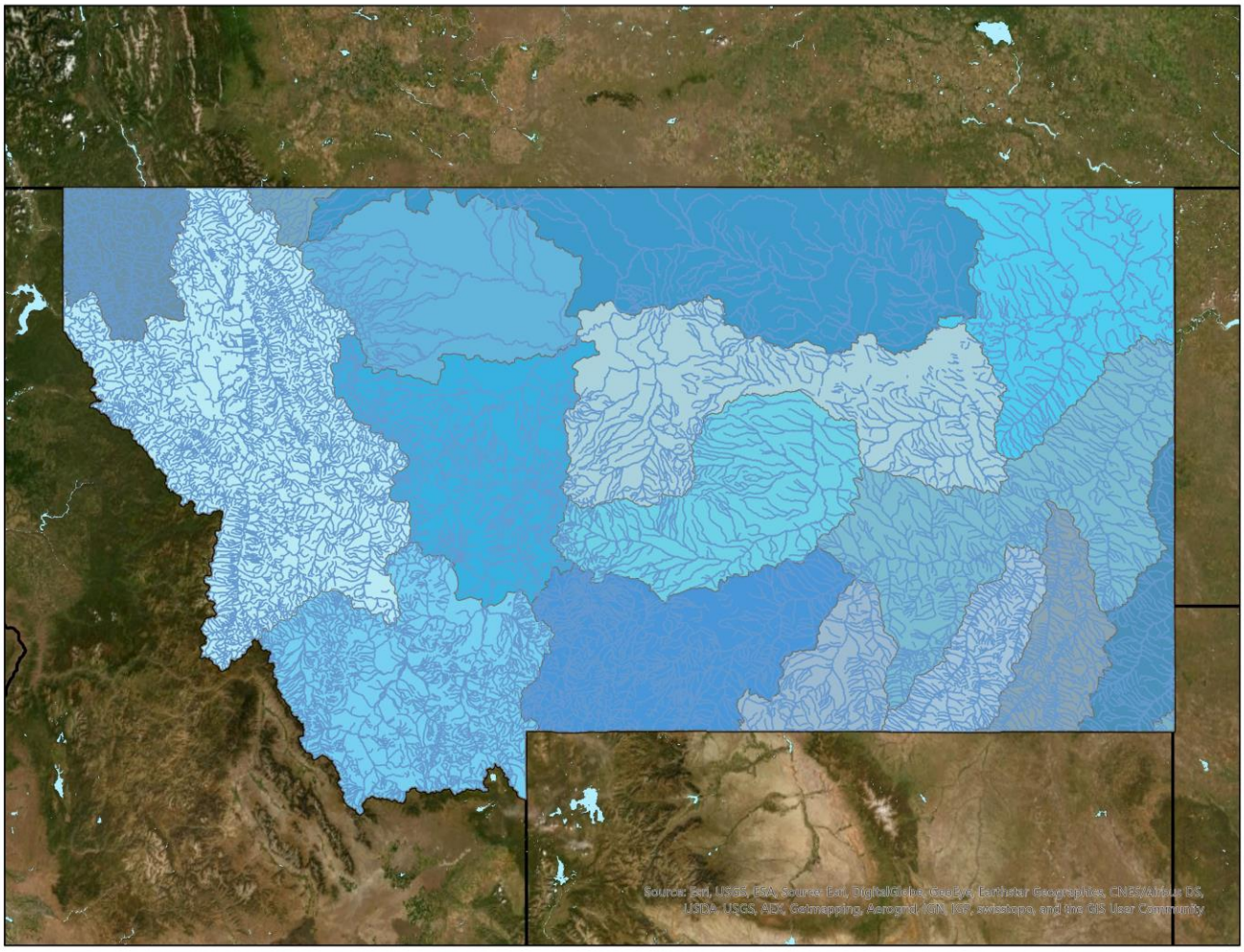

Watershed Resiliency Projects

Draft Programmatic Environmental Assessment

Montana | ***August 2022***

FEMA

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ACRONYMS AND ABBREVIATIONS

ARM	Administrative Rules of Montana
BGEPA	Bald and Golden Eagle Protection Act
BIA	Bureau of Indian Affairs
BMP	Best Management Practice
BRIC	Building Resilient Infrastructure and Communities
CAA	Clean Air Act
CDBG-DR	Community Development Block Grant – Disaster Recovery
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CRS	Congressional Research Service
DHS	Department of Homeland Security
EA	Environmental Assessment
EDA	Economic Development Administration
EO	Executive Order
ESA	Endangered Species Act
EWP	Emergency Watershed Protection
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
FRA	Federal Railroad Administration
FWCA	Fish and Wildlife Coordination Act
HHDP	High Hazard Dam Program
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HUD	U.S. Department of Housing and Urban Development
IPaC	Information, Planning and Consultation System
MBTA	Migratory Bird Treaty Act
MT DEQ	Montana Department of Environment Quality
MT DOT	Montana Department of Transportation
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1996
NRCS	Natural Resources Conservation Service
OSHA	Occupational Health and Safety Administration
PA	Public Assistance
PDM	Pre-Disaster Mitigation

PEA	Programmatic Environmental Assessment
PPE	Personal Protective Equipment
REC	Record of Environmental Consideration
ROW	Right of Way
SEA	Supplemental Environmental Assessment
SFHA	Special Flood Hazard Area
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SRIA	Sandy Recovery Improvement Act
STORM	Safeguarding Tomorrow through Ongoing Risk Management
THPO	Tribal Historic Preservation Office
UFR	Unified Federal Review
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service

SECTION ONE | INTRODUCTION

1.1 OVERVIEW

The mission of the Federal Emergency Management Agency (FEMA) is to reduce the loss of life and property and protect our institutions from all hazards by leading and supporting the nation in a comprehensive, risk-based emergency management program of mitigation, preparedness, response, and recovery. This Programmatic Environmental Assessment was prepared in accordance with Unified Federal Review as outlined in The Sandy Recovery Improvement Act (SRIA) of 2013, Section 1106: Unified Federal Review mandates the establishment of an "…expedited and unified interagency review process to ensure compliance with environmental and historic requirements under Federal law relating to disaster recovery projects, in order to expedite the recovery process, consistent with applicable law." [i] [ii] [iii] *The Disaster Recovery Reform Act of 2018, Section 1220, requires FEMA to report on the Unified Federal Environmental and Historic Preservation review process, established pursuant to Stafford Act Section 429—Unified Federal Review, and report on an analysis of whether and how the unified process has expedited the interagency review process to ensure compliance related to disaster recovery projects; conduct a survey and analysis of categorical exclusions used by other federal agencies that may be applicable to any activity related to a major disaster or emergency; and provide recommendations on further actions, including legislative proposals, to expedite and streamline the review process.*

The Federal Government, through multiple agencies and their programs, proposes to perform comprehensive watershed resiliency actions through river restoration, bank stabilization, structure demolition, relocation, or alteration, and hydraulic capacity mitigation measures for restoring watershed function. These actions may be implemented under funding programs from various federal agencies. [iv] [v] [vi] [vii] [viii]

Issued on August 15, 2017, Executive Order (EO) 13807: Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects, requires Federal agencies to process environmental reviews and authorization decisions for "major infrastructure projects" as One Federal Decision (OFD). The EO sets a government-wide goal of reducing the average time to complete required environmental reviews and authorization decisions for major infrastructure projects to not more than two years from publication of a notice of intent to prepare an Environmental Impact Statement (EIS) to issuance of a Record of Decision (ROD) prepared under the National Environmental Policy Act (NEPA). The EO also requires all Federal authorization decisions for the construction of these projects to be completed within 90 days of the issuance of a ROD. One of the goals of the EO is to ensure that the Federal environmental review and permitting process for infrastructure projects is coordinated, predictable, and transparent. Specifically, the EO directs Federal agencies with a role in the environmental review and permitting process for a major infrastructure project.

The Federal Emergency Management Agency (FEMA) has prepared this Programmatic Environmental Assessment (PEA) to analyze the potential environmental consequences associated with the proposed actions, while providing a framework for the evaluation of Federal and State laws and regulations. The proposed action and no action alternative(s) are being analyzed in accordance with the National Environmental Policy Act of 1969 (NEPA)[1], the Council on Environmental Quality (CEQ) implementing regulations[2] and the Emergency Management and Assistance Code of Federal Regulations (CFR)[3]. This analysis is programmatic in nature and does not address individual site-specific impacts, which will be evaluated for individual projects prior to approval. [ix]

This PEA evaluates typical actions undertaken by federal agencies, or any entity responsible for federal level environmental compliance, (referred to hereafter as 'The Agencies'), to provide financial support or technical assistance to these coalitions, or to any disaster recovery or hazard mitigation project, covered by the scope of this document in the state of Montana. This includes preparing for, and recovering from, future major disaster events such as flooding, fires, and tornados, which result in similar impacts to watershed environments. This PEA also provides the public and decision-makers with the information required to understand and evaluate the potential environmental consequences of these actions, and to consider these impacts in decision making. For wildfire recovery actions that do not affect watersheds, but are not categorically excluded from NEPA review, the *Wildfire Hazard Mitigation Projects in the State of Montana-September 2019* PEA can be utilized.

1.2 BACKGROUND

Over the last five years, Montana has experienced ongoing substantial damage from disaster events. From 2017 to 2022, twenty-four Presidential Major Disaster or Fire Management Declarations have been issued for storms, flooding, or fires in the State of Montana and related Tribes. Exacerbated by climate change, weather extremes throughout the state have expanded the area and volume of wetlands immediately adjacent to structures, widened riverbanks, and rerouted flow patterns, resulting in increased threats to watershed function on a near-annual basis. Fires can harden the soils within watersheds, creating dangerous flooding potential to nearby structures, while damaged facilities impede traditional watershed functionality as a result of major disaster events.

[1] 42 United States Code [USC] 55 parts 4321 et seq., 2000
[2] 40 Code of Federal Regulations [CFR] 30 parts 1500 et seq., 2004
[3] 44 Code of Federal Regulations [CFR] Ch. I Part 10, and 23 CFR 771., 2013

1.3 PROCESS FOR USE OF PEA

NEPA and its implementing regulations direct federal agencies to take into consideration the consequences of proposed actions on the human and natural environment during the decision-making process. All federal agencies must comply with NEPA before making Federal funds available. FEMA has taken the lead in determining that the projects under consideration for funding have reached the level where an Environmental Assessment is required and can be grouped by type of action or location. FEMA proposes that the groups of actions related to restoring watershed function can be evaluated in a PEA for compliance with NEPA and its implementing regulations, without the need to develop an individual agency Environmental Assessment (EA) for every action.

In accordance with Unified Federal Review, as outlined in the SRIA, DRRA, and the One Decision EO #13807, FEMA is required to coordinate with other federal agencies in order to facilitate a comprehensive strategy to address recovery and mitigation efforts.

The interagency environmental analysis found that the project types identified in this PEA will not have a significant impact on the quality of the environment. Compliance with all other federal, tribal, state, and local laws, regulations, Executive Orders, etc. is required and will be evaluated on a project-specific basis. If the description of the site-specific project work and the levels of analysis are fully and accurately described in this PEA, then the Agencies will take no further action other than what is necessary to support and document that conclusion in a Record of Environmental Consideration (REC). All projects reviewed using this PEA must use the Compliance Checklist (Appendix D) to document the project specific information and that the project is consistent with this PEA. If a specific project is expected to (1) create impacts not described in this PEA; (2) create impacts greater in magnitude, extent, or duration than those described in this PEA; or (3) require mitigation measures to keep impacts below significant levels that are not described in this PEA; then a Supplemental Environmental Assessment (SEA) is to be prepared by the grantee, to address the specific action. The SEA would be tiered from this PEA, in accordance with 40 CFR Part 1508.28. Actions determined during the preparation of the SEA to require a more detailed or broader environmental review than covered in this document will be subject to a project specific EA.

