish passage beneath West Broadway. • Eliminates erosion issue at current culvert outfall.	• Maintains an unnatural stream alignment that is subject to stream avulsion in the future. • Difficult to provide removal of rock deposited in channel from steeper upstream reaches. • Existing stream gradient is not improved resulting in continued excess sediment deposition.

Notes:

This alternative will require a significant amount of excavation with the existing grades. Provides less opportunity for development of a natural system with adjacent riparian areas on each side of channel.

Horseshoe Bend Alternative 2 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Construct New Channel From West Broadway Culverts**
Key Alternative Elements • Construct a new stream channel with a riparian corridor from the existing West Broadway crossing to the end of the bend. • Construct channel with terraced section to 40 FT wide, side slopes 3:1. • Set channel slope to 0.06% to 0.085%. • Replace West Broadway culverts to promote fish passage. • Provide area for coarse sediment removal. • Includes channel cleanup at Airport property area.	  	
Advantages		***Disadvantages***
• Provides a more natural stream channel with greater capability for sediment transport than Alternative 1. • Provides a riparian corridor. • Provides an area for removal of rock deposited from steeper upstream reaches. • Allows fish passage beneath West Broadway. • Eliminates erosion issue at current culvert outfall.		• Disrupts current land use and potential future land uses.
Notes:		
This is the most economical alternative because it is the shortest route for both new and existing channel layouts.		

Horseshoe Bend Alternative 3 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Construct New Channel From Railroad Bridge**

Key Alternative Elements	
• Construct a new stream channel with a riparian corridor from the Railroad Bridge to the end of the bend. • Construct channel with terraced section to 40 FT wide, side slopes 3:1. Construct channel with terraced section to 40 FT wide, side slopes 3:1. • Set channel slope to <0.085%. • Replace West Broadway culverts to promote fish passage. • Provide area for coarse sediment removal. • Includes channel cleanup at Airport property area.	 

Advantages	***Disadvantages***
• Provides a more natural stream channel with greater capability for sediment transport than Alternatives 1 or 2. • Provides a riparian corridor. • Provides an area for removal of rock deposited from steeper upstream reaches. • Eliminates potential maintenance in reach from railroad bridge to current West Broadway crossing. • Allows fish passage beneath West Broadway. • Eliminates erosion issue at current culvert outfall.	• Disrupts current land use and potential future land uses to a greater extent than Alternative 2. • Requires raising West Broadway to accommodate culverts. • Requires West Broadway Culvert Alternative 2 to be included as counterpart to this alternative.

Notes:

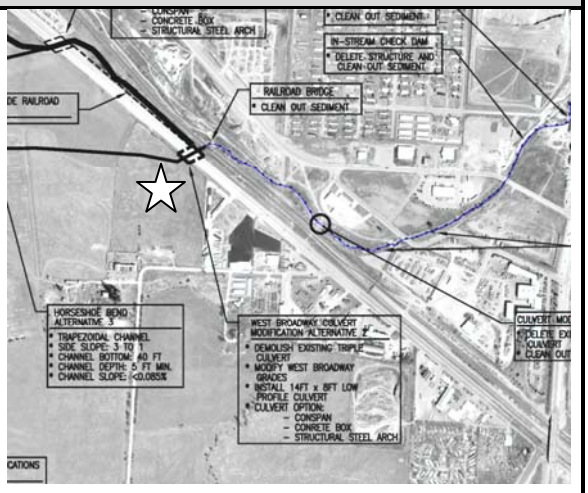
This alternative provides the best opportunities for sediment transport but does not eliminate the need for coarse sediment removal.

West Broadway Culvert Modification Alternative 1 ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Replace Existing Culvert at Existing Location**
Key Alternative Elements		

• Remove existing arch culvert and install with larger 8 FT x 14 FT arch or box culvert.
• Clean and re-establish channel section upstream and down.
• Culvert Options:
  o Conspan
  o Concrete Box
  o Structural Steel Plate Arch.		

Advantages		***Disadvantages***
• Reduce potential flooding of West Broadway. • Improves hydraulic function and fish passage at West Broadway. • Enables transport of sediment load to below West Broadway. • Requires less modification to West Broadway pavement section. • Less impact to West Broadway traffic during construction. • Lower cost.		• Wider channel opening will reduce low flow depths. Will reduce fish passage window.
Notes:		
Maintaining the existing alignment and culvert location will lessen the amount of impact to the West Broadway road section and will result in far less re-grading of the roadway. This alternative provides a lower cost approach than the revised location addressed in Alternative 2, partly due to less restoration that would be associated with removal or abandonment of the existing triple culvert installation.		

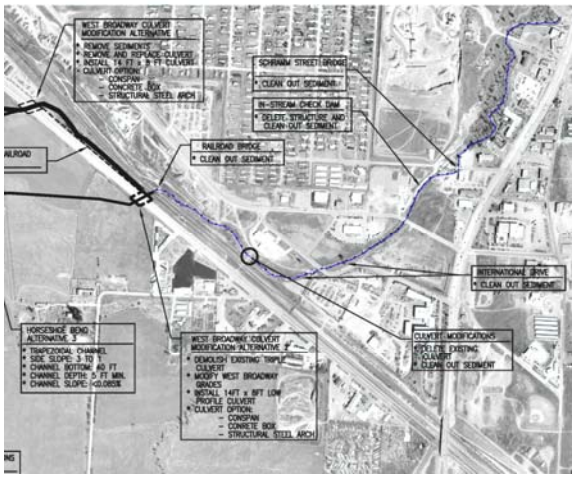
West Broadway Culvert Modification Alternative 2	**Description:**	**Replace Existing Culvert at New Location (East Near Railroad Crossing)**
Grant Creek Environmental Restoration and Flood Control		

Key Alternative Elements	
• Remove or abandon existing arch culvert. Install larger 8 FT x 14 FT arch or box culvert at location east of existing culverts. • Clean and re-establish channel section upstream and down. • Re-grade West Broadway to enable culvert installation at required grades. • Re-locate existing flow measurement staff gauge. • Culvert Options: o Conspan o Concrete Box o Structural Steel Plate Arch.	

Advantages	***Disadvantages***
• Reduces potential flooding of West Broadway by elimination of berm along West Broadway. • Improves hydraulic function and fish passage.	• Greater impact to West roadway traffic during construction. • Requires additional channel to be constructed. • Requires re-grading of West Broadway road profile. • Greater cost.

Notes:

Changing the existing alignment and culvert location will increase the amount of impact to the West Broadway road section and will result in re-grading of the roadway. This alternative provides a higher cost approach than the existing location addressed in Alternative 1. There is no hydraulic benefit to revising the location of the existing culvert.

Upper Grant Creek Improvements ***Grant Creek Environmental Restoration and Flood Control***	**Description:**	**Upper Grant Creek Improvements**
Key Alternative Elements		
• Upgrade the berm between Grant Creek and West Broadway. • Remove sediment and debris under the railroad bridge. • Remove unused culverts behind the Pepsi warehouse and reconstruct the channel through this reach. • Remove rock where it has accumulated upstream of the upper diversion dam and downstream of the International Road bridge to improve channel function. • Remove the irrigation diversion dam between International Road and Expressway.		
Advantages		***Disadvantages***
• Reduce potential flooding of West Broadway. • Improve hydraulic function and fish passage at Railroad bridge, behind Pepsi warehouse, and near International Avenue.		• Removal of culverts and abandoned irrigation diversions will require channel repairs.
Notes:		
No alternatives were developed for this reach because there are limited opportunities to reduce flood effects downstream or improve the riparian corridor. A number of maintenance tasks are planned to improve stream function and fish passage. The berm currently is high enough to contain the 100-year. The active irrigation diversion below International Road will remain in place.		

4.2. Development of System-Wide Alternatives

Following evaluation of the alternatives presented above for each reach, the reach alternatives were then combined into system-wide mitigation alternatives that combined the alternatives considered most viable for each reach. These system-wide alternatives were considered the top four alternatives for meeting identified project goals and objectives. The No Action Alternative was also included for consideration. Descriptions of the system-wide alternatives are presented in the paragraphs below.

4.2.1. System-Wide Alternative No. 1 – No-Action

The No-Action Alternative serves as a baseline so that decision-makers can compare the environmental effects of the action alternatives. Under the No-Action Alternative, no flood control or environmental restoration measures would be taken. The project team determined that the No-Action Alternative would not meet the project's purpose and need because it would not eliminate the existing flood hazards or restore the stream environment. In addition, flood hazards and environmental degradation could continue to worsen under this alternative due to future development in the study area.

4.2.2. Alternative No. 2 – Maintain Existing Channel

In general, this system-wide alternative involves the low-cost alternative, including maintaining the existing channel alignment and using flow control levees or berms for flood protection. Specifically, this alternative includes:

Clark Fork Confluence Reach: Option 1 of the Clark Fork Confluence Reach is included in this alternative. This option involves modification of the existing channel cross section and maintaining the existing channel alignment.

Mullan Road Reach: This alternative includes Option 1 that maintains the existing culvert at Mullan Road and installs a second parallel culvert.

Prairie Schooner and Mullan Trail Reaches: This alternative incorporates Option 1 of the Prairie Schooner reach that includes maintaining the existing channel alignment and installing/repairing existing flood control levees.

Hiawatha Lake Reach: This alternative includes maintaining the existing channel at Hiawatha Lake and continues to allow impoundment of water upgradient of the Hiawatha Railroad grade. This option requires flood protection and an existing residence that is currently within the floodplain.

Irrigation System Flow Control: This alternative considers abandonment of the Hellgate Valley Irrigation Company's irrigation flows.

Pruyn Property Check Dam: This alternative would call for removal of the Pruyn check dam.

Horseshoe Bend: This alternative includes construction of a new channel from the West Broadway Culvert. The alternative to rebuild the existing channel was a higher cost alternative, did not meet the associated landowner's needs, and was eliminated from further consideration.

West Broadway: Replacing the existing culvert at its current location with a box culvert was selected for all alternatives evaluated because roadway grades on West Broadway preclude moving culvert locations. Other culvert locations would require raising the roadway profile at a considerable cost.

Upper Grant Creek Improvements: All alternatives considered include removal of the steel culverts at the Pepsi Company plant site, removal of an existing irrigation diversion near International Drive and miscellaneous channel cleaning.

4.2.3. System-Wide Alternative No. 3 – Relocate Existing Channel and Terrace Channel with Levees

In general, this system-wide alternative includes development of flood control channel terracing to build more natural systems. However, this alternative also utilizes flood control levees or berms for flood protection. Specifically, this alternative includes:

Clark Fork Confluence Reach: Similar to Alternative No. 2.

Mullan Road Reach: This alternative includes Option 3 of the Mullan Road Reach, which replaces the existing culvert at Mullan Road with a culvert that has greater hydraulic capacity.

Prairie Schooner and Mullan Trail Reaches: This alternative includes maintaining the existing channel alignment and grade. This alternative also includes the use of flood control berms or levees, in conjunction with channel terracing, to mitigate flooding to the Mullan Trail Estates subdivision area.

Hiawatha Lake Reach: This alternative includes construction of floodplain terracing and channel improvements in the Hiawatha Lake area. This alternative also incorporates clay lining of the floodplain area upgradient from the Hiawatha Railroad grade to limit recharge of floodwaters to the groundwater system.

Irrigation System Flow Control: This alternative includes elimination of the south waste ditch on the Hellgate Valley Irrigation Company system, abandonment of the south feeder ditch and re-railing of the north irrigation lateral.

Pruyn Property Check Dam: This alternative includes re-construction of the Pruyn Check Dam and reconstruction of a fish ladder or other fish passage mitigation measures.

Horseshoe Bend and West Broadway Reaches, Upper Grant Creek Improvements: This alternative is similar to System-Wide Alternative No. 2.

4.2.4. System-Wide Alternative No. 4 – Peak Flow Bypass with Channel Terracing

This system-wide alternative is similar to System-Wide Alternative 3, except it also includes a peak-flow bypass pipeline system at the Clark Fork Confluence to eliminate the need for flood control levees or berms in the vicinity of the Mullan Trail Estates subdivision. Specifically, this alternative includes:

Clark Fork Confluence Reach: This alternative includes maintaining the existing culvert at Mullan Road and installing a peak flow bypass structure upgradient from Mullan Road that will divert peak flows directly to the Clark Fork River floodplain.

Mullan Road Reach: The existing Mullan Road culvert will remain in this alternative.

Prairie Schooner and Mullan Trail Reaches: This alternative includes the excavation of flood control terracing and realignment of the channel. The channel modifications will function as a more naturally operating system that, in conjunction with the peak flow bypass system, will mitigate flooding in the Mullan Trail Estates subdivision areas without the use of levees or flood control berms.

Hiawatha Lake Reach: Similar to System-Wide Alternative No. 3.

Irrigation System Flow Control: Similar to System-Wide Alternative No. 3.

Pruyn Property Check Dam: Similar to System-Wide Alternatives No. 2 and No. 3.

Horseshoe Bend and West Broadway Reaches, Upper Grant Creek Improvements: This alternative is similar to System-Wide Alternative No. 2.

4.2.5. System-Wide Alternative No. 5 – Deep Channel Excavation

This system-wide alternative includes excavating the existing channel 5 to 8 feet to eliminate the need for flood control levees or berms and eliminate the need for a peak flow bypass system. This system-wide alternative has the highest capital cost and also includes the need for significant easements for construction and channel configuration. Specifically, this system-side alternative includes:

Clark Fork Confluence Reach: The existing alignment is maintained and channel excavation up to 8 feet is involved in this reach.

Mullan Road Reach: Deep excavation at the Clark Fork Confluence Reach requires replacing the existing culvert at Mullan Road. This alternative includes Mullan Road Option 3 that replaces the existing culvert with a 9 foot x 18 foot arch or box culvert.

Prairie Schooner and Mullan Trail Reaches: This alternative includes deep channel excavation in the existing alignment similar to the Clark Fork Confluence Reach noted above. The deep excavation alternative mitigates flooding at Mullan Trail Estates without the need for flood control levees or berms.

Hiawatha Lake Reach: This alternative is similar to Alternatives No. 3 and 4 for this reach.

Irrigation System Flow Control: This alternative is similar to Alternatives No. 3 and No. 4.

Pruyn Property Check Dam: This alternative includes reconstruction of the Pruyn Property Check Dam and the use of an Obermeyer Weir or other automated weir mechanism for irrigation control.

Horseshoe Bend and West Broadway Reaches, Upper Grant Creek Improvements: This system-wide alternative is similar to system-wide Alternative No. 3 and No. 4 in these areas.

4.3. Selection of the Recommended Plan

While the technical team has taken great care to document and identify the issues along Grant Creek within the study area, they also discovered that some restoration or flood mitigation solutions that address a specific project goal may provide other incidental benefits or detriments to the project. For example, making improvements to channel configuration that favor hydraulic conveyance capacity could also favor fish passage. Potential incidental recreation benefits may also provide for a more sustainable riparian corridor.