1.4 AREA OF STUDY

The area studied for this PEA encompasses the State of Montana, including 56 Counties and seven Tribal Reservations (See Figure 1-1: Montana State Map).

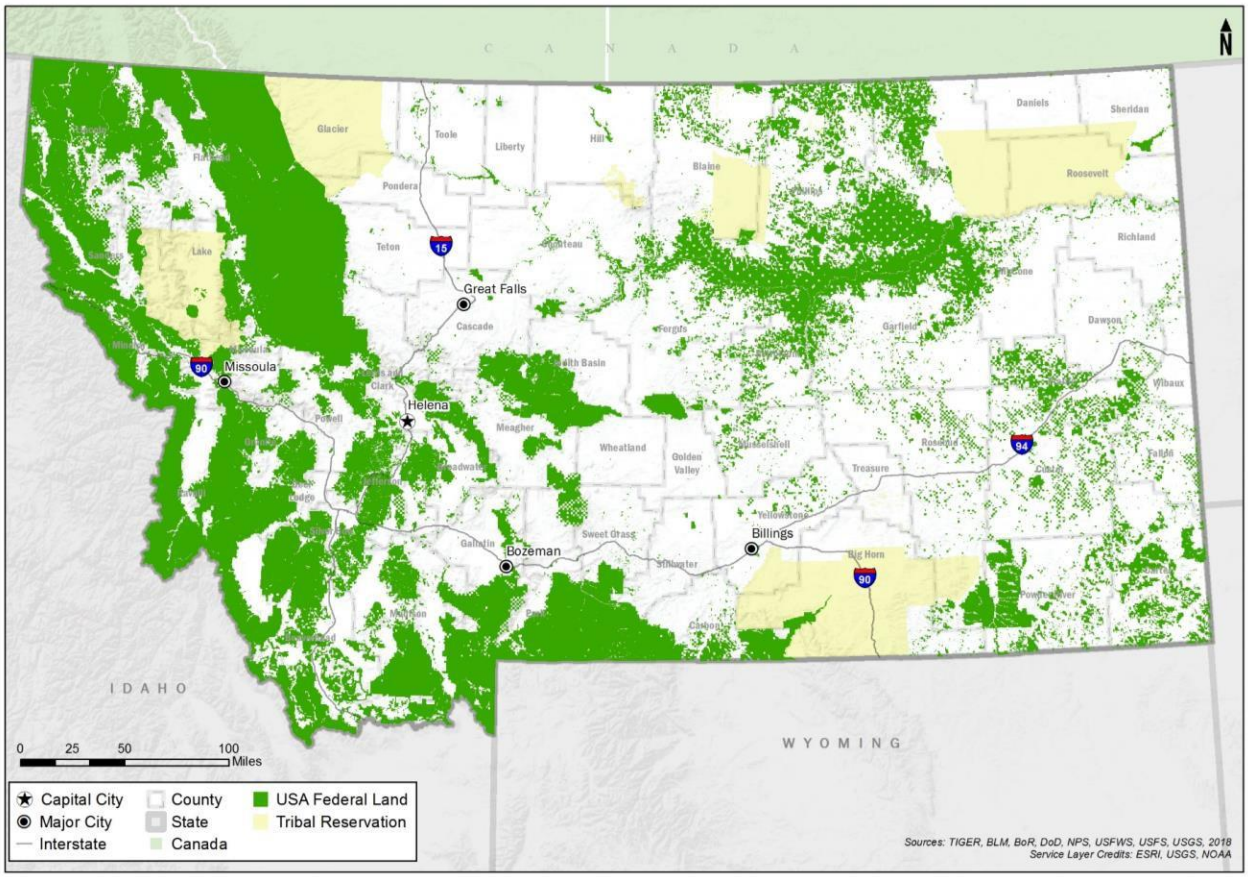

Figure 1-1: Montana State Map

SECTION TWO | PURPOSE AND NEED

This PEA addresses numerous individual projects where comprehensive watershed resiliency actions will be undertaken by the agencies to provide permanent restoration of function to facilities impacted by losses to watersheds. It also addresses hazard mitigation activities that reduce disaster losses to watersheds from future disaster damages and protect life and property. These actions are applicable to all proposed alternatives described in this document. This PEA also provides the public and decision-makers with the information required to understand and evaluate the potential environmental consequences of these actions, and to consider these impacts in decision making. The purpose of this action is to help agencies fulfill and expedite the environmental review process required by NEPA.

The Agencies will use this PEA to determine the level of environmental analysis and documentation required under NEPA for any of the proposed alternatives. Projects will be funded with a variety of federal sources, including but not limited to: grants provided by FEMA, the Federal Highways Administration (FHWA), Natural Resources Conservation Service (NRCS) and U.S. Department of Agriculture (USDA), and the U.S. Department of Housing and Urban Development (HUD). Other Federal Agency (OFA) grant programs may also be applicable. The U.S. Army Corps of Engineers (USACE) will be responsible for issuing appropriate Clean Water Act (CWA) Section 404 permits as required. These agencies all have programs that share a similar goal of helping state, local, or tribal governments recover from disasters and mitigate future losses. The purpose of the proposed projects is to meet these programs' goals.

During the increasingly long periods of inundation following disaster events, residents may not have access to their homes and local governments may be unable to provide emergency services, including fire, police, and ambulance, creating a potential threat to life, public health, and safety. The gradual rise in water level elevations has resulted in hundreds of millions of dollars in damage due to the inundation of facilities, including roads, utilities, land, and homes, and has created the need for this action. Structures become inundated by water in wetland areas that have no natural outlet for water to drain, resulting in indeterminate durations of inundation, even without additional precipitation. Federal funds may be used in an effort to make structures safe and useable, and the watersheds functional and more resilient.

These projects will satisfy the need to restore watershed hydraulic capacity and floodplain capacity in the State of Montana through:

- Nature-based and biologically inspired mitigation measures such as bank stabilization using natural materials and re-vegetation in combination with hard armoring, referred to as bioengineering; [4]

- Multi-objective project design of hydraulic control elements such as fish-passage friendly drop structures, energy dissipating fish ladders or the creation of recreational open space to preserve watershed functions; [5]

- Demolition, relocation, or transfer of function for structures, including public utilities and roads, that currently impede, or threaten to impede, watershed functions; and

- Watershed restoration and mitigation including channel shaping or re-profiling, floodplain construction, overflow channel construction, riparian re-vegetation, and in-stream habitat improvement.

All actions must comply with all applicable Federal, Tribal, State, and local laws, regulations, ordinances, and requirements. Other Federal agencies may use this document to demonstrate compliance with NEPA at their discretion and under their own authorities.

[4] See Sections 4.8 and 4.9 of this PEA and Appendix F: *Engineering with Nature*
[5] See Sections 4.8 and 4.9 of this PEA and https://www.fema.gov/emergency-managers/risk/hazard-mitigation-planning/best-practices and Appendix F: Engineering with Nature. Another useful, though dated, resource is UsingMulti-Objective Management to Reduce Flood Losses in Your Watershed prepared by the Association of State Floodplain Managers Inc (ASFPM), in 1996. https://cdn.ymaws.com/floodplain.org/resource/resmgr/old_website_files/Using_MOM_in_Watershed.pdf

SECTION THREE | ALTERNATIVES

3.1 INTRODUCTION

The following alternatives are being considered for further evaluation in this PEA. These alternatives represent classes of actions that may be implemented individually or in combination with one another. Depending upon the action determined necessary by the Agencies to restore and improve watershed function, and the individual characteristics of the specific site, some options may not be viable.

3.2 ALTERNATIVES CONSIDERED

Alternative 1: No Action

A "No Action" alternative is required to be included in this environmental assessment in accordance with CEQ regulations implementing NEPA. The "No Action Alternative" is defined as maintaining the status quo with no Agency involvement. This alternative is used to evaluate the effects of not performing watershed resiliency activities and so provides a benchmark against which other alternatives may be evaluated.

Existing watershed conditions enable chronic infliction of damages to infrastructure, properties, and watershed elements in future overtopping events. Additionally, the existing watershed deposition features shallow drainage corridors that run through both upland and low-lying areas, presenting threats to adjacent communities. Conveyance of large debris can destroy emergency access to communities and cause destruction of private property. In this scenario, communities will become isolated and suffer delayed emergency response actions and medical services. The conveyance of large debris combined with infrastructure damage can also block or destroy safe egress for evacuations, creating the potential for loss of life.

In this alternative there is likelihood that recovery projects would still be completed by locals or private landowners and may be approached in an uncoordinated manner that does not appropriately consider environmental impacts. Individual projects may accomplish inconsistent hydraulic capacity, creating upstream or downstream impacts. Unpredictable downstream flows could lead to chronic infrastructure and property damages and unpredictable flood events. Infrastructure with in sufficient hydraulic capacity could lead to structural failure and risk loss of life. A lack of watershed capacity coordination could have lasting effects on Montana agricultural resources.

For the purpose of this programmatic environmental analysis, under the "No Action Alternative" the State of Montana and individual project proponents would have to rely on savings, insurance, loans, or other forms of assistance to restore watersheds.

Alternative 2: Watershed Resiliency Activities

This alternative applies to restoration, replacement, and mitigation of existing watershed elements. It differs from "No Action", in that it includes watershed restoration activities with natural and cultural resource consideration, bioengineering and multi-objective design considerations as outlined in Section Four of this PEA. Watershed flood hazards would be mitigated without major relocation of watershed elements. In some locations, leaving watershed features in post-flood locations may be the safest and/or most cost-effective option.

Changes to materials and dimensions are included in this alternative. This includes upgrades to meet existing codes and standards as well as upgrades warranted to address conditions that have changed since the original construction. Structures, such as public roads, utilities, and buildings may be demolished or relocated. In the case of stream corridors that no longer serve as functional drainage, bank stabilization and/or grade control may be needed to restore stream corridor function and stability.

Alternative 2 will result in the redistribution of sediment, rock, woody debris, and other materials within watersheds to re-establish appropriate hydraulic capacity of stream corridors, river channels and accompanying floodplains. Engineering plans, which define the appropriate geometry and elevations to re-establish desired hydraulic capacity, and a monitoring plan of action that oversees all contractor activity utilized to complete the scope of work, will be required. Local standard Best Management Practices (BMPs) to prevent erosion, sedimentation, contamination, and the spread of noxious weeds must be implemented. Standard BMPs are available from local municipal authorities and specific BMP recommendations can be found through the Montana Department of Environmental Quality (DEQ).

Watershed restoration generally involves the following activities:

- General construction activities within previously defined right of ways (ROW).
- Creation of access and staging areas when needed to move trucks and heavy equipment.
- Dewatering to allow operations in-stream.
- Use of heavy equipment within a floodplain, stream bank or in-stream position.
- Establishment of temporary low-flow channels.
- Grading, shaping, and re-vegetation of watersheds by seeding or planting.
- Use of rip rap or other hard armoring in combination with nature-based bioengineering for erosion control.
- Restoration of floodplain dimension, pattern, and profile.

Creating access may require removing riparian vegetation, excavating and bank filling, grading, and stabilization. The number of access routes should be minimized. Access routes and staging areas should be located within un-vegetated and previously disturbed areas. Existing riparian vegetation should not be disturbed or buried. Dewatering diverts water within a stream, resulting in dry conditions needed to perform work. Some projects will require usage of heavy equipment either from the bank or in-stream.

In establishing a low-flow channel, heavy equipment is used to excavate an impaired streambed to restore the stream's channel on its outside bends. The low-flow channel maintains the base flow (normal stream flow during average periods of rainfall) of the stream, aids in transporting fine sediment, and reduces impacts to aquatic habitats. Grading and shaping affected stream banks may be necessary during the finishing phase of a job to create slopes with a gradient suitable for sustaining vegetative growth. Re-establishing vegetation is accomplished by hand or mechanical seeding or planting. Any disturbed areas should be restored using native riparian plant species and weed-free mulch and fertilizers.

Debris use or disposal involves a number of choices, and the advantages and disadvantages of each option are affected by feasibility and cost. The method selected depends on the circumstances at the disposal site and an evaluation of how disposal may affect the environment. Debris can be used for a number of purposes either on-site or off-site. Construction and demolition debris or any debris containing hazardous materials requires special consideration. Disposal should follow all applicable State and local regulations regarding handling and disposal. Regulations can be found through the Montana Department of Environmental Quality -Solid & Hazardous Waste program.[6]

Cobbles or boulders may be used to stabilize banks, although retention of cobbles on site may contribute to the debris load in flood events. Where practical, cobbles and debris will be removed from the floodplain. Cobble and gravel can be used to restore fish habitat and/or to dissipate energy. Root wads (tree trunks with root structure intact) and tree trunks can also be used to stabilize stream banks but must be anchored in a way to prevent release back into the waterway.[7] Further technical documentation on seed and plant sources and Riparian and Bioengineering can be found through the Natural Resources Conservation Service (NRCS) Plant Materials Program.[8]

[6] Solid Waste -Montana Department of Environmental Quality: https://deq.mt.gov/twr/Programs/solidwaste
[7] See Sections 4.8 and 4.9 of this PEA and https://www.fema.gov/emergency-managers/risk/hazard-mitigation-planning/best-practices and Appendix F: Engineering with Nature for more information on the types of bank stabilization and fish passage required by this alternative.
[8] Plant Materials Program | Riparian and Bioengineering | Natural Resources Conservation Service: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/plantmaterials/technical/publications/?cid=stelprdb1043002

3.3 ALTERNATIVES NOT CONSIDERED

Applicants for federal grant funding may repair watershed elements to pre-disaster condition or have mitigation upgrades under programs like FEMA Public Assistance (PA), Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Grant Programs (HMGP), Pre-Disaster Mitigation (PDM), High-Hazard Dam Program (HHDP), Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM), and/or additional programs that fall into Categorical Exclusion under NEPA, and will be evaluated accordingly. No further review of these types of projects will be considered in this PEA.

SECTION FOUR | AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4.1 PHYSICAL RESOURCES

4.1.1 Affected Environment

Montana has total area of 147,047 square miles. Its geology is diverse, ranging from the western mountains lifted and folded by tectonics and sculpted by glaciers to the eastern plains partly overlain by glacial till and dissected by wind and water. The 2007 state geological map included 324 distinct geological units – a rock formation that is recognizable from everything else around it and extends over a distance.

The mean elevation in Montana is approximately 3,400 feet. The Rocky Mountains cover the western two-fifths of the state, with the Bitterroot Range along the Idaho border; the high, gently rolling Great Plains occupy most of central and eastern Montana. The highest point in the state with an elevation of 12,799 feet is Granite Peak, located in south-central Montana near the Wyoming border. The lowest point at 1,800 feet is in the northwest, where the Kootenai River leaves the state at the Idaho border. The Continental Divide passes in a jagged pattern through the western part of the state, from the Lewis to the Bitterroot ranges.[x]

Montana is divided into four ecosystems: montane forests, plains grasslands, intermountain grasslands, and shrub grasslands. The montane forest ecosystem represents 26% of Montana and includes the mountains of Montana that have been formed by tectonic uplift and glacial erosion. Along the western third of the state these high elevation areas encompass mountains from their base to their summit with elevations increasing from the north where the Kootenai River flows into Idaho (1,800 feet) southward to the snow-capped peaks in the Beartooth Range (12,800 feet) adjacent to Yellowstone National Park. Montana forests are grouped into forest types, using dominant tree species as the determining characteristic. Much of this ecosystem is in public ownership through the USFS.

Montana's eastern high plains represent 43.2% of the state and are a part of America's Great Plains region. This ecosystem type is generally found on high, rolling land and on some scattered hills and in wide river valleys. Plants of the plains grassland and forest are adapted to dry conditions and extreme temperatures. A variety of shrubs is found here, but not enough to be classified as the dominant plant species. Grasses dominate the landscape, as they are well adapted for an environment where drought and fire are common.

The intermountain/foothill grassland ecosystem (14.3% of the state) is a mosaic of private and public land that extends from the glaciated Flathead River Valley in the north, south to the Centennial Valley, and east to the Little Belt foothills. The intermountain grasslands are the transition zone between prairie grasslands and montane forests, sometimes referred to as foothill grasslands. These large, open valleys

support plant communities dominated by grasses. Large rivers surrounded by lush riparian plant communities flow through the larger valleys.

The shrub grassland ecosystem (7.7%) occurs in widely separated segments across most of the eastern half of the state in high-elevation valleys and along non-forested slopes. Juniper and sagebrush characterize these generally dry slopes. They are interspersed with low cover grasslands and offer a unique transitional area habitat that supports many of Montana's species of greatest conservation need. Over half of this limited ecosystem is privately owned. Land use in Montana consists primarily of grassland/herbaceous areas (44.7%), Evergreen Forest (21.6%), and Small Grains (10.6%) according to the National Land Cover Statistics Database[xi].

Surface waters in Montana are divided into four basins: Columbia, Lower Missouri, Upper Missouri, and Yellowstone. Montana has approximately 58,200 miles of perennial (year-round continuous flow) rivers and streams. The majority of perennial river miles are within the Upper Missouri basin (26 percent), Columbia basin (25 percent), and Lower Missouri basin (16 percent). Major rivers in Montana include the Yellowstone, Missouri, Clark Fork, Flathead, and Kootenai Rivers (DEQ 2018). Additionally, Montana has approximately 307,000 miles of intermittent or ephemeral streams that flow for part of the year.

Montana has 1,417 named lakes, reservoirs, and ponds that are 5 acres or greater. In total, these water bodies cover approximately 730,000 acres. The majority of lake acres (44 percent) are in the Lower Missouri and Columbia basins (23 percent). Montana’s lacustrine water bodies vary in nature from alpine lakes to hydropower reservoirs. There are 33 major dams in Montana, including the largest earthen dam in the U.S., which creates Fort Peck Reservoir, the fifth largest man-made reservoir in the U.S. [xii]

Residential development covers less than 1% of Montana lands. Shrub and Herb Vegetation, in combination with Forest & Woodland, make up more than half of Montana’s land cover (See Table 4-1: Land Cover of Montana) [xiii].

Table 4-1: Land Cover of Montana

Land Cover Class	Acres	Percent of Land
Agricultural & Developed Vegetation	15,700,187	16.68%
Desert & Semi-Desert	18,776,603	19.95%
Developed & Other Human Use	1,413,087	1.50%
Forest & Woodland	23,491,815	24.69%
Introduced & Semi Natural Vegetation	1,690,885	1.80%
Nonvascular & Sparse Vascular Rock Vegetation	13,078	0.01%
Open Rock Vegetation	2,404,196	2.55%
Open Water	885,317	0.94%
Polar & High Montane Scrub, Grassland & Barrens	764,453	0.81%
Recently Disturbed or Modified	1,776,037	1.89%
Shrub & Herb Vegetation	27,189,827	28.89%
State Total	**94,105,485**	**100%**

Source: USGS 2011

According to the U.S. Department of Agriculture 2021 State Agriculture Overview, there were 57,900,000 acres in Montana classified as farmland and 27,100 farms. Prime farmland is found throughout the state. Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well-managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment[xiv].

Montana is the 4th largest state by land and has an area of 94,104,586 acres. Property is divided into private, federal, state, tribal and Bureau of Indian Affairs (BIA), and water (see Table 4-2: Land by Ownership in Montana).

Table 4-2: Land by Ownership in Montana[xv]

Landowner	Percentage and Acres
Percent Federal Land	**29.0%**
U.S. Bureau of Land Management	8,022,852
U.S. Bureau of Reclamation	125,044
U.S. Fish and Wildlife Service	653,097
National Park Service	1,214,193
U.S. Forest Service	17,186,331
U.S. – Other Federal Land	82,075
Percent State Land	**6.0%**
Montana State Trust Land	5,182,439
Montana Fish, Wildlife, and Parks	405,817
Montana University system	35,727
Montana Dept of Corrections	35,426
Montana --Other State Land	28,227
Local Government	23,749
Percent Indian Trust and BIA Land	**5.3%**
Tribal and BIA Land	4,997,717
Percent Private Land	**58.7%**
Private Land	55,015,683
Private Conservation Land	227,154
Percent Water	**0.8%**
Water	779,337

Source: CRS 2020

Government controls land use through the use of comprehensive plans, zoning regulations, and subdivision regulations. In general, the Montana State government has passed these powers to the local governments. However, the State does have some control over certain types of land uses, including confined animal feeding operations, solid waste management, mining, and energy facility siting.

The Farmland Protection Policy Act (FPPA) require federal agencies to evaluate the effects (direct and indirect) of their activities before taking any action that could result in converting designated prime or unique farmland for nonagricultural purposes. If an action would adversely affect farmland preservation, alternative actions that could avoid or lessen adverse effects must be considered. Determination of the level of impact to prime and unique farmland or farmland of statewide and local importance is done by the lead federal agency, which inventories farmlands affected by the proposed action and scores part of an AD 1006 Form, Farmland Conversion Impact Rating, for each alternative. In consultation with the lead federal agency the Natural Resource Conservation Service (NRCS) completes the AD 1006 Form and determines the level of consideration for protection of farmlands that needs to occur under the Act.

The National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) --This Act, derived from sections 4 and 5 of Public Law 89-669 (October 15, 1966; 80 Stat. 927), constitutes an "organic act" for the National Wildlife Refuge System. It was recently amended by P.L. 105-57, "The National Wildlife Refuge System Improvement Act of 1997." Public Law 105-57, approved October 9, 1997, (111 Stat. 1253) gives guidance to the Secretary of the Interior for the overall management of the Refuge System. The Act's main components include: a strong and singular wildlife conservation mission for the Refuge System; a requirement that the Secretary of the Interior maintain the biological integrity, diversity and environmental health of the Refuge System; a new process for determining compatible uses of refuges; a recognition that wildlife-dependent recreational uses involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation, when determined to be compatible, are legitimate and appropriate public uses of the Refuge System; that these compatible wildlife-dependent recreational uses are the priority general public uses of the Refuge System; and a requirement for preparing comprehensive conservation plans.

Under the Montana Stream Access Law, the public may use rivers and streams for recreational purposes up to the ordinary high-water mark. Although the law gives recreationists the right to use rivers and streams for water-related recreation, it does not allow them to enter posted lands bordering those streams or to cross private lands to gain access to streams. House Bill 190, passed during the 2009 Legislative Session, confirmed that the public has access to surface waters by public bridge or county road right-of-way. The Department, in cooperation with the affected landowner and county, is responsible for providing public passage around or through a fence preventing such access. A typical access feature would be a stile, gate, roller, walkover, or wooden rail fence. Access may be restricted by a county commission for public safety or where the county road ROW did not allow access.

4.1.2 Environmental Consequences

Alternative 1: No Action

This alternative does not include any federal action. "Alternative 1" has potential to pose safety threats, permanently displace residents, further economic strains on the State of Montana, alter drainage and flow rates, and change land use if watersheds are not restored to functional capacity. Loss in residential, commercial, agricultural, or recreational land use may occur.

Alternative 2: Watershed Resiliency Activities

This alternative applies to restoration or replacement of watershed features and as such, a hydrologic and hydraulic study will be used to determine the best redistribution for watersheds. Although this will affect the physical environment, the "No Action" alternative is expected to alter stream corridors at a more significant rate than the proposed actions. Watershed features are expected to remain within the previous ROW, thus no changes in land use are anticipated.