Because there is an absence of readily and generally accepted monetized environmental benefits for projects like Grant Creek, the value of environmental outputs and other non-monetary criteria, which were determined to be key project goals or opportunities, were evaluated by the project team for each system-wide mitigation alternative. This non-monetary evaluation of the system-wide alternatives is presented in Table 4.1. Each system-wide alternative was evaluated against the following evaluation criteria.

- Surface Water Flood Control – Flood mitigation is a key project goal and existing flooding problems in the Mullan Trail subdivision, Broadway culvert and Mullan Road culvert areas need to be addressed by the recommended plan. This key criterion was assigned the highest weighting factor of 3.
- Groundwater Control – Similar to controlling flooding due to surface water, elevated groundwater levels in the vicinity of Mullan Trail Estates should be addressed by the recommended plan, and was assigned a weighting factor of 2.
- Fish Passage – Elimination of existing known barriers to fish passage was identified as a key project goal. Removal of fish barriers is a key criterion and was assigned the highest weighting factor of 3.
- Sustainable Riparian Corridor – Riparian corridor development and enhancement is considered a key project goal. Incidental benefits from development of riparian zones include reduced maintenance costs and improved public benefits, and was assigned a weighting factor of 2.

Table 4.1 System-Wide Alternatives Non-Monetary Evaluation

System Wide Alternatives Non-Monetary Evaluation			Criteria Scoring (Base Criteria Score/Weighted Score)								
Evaluation Criteria	**Average Annual Cost**	**Weighted Site-Wide Alternative Score**	**Surface Water Flood Control**	**Ground Water Control**	**Fish Passage**	**Sustainable Riparian Corridor**	**Recreation & Aesthetic Opportunities**	**Minimizes Maintenance & Stabilized Channels**	**Meets County Regulatory Compliance**	**Meets Water Rights**	**Meets Stakeholder Acceptance**
Criteria Weighting Factor			**3**	**2**	**3**	**2**	**2**	**2**			
Alternative 1 **Do Nothing**	$ 50,000	$ 2	0/0	0/0	0/0	1/2	0/0	0/0	No	Yes	No
Alternative 2 **Maintain Existing Channel**	$ 177,400	$ 32	3/9	3/6	3/9	1/2	1/2	2/4	No (1)	No	Yes
Alternative 3 **Relocate Existing Channel & Terrace**	$ 242,700	$ 43	4/12	3/6	3/9	3/6	2/4	3/6	No (1)	Yes	Yes
Alternative 4 **Peak Flow Bypass and Channel Terrace**	$ 358,500	$ 54	4/12	4/8	4/12	5/10	4/8	2/4	Yes	Yes	Yes
Alternative 5 **Deep Channel Excavation**	$ 411,500	$ 51	5/15	4/8	4/12	3/6	1/2	4/8	Yes	Yes	No

0 = No Benefit
5 = Greatest Benefit

(1) County's Regulations do not permit levees or berms

- Recreation and Aesthetic Opportunities – Critical to project stakeholder and public acceptance is enhancement to the benefits of high-valued recreation opportunities. Increased public access opportunities in the area are not expected to be in conflict with the project purpose of environmental restoration and flood control.

Table 4.1 also identifies three criteria the system-wide alternative must meet to be considered for the recommended plan. These include:

- Meets County Regulatory Compliance – The plan must meet current County regulations for land use and flood control.
- Meets Water Rights – The plan must comply with current water rights conditions.
- Meets Stakeholder Acceptance – Many portions of the project will occur on private property. The plan must meet landowners' needs as well as public/agency expectations or necessary easements will not be obtainable.

The recommended plan for ecosystem restoration, referred to as the NER plan, must be based upon selection of the alternative which produces the maximum monetary and non-monetary beneficial effects. Table 4.2 presents a comparison of the evaluated system-wide mitigation alternatives considered. Table 4.2 utilizes detailed construction cost estimates presented in Appendix F – Task 600 Economic Analysis. Appendix F also provides the basis for the cost estimate unit prices used and a detailed benefit cost analysis of the preferred alternative. Table 4.2 provides the Total Estimated Project First Cost (Capital Cost) and a Total Average Annual Cost.

The non-monetary evaluation presented identifies Site Wide Alternative No.4 as the highest scoring alternative for selected criteria and is the only alternative that meets County regulatory compliance, water rights and stakeholder acceptance. The comparison of alternative costs presented in Table 4.2 shows Alternative No. 5 is the highest cost. Alternative No. 2 is the second lowest cost alternative but does not meet minimum project goals of addressing flooding. System-wide Alternatives No. 3 and No. 4 were advanced for final evaluation. Since Alternative No. 3 included flood control levees or berms that are not acceptable under Missoula County regulations, System-Wide Alternative No. 4 was selected as the preferred plan.

Table 4.2 Comparison of System-Wide Mitigation Alternative Costs

Comparison of System Wide Mitigation Alternative Costs							
	Segment (Reach) Alternatives	**Segment Cost**	**System Wide Alternative No. 1**	**System Wide Alternative No. 2**	**System Wide Alternative No. 3**	**System Wide Alternative No. 4**	**System Alternative No. 5**
			No Action	**Maintain Existing Channel**	**Re-locate Existing Channel and Channel Terracing With Levees**	**Peak Flow Bypass With Channel Terracing**	**Deep Channel Excavation**
0	**Do Nothing**						
$O_{(1)}$	No New Construction, Maintain All Reaches	$ -	$ -				
I	**Clark Fork Confluence**						
$I_{(1)}$	Modify Existing Channel	$ 70,600		$ 70,600			
$I_{(2)}$	Move Exisiting Channel	$ 116,000			$ 116,000		
$I_{(3)}$	Construct Peak Flow Bypass	$ 860,800				$ 860,800	
$I_{(4)}$	Deepen Channel on Existing Alignment	$ 160,000					$ 160,000
II	**Mullan Road**						
$II_{(1)}$	Maintain Existing Culvert & Install Parallel Culvert	$ 167,000		$ 167,000			
$II_{(2)}$	Maintain Existing Culvert	$ 9,500				$ 9,500	
$II_{(3)}$	Replace Existing Culvert	$ 209,800			$ 209,800		$ 209,800
III	**Prairie Schooner Channel**						
$III_{(1)}$	Maintain Existing Channel Alignment	$ 281,000		$ 281,000	$ 281,000		
$III_{(2)}$	Revise Channel Alignment & Terrace	$ 408,000				$ 408,000	
$III_{(3)}$	Deepen Channel on Existing Alignment	$ 838,500					$ 838,500
IV	**Mullan Trail Channel**						
$IV_{(1)}$	Maintain Existing Channel Alignment	$ 214,500		$ 214,500			
$IV_{(2)}$	Revise Channel Alignment & Terrace	$ 636,300			$ 636,300	$ 636,300	
$IV_{(3)}$	Deepen Channel on Existing Alignment	$ 1,289,000					$ 1,289,000
V	**Hiawatha Lake**						
$V_{(1)}$	Maintain Existing Channel	$ 37,000		$ 37,000			
$V_{(2)}$	Construction Riparian Zone & Terrace	$ 574,000					
$V_{(3)}$	Construct Terrace & Install Clay Liner	$ 695,000			$ 695,000	$ 695,000	$ 695,000
VI	**Irrigation System Flow Control**						
$VI_{(1)}$	Abandon Hellgate Valley Irrigation	$ 15,500		$ 15,500			
$VI_{(2)}$	Eliminate Waste in S. Ditches/Improve N. Ditch	$ 48,000			$ 48,000	$ 48,000	$ 48,000
VII	**Pruyn Property Check Dam**						
$VII_{(1)}$	Check Dam Removal	$ 27,000		$ 27,000			
$VII_{(2)}$	Check Dam, Reconstruction with Fish Ladder	$ 36,000			$ 36,000	$ 36,000	
$VII_{(3)}$	Check Dam Reconstruction with Obermeyer Weir	$ 110,000					$ 110,000
VIII	**Horseshoe Bend**						
$VIII_{(2)}$	Construct New Channel from West Broadway Culvert	$ 463,000		$ 463,000	$ 463,000	$ 463,000	$ 463,000
IX	**West Broadway**						
$IV_{(2)}$	Replace Existing Culvert at Existing Location	$ 378,700		$ 378,700	$ 378,700	$ 378,700	$ 378,700
X	**Upper Grant Creek**						
$X_{(1)}$	Upper Grant Creek Improvements	$ 122,800		$ 122,800	$ 122,800	$ 122,800	$ 122,800
	Subtotal		$ -	$ 1,777,100	$ 2,986,600	$ 3,658,100	$ 4,314,800
	Mobilization and Bonds	3%	-	$ 53,313	$ 89,598	$ 109,743	$ 129,444
	Subtotal		-	$ 1,830,413	$ 3,076,198	$ 3,767,843	$ 4,444,244
	Contractor's Overhead and Profit	8%	-	$ 146,433	$ 246,096	$ 301,427	$ 355,540
	Subtotal		-	$ 1,976,846	$ 3,322,294	$ 4,069,270	$ 4,799,784
	Miscellaneous Items and Contingencies	15%	-	$ 296,527	$ 498,344	$ 610,391	$ 719,968
	Subtotal		-	$ 2,273,373	$ 3,820,638	$ 4,679,661	$ 5,519,751
	Montana State Public Works Tax	1%	-	$ 22,734	$ 38,206	$ 46,797	$ 55,198
	Subtotal		-	$ 2,296,107	$ 3,858,844	$ 4,726,458	$ 5,574,949
	Engineering, Legal and Fiscal	15%	-	$ 344,416	$ 578,827	$ 708,969	$ 836,242
	Total Estimated Project First Cost		-	$ 2,640,523	$ 4,437,671	$ 5,435,426	$ 6,411,191
	Annual First Cost @ 7.0% interest over 30 years		-	$ 212,826	$ 357,676	$ 438,095	$ 516,742
	Operation, Maintenance & Replacement (OM&R)		$ 18,000	$ 5,000	$ 4,000	$ 5,000	$ 4,000
	Total Average Annual Cost		$ 18,000	$ 217,826	$ 361,676	$ 443,095	$ 520,742

5. RECOMMENDED PLAN

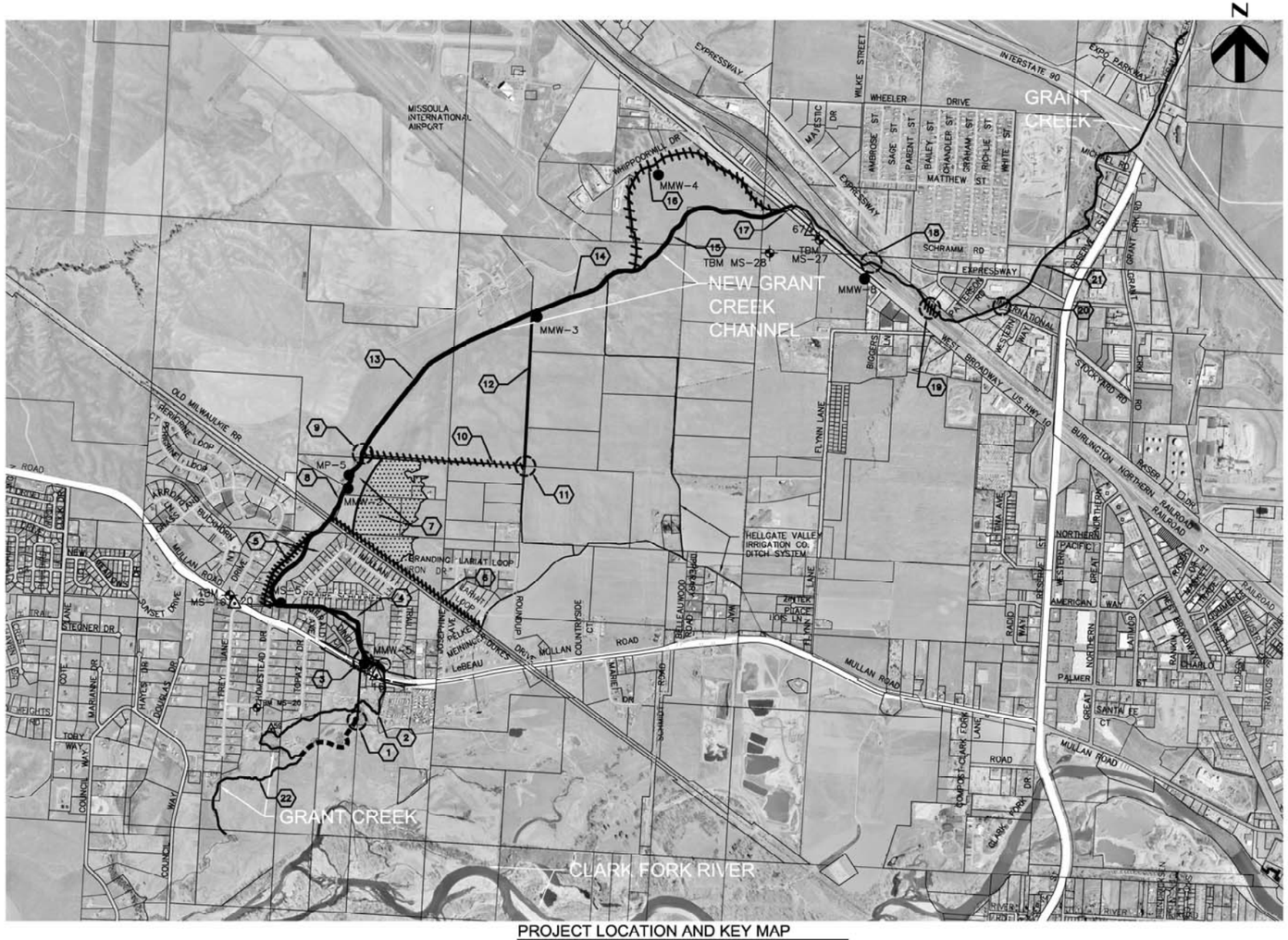
The recommended plan of action, also called the *preferred alternative*, is System-Wide Alternative No. 4, Peak Flow Bypass with Channel Terracing. This alternative is described in detail in previous paragraphs. This alternative includes the following components:

- Remove existing culverts above West Broadway and complete miscellaneous channel improvements;
- Replace the triple culverts at West Broadway with oversized box culverts;
- Install a peak-flow bypass structure that will divert the flow of Grant Creek into the floodplain of the Clark Fork River when flows exceed 300 cfs;
- Enhance a check dam;
- Develop an engineered floodplain within the flood-prone area by widening and terracing the channel and lining it with clay to eliminate percolation;
- Realign the stream channel and stabilize the bank at various sites in the study area;
- Remove a diversion structure and damaged culvert in the upper Grant Creek area;
- Remove sediment accumulation at various sites in the study area; and
- Restore riparian habitat.