4.2 TRANSPORTATION FACILITIES

4.2.1 Affected Environment

Montana has 74,792 miles of highways, roads, and streets and 4,126 bridges as of 2010. There were 923,819 registered motor vehicles and 704,509 licensed drivers in the state. Mobility in regional areas is critical for social and economic activities. Commuting is a part of daily life and truck transportation plays a vital role in Montana's economy. Any impediment to freight movement hinders economic performance and growth. In addition, millions of dollars in costs have been incurred by businesses and the general public due to the extra travel distance and time because of detours from permanent and temporary road closures. Some detours can add up to 50 miles of one-way travel for school buses, emergency vehicles, employees, and customers of businesses.

4.2.2 Environmental Consequences

Alternative 1: No Action

This alternative does not include any federal action. Immediate threats would persist unless actions to restore watershed function would be provided by the State and/or local municipalities. This alternative may result in significant adverse impacts due to increased travel times and traffic volumes, as damages to transportation facilities would remain.

Alternative 2: Watershed Resiliency Activities

This alternative applies to restoration or replacement of existing watershed elements in the existing location, or relocation of transportation facilities. Short term impacts would be expected during construction as traffic delays and alternate routes may be required. No significant adverse long-term impacts are expected to the transportation volume, capacity, or time of transit. The transportation facilities would be more resilient and less likely to experience substantial damage from future severe weather events.

4.3 SAFETY AND OCCUPATIONAL HEALTH

4.3.1 Affected Environment

Safety and occupational health issues include exposure to natural hazards; one-time and long-term exposure to asbestos, lead, radiation, chemicals, and other hazardous materials; and injuries or deaths resulting from a one-time accident. Safety and occupational health concerns could impact personnel working on the project and in the surrounding area, as well as travelers using the project sites. Utilities are damaged or isolated creating public safety issues due to disaster events. Structures may be present in the project area that were constructed prior to 1978 and have the potential to contain lead-based paint or asbestos.

Lead exposure can result from paint chips or dust, or inhalation of lead vapors from torch-cutting operations. Lead exposure can adversely affect the human nervous system. Due to the size of children, exposure to lead based paint is especially dangerous to small children. Occupational Health and Safety Administration (OSHA) considers all painted surfaces in which lead is detectable to have a potential for occupational health exposure.

Asbestos exposure can result from the inhalation of dust from a plethora construction materials or household products. In 1988 the EPA issued regulations requiring certain companies to report the asbestos

used in their products. However, to this day these products can easily be found anywhere in the United States. Asbestos fibers cannot be seen with the naked eye and when inhaled can cause asbestosis that often progresses to disability and death.

Residents of Montana are vulnerable to natural hazards, the most significant of which include flood, debris flows, wildfire, drought, and windstorm. Other hazards that could impact Montana include hailstorm, lightning, and severe winter storms.

4.3.2 Environmental Consequences

Alternative 1: No Action

This alternative does not include any federal action. Residents, communities, and properties would be left susceptible to significant future damages. Materials could be washed downstream impacting other structures. These materials may have the potential to cause both lead and asbestos exposure. A "No Action" alternative may also result in restricted access for emergency, police, and fire services, causing the potential for significant delay. The "No Action" alternative provides a significant adverse safety affect to residents of the State of Montana.

Alternative 2: Watershed Resiliency Activities

"Alternative 2" would have no significant impact to public safety or occupational health. Communities are expected to benefit from watershed resiliency activities. Removal or redistribution of materials with painted surfaces or containing asbestos may be required and construction workers are required to follow OSHA regulations to provide appropriate asbestos abatement and avoid release of lead from paint. Construction workers and equipment operators are required to wear appropriate personal protective equipment (PPE) and be properly trained for the work being performed. All solid or hazardous wastes that might be generated during restoration or replacement must be removed and disposed of at a permitted facility or designated collection point (e.g., for solid waste, a utility or construction company's own dumpster). Standard construction traffic control measures will be used to protect workers, residents, and the travelling public.

4.4 SOCIOECONOMICS AND ENVIRONMENAL JUSTICE

4.4.1 Affected Environment

Executive Order (EO) 12898 (Federal Actions to Address Environmental Justice in Minority and Low-Income Populations) requires federal lead agencies to ensure rights established under Title IV of the Civil Rights Act of 1964 when analyzing environmental effects. FEMA and most federal lead agencies determine impacts to low-income and minority communities as part of the NEPA compliance process. Agencies are required to identify and correct programs, policies, and activities that have disproportionately high and adverse human health or environmental effects on minority or low-income populations. The CEQ defines the term "minority" as persons from any of the following groups: Black, Asian or Pacific Islander, American Indian or Alaskan Native, and Hispanic. Low-income or poverty areas are defined using the statistical poverty threshold from the U.S. Census Bureau (USCB), which is based on income and family size. CEQ considers a census tract to be minority or low-income when at least 50 percent or more of its residents are minority or low-income or when the population in the census tract has a "meaningfully greater" number of minority and low-income persons when compared to larger geographic areas such as a county or state. The 2017 poverty threshold for a family of four with two children under the age of 18 was $24,85820. EO 12898 also tasks federal agencies with ensuring that public notifications regarding environmental issues are concise, understandable, and readily accessible.

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EO 13045 (Protection of Children from Environmental Health Risks and Safety Risks) required federal agencies to identify and assess health risks and safety risks that may disproportionately affect children. As with EO 12898, FEMA and most federal lead agencies determine impacts to children as part of the

NEPA compliance process. Agencies must ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Montana had an estimated population of 1,068,778 persons in 2019 According to the 2010 U.S. Census, the population of Montana in 2010 was 989,415. In 2017 there was an approximately 18.46% increase from the 2000 population (902,195). The five largest cities in Montana at the time of the 2010 Census were: Billings with 104,170; Missoula with 66,789; Great Falls with 58,505; Bozeman with 37,280; and Butte with 34,525. The rankings were the same for 2000. All of the cities showed population growth from 1990 to 2000, except Butte, which registered a 1.2% decrease in population. Of those showing an increase in population from 2000 to 2010, Bozeman registered the largest increase (35.5%), and Great Falls registered the smallest increase (3.5%). All of these cities, except Billing, are located in the western half of the state. [xvi]. At the time of the 2010 Census, the population was 49.8% female (492,748) and 50.2% male (496,667). The median age of the residents of Montana in 2010 was 39.8 years. The percentage of the population 18 years and older in 2000 was 77.4%. Of those 18 years or older, 49.3% were female and 50.7% were male. Average household size was 2.35 in 2010 while the average family size was 2.91.

According to the 2013-2017 American Community Survey, the majority of the Census respondents (97.5%) identified themselves as being of one race. Of those who identified themselves as being of one race, 89.0% identified themselves as being White and 6.5% identified themselves as an American Indian or Alaska Native. The remaining respondents identified themselves as Black or African American (0.4%), Asian (0.7%), Native Hawaiian or Other Pacific Islander (0.1%) or some other race (0.5%). An estimated 3.6 percent of the people in Montana were Hispanic, people of Hispanic origin may be of any race. Among people at least five years old living in Montana in 2013-2017, 3.9 percent spoke a language other than English at home. Spanish was spoken by 1.4 percent of people at least five years old; 0.8 percent reported that they did not speak English "very well".

Of the population 25 years and older, 29.3% identified their highest educational attainment as a high school graduate (or equivalency). Another 24.2% identified themselves as having some college education, but not a degree. 31.2% identified themselves as having a bachelor's degree or higher. 7.1% of the population reported themselves as having less than a high school diploma.[xvii] In 2017, 60.1% of the population 16 and over were employed in the labor force. The employed civilian population 16 years and older is primarily engaged in management, professional, and related occupations (36.8%) and sales and office occupations (21.1%). Another 19.0% are engaged in service occupations, 12.4% in natural resource, construction, and maintenance occupations and 9.2 % in production, transportation, and material moving[xviii].

The majority of workers (73.3%) are private wage and salary workers. Government workers account for another (17.5%), while self-employed workers in their own unincorporated businesses account for (8.8%) of the working class. The median household income for 2018 was reported as $52,559 and the median family income was $68,139. The median income for female, full-time year-workers was $35,665, while

the median income for male, full-time year-round workers was $47,287. In 2018, 87.4% of households in Montana had a computer, and 78.1 percent had a broadband internet subscription. Poverty levels in Montana were 14.4 % for all people and 20.1% for children under age 18 in 2013-2018. By race respondents reported poverty levels for White at 13.4%, American Indian or Alaska Native residents reported 30.5%, Asian 15% and other at 21.6%. While American Indian or Alaska Native only account for 6.5% of the population of Montana, they account for 30.5% of poverty in the state.

There are eight federally recognized American Indian tribes in Montana: Assiniboine & Sioux Tribes (Fort Peck Indian Reservation), Blackfeet Tribe (Blackfeet Indian Reservation), Chippewa-Cree Indians (Rocky Boy's Reservation), Confederated Salish & Kootenai Tribes (Flathead Reservation), Crow Tribe of Montana, Ft. Belknap Indian Community: Assiniboine (Nakoda) and Gros Ventre (Aaniiih) (Fort Belknap Reservation), Northern Cheyenne Tribe (Northern Cheyenne Reservation), and the Little Shell Tribe[xix]. The Little Shell Chippewa Tribe obtained federal recognition on December 20, 2019 (see Table 4-3: Reservation and Off-Reservation Trust Land Statistics)[xx].

Table 4-3: Reservation and Off-Reservation Trust Land Statistics[xxi]

Reservation	Population	Median Household Income	Unemployment Rate
Blackfeet Reservation and Off-Reservation Trust Land	10,772	$26,264	**10%**
Crow Reservation and Off-Reservation Trust Land	7,184	$47,454	**15.3%**
Flathead Reservation	29,717	$42,154	**6.4%**
Fort Belknap Reservation and Off-Reservation Trust Land	3,187	$30,875	**31.1%**
Fort Peck Reservation and Off-Reservation Trust Land	10,319	$36,786	**14.2%**
Northern Cheyenne Reservation and Off-Reservation Trust Land	4,931	$46,300	**22.4%**
Rocky Boy's Reservation and Off-Reservation Trust Land (MT part)	3,634	$28,897	**10.7%**
Little Shell Tribe (No Census Bureau Information)	5,300	N/A	**N/A**
Turtle Mountain Reservation and Off-Reservation Trust Land, MT-ND-SD (MT part)	24	$30,625	**$31,875**

Source: USCB 2018

4.4.2 Environmental Consequences

Alternative 1: No Action

This alternative does not include any federal action. There is no requirement for compliance with Executive Orders (EO) 12898: Environmental Justice, 13045: Protection of Children from Environmental Health Risks and Safety Risks, or 13985: Advancing Racial Equity and Support for Underserved Communities through the Federal Government since there are no federal actions. "Alternative 1" has potential to result in significant adverse impact to the socioeconomics of a community if watershed elements are left in disrepair, leaving infrastructure and private property vulnerable to major disaster events. Residents may be isolated from their homes and businesses by roadway damages. The "No Action" alternative may cause significant damages to property and compromise infrastructure.

Alternative 2: Watershed Resiliency Activities

During the construction period, this alternative may provide some short-term benefits by providing construction jobs and a multiple effect of increased expenditures in the local economy. There may be effects to populations during construction periods due to road detours, to provide access to watershed features.

Efforts would be made during any construction to minimize short-term disruption to the local transportation system. This alternative also likely benefits underserved populations, as decreased watershed function can disproportionally affect these communities. Any adverse impacts to low income or minority populations are expected to be minor and short-term.

4.5 AIR QUALITY

4.5.1 Affected Environment

Air quality is regulated by the EPA under the jurisdiction of the Clean Air Act (CAA) of 1970 and its amendments. The EPA has generally applied a two-pronged approach to controlling air pollution: 1) setting National Ambient Air Quality Standards (NAAQS) that define maximum pollution levels in the air that is still protective of human health and welfare and 2) developing emission standards for sources of air pollutants to reduce pollutant emissions to the atmosphere. Pollutants for which NAAQS have been established are called criteria pollutants, which include ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), lead (Pb), and particulate matter (PM). EPA designates locations that do not meet or persistently exceed one or more of the NAAQS as non-attainment areas for each pollutant that does not meet the standards.