Implementing the recommended plan would alleviate flood hazards in the study area.

5.1. Description of Recommended Plan

Figure 5.1 provides an overview of the recommended plan. Numbers on the figure correspond to the numbers presented in Table 5.1 and locations of proposed improvements are identified. The detailed design of the recommended plan is presented in the full design plan set provided in Appendix O – Task 1100 Design Drawings.



PROJECT LOCATION AND KEY MAP
1" = 1000'

PROJECT SOIL BORINGS AND MONITORING WELLS

POINT	NORTHING	EASTING	ELEVATION
MS-5	996381.40	822127.90	3142.30
MMW-2	997613.83	822679.14	3145.80
MMW-3	1000614.11	825972.94	3151.30
MMW-4	1003083.77	828088.90	3159.40
MMW-5	994564.65	822950.72	3144.00
MMW-8	1001265.70	831680.60	3173.40
MP-5	997849.75	822728.95	3151.30

PROJECT VERTICAL CONTROL

TBM MS-10 ELEVATION 3163.23
60D NAIL WITH YELLOW PLASTIC CAP IN SOUTH FACE OF POWER POLE, NORTH SIDE OF MULLAN ROAD, NORTHWEST QUADRANT OF GRASSLAND DRIVE AND MULLAN ROAD. (LINE D, STA. 10+13, 29' RIGHT)

TBM MS-20 ELEVATION 3144.63
RAILROAD SPIKE IN EAST FACE OF POWER POLE, SOUTH END OF HOMESTEAD DRIVE, FIRST POWER POLE TO THE EAST. (LINE B, STA. 23+28, 29' RIGHT)

TBM MS-27 ELEVATION 3166.50
60D NAIL IN NORTH SIDE OF A POWER POLE LOCATED WEST OF A SIGN 'CENTER LANE ONLY'. SOUTH SIDE OF WEST BROADWAY.

TBM MS-28 ELEVATION 3161.27
BOLT ON SOUTH SIDE OF A RAILROAD TIE FENCEPOST 0.6' ABOVE GROUND AND 3' SOUTHEAST OF CONTROL POINT # MRS-91. (LINE N, STA. 93+12, 145' RIGHT)

TBM MS-5 ELEVATION 3155.45
60D NAIL WITH YELLOW PLASTIC CAP IN SOUTH FACE OF POWER POLE, NORTH SIDE OF MULLAN ROAD, EAST OF COUNTRYSIDE CT., ACROSS FROM MARIE DR. (LINE C, STA. 61+29, 8' RIGHT)

PROJECT HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
16	995117.95	823798.25	WGM GROUP RED PLASTIC CAP SOUTH SIDE OF MULLAN ROAD, WEST OF MULLAN TRAIL, NORTH OF HOUSE #6443, 64.1' EAST OF MAILBOXES. (LINE C, STA. 19+97, 3' LEFT)
20	996364.52	821321.68	WGM GROUP RED PLASTIC CAP SOUTH SIDE OF MULLAN ROAD, SOUTHWEST QUADRANT OF FREY LANE AND MULLAN ROAD, 73.5' WEST OF STOP SIGN. (LINE D, STA. 8+59, 54' LEFT)
59	994178.86	821961.81	WGM GROUP RED PLASTIC CAP 18' SOUTH OF DRIVEWAY GOING EAST FROM THE SOUTH SIDE OF HOMESTEAD DRIVE, NORTH OF FENCE.
67	1002861.86	831377.85	PK NAIL IN EDGE OF ASPHALT, 9.8' SOUTH OF FOG LINE, 39.6' NORTH OF SIGN 'CENTER LANE ONLY', 33' NORTH OF A POWER POLE. (LINE N, STA. 101+53, 494 RIGHT)

KEY NOTES:

1. PEAK FLOW BYPASS PIPELINE, ENERGY DISSIPATION BASIN AND OUTFALL. SEE SHEET 204.
2. CLARK FORK CONFLUENCE REACH IMPROVEMENTS. SEE SHEETS 101 THROUGH 106.
3. PEAK FLOW BYPASS PIPELINE AND WEIR STRUCTURE. SEE SHEETS 201 THROUGH 204.
4. PRAIRE SCHOONER REACH CHANNEL CLEANING, FLOODPLAIN TERRACING AND CHANNEL RE-ALIGNMENT. SEE SHEETS 301 THROUGH 304.
5. MULLAN TRAIL REACH CHANNEL RE-ALIGNMENT AND FLOOD PLAIN TERRACING. SEE SHEETS 304 THROUGH 307.
6. ABANDON IN PLACE EXISTING SOUTH WASTE DITCH ON HELLGATE VALLEY IRRIGATION CO. SYSTEM. SEE SHEET 401, NOTE 5.
7. LOWER HIAWATHA LAKE REACH FLOODPLAIN TERRACING AND WASTE MATERIAL PLACEMENT. SEE SHEETS 401 THROUGH 402.
8. LOWER HIAWATHA LAKE REACH CHANNEL CLEANING AND FLOODPLAIN TERRACING. SEE SHEETS 401 THROUGH 402.
9. PRUYN CHECK DAM MODIFICATIONS. SEE SHEET 416.
10. ABANDON IN-PLACE EXISTING NORTH WASTE DITCH ON HELLGATE VALLEY IRRIGATION CO. SYSTEM. SEE SHEET 417.
11. NORTH IRRIGATION LATERAL DITCH DIVERSION STRUCTURE. SEE SHEET 417.
12. NORTH IRRIGATION LATERAL DITCH EXTENSION AND DITCH LINING. SEE SHEET 417.
13. MIDDLE HIAWATHA LAKE REACH CHANNEL CLEANING AND PROFILE ADJUSTMENT. SEE SHEETS 403 THROUGH 417.
14. UPPER HIAWATHA LAKE REACH CHANNEL ALIGNMENT MODIFICATION AND FLOODPLAIN TERRACING. SEE SHEETS 408 THROUGH 411.
15. HORSESHOE BEND REACH CHANNEL RE-ALIGNMENT AND FLOODPLAIN TERRACING. SEE SHEETS 411 THROUGH 415.
16. HORSESHOE BEND REACH EXISTING CHANNEL REMOVAL AND BACKFILLING. SEE GENERAL SITE PLAN SHEETS 6 THROUGH 7.
17. US HIGHWAY 10 / WEST BROADWAY BOX CULVERT REPLACEMENT AND ROAD MODIFICATIONS. SEE SHEETS 501 THROUGH 503.
18. UPPER GRANT CREEK CHANNEL IMPROVEMENTS AND RAILROAD CROSSING MATERIAL REMOVAL DETAILS. SEE SHEETS 601 THROUGH 603 AND 614.
19. PEPSI CO. PLANT CULVERT REMOVAL AND CHANNEL RESTORATION. SEE SHEET 614.
20. IRRIGATION DIVERSION DAM DEMOLITION AND CHANNEL RESTORATION. SEE SHEETS 607 AND 615.
21. UPPER GRANT CREEK REACH MISCELLANEOUS CHANNEL IMPROVEMENTS AND MATERIAL REMOVAL. SEE SHEETS 601 THROUGH 613.
22. LIVESTOCK ACCESS BRIDGE REPLACEMENT. SEE SHEET 205.

PROJECT GENERAL NOTES

1. UTILITIES SHOWN ARE AT LOCATIONS IDENTIFIED PREVIOUSLY BY ONE-CALL LOCATORS. CONTRACTOR SHALL FIELD VERIFY ALL UTILITIES INCLUDING ALL SERVICES TO ALL PROPERTIES. THESE DRAWINGS MAY NOT SHOW ALL UTILITIES. SEE SPECIFICATIONS FOR REQUIREMENTS REGUARDING UTILITIES. THE DEPTH OF ALL EXISTING UTILITIES ARE UNKNOWN.
2. NOT ALL OVERHEAD LINES ARE SHOWN ON THE DRAWINGS. WHERE MULTIPLE LINES GO FROM POLE TO SINGLE PROPERTY, ONLY SINGLE AERIAL POWER LINE HAS BEEN SHOWN FOR CLARITY.
3. THE FLIGHT DATE OF THE AERIAL PHOTOS FOR THIS PROJECT WAS APRIL, 1999. THE PHOTOS ARE FOR REFERENCE ONLY AND CANNOT BE RELIED UPON FOR THE LOCATIONS OF ANY PROPOSED OR EXISTING UTILITIES, STRUCTURES, OR FOR SCALE.
4. ALL WORK SHALL CONFORM TO THE MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS, FIFTH EDITION, MARCH, 2003 AS REVISED BY SPECIAL PROVISIONS.
5. DATUM: NAD 83 HORIZONTAL
   NAVD 88 VERTICAL
6. COORDINATES GIVEN ARE IN GROUND. TO CONVERT TO GRID COORDINATES MULTIPLY BY 0.999246725.
7. DIAL BEFORE YOU DIG!!
   CALL ONE CALL LOCATORS
   #1-800-424-5555
8. RIGHT-OF-WAY AND PROPERTY BOUNDARIES SHOWN ARE BASED UPON MISSOULA COUNTY OWNERSHIP DATABASE AND ARE APPROXIMATE.

HDR Engineering, Inc.

MAXIM TECHNOLOGIES INC®
A TETRA TECH COMPANY

MISSOULA COUNTY, MONTANA

GRANT CREEK RESTORATION AND FLOOD CONTROL

Project Manager	D. HARMON
Designed	D. HARMON
Drawn	B. NEWELL
Checked	
Project Number	00000000005596
Date	FEBRUARY 2005

MONTANA
DANIEL J. HARMON
No. 6151 PE
REGISTERED PROFESSIONAL ENGINEER

THIS LINE IS ONE INCH WHEN DRAWING IS FULL SIZE. IF NOT ONE INCH, SCALE ACCORDINGLY.

No	By	Description	Date

PROJECT AREA AND PROJECT CONTROL MAP, GENERAL NOTES

Sheet Number	Issue
3	

P:\Work\00_5596 Grnt Creek\Cadd\Drawing\GCFR-003.DWG
03-14-05 ASBROCK 08:05:50

Figure 5.1 Recommended Plan

Table 5.1 Recommended Plan Project Elements

Key Number[(1)]	Description
1	Peak flow bypass pipeline, energy dissipation basin and outfall
2	Clark Fork confluence reach improvements
3	Peak flow bypass pipeline and weir structure
4	Prairie Schooner reach channel cleaning, floodplain terracing and channel realignment
5	Mullan Trail reach channel realignment and floodplain terracing
6	Abandon existing south waste ditch on HVIC system
7	Lower Hiawatha Lake reach floodplain terracing and waste material placement
8	Lower Hiawatha Lake reach channel cleaning and floodplain terracing
9	Pruyn check dam modifications
10	Abandon existing north waste ditch on HVIC system
11	North irrigation lateral, ditch diversion structure
12	North irrigation lateral ditch extension and ditch lining
13	Middle Hiawatha Lake reach channel cleaning and profile adjustment
14	Upper Hiawatha Lake reach channel alignment modification and floodplain terracing
15	Horseshoe bend reach existing channel realignment and floodplain terracing
16	Horseshoe bend reach existing channel removal and backfilling
17	Highway 10 box culvert replacement and road modifications
18	Upper Grant Creek Highway 10 channel improvements and railroad crossing material removal
19	Pepsi Co. plant culvert removal and channel restoration
20	Irrigation diversion dam demolition
21	Upper Grant Creek reach miscellaneous channel improvements and material removal
22	Livestock access bridge replacement

[(1)] Key numbers reference improvements located on Figure 5.1 Recommended Plan

5.2. Environmental Compliance

5.2.1. National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) is the basic charter for protecting the environment and establishes policy, sets goals, and provides means for carrying out the policy. This design report, and associated environmental documentation in the following Appendices, describes the environment of the Grant Creek study area:

- Appendix G – Task 700 – Fisheries
- Appendix H – Task 703 – Cultural Resources

- Appendix I – Task 704 – Wetlands Assessment
- Appendix J – Task 705 – Riparian Restoration
- Appendix K – Task 707 – Biological Assessment

The above appendices discuss the environmental impacts of the preferred alternative. The above appendices will be used by the U.S. Army Corps of Engineers for completion of the project Environmental Assessment (EA). Any adverse environmental effects that cannot be avoided if the proposed action is implemented and the relationship between the short-term use of the human environmental and any irreversible or irretrievable commitments of resources that would occur if the proposed system-wide alternative is implemented will be identified in the EA.

The Grant Creek project could affect the following environmental resources: fisheries, cultural resources, wetlands, riparian corridor and endangered species. This design report has been prepared in compliance with NEPA and assumes that the requirements of NEPA/MEPA can be met with an environmental assessment (EA).

5.3. Preferred System-wide Alternative Implementation

5.3.1. Project Cost Estimate

The project cost estimate is provided in Appendix F – Economic Analysis. The unit costs presented are the direct cost of installed project goods and services. They are estimated based upon the following cost indices/services:

- RSM - RS Means, 2004
- HDRM – HDR Engineering, Inc. Mullan Road Bid Tabulation Avg.
- HDR – HDR Company Cost Tabulation, Past Area/Applicable Projects
- MDT – Montana Department of Transportation 2004 Average Bid Tabulation
- CQ – Cost Quotation. Refer to Quotation Sheet
- MTI – Maxim Technology, Inc. Silver Bow Creek Project Benchmarking
- MC – Missoula County Cost, Benchmark for Similar Projects

The construction cost estimate, presented in Table 600-3 of Appendix F, for the recommended system-wide alternative is $4,145,000. The construction cost estimate does not include project engineering or construction consequences.

Table 600-2 of Appendix F presents the estimate for the entire System-Wide Alternative No. 4, including engineering and contingencies.

5.3.2. Construction Contingency Costs

Contingencies have been added to System-Wide Alternative No.4, presented in Table 600-2 in Appendix F to reflect the effects of unforeseen conditions on construction cost estimates. They are completed as a percentage of construction cost.

5.3.3. Design and Construction Schedule

The preliminary design and design drawings have been completed for the project. See Appendix O – Task 1100 Design Drawings. Final right-of-way acquisition, permitting and construction activities remain. Assuming project funding is acquired within the first two quarters of 2005, a preliminary project implementation schedule is shown in Figure 5.2. Figure 5.2 assumes sufficient funding is secured to complete project construction as a single construction contract. This schedule is tentative and is heavily dependent upon funding acquisition.