The CAA requires that state implementation plans (SIPs) be prepared and implemented by the applicable state or local regulatory agency for each criteria pollutant in non-attainment in an air basin. Montana Department of Environmental Quality (DEQ) is the state agency responsible for regulating air quality and developing SIPs for Montana. There are currently no approved federal implementation plans or tribal implementation plans for air quality in the state[xxii]. The EPA also assigns a designation to each area of the United States regarding compliance with the NAAQS. The EPA categorizes the level of compliance or non-compliance as follows: attainment (area currently meets the NAAQS), maintenance (area currently meets the NAAQS but has previously been out of compliance), and non-attainment (area currently does not meet the NAAQS).

On November 30, 1993, EPA promulgated a set of regulations known as the "general conformity rule" that included procedures and criteria for determining whether a proposed federal action would conform to the applicable SIPs. The purpose of the general conformity rule is to ensure that federal activities do not cause or contribute to new violations of the NAAQS, ensure that actions do not worsen existing violations of the NAAQS, and ensure that attainment of the NAAQS is not delayed. Before any approval is given for federal action, an applicability analysis must be conducted to determine whether the general conformity rule applies.

The general conformity rule does not apply to any federal action occurring in counties designated as attainment for all criteria pollutants. The general conformity rule does apply in areas the EPA has designated "non-attainment" or "maintenance" to ensure that a federal action does not interfere with a state's plans to meet national standards for air quality.

Montana currently has non-attainment areas in Particulate Matter (PM10) and Lead, and maintenance areas for Carbon Monoxide (CO) under the National Ambient Air Quality Standards (NAAQS)[xxiii]. There are five regions listed as non-attainment. These include Lake County (Polson and Ronan), Lincoln County (Libby), Rosebud County (Lame Deer), and Yellowstone County (Laurel Area).

> The Administrative Rules of Montana Title 17, chapter 8, covers air quality requirements for the state. The Montana Department of Environmental Quality (MT DEQ) has programs to deal with issues that affect the comfort, health, safety, and wellbeing of Montana citizens and their environment. Enforcement of state and federal environmental laws is accomplished through permitting, inspection, sampling, analytical services, and monitoring activities of the department. Programs that may become applicable to the alternatives include:
>
> Air Quality Program-The air quality program is responsible for protecting and fostering the state's air quality resources. The program promotes clean-air activities and initiates enforcement action to correct existing air pollution problems.

Open burning must comply with state air quality burning according to Administrative Rules of Montana 01)[xxiv]. Some counties and municipalities in the state have established and administer local air pollution

control programs under state law (MCA 75-2-301)[xxv]. Cascade, Flathead, Lincoln, Missoula, and Yellowstone Counties and all of Montana's Native American reservations issue open burning permits for minor activities through their local health department or fire authority. MT DEQ controls open burning in all other counties in the state and issues permits for major open burning activities.

In general, the state allows open burning activities from March through November when there is better air dispersion. This eliminates complications from wintertime inversions, which hold smoke close to the ground, increasing the chances that pollution will have adverse health effects on local communities. In fall months (September through November), burners must adhere to air quality restrictions published by the MT DEQ. In winter, especially in western Montana, burners must determine favorable air quality conditions for burning and notify the MT DEQ before ignition[xxvi].

4.5.2 Environmental Consequences

Alternative 1: No Action

This alternative does not include any federal action. Vehicle emissions may increase due to alternative transportation routes.

Alternative 2: Watershed Resiliency Activities

Watershed resiliency actions will require heavy construction equipment to reshape watershed elements. During construction there may be temporary increases in equipment exhaust emissions and fugitive dust. However, the temporary increase in equipment exhaust is expected to be negligible as long as the equipment is well maintained, and idling is minimized. All necessary measures must be taken to minimize fugitive dust emissions created during construction activities. Any complaints that may arise are to be dealt with in an efficient and effective manner. The contractor would be required to keep all equipment in good working order to minimize air pollution.

Where bank stabilization/construction within the stream corridor is required, there would be some short-term increase in fugitive dust and vehicular emissions. Mitigation of fugitive dust, if necessary, can be accomplished by periodic watering of the demolition site.

After construction, there would be no change in air quality, as this alternative would not change roadway length and therefore would not change the amount of vehicle emissions.

4.6 NOISE

4.6.1 Affected Environment

Sounds that disrupt normal activities or otherwise diminish the quality of the environment are considered noise. Noise events that occur during the night (10 p.m. to 7 a.m.) are more disruptive than those that occur during regular waking hours (7 a.m. to 10 p.m.). Assessment of noise impacts includes consideration of the proximity of the noise sources to sensitive receptors. A sensitive receptor is defined as an area of frequent human use that would benefit from a lowered noise level. Typical sensitive receptors in developed areas include residences, schools, churches, hospitals, and libraries. In more sparsely developed areas, noise-sensitive receptors would include recreational development such as parks, campgrounds, water access sites, and trails.

Recreational areas are areas, such as parks, campsites, water access sites, and trails, that rely on quiet settings as an essential part of their character. Typical noise sources in residential or recreational areas are associated with climatic conditions (wind, rain), transportation (traffic on roads, airplanes), and "life sounds" (people talking, children playing, yard maintenance). Sources of noise can include construction equipment, including motorized tools, equipment, and vehicles.

Urban environments are likely to have high noise levels from vehicular traffic and construction. Typical highways produce noise levels that range from 80 to 100 A-weighted decibels (dBA), and construction produces noise levels between 93 and 108 dBA[xxvii]. Major urban areas in Montana include Billings, Missoula, Great Falls, Bozeman, and Helena.

Airports generate high levels of noise from aircraft activities that increase ambient noise levels in nearby communities. Commercial aircraft generally emit between 70 to 100 dBA[xxviii]. Jet airplanes can produce sounds up to 120 dBA. In Montana, there are 13 commercial airports and 124 public use airports. Highways produce noise levels ranging from 80 to 100 dBA even outside of urban areas. Major highways in Montana include I-15, I-90, and I-94. Railways can produce higher noise levels that range from 70 to 115 dBA[xxix]. Montana contains approximately 3,375 miles of rail lines. National and State Parks generally have lower average noise levels due to their location in wilderness areas away from human infrastructure. Typical noise levels for national and state parks are as low as 10 dBA[xxx].

Studies have shown that some of the most pervasive sources of noise in our environment today are those associated with transportation. Traffic noise tends to be a dominant noise source in our urban as well as rural environment. In response to the problems associated with traffic noise, the United States CFR 23 Part 772[9], "Procedures for Abatement of Highway Traffic Noise and Construction Noise," establishes standards for mitigating highway traffic noise.

[9] Code of Federal Regulations [CFR] 23 Part 772., 2010

The level of highway traffic noise depends on three things: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of the traffic. Generally, the loudness of traffic noise is increased by heavier traffic volumes, higher speeds, and greater numbers of trucks. Vehicle noise is a combination of the noises produced by the engine, exhaust, and tires. The loudness of traffic noise can also be increased by defective mufflers or other faulty equipment on vehicles. Any condition (such as a steep incline) that causes heavy laboring of motor vehicle engines will also increase traffic noise levels. In addition, there are other, more complicated factors that affect the loudness of traffic noise. For example, as a person moves away from a highway, traffic noise levels are reduced by distance, terrain, vegetation, and natural and manmade obstacles. Traffic noise is not usually a serious problem for people who live more than 150 meters (approximately 492 feet) from heavily traveled freeways or more than 30 to 60 meters (approximately 98 to 197 feet) from lightly traveled roads.

Traffic noise impacts occur when the predicted traffic noise levels approach or exceed noise abatement criteria, or when the predicted traffic noise levels substantially exceed the existing noise levels.

4.6.2 Environmental Consequences

Alternative 1: No Action

This alternative does not include any federal action. There is the potential that overall noise level s in the immediate area may increase due to locally funded temporary construction. However, noise impacts are not expected to be significant.

Alternative 2: Watershed Resiliency Activities

Watershed resiliency activities are anticipated to carry a similar noise level to that which existed at pre-disaster damage levels. Noise from construction activities may have short term adverse effects on persons who live near the construction area. Noise levels can be minimized by ensuring that construction equipment is equipped with a recommended muffler in good working order. Noise impacts on residences can also be minimized by ensuring that construction activities are not conducted during early morning or late evening hours. Noise levels of construction equipment (70 to 72 dBA) at the distance in which affected parties would likely be located (>200 feet/60 meters) will not be of a duration to be significant.

4.7 PUBLIC SERVICES AND UTILITIES

4.7.1 Affected Environment

Utility lines often cross or run along roads, either overhead or underground. Public services and utilities include:

- Fire protection
- Law Enforcement
- Emergency Medical Services
- Schools
- Water
- Wastewater
- Sanitation
- Solid waste disposal
- Stormwater drainage
- Electric utilities
- Natural gas
- Telephone/Telecommunications

4.7.2 Environmental Consequences

Alternative 1: No Action

This alternative does not include any federal action. "Alternative 1" has the potential to affect public services and utilities, as watershed hazards can undermine, damage, or destroy facilities in subsequent events if not removed. Fire, emergency, law enforcement, and school services would be delayed as a result of continued inaccessibility of the route, due to closed roads or bridges. Depending on the length of detour required, these services could be significantly impacted. In addition, utility repair crews may not be able to reach damaged utility lines, resulting in lengthy service outages.

Alternative 2: Watershed Resiliency Activities

During construction, delays in fire, emergency, law enforcement and school services may continue, but these impacts would be short-term. Once completed, public services would be restored to pre-disaster levels. Utilities that cross or run along the watershed may be temporarily interrupted, but this would be a short-term impact. No long-term impacts would occur under this alternative.

4.8 WATER RESOURCES

4.8.1 Affected Environment

Montana has a total 176,750 stream miles, which include 53,221 miles of perennial stream and 116,608 miles of non-perennial streams. Montana is one of the few geographic areas in the world where rivers form parts of three major watersheds feeding the Pacific Ocean, the Gulf of Mexico and Hudson Bay. Montana has fifteen major river basins, most of which drain into the Missouri River. West of the continental divide the river basins drain into the Clark Fork of the Columbia River. The Missouri River basin is the largest basin in Montana. The Missouri River flows through the central part of the state until crossing into North Dakota.

Montana DEQ has developed more than 600 Total Maximum Daily Loads (TMDL) and identified more than 1,400 impaired waterbody – pollutant combinations that still require TMDL development within Montana. The majority of all impairment causes requiring TMDL development in Montana fall within one of the following pollutant groups: sediment, nutrients, metals, temperature, pathogens, or salinity.

Groundwater provides 39% of public water supply and 94% of rural domestic water supply in Montana. On a daily basis approximately 90 million gallons of ground water are used for irrigation, 16 million gallons to supply water for livestock, and 20 million gallons per day are used to support industry.

Montana is divided into three ground water regions: Western Mountain Ranges Region – the western third of Montana and the Bighorn Mountains that cross the Montana-Wyoming border south of Billings; The Glaciated Central Region – includes an area in northern Montana that extends east roughly from the Rocky Mountain Front to the North Dakota border; and Non-Glaciated Central Region – the majority of the state.

There are 11 principal aquifers within the state divided into Alluvial aquifers, Lower Cretaceous aquifers, Lower Tertiary aquifers, Northern Rocky Mountains Intermontane Basins aquifer systems, Pacific Northwest volcanic-rock aquifers, Paleozoic aquifers, Sand and gravel aquifers (glaciated regions), and Upper Cretaceous aquifers.