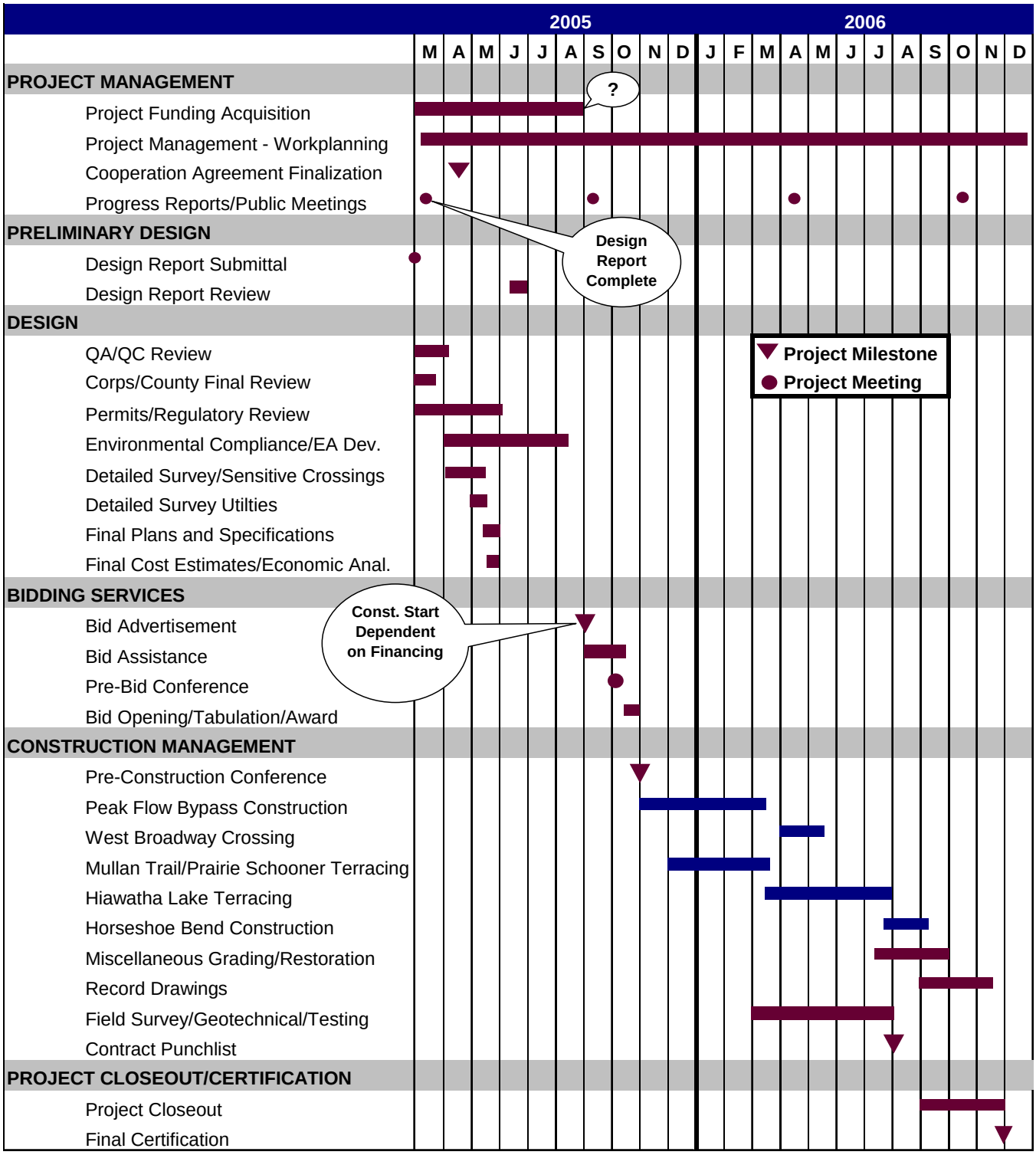
5.3.4. Sponsor's Financial Plan and Potential Construction Phasing

The project financial plan is presented in Appendix F – Economic Analysis for the project sponsor, Missoula County. Missoula County, through their identified sources, will provide the 25% non-federal matching funds for the project. Coordination with Missoula County on land agreements and financial plans will continue through the current period. There is the potential that Missoula County, serving as project sponsor, may be required to implement the project in phases if full funding does not become available. Should project phasing be required, the recommended project phasing is, in general, as follows:

- Phase 1 – Clark Fork Confluence Improvements, including Peak Flow Bypass Structures and Pipelines
- Phase 2 – West Broadway Culvert Replacement and Associated Channel Improvements and Pepsi, Co. Culverts Removal
- Phase 2A – Irrigation System Flow Control Improvements, including Relocation of South Lateral to North Lateral Location
- Phase 3 – Mullan Trail and Prairie Schooner Reach Channel Improvements, including Floodplain Terracing
- Phase 4 – Horseshoe Bend Channel Improvements, including Floodplain Terracing and Riparian Zone Improvements
- Phase 5 – Hiawatha Lake Channel Improvements, including Floodplain Terracing and Clay Liner Installation
- Phase 5A – Other Miscellaneous Channel Improvements, including Upper Grant Creek Improvements.

Figure 5.2 Project Implementation Schedule

Phase 3 - Project Implementation (Assumes Funding Acquisition For Full Project)



The above recommended project phasing is based upon the greatest risk to existing infrastructure for flooding and highest potential for environmental restoration for each of the project areas identified.

5.3.5. Operation and Maintenance Consideration

The operation and maintenance requirements for the riparian components will consist primarily of removal and prevention of invasive species and monitoring of planed vegetation to ensure survival and viability of materials. To achieve this goal, site irrigation may be necessary for the first several years following planting. Monitoring goals include sufficient monitoring to assess the effectiveness of the restoration features and improvements to aquatic and terrestrial habitat.

In order to measure the overall effectiveness of the Grant Creek Environmental Restoration and Flood Control project and to provide essential information to best direct and focus future actions, project non-federal sponsor Missoula County is interested in requesting a 2.5 percent allowance for post-construction monitoring activities. These activities are presented in preliminary form in Appendix B – Long Term Monitoring Plan.

The activities presented in Appendix B would be the responsibility of the sponsor, Missoula County, and would include 1-3-5 year post-construction actions to include, but not be limited to:

- Monitoring key technical components of the restoration to determine whether system hydraulics will allow 100-year peak flow events as predicted;
- Monitoring key technical and biological components of the restoration so that the successful restoration techniques deployed on this project can be exported to similar streams and creeks in the Clark Fork River watershed;
- Developing more accurate predictor responses of the restoration activities to changes in anthropogenic influences;
- Gathering data and information for effective and efficient management of the various reaches of Grant Creek;
- Collecting sufficient baseline data of pre-construction and post-construction condition changes to measure overall project performance and to determine ecosystem response; and
- Creation of both habitat management information products and a parallel public outreach program.

6. Technical Analysis

This section provides a summary of technical analysis reports that were prepared for various resources and for support of the development of the alternatives considered. These reports have been included as appendices to this design report.

6.1.1. Task 106 Public Meetings (Appendix A)

Two public open houses were held to address the project. The purpose of the public meetings was to gain input from residents and interested agencies regarding the creek restoration and flood mitigation design. The public was encouraged to point out any items that may have been overlooked and to provide any personal knowledge regarding Grant Creek. The primary focus of the first meeting was to discuss the project background and the range of alternatives and to gather any additional information that was available. The focus of the second meeting was to more clearly define the final elements of the project. Public open houses were held in the Ponderosa Room of the Grant Creek Inn (5280 Grant Creek Road) from 5 PM to 8 PM on August 4 and September 1, 2003. The project team also gave a presentation to the Water Quality District on September 9, 2003. One additional public meeting will be held to present the preferred alternative. This meeting has not yet been scheduled.

In addition to the public open houses, Missoula County and the project team have been in contact individually with key landowners and stakeholders. The Mullan Trail Homeowners group and the Clark Fork Coalition (a local environmental organization) have been represented on the County's management team and have participated in and supported the project since its inception.

In a related process, several public meetings have been held to discuss the growth planning process in the lower Grant Creek area. The Missoula Office of Planning and Grants has been coordinating the development of the Wye-Mullan West Comprehensive Plan by holding regular neighborhood meetings and citizen involvement. The Grant Creek flood mitigation/stream restoration project has been discussed at some of those meetings, and citizens have been given periodic updates through local newsletters.

The following organizations are aware of the Grant Creek flood mitigation/stream restoration project and have written letters of support or given verbal approval of the project: Missoula County Commissioners; Mayor of Missoula; Missoula Office of Planning and Grants; Montana Fish, Wildlife and Parks; Mullan Trail Landowners Association; Trout Unlimited; Clark Fork Coalition, and several local landowners.

Please see Appendix A for comments, letters, sign-in sheets, meeting agendas, and materials presented at the public meetings.

6.1.2. Task 108: Long-Term Monitoring Plan (Appendix B)

A long-term monitoring strategy will be developed to evaluate the success of the selected alternative, and to delineate roles and responsibilities for managing the implemented project. A preliminary draft of the long-term monitoring plan is presented in Appendix B. The monitoring plan includes recommendations for collaboration between Missoula County, the City of Missoula, and the University of Montana for long-term monitoring. The plan will require acquisition of additional funding to implement the Monitoring Plan. See Appendix B for detailed information.

6.1.3. Task 300: Surface Water Hydrologic Analyses (Appendix C)

A surface water hydrologic analysis was completed for the Grant Creek project. The objective was to provide hydrologic inputs including peak design flows and stream flow hydrographs with associated return periods to support hydraulic, groundwater, and design studies that focused on the mitigation of flood hazards and restoration of floodplain habitat. The surface water report presents a discussion of six subtasks: a limited watershed analysis and reference site survey, a regional gauge analysis, limited hydrologic modeling, an inventory of tributary storm water discharges, a future conditions hydrology analysis, and a surface water monitoring plan.

The Grant Creek basin is located immediately north of Missoula, Montana, in the central part of the Clark Fork River basin in western Montana (see Figure 6.1, Watershed Location). The basin drains about 25 square miles of a southward-sloping drainage basin with land cover primarily consisting of grasslands and coniferous forests. Elevations in the basin range from 8,150 feet east of Murphy Peak to 3,100 feet at the creek's confluence with the Clark Fork River.

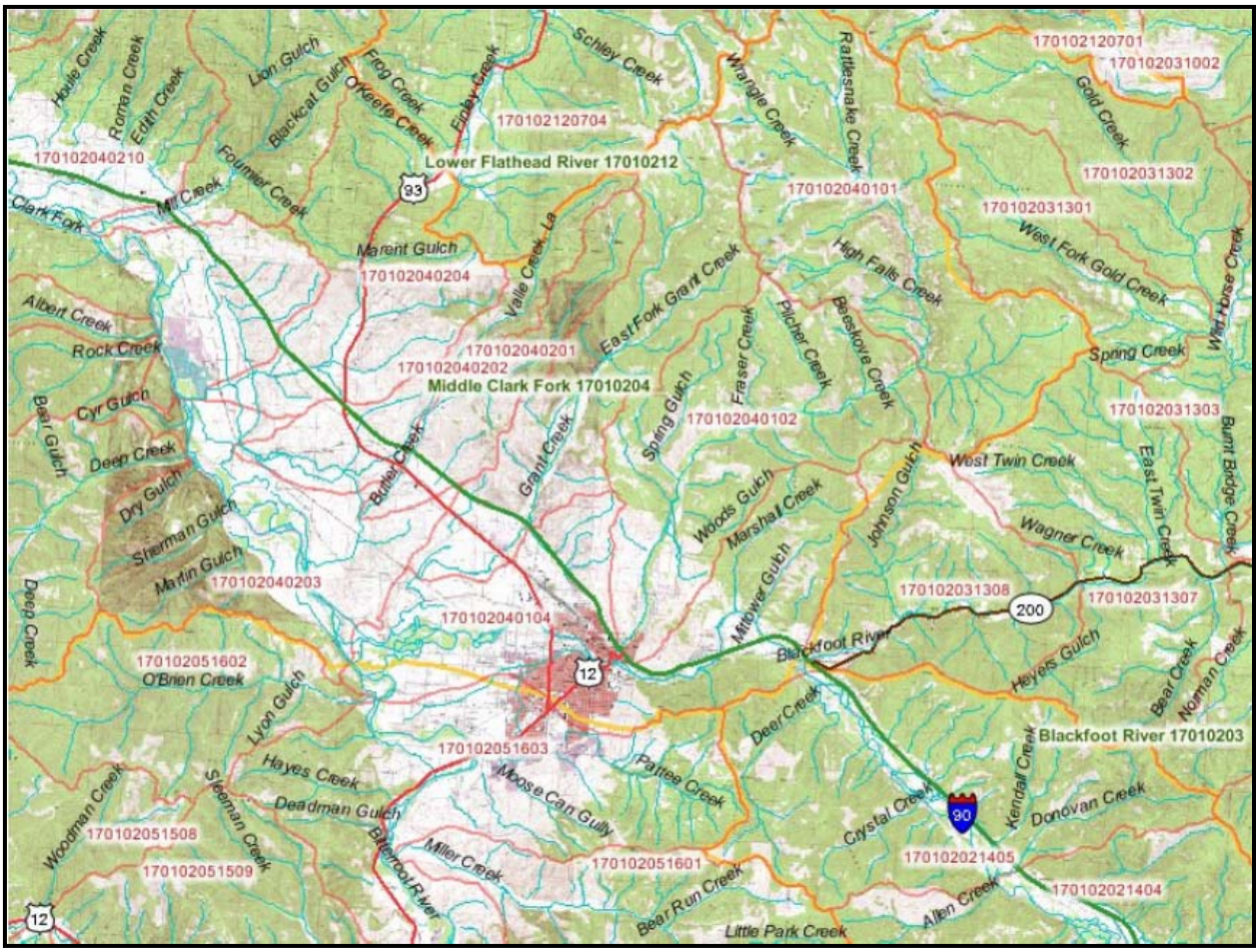


Figure 6.1 Watershed Location

The natural drainage system in the Grant Creek basin consists of three distinctly different regions. The upper watershed consists of steep mountainous slopes with substantial areas of Belt metasediments and localized outcrops of igneous rock. The steep tributary channels of the upper watershed have slopes averaging 10%. Bed composition in this area consists of mainly large cobbles. Downstream of the confluence of the east and main forks of Grant Creek, the channel system transitions onto a flatter sloped alluvial fan with significant deposits of cobbles. Additionally, the porous nature of the alluvial fan results in significant loss of water below ground in this reach.

The lower reach through the Mullan Trail Subdivision has a channel slope of less than 1% and is generally a sand bed stream. Toward the confluence with the Clark Fork River, the bed materials change towards finer sands and silts. In addition to natural sources of water to the creek, a significant amount of irrigation return flow enters the creek system immediately upstream of the Hiawatha Trestle Bridge from the HVIC diversion on the Clark Fork River. Initial groundwater monitoring by Maxim indicates that this and other irrigation flows might be significantly influencing the local hydrology of the creek system downstream of West Broadway.