Approximately 33 percent of Montana's assessed rivers and streams and 28 percent of assessed lakes and reservoirs were impaired from pollution. The most common causes of impairment include sediment and modification of vegetation associated with streams. Most assessed rivers and streams in Montana are not classified for aquatic life beneficial use but are classified as drinking water, agriculture, and recreational beneficial uses.

Groundwater sources vary across the state. In western Montana, groundwater is typically contained within surficial aquifers, which are shallow (less than 50 feet) and consist of loose sand and gravel deposits. Surficial aquifers are replenished by streams and therefore vary in volume. Because they are shallow, surficial aquifers are prone to contamination from surface uses, such as fuel spills and industrial

discharges. Montana contains one EPA-designated sole source aquifer, the Missoula Valley aquifer, which is located in Missoula County. In contrast, eastern Montana has many bedrock aquifers, which are deeper and contain water within hard, bedrock layers. Bedrock aquifers typically contain less water than the surficial aquifers, and it is harder to obtain. [xii]

Approximately 1,938 public drinking water systems in Montana rely on groundwater as a primary or secondary source of drinking water. The majority of Montana's population (about 61 percent) relies on groundwater for drinking water and approximately 32 percent of Montanans obtain their drinking water from private wells. Montana Bureau of Mines and Geology tests groundwater for eight general pollutants: total dissolved solids, nitrate, fluorine, sulfate, chloride, arsenic, iron, and manganese. Of the 423 samples that were evaluated between 2015 and 2017, the majority met contaminant-level standards and DEQ standards for contamination. However, 53 percent of unconsolidated groundwater sources and 33 percent of consolidated groundwater sources exceeded standards for total dissolved solids.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act,16 U.S.C. 1271 et seq. [10], was enacted in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Act safeguards the unique character of these designated wild and scenic rivers while recognizes the potential for their appropriate use, development, and encourages river management.

Federally designated rivers are classified as wild, scenic, or recreational. Wild river areas are rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines that are essentially primitive and unpolluted waters. These represent the vestiges of primitive America. Scenic river areas are rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but which are accessible in places by roads. Recreational river areas are rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Montana has approximately 169,829 miles of river, of which 388 miles are designated as wild & scenic—approximately 2/10ths of 1% of the state's river mile. Under the wild and scenic river designation, Montana has two rivers and one creek classified: Flathead River, Missouri River, East Rosebud Creek[xxxi]. The Flathead River has 97.9 miles of designated as Wild; 40.7 miles as Scenic, and 80.4 miles as Recreational for a total of 219.0 miles. The designation includes the North Fork, Middle Fork, and South

[10] Public Law 90-542; 16 U.S. Code. 1271 et seq: Congressional declaration of policy., 1968

Fork above Hungry Horse Reservoir and features recreation, scenery, historic sites, unique fisheries, and wildlife such as grizzly bears and wolves. The rugged area includes the landscapes of Glacier National Park and the Bob Marshall and Great Bear Wilderness areas. The Missouri River segment from Fort Benton downstream to Robinson Bridge was designated in 1976 and includes 64.0 miles of Wild, 26.0 miles of Scenic, and 59.0 miles of Recreational for a total of 149.0 miles. East Rosebud Creek from its source in the Absaroka-Beartooth Wilderness downstream to East Rosebud Lake, including the stream reach between Twin Outlets Lake and Fossil Lake, and from immediately below but not including the outlet of East Rosebud Lake downstream to the Custer Gallatin National Forest boundary.

Floodplain

Executive Order (EO) 11988 requires federal agencies to consider the effect of their actions on the floodplain, evaluate alternatives to taking action in the floodplain and to provide opportunity for public comment if there is no practicable alternative. Under requirements established in 44 CFR Section 60.3, participating communities shall require permits for all development, including temporary development, in the Special Flood Hazard Areas (SFHA). Development is defined as "any man-made change to improved and unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials." It includes both permanent and temporary actions such as stream crossings and conveyance structures (public and private), sediment removal, channel restoration or relocation, etc.

Wetlands

EO 11990 requires federal agencies minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. To meet these objectives, the EO requires federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. Montana has lost approximately one-third of its naturally occurring wetlands since settlement. Wetlands provide flood control, recharge groundwater, stabilize stream flows, improve water quality, and provide habitat for wildlife; however, these positive attributes have not always been recognized. The Federal Clean Water Act (CWA) requires that impacts to wetlands be avoided, then minimized, and finally mitigated. If no practicable alternative exists for wetland filling projects, then wetlands will continue to be impacted in the face of development.

4.8.2 Environmental Consequences

Alternative 1: No Action

In the "No Action" alternative watershed resiliency activities would not be completed. No work would occur in water, thus there would be no direct impact to water resources due to the proposed action. Hazards may cause a flow impediment, potentially causing significant impacts to stream and floodplain hydraulics and function.

Alternative 2: Watershed Resiliency Activities

Under this alternative watershed resiliency activities will be performed within waterways and floodplains. Excavation, redistribution, and fill materials may be necessary for the proposed project thus impacting waters of the U.S. Discharge into surface water may provide a temporary alteration of surface water quality including but not limited to temperature, dissolved oxygen, or turbidity.

Mitigation Best Practices

Watershed resiliency activities include bioengineering inspired bank stabilization (Figure 4-3), utilization of engineering woody debris (Figure 4-4 and Figure 4-5), re-vegetation, and in-stream grade control (Figure 4-6) that does not restrict aquatic species passage. Additionally, watershed resiliency activities are composed primarily of multi-objective design projects such as reactional usages for floodplains. [11]

Activities that result in hardened channelization or the creation of new impervious surfaces are not covered in this alternative. For examples of the types of biologically inspired engineering covered in alternative two, see Mitigation Best Practices | FEMA.gov and Appendix F: *Engineering with Nature | Alternative Techniques to Riprap Bank Stabilization*.

[11] Another useful, though dated, resource is Using Multi-Objective Management to Reduce Flood Losses in Your Watershed prepared by the Association of State Floodplain Managers Inc (ASFPM), in 1996. https://cdn.ymaws.com/floodplain.org/resource/resmgr/old_website_files/Using_MOM_in_Wate rshed.pdf

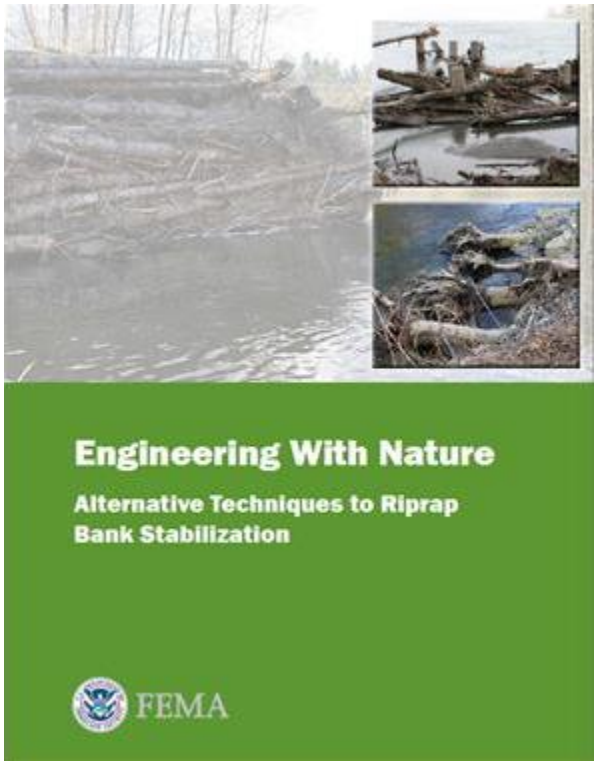

Figure 4-1: Engineering with Nature Publication

Figure 4-2: Bioengineering Using Engineered Woody Debris

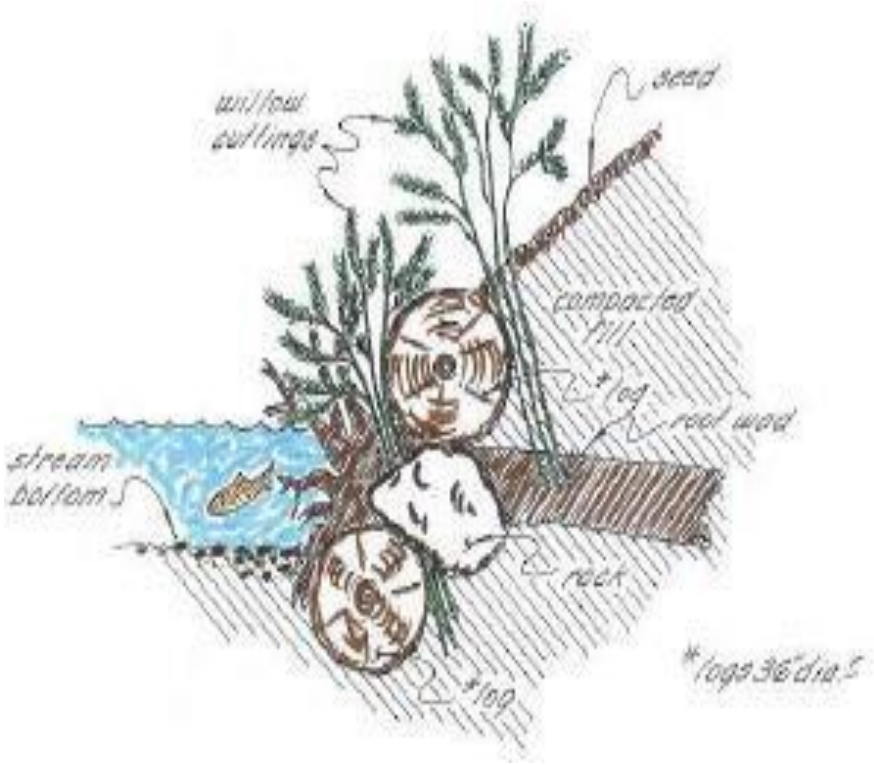

Figure 4-3: Woody Debris Bank Stabilization Cross-Section

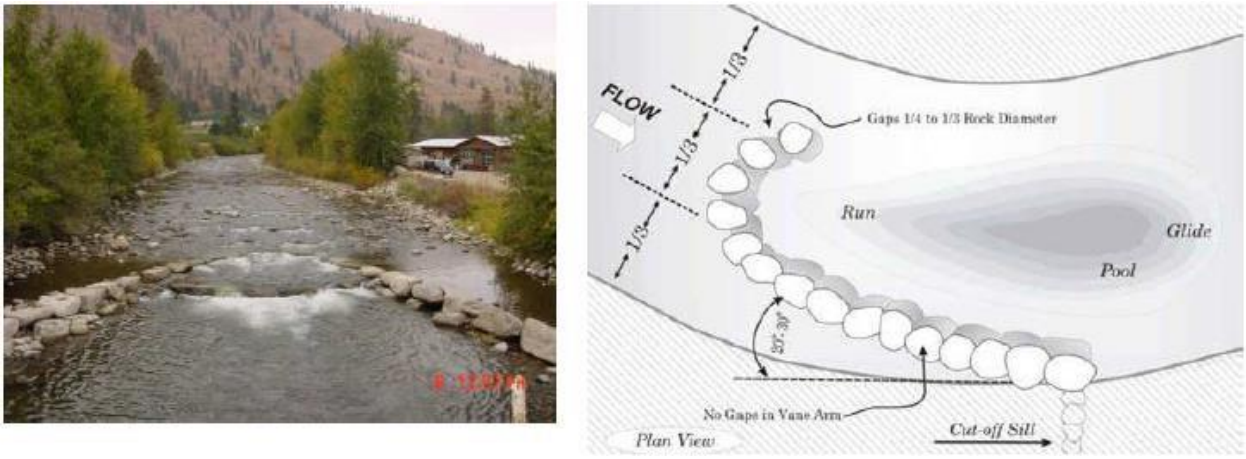

Figure 4-4: Grade Control

Through the NRCS, myriad bioengineering resources and case studies are available (Figure 4-5: Bioengineering Resources): [12] [13] [14] [15]