6.1.4. Task 400: Hydraulics Report (Appendix D)

The hydraulics report summarizes pertinent technical issues and methods used in the hydraulic analysis of Grant Creek. The purpose of the hydraulics study is to determine channel routing characteristics and flood levels along the stream channel and to model and test potential future drainage improvements along the stream corridor.

To develop a (HEC-RAS) model, the team began by using the best available model, which was an existing HEC-RAS model developed in 2001 by HKM Engineers. Components of this model were reviewed including topography, cross sections, hydraulic roughness, hydraulic structures, expansion/contraction coefficients, and discharges. Also, additional surveys were conducted and new cross sections were added to the model. Water surface elevations for the 2-, 10-, 50-, 100-, and 500-year flood events were developed for the watershed (Task 300). The flow rates used in the hydraulic modeling were estimated using a combination of regional regression results, actual stream flow measurements, and the Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) program, which is designed to simulate the precipitation-runoff process of watersheds.

Model findings concluded that the channel downstream of Mullan Road is under capacity and flooding is evident for the surrounding areas. The Mullan Road culvert itself acts as a significant restriction to flow. This restriction causes an expansive backwater area that produces flooding over much of the Mullan Trail Subdivision. Just upstream of the subdivision, the abandoned railroad grade also acts as a flow restriction and causes additional flooding immediately to the north in the Hiawatha Lake area.

Four of the five site-wide alternatives (all but the No-Action Alternative) were modeled using HEC-RAS. Two design flows were used to evaluate each alternative: the 2-year discharge (213 cfs) and the 100-year flow (822 cfs). The goal of this analysis was to explore a variety of different configurations of the channel and floodplain that would reduce flooding throughout the project reach, but specifically in the Mullan Trail Subdivision and the developed areas immediately downstream of the Mullan Road culvert.

6.1.5. Task 500: Groundwater Studies (Appendix E)

The objective of groundwater studies performed in the Grant Creek study area was to describe the hydrogeology of the area by identifying and characterizing the major components of the system including groundwater and surface water in the study area. Groundwater field investigation tasks included installing several monitoring wells and piezometers; collecting soil samples to determine soil properties; performing an aquifer test on a well completed in the shallow sand and gravel aquifer; collecting creek bed and bank sediment samples to determine sediment gradation distribution; measuring depth to groundwater in all new monitoring wells and piezometers, existing monitoring wells, and selected private wells to establish baseline groundwater conditions over a period of 12 months; measuring depth to groundwater,

groundwater temperature, pH, and specific conductance; and measuring stage in Grant Creek and irrigation ditches.

The shallow groundwater system in the study area generally consists of an approximately 20-foot-thick sand and gravel unit overlaid by an approximately 10-foot-thick layer of silt and sand. Groundwater flow direction in the sand and gravel unit is generally to the southwest with a gradient of about 3% northeast of West Broadway and less than 0.2% southwest of West Broadway. Groundwater elevations decreased between August 2003 and March 2004 and then increased between March and June 2004 in response to spring runoff.

Aquifer test analysis yielded transmissivity estimates for the shallow sand and gravel aquifer that ranged from 1,350 to 6,420 square feet per day. Hydraulic conductivity estimates from the test ranged from 350 to 730 feet per day.

Maxim developed a conceptual model of groundwater flow within the shallow system based on data collected during this study and previous studies. A numerical model of groundwater flow was then developed using MODFLOW based on the conceptual model. The numerical model was developed to help evaluate the effects of flood-control alternatives on groundwater elevations in the Mullan Trail subdivision.

The model is 13,600 feet wide and 18,600 feet long with a finite difference grid consisting of 68 columns, 93 rows, and uniform 200-foot grid spacing. The model consists of two layers with Layer 1 representing the shallow silt/sand unit and Layer 2 representing the underlying sand and gravel unit. Boundary conditions include general head boundaries at northern and southern margins of the domain with no flow boundaries assigned to the eastern and western margins. The recharge and river packages in MODLFOW were used to simulate seepage from Grant Creek and irrigation ditches within the model domain.

The model was successfully calibrated to steady-state conditions based on March 2004 data. A transient calibration of the model based on 2004 data was performed next to increase confidence in the model's ability to simulate seasonal groundwater conditions. Because Grant Creek did not exceed flood stage during 2004, the team also developed model scenarios representing estimated conditions during flooding in 1997 and during a 100-year flood event. The model was then used to evaluate various flood control alternatives to assess the effect of each alternative on peak groundwater elevations near Mullan Trail Estates.

Results of groundwater modeling suggest that the alternative with the most potential to reduce water table elevations in the Mullan Trail Estates is the proposed improvements to the Flynn Lowney ditch system. This alternative would eliminate all ditch laterals north and west of Tipperary Lane and replace them with a single lined ditch that would discharge to Grant Creek on the north end of the Pruyn property. Modeling indicates that these improvements could reduce peak groundwater elevations in Mullan Trail Estates by about 3 feet.

Another alternative is the proposed realignment of Grant Creek in the horseshoe bend area and Mullan Trail reaches along with constructing engineered floodplains in Hiawatha Lake and the Mullan Trail reach. Modeling results suggest that these improvements would help reduce peak groundwater elevations by about 1 foot.

In addition, lining the engineered floodplains at Hiawatha Lake and the Mullan Trail reach with compacted native clay would reduce simulated groundwater elevations beneath the subdivision. However, the benefits of these mitigation measures would be relatively small; each improvement would reduce peak groundwater elevations by less than 0.2 feet.

Groundwater modeling results indicate that installing a slurry wall along the south end of Hiawatha Lake is not advisable. Although a slurry wall might reduce groundwater elevations in the Mullan Trail Estates, it would raise groundwater elevations in other areas such as near Lariat Loop.

A model scenario was developed that simulated a combination of realigning the horseshoe bend, constructing engineered floodplains in Hiawatha Lake and the Mullan Trail reach, making improvements to irrigation ditch systems, and lining the engineered floodplain in Hiawatha Lake with 1 foot of compacted native clay. Model results indicate that the combination of these measures could reduce peak groundwater elevations near Mullan Trail Estates by 3 to 4 feet during a flood.

See Appendix E for details on the groundwater studies.

6.1.6. Task 600: Economic Analysis (Appendix F)

Summary cost estimates are presented for the five system wide alternatives in Tables 600-1 and 600-2 of Appendix F. The detailed cost estimates also include project contingencies and other allied costs. A present-day annual cost is also presented for each alternative for cost comparison. The present-day estimates utilize a 7% interest rate as required by FEMA and the Office of Management and Budget (OMB) and a 30-day design life of the period.

A summary of the cost comparison of the system-wide alternatives is presented below.

Table 6.1 Cost Comparison

System-Wide Alternative	Total Estimated Project First (Capital) Cost	Total Average Annual Cost
No. 1 – No Action	$0	$18,000
No. 2 – Maintain Existing Channel	$2,640,000	$218,000
No. 3 – Relocate Exiting Channel and Channel Terracing with Levees	$4,438,000	$362,000
No. 4 – Peak Flow Bypass with Channel Terracing	$5,435,000	$443,000
No. 5 – Deep Channel Excavation	$6,411,000	$521,000

Table 600-3 of Appendix F provides a detailed cost estimate for construction costs associated with the preferred System-Wide Alternative No. 4. The table also includes information on the basis of the unit costs. In addition to costs presented in Table 600-3 of Appendix F, a detailed Benefit-Cost Analysis was also conducted for the preferred alternative. A benefit-to-cost ratio of 1.83 has been calculated for the preferred alternative. See Appendix F – Task 600 Economic Analysis for additional information.

6.1.7. Task 701: Fisheries Study (Appendix G)

Montana Fish, Wildlife and Parks (MFWP), along with the Montana Natural Heritage Program (MTNHP), produce a Montana Animal Species of Concern Report annually.[5] Two fish species of concern are found in the Grant Creek study area: bull trout and westslope cutthroat trout.

Bull Trout. Bull trout (*Salvelinus confluentus*) are found locally in the Clark Fork and Flathead drainages of western Montana, and a MFWP survey conducted from 1999 to 2004 found bull trout in Grant Creek.

This species' slowly declining population trend led to their designation as a threatened species in 1998. Open migratory corridors, both within and among tributary streams, and larger rivers and lake systems are critical for maintaining bull trout populations. Habitat fragmentation and degradation, passage restrictions, and hybridization have been associated with declines in bull trout population. The Grant Creek project proposes to improve the confluence with the Clark Fork River, which would increase migration opportunities. In addition, the project would improve fish passage by eliminating known fish barriers and would enhance fish habitat by improving the overall stream ecology.

Westslope Cutthroat Trout. The westslope cutthroat trout (*Oncorhynchus clarki lewisi*) is one of two subspecies of native cutthroat that together have been designated Montana's state fish. A MFWP survey conducted from 1999 to 2004 found westslope cutthroat in Grant Creek. Westslope cutthroat trout require cool, clean, oxygenated waters and are therefore sensitive to fine sediment loads that affect streams close to disturbed areas. Due to their stringent habitat needs, they can serve as an indicator of ecosystem health. Westslope cutthroat trout seek out gravel substrate in riffles and pool crests for spawning habitat.

[5] Montana species of concern include species that are considered to be at risk due to declining population trends, rarity, threats to their habitat, and/or restricted distribution as determined by MTNHP and MFWP biologists in consultation with representatives of the Montana Chapter of the Wildlife Society, the Montana Chapter of the American Fisheries Society, and other experts. In addition, the list includes species that have a special designation by other agencies including the Bureau of Land Management, U.S. Forest Service, and U.S. Fish and Wildlife Service.

Results of the MFWP fish sampling efforts conducted from 1999 to 2004 indicate that this confluence serves as a migration route for westslope cutthroat and bull trout as well as other trout species including rainbow trout, northern pike minnow, and brook trout.

Please see Appendix G for more information.

6.1.8. Task 703: Cultural Resources (Appendix H)

Historical Research Associates, Inc. (HRA) of Missoula, Montana, contracted with HDR Engineering, Inc. (HDR) of Missoula, to conduct a Class I cultural review of the Grant Creek Environmental Restoration and Flood Control Project for use as a part of the Environmental Assessment (EA) for National Environmental Protection Act (NEPA) compliance.

The above Class I background research defined a number of previously recorded historical cultural resources and identified the project area as a moderate to high probability area for additional historic and prehistoric sites. HRA recommended pedestrian cultural resource inventory of areas of the project to be affected by ground disturbance during construction. This includes inventory of the limits of construction from the existing Grant Creek channel south of Mullan Road to the MRL tracks (24MO484) north of Broadway. Other areas recommended for cultural resource inventory include the two areas proposed for topsoil stripping and storage, two areas where impacts may occur on existing irrigation ditches, and three areas between Broadway and I-90 where culvert and stream bank replacement may affect existing cultural resources. Resources encountered during cultural resource inventory of the project area should be recorded to professional standards and recommendations of NRHP-eligibility made for each affected resource. See Appendix H for additional information.

HRA also conducted a cultural survey for the Mullan Road Corridor Sewer project, located entirely within the Grant Creek Study Area, and identified a total of five cultural resource properties and one isolated find within the area of potential effect for the proposed action (Table 3.3.8). Four of the properties are irrigation ditches, none of which would be affected by construction or operation of the new sewer line. However, the fifth property—a segment of the Hiawatha Railroad (24MO733)—might be affected by the construction of Line F. Depending on the level of disturbance, the project could be considered an “adverse effect” and could require mitigation before construction. Disturbance to the grade, especially to its associated drainage culverts, should be minimized. Photographic documentation of the drainage features could be an appropriate way to mitigate the effects of the proposed action on this resource.

Table 6.2 Summary of National Register Recommendations for Recorded Sites

Site Number	Site Type	Location	Recommended Eligible
24MO713	Hiawatha Railroad	T13N R20W, Section 10 NE	Yes
24MO901	Flynn-Dougherty Irrigation Ditch	T13N R20W , Section 12 SE SE	No
24MO550	Flynn-Lowney Irrigation Ditch	T13N R19W, Section 18 N ½	Yes

24MO902	Field-Dougherty Irrigation Ditch	T13N R20W , Sections 11 SW SE Section 14 N ½	Yes
24MO903	Grass Valley French Ditch	T13N R20W, Section 9 N ½ SE	Yes

6.1.9. Task 704: Wetland Assessment (Appendix I)

A wetland assessment of the Grant Creek project corridor was conducted on July 20 and October 20, 2004, to determine if areas adjacent to Grant Creek met the Corps' wetland criteria. Methods used to identify and delineate wetland areas in the study area included a review of existing information and an onsite field investigation.

Project team biologists conducted the investigation using standard methods described in the 1987 *Corps of Engineers Wetlands Delineation Manual* (online revised edition). Potential wetland areas were evaluated by sampling soil and by examining vegetation and hydrology. Based on the field assessment and the review of National Wetland Inventory, aerial photographs, and topographic maps, it appears that no areas adjacent to the creek/ditch currently meet wetland criteria, although some segments do contain riparian or floodplain vegetation.

Please see Appendix I for more information.

6.1.10. Task 705: Riparian Restoration Plan (Appendix J)

The Riparian Restoration Plan describes existing conditions in the study area, proposed modifications that would affect riparian restoration, and potential limitations for establishing diverse and riparian communities. Proposed seeding and planting mixtures are expected to regenerate stable and self-sustaining plant communities in balance with site conditions.

Factors affecting the establishment and maintenance of a sustainable riparian corridor include timing of water availability, amounts of water, substrate characteristics, structure of channels, projected future land uses, and floodplain management priorities. The primary objective of the Grant Creek project is flood control, so developing riparian vegetation must be consistent with flood control management objectives. The availability and timing of water delivery to the riparian zone of Grant Creek will be a major constraint in developing a self-sustaining, diverse riparian zone. The Riparian Restoration Plan outlines these constraints and identifies the potential of the area for revegetation.

Generally, there are three different revegetation approaches described in the plan: a wetland riparian mixture of seeding and planting, a dryland riparian mixture of seeding and planting, and a dryland riparian mixture of seeding only grasses and forbs. For a summary of proposed revegetation methods for various areas of the project site, see Table 1 and Figure 1 of the plan. A summary can also be found in Appendix J of this report along with additional information.

6.1.11. Task 707: Biological Assessment (Appendix K)

The Biological Assessment specifically discusses the effects of the proposed action on threatened and endangered species that could occur within the study area. Information used to conduct the Biological Assessment was obtained through personal communications with state and federal natural resource management agencies, accessing natural resource management databases, reviewing pertinent literature, and performing a field investigation.

The U.S. Fish and Wildlife Service identified the following threatened species that might be found in Missoula County. The agency did not identify any endangered species in Missoula County.

- Bald eagle (*Haliaeetus leucocephalus*), threatened
- Bull trout (*Salvelinus confluentus*), threatened
- Canada lynx (*Lynx canadensis*), threatened
- Gray wolf (*Canis lupus*), threatened
- Grizzly bear (*Ursus arctos horribilis*), threatened
- Water howellia (*Howellia aquatilis*), threatened
- Yellow-billed cuckoo (*Coccyzus americanus*), candidate

Based on the Biological Assessment, the proposed action would have no effect on any of the species listed above, with the exception of bull trout.

As discussed in the Biological Assessment, the proposed action would have beneficial impacts to bull trout and bull trout habitat because opportunities for fish passage and migration between fish populations in Grant Creek and the Clark Fork River would be increased and improved. The project would not change the period of time when Grant Creek flows into the Clark Fork River each year, but the bull trout habitat and stream flow conditions would be improved during this period when migration could occur.

See Appendix K for more information.

6.1.12. Task 800: Real Estate Plan (Appendix L)

The Real Estate Plan is detailed in Appendix L. There are 52 separate properties identified to be associated with the proposed system-wide mitigation plan. Most private parties have been contacted about the proposed plan and all property owners have expressed support of the plan. Right-of-way easements have been acquired for several large properties within the planning area. Missoula County is currently continuing development of the remaining easement documents. See Appendix L for additional details.

6.1.13. Task 900: Water Rights Analysis (Appendix M)

A water rights evaluation was completed to identify existing water rights and potential impacts from the alternatives that were considered. In the study area, water rights are obtained from either the HVIC, by way of the Clark Fork River, or Grant Creek itself.

There are 182 water rights filed with the DNRC on Grant Creek. Major water rights holders include Dougherty, Dougherty Ranch Partnership, Evans Products Company, Flynn and Flynn Ranch, Sinclair, and Wheeler. A detailed list of all the water rights on Grant Creek is included in Appendix M. The HVIC owns four separate water rights from the Clark Fork River, which are listed in the appendix.

The Grant Creek preferred alternative proposes to eliminate the waste and south lateral irrigation ditches and improve the north lateral irrigation ditch by adding a clay liner to prevent groundwater seepage. This alternative would not significantly change or eliminate any existing water rights, but would simply reroute existing irrigation flows to minimize flow into the Hiawatha Lake area, thus reducing flood hazards due to groundwater seepage. See Appendix M for additional details

6.1.14. Task 1100: Survey (Appendix N)

See Appendix N for a summary of the survey data including cross sections, Mullan Trail houses, and the survey report.

6.1.15. Task 1100: Design Drawings (Appendix O)

See Appendix O for a complete set of the design plan drawings for the preferred System-Wide Alternative No. 4.

6.1.16. Task 100: Project Elements Summary (Appendix P)

See Appendix P for a summary of the individual project mitigation elements initially considered for each reach of the study area.

7. REFERENCES

See Section 2.1.4 of this report for a list of references that were used specifically for this report. Please see each individual technical memorandum and associated appendix for additional references.

8. LIST OF PREPARERS

Missoula County Consultant Team:

- Dan Harmon, P.E., HDR Engineering, Inc.
- Kevin Coulton, P.E., HDR Engineering, Inc.
- Shanna Adams, E.I.T., HDR Engineering, Inc.
- Jeff Blank, P.E., HDR Engineering, Inc.
- Mitch Blum, HDR Engineering, Inc.
- Steve Foster, HDR Engineering, Inc.
- Cam Stringer, Maxim Technologies
- Gary Fischer, Maxim Technologies
- Bill Bucher, Maxim Technologies
- Chris Cerquone, Maxim Technologies
- Larry Caulfield, Maxim Technologies
- Sally Staley, Maxim Technologies
- Joe Elliott, Maxim Technologies
- Gant Massey, Bitterroot Restoration, Inc.

Missoula County Project Management Team:

- Greg Robertson, Missoula County Public Works Department
- Marnie McClain, Missoula County Attorney's Office
- Todd Klietz, Missoula County Office of Planning and Grants
- Chris Brick, Clark Fork Coalition
- Nancy Heil, Missoula City/County Office of Planning and Grants
- Vern Sandberg, Mullan Trail Homeowner's Association
- Kirby Campbell, Local Homeowner

Grant Creek Hydrology and Hydraulics

Mullan Build

Missoula, MT

May 15, 2020

Contents

1 Grant Creek Restoration and Flood Control 1
1.1 Background 1
1.2 Hydrologic Analysis 1
1.2.1 Effective FEMA Discharges 1
1.3 Regional Regression Equation Analysis 2
1.4 Recommended Discharges 3
1.5 Hydraulic Analysis 3
1.5.1 Hydraulic Model Development 3
1.5.2 Effective FEMA Model 4
1.5.3 Duplicate Effective Model 4
1.5.4 Corrected Effective Model 4
1.5.5 Existing Conditions Model 5
1.5.6 Preliminary Proposed Conditions Models 5
1.5.7 Cost Estimate 8
2 References 10

Tables

Table 1. FEMA effective discharges for Grant Creek 2
Table 2. Calculated regression parameters 2
Table 3. Results of the regression analysis 2
Table 4. Comparison of Computed Discharges for Grant Creek at Mullan Road 3
Table 5. Recommended Discharges for Grant Creek at Mullan Road 3
Table 6. Project Cost Estimate - Grant Creek Stream Restoration 8

Figures

Figure 1. 2D Domain of 2019 Model with Cross Sections from 2011 Effective Model 4
Figure 2. Layout of Grant Creek Design Elements 6
Figure 3. Potential alignment of the floodplain swale 8

Appendices

Appendix A. Stream Stats 1
Appendix B. Effective Floodplain Information 2
Appendix C. Cost Estimate 3

This page is intentionally left blank.

1 Grant Creek Restoration and Flood Control

1.1 Background

The Mullan BUILD Project (project) is a joint effort between the City of Missoula and Missoula County to develop infrastructure and Grant Creek improvements west of Reserve Street in the Mullan Road area of Missoula. The project will consist of designing, permitting, and constructing Grant Creek from Broadway through the proposed George Elmer Drive crossing to promote improved stream health, aquatic habitat, and water quality. The purpose of the hydrologic analysis is to confirm the discharge values required to assess the floodplain impacts and hydraulic design associated with the proposed Grant Creek and hydraulic crossing of George Elmer Drive associated with the Mullan Build project. The present hydraulic analysis is focused on developing a 20% design and planning level assessment of the Grant Creek channel design, proposed George Elmer crossing, and potential flood mitigation measures.

1.2 Hydrologic Analysis

1.2.1 Effective FEMA Discharges

The effective Grant Creek floodplain currently regulated by the Federal Emergency Management Agency (FEMA) was developed utilizing discharges calculated from regional regression equations presented in USGS Report Number 2003-4308 *Methods for Estimating Flood Frequency in Montana Based on Data Through Water Year 1998* (Reference 7). As noted in the CLOMR report submitted to FEMA in 2008 (Reference 2), the floodplain study team selected the most current regression equation methodology as the most defensible method for estimating peak discharges for the effective study.

The 2004 USGS study includes three regression methods for estimating of peak flow rates; the watershed characteristic method, a method based on active channel characteristics, and a third method based on bank full width.

The basin characteristics method is based upon watershed area, mean annual precipitation and percentage of the basin covered by forest. Watershed area was estimated using USGS and topographic mapping for the project. At Mullan Road the watershed area was measured to be 29.5 square miles. The results from this method produced a peak discharge estimate of 629 cfs at Mullan Road.

The active channel width method requires segments of channel that are still representative of the natural channel. Grant Creek has been significantly altered between I-90 and downstream of Mullan Road, rendering this method less useful for this reach of Grant Creek. However, a comparison was made upstream of I-90. In the undisturbed reaches of Grant Creek upstream of I-90, the active channel width was found to be relatively consistent with width ranges typically between 16 and 18 feet. Based on this method, the peak flow estimate ranged from 533 to 632 cfs with an average of 583 cfs. A regression analysis based on basin characteristics for this same location resulted in an estimate of 597 cfs. The average value has less than a 5% difference compared to the basin characteristic method. Hence, the discharges

associated with the basin regression estimate were used in the hydraulic analysis and are presented below in **Error! Reference source not found.**.

Table 1. FEMA effective discharges for Grant Creek

Location	Computed Peak Flow Rate (cfs)				
	2-year	10-year	50-year	100-year	500-year
Grant Creek at Mullan Road	170	358	538	629	864

It is noted that these discharges don't match those listed in the effective Flood Insurance Study (FIS). However, these discharges match those present in the FEMA model's submitted in 2011 and 2019.

1.3 Regional Regression Equation Analysis

Since the development of the Grant Creek floodplain study, the USGS has updated regional regression equations for estimating flood frequency flow rates. The equations are presented in USGS's report titled *Methods for Estimating Peak-Flow Frequencies at Ungaged Sites in Montana Based on Data through Water Year 2011* (SIR 2015-5019) (Reference 9). SIR 2015-5019 separates Montana into eight different regions based on topography and climatic conditions. The project site is located in the West Region. Regression equation parameters for the West Region include drainage area, mean annual precipitation, and percent forest. Site specific values for these variables were obtained from USGS StreamStats Version 4.3.11: Montana (Reference 10) (Appendix A) and are summarized in Table 2. The results of the regression analysis are presented in Table 3.

Table 2. Calculated regression parameters

Description	Drainage Area, DA (mi^2)	Mean Annual Precipitation P (in)	Percent Forest (%)
Range of values used for West Regression equation development	0.6 to 2,470	14.6 to 62.1	20.4 to 99.1
Grant Creek at Mullan Road	30.1	29.86	57.4

Table 3. Results of the regression analysis

Location	Computed Peak Flow Rate (cfs)				
	2-year	10-year	50-year	100-year	500-year
Grant Creek at Mullan Road	195	422	642	749	992

1.4 Recommended Discharges

The calculated discharges for the methods described in the previous sections are displayed in Table 4.

Table 4. Comparison of Computed Discharges for Grant Creek at Mullan Road

Method	Computed Peak Flow Rate (cfs)				
	2-year	10-year	50-year	100-year	500-year
FEMA Effective Discharges	170	358	538	629	864
Regional Regression Analysis	195	422	642	749	992

Upon reviewing the hydrologic analysis, it is recommended that the discharges utilized in FEMA's effective analysis be used for this project. Given that the intent of the project is to assess the floodplain impacts of the project, use of the effective discharges will provide a consistent comparison with the FEMA effective hydraulics. These discharge values are presented in Table 4 and below in Table 5.

Table 5. Recommended Discharges for Grant Creek at Mullan Road

Method	Computed Peak Flow Rate (cfs)				
	2-year	10-year	50-year	100-year	500-year
FEMA Effective Discharges	170	358	538	629	864

1.5 Hydraulic Analysis

The objective of the hydraulic analysis is to prepare an existing conditions, or baseline, HEC-RAS model of Grant Creek from just upstream of West Broadway through the project reach to just upstream of Mullan Road. FEMA's Effective model was used as a starting point and refinements were made as necessary to develop the hydraulics models representing the existing and proposed conditions. The following sections describe the basic model setup, refinements made to the Effective model, comparison to previous FEMA modeling and results.

1.5.1 Hydraulic Model Development

In order to assess impacts of the proposed project and establish preliminary proposed water surface elevations, the Effective FEMA HEC-RAS 1D/2D model was developed to simulate the pre-project (existing) and post-project (proposed) conditions. The development of these models are explained in detail below.

1.5.2 Effective FEMA Model

The effective hydraulic model for this study was originally developed in HEC-RAS in 2011 using a steady state 1D analysis. The FIS and Flood Insurance Rate Maps (FIRM) corresponding to the preliminary effective FEMA model are dated July 6, 2015 (Reference 2) and illustrate the project area to be a Zone AE without Floodway and Zone A. The FIRM panels associated with the BUILD project are 30063C1190E and 30063C1195E (Appendix B). The proposed project is located between river station (RS) 14020 and RS 20976 of the Effective model. In addition to the 2011 Effective model, a Letter of Map Amendment (LOMA) was submitted in July of 2019, in which a 2D domain was added to the model to better define the overland flow paths of the discharge overtopping West Broadway between RS 21762 and RS 22698. The 2D domain for the 2019 model is shown in Figure 1.

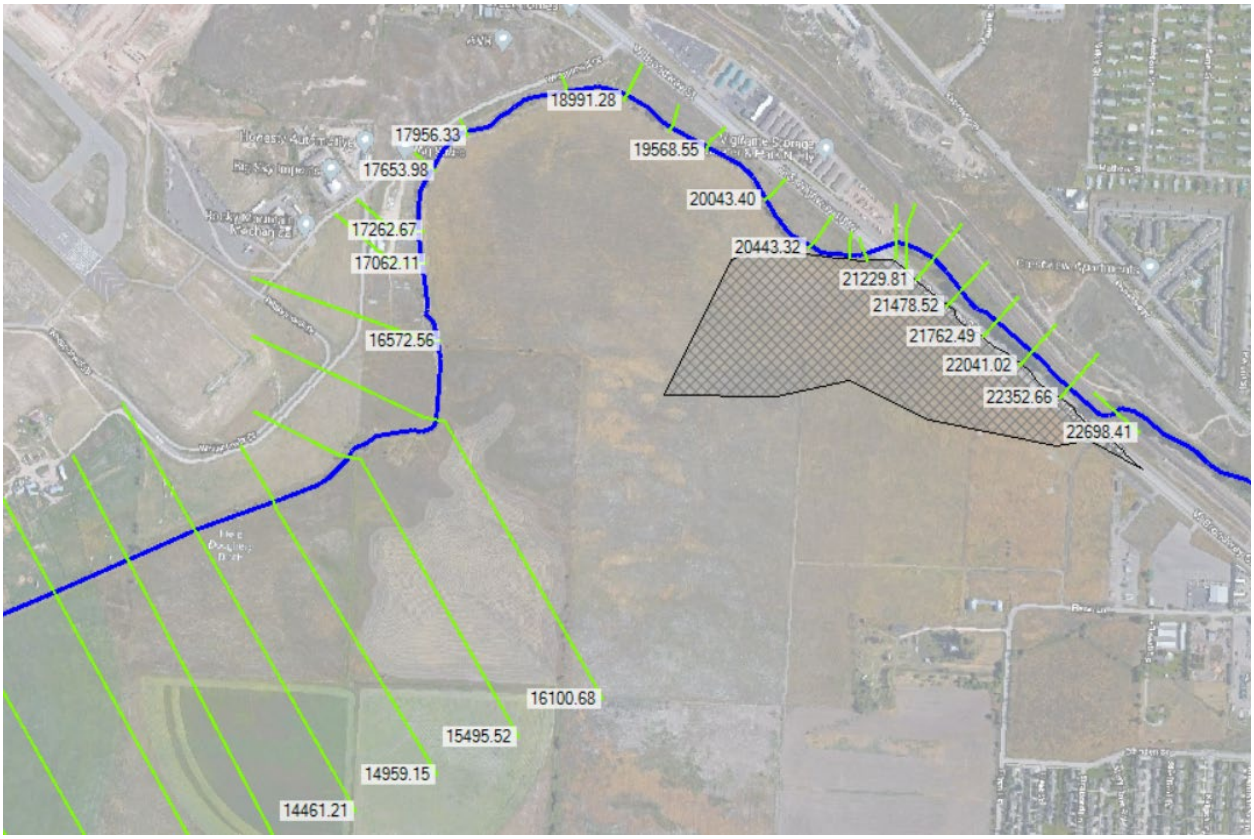


Figure 1. 2D Domain of 2019 Model with Cross Sections from 2011 Effective Model

1.5.3 Duplicate Effective Model

The Effective models mentioned above were received and simulated in the latest version of HEC-RAS (V5.0.7) to assess the impacts in the changes in software versions.