- Riparian and Bioengineering
- Bioengineering Seed and Plant Sources,
- The Practical Stream Bank Bioengineering Guide
- Stream Restoration Design (National Engineering Handbook 654)
- Federal Stream Corridor Restoration Handbook (National Engineering Handbook 654)
- Emergency Watershed Protection Program Final Programmatic Environmental Impact Statement

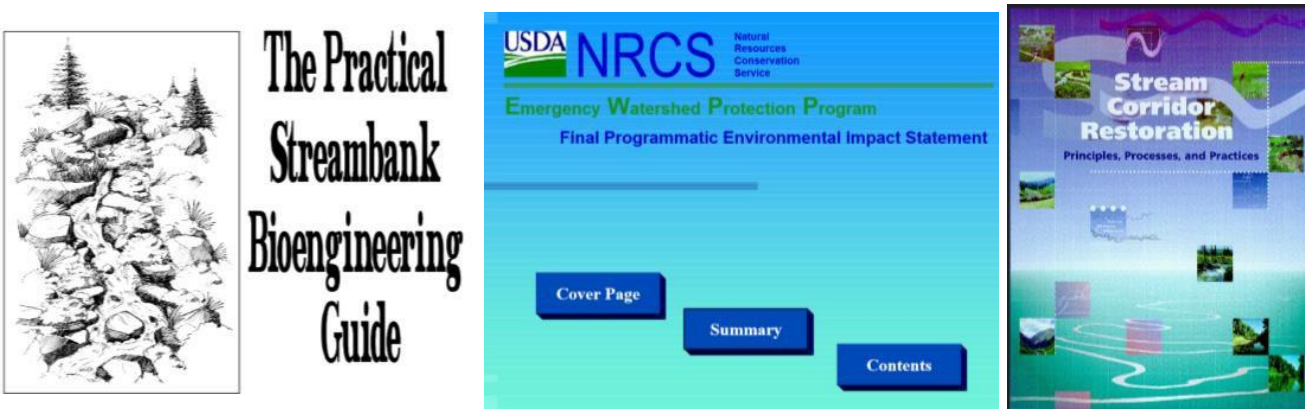

Figure 4-5: Bioengineering Resources

Waters of the U.S. are heavily regulated. Watershed resiliency activities will require a hydrologic and hydraulic analysis to determine magnitude and frequency of flows. During construction the Agencies would mitigate impacts by requiring the applicant to apply local BMPs to reduce sediment and fill material from entering the water. The applicant may be required to prepare a Storm Water Pollution Prevention

[12] U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov/wps/portal/nrcs/detail/plantmaterials/technical/publications/?cid=stelprdb1043002
[13] U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/quality/?cid=stelprdb1044707
[14] U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/quality/?cid=stelprdb1043244
[15] U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/ecosciences/ec/?cid=nrcs143_008451

Plan (SWPPP).[16] The applicant may also be required to obtain a Section 404 permit from the USACE[17] and a Section 401 Water Quality Certification permit from MT DEQ Surface Water Quality Division or the Environmental Protection Agency (EPA).[18] Discharges of water encountered during excavation or work in wet areas may require a Temporary Discharge Permit.[19] The applicant is responsible for complying with any conditions outlined within these permits. Compliance with local floodplain ordinances will also be required.

Certain activities could result in new construction, materials or fill being placed in a floodplain or a wetland. Wetland boundaries would be determined in accordance with the latest regulatory guidance from the USACE and the USFWS.[20] Regulatory floodplain boundaries and designations can be found at the FEMA Map Service Center.[21] In these situations, agency projects are required to implement the Eight-step Process to evaluate effects.[22]

Water quality may be adversely affected through the transmission of sediment, debris, oils, and hazardous substances into surface waters. During construction, agencies would mitigate these impacts by requiring the applicant to apply local BMPs to reduce impacts on wetlands and waterways.

For any work completed within the designated sections of river that is listed as Wild and Scenic, agencies would confer with the regulatory agency overseeing that section.

4.9 BIOLOGICAL RESOURCES

4.9.1 Affected Environment

Biological resources include native or naturalized plants and animals and the habitats (e.g., wetlands, forests, and grasslands) in which they exist. Protected and sensitive biological resources include federally listed (endangered or threatened), proposed, and candidate species designated by the United States Fish and Wildlife Service (USFWS). Sensitive habitats include those areas designated by the USFWS as critical habitat protected by the Endangered Species Act (ESA) and sensitive ecological areas as designated by

[16] Environmental Protection Agency: Storm Water Pollution Prevention Plans for Construction Activities: https://www.epa.gov/npdes/stormwater-discharges-construction-activities
[17] Environmental Protection Agency: Clean Water Action Section 404 Permits to Discharge Dredge or Fill Material: https://www.epa.gov/cwa-404
[18] 401 Water Quality Certification -Montana Department of Environmental Quality: https://deq.mt.gov/water/assistance
[19] Storm Water Permitting -Montana Department of Environmental Quality: https://deq.mt.gov/water/assistance
[20] U.S. Fish and Wildlife Service: National Wetlands Inventory: http://www.fws.gov/wetlands/data/mapper.HTML
[21] Federal Emergency Management Agency (FEMA) Map Service Center (MSC) -https://msc.fema.gov/
[22] Federal Emergency Management Agency: Eight Step Planning Process for Floodplain/Wetland Management: https://www.fema.gov/pdf/plan/ehp/final_e.pdf

state or federal rulings. Sensitive habitats also include wetlands, plant communities that are unusual or of limited distribution, and important seasonal use areas for wildlife (e.g., migration routes, breeding areas, and crucial summer and winter habitats).

Vegetation

EO 13112: Invasive Species, requires federal agencies to prevent the introduction of invasive species and provide for their control to minimize the economic, ecological, and human health impacts that invasive species cause. EO 13112 defines invasive species as an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health, including noxious weed plant species. Invasive species often outcompete the species that historically occurred in a particular ecosystem, altering the species composition of the plant community and its functions.

Montana is divided into four ecosystems: montane forests, plains grasslands, intermountain grasslands, and shrub grasslands. Montana's eastern high plains represent 43.2% of the state and are a part of America's Great Plains region. This ecosystem type is generally found on high, rolling land and on some scattered hills and in wide river valleys. Plants of the plains grassland and forest are adapted to dry conditions and extreme temperatures. A variety of shrubs are found here, but not enough to be classified as the dominant plant species. Native grasses dominate the landscape, as they are well adapted for an environment where drought and fire are common. Grasses have specialized root systems that allow them to store nutrients that can be used during times of stress. Forests of ponderosa pines can be found growing on sites that receive more than 14 inches of moisture and along the Missouri and Yellowstone rivers and their tributaries where water loving riparian plant communities grow. Rangeland is common, but spring wheat and alfalfa farming also occur. Agriculture is affected by erratic precipitation and few opportunities for irrigation.

The montane forest ecosystem represents 26% of Montana and includes the mountains of Montana that have been formed by tectonic uplift and glacial erosion. Along the western third of the state these high elevation areas encompass mountains from their base to their summit with elevations increasing from the north where the Kootenai River flows into Idaho (1,800 feet) southward to the snowcapped peaks in the Beartooth Range (12,800 feet) adjacent to Yellowstone National Park. Montana forests are grouped into the following forest types, using dominant tree species as the determining characteristic: Douglas-fir, lodgepole pine, ponderosa pine, spruce-fir, western larch, Engelmann spruce, grand fir, and limber pine. The Douglas-fir, lodgepole pine, and ponderosa pine forest types combined total over two-thirds of the state's forest lands. Much of this ecosystem is in public ownership through the USFS.

The intermountain/foothill grassland ecosystem (14.3% of the state) is a mosaic of private and public land that extends from the glaciated Flathead River Valley in the north, south to the Centennial Valley, and

east to the Little Belt foothills. The intermountain grasslands are the transition zone between prairie grasslands and montane forests, sometimes referred to as foothill grasslands. These large, open valleys support plant communities dominated by grasses. Large rivers surrounded by lush riparian plant communities flow through the larger valleys.

The shrub grassland ecosystem (7.7%) occurs in widely separated segments across most of the eastern half of the state in high-elevation valleys and along non-forested slopes. Juniper and sagebrush characterize these generally dry slopes. They are interspersed with low cover grasslands and offer a unique transitional area habitat that supports many of Montana's species of greatest conservation need. Over half of this limited ecosystem is privately owned.

Wildlife

Fish and wildlife include the species that occupy, breed, forage, rear, rest, hibernate, or migrate through the project areas. Regulations relevant to fish and wildlife include the Bald and Golden Eagle Protection Act (BGEPA), the Migratory Bird Treaty Act (MBTA), and the Endangered Species Act (ESA).

The BGEPA as amended, 16 U.S.C. 5A-II 668 et seq.[23], provides for the protection of bald and golden eagles by prohibiting the take, possession, sale, purchase, barter, transport, export, or import of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. This Act requires consultation with the USFWS to ensure that proposed federal actions do not adversely affect bald or golden eagles. Bald eagles and golden eagles are found throughout Montana. Breeding and wintering habitats may be different, and activities that would affect nesting areas or winter roosts could result in significant impacts. Bald eagles live near rivers, lakes, and marshes where they can find fish, their staple food. Bald eagles also feed on waterfowl, turtles, rabbits, snakes, and other small animals and carrion. Bald eagles require a good food base, perching areas, and nesting sites. Their habitat includes large lakes, reservoirs, and rivers. In winter, the birds congregate near open water in tall trees for spotting prey and night roosts for sheltering[xxxii]. Golden eagles build nests on cliffs or in the largest trees of forested stands that often afford an unobstructed view of the surrounding habitat. Their nests are usually made of sticks and soft material added to existing nests or new nests that are constructed to create strong, flat, or bowl-shaped platforms. Golden eagles avoid nesting near urban habitat and do not generally nest in densely forested habitat. Individuals will occasionally nest near semi-urban areas where housing density is low and in farmland habitat; however, golden eagles have been noted to be sensitive to some forms of human presence.

[23] 16 U.S. Code [U.S.C] 668 et seq.

The MBTA, 16 U.S.C. 701-719c, decrees that all migratory birds and their parts (including eggs, nests, and feathers) are protected. Nearly all native North American bird species are protected by the MBTA. Under the MBTA, the taking, killing, or possessing migratory birds is unlawful. Projects that are likely to result in the purposeful taking of birds protected under the MBTA would require the issuance of taking permits from the USFWS. Over 1,000 native bird species, including common species such as American robin (Turdus migratorius) and American crow (Corvus brachyrhynchos) are protected by the MBTA. Montana is located in both the internationally designated Central Flyway, and the Pacific Flyway used to manage migratory birds. USFWS and its partners establish the flyway areas based on the routes different bird species follow as they migrate between nesting and wintering areas in North America.[xxxiii]

Invasive species are organism that are brought into the state from another place and compete with or kill native species. There are 34 Aquatic Invasive Species, 24 Agricultural Pests, 15 Forest Pests, 45 Noxious Weeds listed in the Montana Field Guide[xxxiv].

Threatened and Endangered Species

The ESA of 1973, 16 U.S.C. 1531–1544, directs federal agencies to protect threatened and endangered species in consultation with the USFWS. This protection includes a prohibition against direct take (e.g., killing, harassing) and indirect take (e.g., destruction of habitat). Section 7 of the ESA requires federal agencies to aid in the conservation of listed species and to ensure the activities of federal agencies will not jeopardize the continued existence of listed species or adversely modify designated critical habitat.