1.5.4 Corrected Effective Model

Per FEMA guidance (Reference 2), the Corrected Effective model is a model that "corrects any errors that occur in the Duplicate Effective model, adds any additional

cross sections, or incorporates more detailed topographic information than that used in the current effective model." The Corrected Effective model is an updated version of the 2011 Effective model as it combines the updates made in 2019 model. The Corrected Effective model includes the following revisions to the Effective FEMA model:

- The 2019 LOMA model was imported and combined with the 2011 Effective model. This import overwrote the Effective model from RS 13542 – 22698. It also included the addition of Lateral Structures (LS) 21800 – 22400 representing the existing conditions of West Broadway.
- The downstream extent of the model was trimmed to make the downstream most cross section on the upstream side of the abandoned railroad line (RS 8806).
- Due to the change in the downstream reach, the downstream boundary condition was defined as a Known Water Surface Elevation equivalent to the resultant water surface elevations of the 2011 Effective model.
- The 2D domain of the model was extended to include all overflow areas in the left overbank and to an extent until all 100-yr discharges within the 2D domain were merged into the 1D portion of the model.
- The grid cell size of the 2D domain was increased from 20' to 25' in order to provide more efficient run times without compromising the results.
- Extending the 2D domain required the additions of LS 16090 - 8920.
- The 2D portion of the model was supplemented with LiDAR data provided by the Montana State Library. The cross-sectional data of the model was left "as-is" as it was developed from survey and considered to be more accurate than the LiDAR grid.

1.5.5 Existing Conditions Model

The Existing Conditions model typically builds upon the Corrected Effective model previously described by including any modifications that have occurred within the floodplain since the date of the Effective model (Reference 2). Since there are no known changes within the modeled reach, there were no changes made to the Corrected Effective model. The Corrected Effective model is considered the Existing Conditions model.

1.5.6 Preliminary Proposed Conditions Models

The Proposed Conditions model builds upon the Existing Conditions model. The Proposed Conditions model includes the proposed project grading and channel design associated with the realignment of Grant Creek as well as the new hydraulic crossing where George Elmer Drive crosses the proposed Grant Creek. These design elements are illustrated in Figure 2 and further described below.

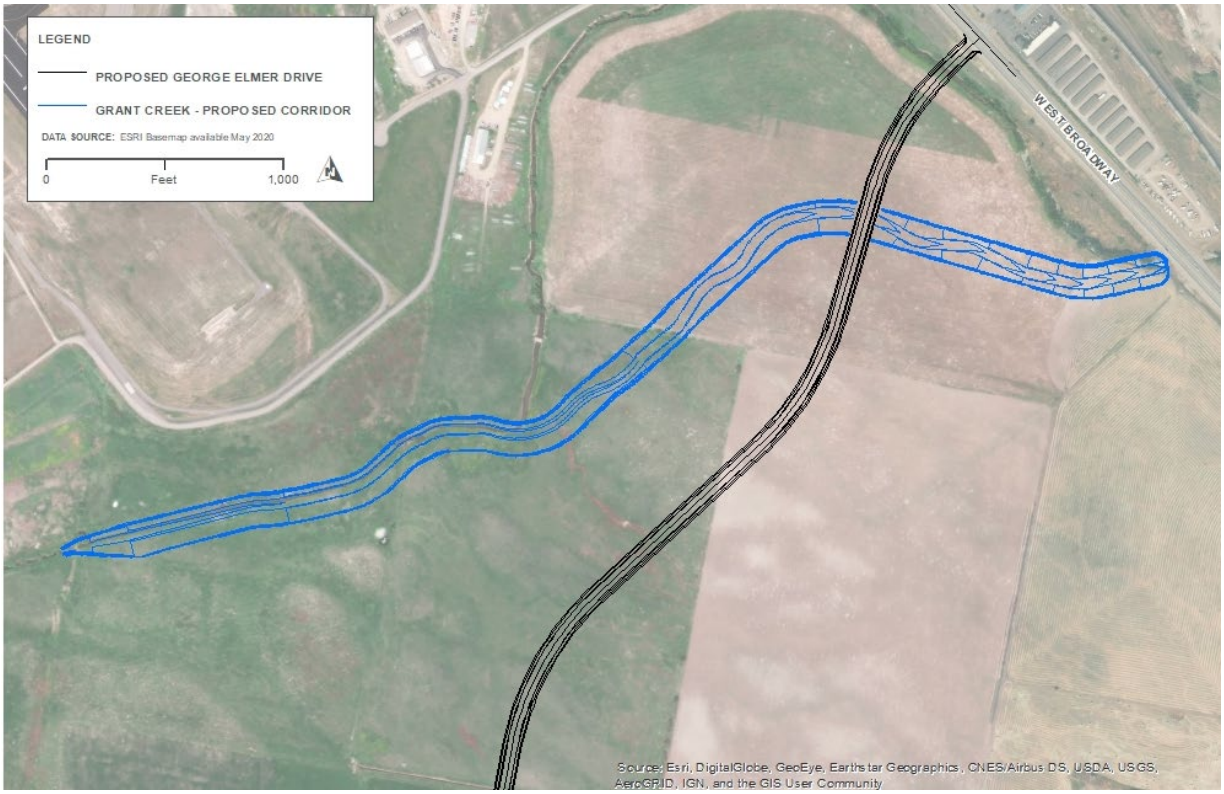


Figure 2. Layout of Grant Creek Design Elements

Grant Creek Design

The proposed realignment of Grant Creek extends from the downstream side of West Broadway to RS 14020. As a result of the realignment, the reach distance of Grant Creek downstream of West Broadway is decreased approximately 1670 feet. The slope of the proposed channel varies from 0.0086 ft/ft downstream of West Broadway to 0.0006 ft/ft where it ties into the existing alignment. These slopes approximate the existing upstream and downstream slopes of Grant Creek, respectively. The cross section of the proposed channel is designed to stably pass the 2-yr event within the channel with an excavated floodplain that is designed to contain the 100-yr event. This design was referenced from the original design developed in 2005 (Reference 5).

George Elmer Drive Crossing

The BUILD project proposes for a new road to cross the proposed Grant Creek alignment at RS 17862 (approximately Station 135+40). The preliminary design of the hydraulic crossing was developed using the following design parameters:

1. Pass the 100-yr event without overtopping the banks of the excavated floodplain.
2. Limit the velocity of the 10-yr event to less than 10 fps to reduce the likelihood of scour or requirement of scour mitigation at the structure.
3. Structures shall be sunk or bottomless to allow for natural channel sediments to be present within the structure.

Preliminary design of the hydraulic crossing has identified the following hydraulic structures meet the aforementioned design criteria:

1. 2-10'x4' RCB with wingwalls
2. 2-9.75'x6.5' SSPA mitered to the roadway slope
3. 20'x5' CONSPAN

Both of these alternatives are placed in the channel at the local channel slope (0.006 ft/ft) and countersunk 0.5' to provide the opportunity for recruitment of native sediments and improve fish passage opportunities.

Floodplain Mitigation

In its existing condition, the 100-yr water surface elevations overtop West Broadway between RS 21762 – 22698. In its existing and proposed state, the area that is flooded by the discharge overtopping West Broadway could be mapped as Zone X as it exhibits depths primarily less than 0.5'. In order to alleviate the flooding potential to the areas downstream of West Broadway Ave, the following mitigation options were analyzed.

Removal of Berm Upstream of West Broadway

In an attempt to keep the floodwater from overtopping West Broadway, the existing berm in the left overbank was removed from the model to increase the conveyance of the floodplain. By removing the berm down to the elevation of the 2-yr event, the amount of flow overtopping West Broadway is decreased from approximately 125 cfs to approximately 73 cfs. Hence, while it slightly decreases the depth of flooding and inundated area, it doesn't solve the problem or justify the costs of removing the berm.

Floodplain Swale Downstream of West Broadway

In order to mitigate the issue of the overland flooding downstream of West Broadway, a floodplain swale was sized to capture the overtopping flood flows of the 100-yr event (125 cfs). The geometry of the swale would parallel the southwest edge of the roadway at a slope of 0.005 ft/ft which approximates the existing ground. Assuming a trapezoidal channel with 2:1 side slopes, a bottom width of 3', 15' top width, and an approximate channel depth of 4', the overtopping discharge would be directed to the proposed Grant Creek floodplain at the downstream end of the Broadway Ave crossing with a 1' freeboard. The outline of the potential swale is illustrated in Figure 3.

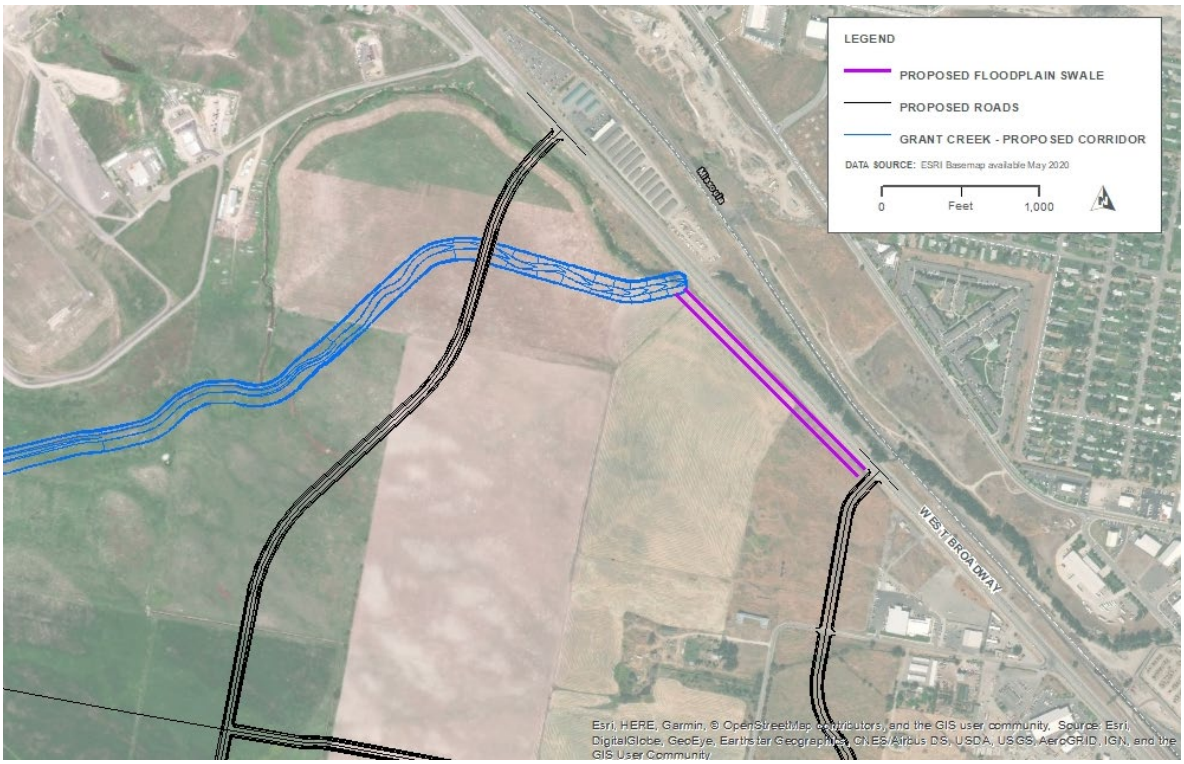


Figure 3. Potential alignment of the floodplain swale

1.5.7 Cost Estimate

A summary of the preliminary opinion of probable construction cost (OPCC) for the Grant Creek stream restoration portion of the Mullan BUILD Project is shown in Table 6. The complete cost estimate, excluding miscellaneous work, design contingencies and mitigation, is included in Appendix C.

Table 6. Project Cost Estimate - Grant Creek Stream Restoration

Project Element	Preliminary OPCC
Grant Creek Stream Restoration	$ 1,201,284.44

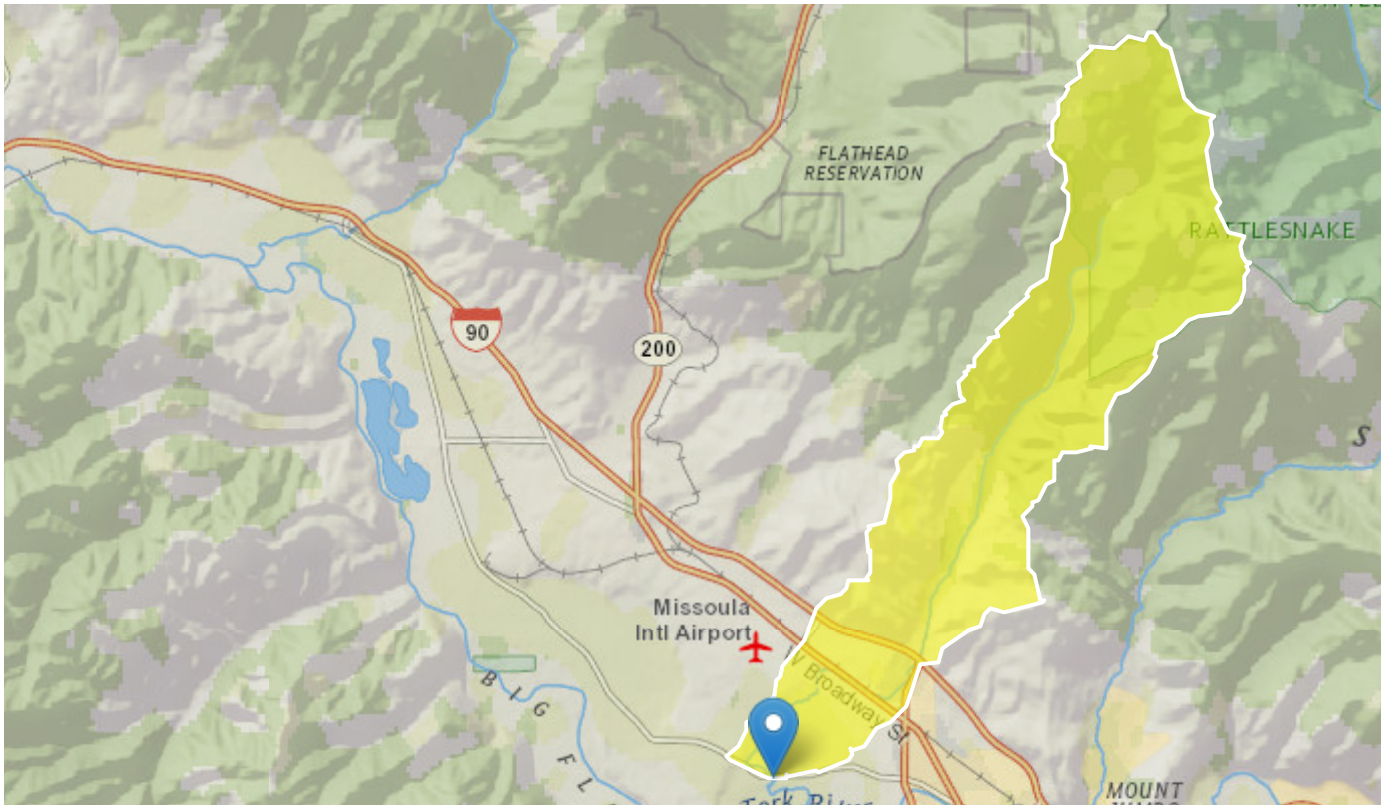
2 References

1. Dalrymple, Tate, and M.A. Benson, *Flood-Frequency Analysis, Manual of Hydrology, Part 3: Flood-Flow Techniques, U.S. Geological Survey Water Supply Paper, Number 1543-A*, 1960.
2. Federal Emergency Management Agency, *Missoula County, Montana and* Incorporated *Areas, Flood Insurance Study*, July 6, 2015.
3. Federal Emergency Management Agency, Procedures for “No-Rise” Certification For Proposed Developments in the Regulatory Floodway, October 2013.
4. HDR, Project Summary Report – Conditional Letter of Map Revision, Grant Creek CLOMR – Missoula, MT, 2008.
5. HDR and Maxim Technologies, Design Report – Grant Creek Environmental Restoration/Flood Control, February 2005.
6. Interagency Advisory Committee on Water Data, *Guidelines for Determining Flood Flow Frequency*, Bulletin No. 17B of the Hydrology Subcommittee, 1982.
7. U.S. Army Corps of Engineers. HEC-RAS River Analysis Systems – Hydraulic Reference Manual. Version 5.0. February 2016.
8. United States Geological Survey, *Methods for Estimating Flood Frequency in Montana Based on Data through Water Year 1998,* USGS Water Resources Investigation Report 03-4308, 2004.
9. United States Geological Survey, *Methods for Estimating Peak-Flow Frequencies at Ungaged Sites in Montana Based on Data through Water Year 2011*, Montana StreamStats Scientific Investigations Report 2015-5019, 2016.
10. United States Geological Survey, StreamStats Version 4.3.11:Montana https://streamstatsags.cr.usgs.gov/streamstats/, accessed April 2020

Appendix A. Stream Stats

StreamStats Report - Grant Creek at Mullan Rd

Region ID: MT
Workspace ID: MT20200415230243325000
Clicked Point (Latitude, Longitude): 46.88541, -114.08480
Time: 2020-04-15 17:02:58 -0600



StreamStats report developed for Grant Creek at Mullan Road

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CONTDA	Area that contributes flow to a point on a stream	30.1	square miles
PRECIP	Mean Annual Precipitation	29.86	inches
FOREST	Percentage of area covered by forest	57.4	percent

General Disclaimers

Upstream regulation was checked for this watershed.

This watershed has been edited, computed flows may not apply.

Peak-Flow Statistics Parameters[W Region BasinC 2015 5019F]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	30.1	square miles	0.6	2470
PRECIP	Mean Annual Precipitation	29.86	inches	14.6	62.1
FOREST	Percent Forest	57.4	percent	20.4	99.1

Peak-Flow Statistics Flow Report[W Region BasinC 2015 5019F]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIl	PIu	SEp
1.5 Year Peak Flood	152	ft^3/s	61.7	374	59.4
2 Year Peak Flood	195	ft^3/s	81.7	463	56.5
2 33 Year Peak Flood	216	ft^3/s	91.5	510	55.7
5 Year Peak Flood	316	ft^3/s	138	720	53.4
10 Year Peak Flood	422	ft^3/s	187	955	52.8
25 Year Peak Flood	542	ft^3/s	239	1230	53.2
50 Year Peak Flood	642	ft^3/s	278	1480	54.2
100 Year Peak Flood	749	ft^3/s	318	1760	56
200 Year Peak Flood	859	ft^3/s	355	2080	58
500 Year Peak Flood	992	ft^3/s	392	2510	61.4

Peak-Flow Statistics Citations

Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M.,2016, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011: U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p. (https://doi.org/10.3133/sir20155019)

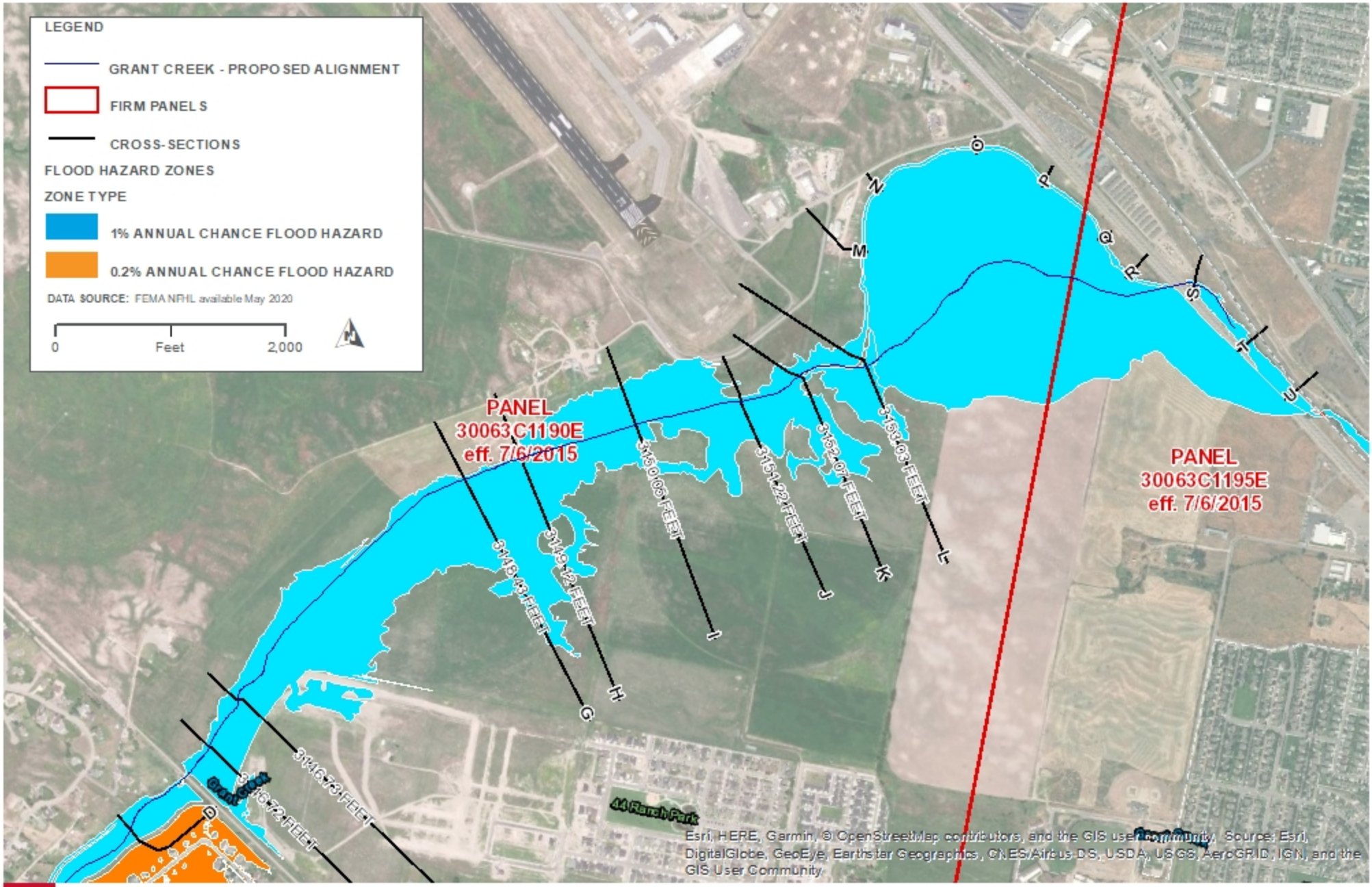
USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

USGS Software Disclaimer: This software has been approved for release by the U.S. Geological Survey (USGS). Although the software has been subjected to rigorous review, the USGS reserves the right to update the software as needed pursuant to further analysis and review. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the software and related material nor shall the fact of release constitute any such warranty. Furthermore, the software is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.3.11

Appendix B. Effective Floodplain Information


LEGEND
GRANT CREEK - PROPOSED ALIGNMENT
FIRM PANELS
CROSS-SECTIONS
FLOOD HAZARD ZONES
ZONE TYPE
1% ANNUAL CHANCE FLOOD HAZARD
0.2% ANNUAL CHANCE FLOOD HAZARD
DATA SOURCE: FEMA NRHL available May 2020
0
Feet
2,000
PANEL
30063C1190E
eff. 7/6/2015
PANEL
30063C1195E
eff. 7/6/2015
3160.06 FEET
3161.22 FEET
3162.07 FEET
3163.06 FEET
3159.42 FEET
3159.92 FEET
3167.73 FEET
3167.72 FEET
44 Ranch Park
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix C. Cost Estimate

Mullan Build

ELEMENT 4: GRANT CREEK RESTORATION AND FLOOD CONTROL

BASE SCHEDULE - STREAM STATIONS 97+00 TO 148+71.32 - 20% Preliminary

Prepared By: DJ&A ENGINEERS PLANNERS SURVEYORS

Job No. 7065

Computed **DJH** Date **5/13/2020**

Checked **XXX** Date **5/13/2020**

LINE ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
M999109200	*MOBILIZATION*	LS	1	$101,118.22	$101,118
M999107100	*PERMITS*	LS	1	$10,011.70	$10,012
M104030010	*MISCELLANEOUS WORK*	UNIT	1	$0.00	$0
01400	*CONTRACTOR QUALITY CONTROL AND ASSURANCE*	LS	1	$9,912.58	$9,913
01570,HDRM	*TEMPORARY TRAFFIC CONTROL*	LS	1	$2,000.00	$2,000
M622011042	*SOIL EROSION & POLLUTION CONTROL*	SY	66,600	$1.00	$66,600
02110-A	*GEOTEXTILE SEPARATION FABRIC*	SY	6,340	$1.28	$8,115
M999107000	*RELOCATE EXISTING UTILITIES*	LS	150	$15.00	$2,250
M201130005	*CLEARING AND GRUBBING*	ACRE	19	$6,568.42	$122,829
02221-B	*EXCAVATION*	CY	48,770	$5.20	$253,604
02221-D	*TOPSOIL*	CY	10,075	$23.30	$234,748
02221-E	*IMPORTED BORROW (Gravel Fill)*	CY	8,300	$9.30	$77,190
HDRM	*CONSTRUCT MODIFICATIONS TO EXISTING STORM WATER OUTFALLS*	EA	4	$440.00	$1,760
HDRM	*CONSTRUCT BYPASS OUTFALL STRUCTURE*	EA	1	$17,500.00	$17,500
2910	*CONSTRUCT BIOTECHNICAL BANK PROTECTION*	LF	5,500	$9.30	$51,150
HDRM	*REINFORCE/SEED CHANNEL BANKS*	ACRE	13	$4.75	$62
2910, HDRM	*PLANT NATIVE RIPARIAN VEGETATION*	LF	5,500	$9.30	$51,150
2910, HDRM	*INSTALL TEMPORARY SPRINKLER SYSTEM FOR VEGETATION*	LF	6,000	$17.05	$102,300
DJ&A	*GEORGE ELMER STREAM CROSSING (assume included in roadway estimate)*	-	0	$0.00	$0

SUBTOTAL	$1,112,300
0% DESIGN CONTINGENCIES	$0
8% CONSTRUCTION CONTINGENCIES	$88,984
INFLATION (5% per year) 0 yrs	$0
TOTAL ESTIMATED COST	**$1,201,284**

Attachment A - Scope of Work
Missoula Grant Creek Realignment

Background:

Grant Creek is a water body impaired by total nitrogen, nitrate/nitrite, sediment, and temperature in the greater Missoula Valley. It experienced a significant flooding event of residential developments in the Mullan Road area in 1997. Modifications to Grant Creek, which includes a stretch of stream approximately 1,000 lineal feet south of Mullan Road and approximately 6,500 lineal feet north of Mullan Road, corrected flooding issues with downstream properties and improved fish passage.

The stream reach of Grant Creek between West Broadway and immediately upstream from the Old Milwaukee Railroad Grade (Horseshoe Bend) is now the focus of in-depth efforts to promote resiliency and complete environmental remediation to restore Grant Creek to a more natural, properly functioning channel. A study of the Horseshoe Bend portion of Grant Creek modeled the effectiveness of realignment of Grant Creek covering a length of approximately 5,200 feet to enable it to pass the 100-year stormwater event and promote water quality. This project will implement the study's recommendation to realign approximately 5,200 feet of the Grant Creek channel for flood events and to reestablish a floodplain to promote water quality.

Scope of Work:

The Missoula Grant Creek Realignment project will address the deficiencies of the stormwater system by improving flood passage and remediate Grant Creek to improve water quality and promote natural streambank and sediment management conditions. This scope of work is the object of this grant and will use ARPA competitive funds expenses within Preliminary Engineering, Project Management, Final Engineering, and Construction budget categories.

Construction will include the following activities:

- Realignment of approximately 5,200 lineal feet of Grant Creek.
- Establishment of an approximately 1,645-foot-long flood control swale with berm located on the southwest right-of way of West Broadway that discharges to the Grant Creek channel.
- Establishment of a riparian area and setback from the Grant Creek channel capable of conveying the 100-year flood.
- Development of a natural-like stream channel capable of conveying the base flow with sinuosity and stable channel design.
- Design of storm water facilities to assure the developed runoff from the area will discharge to Grant Creek at pre-developed conditions.

Facilities will be designed and constructed in accordance with sound engineering practices and will meet the requirements of Federal, State, and local agencies.

This award implements the ARPA Competitive Grant funding as identified in Attachment B.