There are 18 species listed as Endangered (E), Threatened (T), Proposed (P), or Candidate (C) species by the USFWS under ESA that historically occurred, occur, or may potentially occur within Montana (see

Table 4-4: Federally Listed Threatened, Endangered and Candidate Species in Montana). Three of these species, piping plover (Charadrius melodus), bull trout (Salvelinus confluentus), and Canada lynx (Lynx canadensis) have designated critical habitat in Montana. Montana is home to 90 resources managed or regulated by the U.S. Fish and Wildlife Service: 18 threatened or endangered species, 3 critical habitats, 38 migratory birds 29 U.S. Fish and Wildlife Service facilities.[24]

[24] For U.S. Fish and Wildlife Service Endangered Species Information, Planning and Consultation System: http://ecos.fws.gov/ipac/ or http://www.fws.gov/ipac/

Table 4-4: Federally Listed Threatened, Endangered and Candidate Species in Montana

Status	Species/Listing Name
	Mammals
E	Black-footed ferret (Mustela nigripes)
EXPN	Black-footed ferret (Mustela nigripes)
T (CH)	Canada Lynx (Lynx canadensis)
T	Grizzly bear (Ursus arctos horribilis)
P, T	North American Wolverine (Gulo luscus)
T	Northern Long-Eared Bat (Myotis septentrionalis)
	Birds
T (CH)	Piping Plover (Charadrius melodus)
T	Red Knot (Calidris canutus rufa)
E	Whooping crane (Grus americana)
T	Yellow-billed Cuckoo (Coccyzus americanus)
	Fishes
T (CH)	Bull Trout (Salvelinus confluentus)
E	Pallid sturgeon (Scaphirhynchus albus)
E	White sturgeon (Acipenser transmontanus)
	Insects
T	Meltwater Lednian Stonefly (Lednia tumana)
C	Monarch butterfly (Danaus plexippus)
T	Western glacier stonefly (Zapada glacier)
	Flowering Plants
T	Spalding's catchfly (Silene spaldingii)
T	Ute ladies'-tresses (Spiranthes diluvialis)
	Conifers and Cycads
P, T	Whitebark Pine (Pinus albicaulis)

Source: ECOS 2022

ENDANGERED (E) -Any species that is in danger of extinction throughout all or a significant portion of its range.

THREATENED (T) -Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

PROPOSED (P) – Any species of that is proposed in the Federal Register to be listed under section 4 of the Act.

CANDIDATE (C) -Those taxa for which the Service has sufficient information on biological status and threats to propose to list them as threatened or endangered. We encourage their consideration in environmental planning and partnerships, however, none of the substantive or procedural provisions of the Act apply to candidate species.

EXPERIMENTAL POPULATION NON-ESSENTIAL (EXPN) -A population of a listed species reintroduced into a specific area that receives more flexible management under the Act.

CRITICAL HABITAT (CH) -The specific areas within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (I) essential to conserve the species and (II) that may require special management considerations or protection; and specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential.

4.9.2 Environmental Consequences

Alternative 1: No Action

Under the "No Action" alternative, no localized or regional effects to threatened or endangered species are expected. This alternative does not include any action. Therefore, the applicants would not be required to consult with USFWS to comply with the ESA, Migratory Bird Treaty Act (MBTA), Fish and Wildlife Coordination Act (FWCA), or state laws. Damaged structures left in the stream may cause a flow impediment, potentially causing impacts to species habitats and individuals.

Alternative 2: Watershed Resiliency Activities

The actions under this alternative may have the potential to affect sensitive biological resources, wetlands, or natural waterways due to construction activities; a review of available information on the potential for species and critical habitat occurrence in the area will be conducted. The proposed action requires the redistribution or removal of hazards, materials, and possibly structures from the waterway. Embankment

work and in-water work will occur. Federal Agencies will coordinate with USFWS and will review the project and make a determination of effect. If an Agency determines that a project has the potential to affect sensitive biological resources it will initiate the review process under Section 7 of the ESA, MBTA, or FWCA, the results of this consultation with USFWS would be documented in a memorandum to this PEA or in a SEA. If work occurs on U.S. Forest Service (USFS) or Bureau of Land Management (BLM) land additional coordination with these agencies will be required.

Because migratory birds nest on many substrates (e.g., ground, shrubs, trees, utility boxes), should the proposed work occur during the breeding season (May 1st to August 15th) , the Service recommends: the required cutting of trees or shrubs occur between August 16th and April 30th to remove potential nesting surfaces prior to project commencement; and the removal of swallow nests as they are built, but prior to egg laying, from the utility structures that are to be removed; and/or netting of the affected structures or implementation of other measures to prevent swallow nesting prior to the breeding season. In addition, some migratory birds are known to nest outside of the aforementioned primary nesting season period. For example, raptors can be expected to nest during February 1 through July 15. For actions within 0.5 mile of occupied eagle nests coordination with USFWS should occur as a Bald and Golden Eagle Protection Act (BGEPA) permit may be required. Implementation of the National Bald Eagle Management Guidelines would be applied as necessary[25]. If a nest or bird is taken outside the specified timeframe, that take is considered a violation of the MBTA.

4.10 CULTURAL RESOURCES

4.10.1 Affected Environment

Cultural resources include the physical evidence or place of past human activity: site, object, landscape, and structure or a site, structure, landscape, object, or natural feature of significance to a group of people traditionally associated with it.

To preserve historical and archaeological sites in the United States of America, the National Historic Preservation Act (NHPA) passed in 1966. The Act created the National Register of Historic Places, the list of National Historic Landmarks, and the State Historic Preservation Offices (SHPO).

The National Register of Historic Places is the Nation's official list of cultural resources worthy of preservation and is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. Properties listed in the Register include districts, sites, buildings, structures, and objects that are significant in American history,

[25] Bald Eagle Guidelines | https://www.fws.gov/migratorybirds/pdf/management/nationalbaldeaglenanagementguidelines.pdf

architecture, archeology, engineering, and culture. To be eligible for listing, a property must meet one of four eligibility criteria and have sufficient integrity.

Montana's rich cultural history is directly linked to the diversity of the landscape. The Montana Antiquities Database contains over 60,000 documented historic and archaeological sites across the state[xxxv]. As of February 2019, there are 1,193 historic properties listed on the NRHP in the state. Most of the historic properties are aboveground buildings (852), districts (228), or structures (57)[xxxvi]. Only 53 archaeological sites are listed on the NRHP, and there is one unknown historic property. Of the 1,193 historic properties, six districts, five buildings, and two archaeological sites are designated National Historic Landmarks in the state of Montana.

4.10.2 Environmental Consequences

Alternative 1: No Action

No federal action would occur under this alternative. However, new impacts to historic resources are possible as exposed or otherwise disrupted cultural resources would remain vulnerable to future events and accelerated deterioration.

Alternative 2: Restoration or Replacement of Watershed Functions

This alternative has the potential to affect historic or cultural resources. Destruction or alteration of any site, structure, or object of prehistoric or paleontological importance may occur during construction. Physical change could affect unique cultural values. There could be effects on existing religious or sacred uses of a site or area. Infrastructure may be of cultural significance or archeological resources may be present. For non-tribal lands, the Agencies will determine if a project meets any outlined programmatic allowances from Programmatic Agreements with the Montana SHPO. If so, the Agencies would consider the project to be in compliance with Section 106 of NHPA and no further review would occur. If a project does not fall within an allowance, the Agencies will make a determination of the effect and consult with the SHPO. Additional archaeological surveys of ground disturbing activities may be required depending on consultation with Tribal Historic Preservation Office (THPO) and SHPO.

4.11 CUMULATIVE IMPACTS

The CEQ regulations[26] implementing the procedural provisions of NEPA of 1969, as amended[27] defines cumulative effects as: "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or local) or person undertakes such other action".[28] Based on these regulations, if the alternative does not have direct or indirect effects there can be no cumulative effects resulting from the project because there would be no impacts added to past, present, or reasonably foreseeable actions. CEQ regulations also describe cumulative impacts as impacts that "can result from individually minor but collectively significant actions taking place over a period of time". On a programmatic level and combined with other actions affecting watersheds alternatives could lead to cumulative impacts depending on the scale (number of projects) or geography (localized area) in which the actions are performed.

4.11.1 Summary of Cumulative Impacts

Individual projects proposed under this Programmatic Environmental Assessment have the potential to cause significant impacts when compounded and undocumented. In an effort to track and mitigate cumulative impacts any official usage of this PEA must be documented by the completion of the Compliance Checklist found in Appendix D. All supporting documentation, completed project specific compliance checklists and SEAs, must be submitted to the Region at FEMA-R8EHP@fema.dhs.gov and to the FEMA Region 8 Deputy Regional Environmental Officer at Richard.Myers2@fema.dhs.gov.

Cumulative impacts can be reduced, and project streamlining realized, by coordinating natural and cultural resource compliance review responsibilities with nearby projects, exploring multi-objective design, utilizing bioengineering techniques and incorporating effective mitigation strategies.

[26] 40 Code of Federal Regulations [CFR] Section 1500-1508
[27] 42 United States Code [USC] Section 4321
[28] 40 Code of Federal Regulations [CFR] Section 1508.7

Multi-objective Design

Bioengineering:

By utilizing the techniques discussed in Section 4.8 WATER RESOURCES.

Mitigation:

By considering project components that increase watershed function and provide community resilience. Mitigation Best Practices | FEMA.gov

Under Alternative 2: Watershed Resilience Activities, project impacts that are implemented at an individual or cumulative scale, such as to produce significant impacts may potentially be reduced below a level of significance by mitigating for individual impacts using the Mitigation Measures outlined in the next section. A Supplemental Project Specific Environmental Assessment will be completed for any projects that are anticipated to surpass the scope of this document, such that impacts cannot be contained utilizing the Mitigation Measures outlined in the next section.

SECTION FIVE | MITIGATION MEASURES

Project impacts that are implemented at an individual or cumulative scale such as to produce significant impacts can generally be reduced below the level of significance through avoidance, minimization, or by mitigating for individual impacts using mitigation measures as described below. If impact avoidance cannot be achieved, specific mitigation measures including agency consultation will be undertaken by the Agencies to reduce any potentially significant impacts to less than significant levels. Table 5-1 lists the specific mitigation measures the Agencies will use, if applicable.

Table 5-1: Mitigation Measures by Resource Area

Resource Area	Mitigation Measure
Physical Resources, Water Resources	For projects where wetland areas will be impacted, The Agencies will evaluate individual and cumulative impacts and implement avoidance, minimization and/or mitigation measures as necessary to reduce impacts below level of significance.
Physical Resources, Water Resources	For projects in which soil erosion potential is determined to be significant, a project erosion control plan to minimize soil loss, including the use of Best Management Practices, to isolate the construction site and minimize adverse effects of soil loss and sedimentation on soil and water resources will be implemented.
Physical Resources, Water Resources	To mitigate for impacts to floodplain, a hydrology and hydraulics study will be completed to ensure the flow of flood waters. The project must not serve as a dam or otherwise impede water movement thus aggravating flooding upstream of the roadway.
Physical Resources, Water Resources	The Agencies will consult with US Fish and Wildlife Service and/or Natural Resources Conservation Service for any project which extends outside of the original right of way and has the potential to affect land use, including Fish and Wildlife Service easements, prime farmland, or farmland of state/local significance.
Safety and Occupational Health	To minimize any potential to occupation health and safety, construction workers and equipment operators are required to wear appropriate PPE and to be properly trained for the work being performed, including removal and disposal of asbestos and lead-based paint for demolition projects.
Safety and Occupational Health	All waste material associated with the project must be disposed of properly and not placed in identified floodway or wetland areas or in habitat for threatened or endangered species. All hazardous material resulting from demolition activities, including asbestos and lead paint will be disposed of in hazardous waste landfill.
Air Quality	To mitigate for fugitive dust during construction periodic watering of active construction areas, particularly in areas close to sensitive receptors (e.g., hospitals, senior citizen homes, and schools) will be implemented.
Noise	Construction noise levels will be minimized by ensuring that construction equipment is equipped with a recommended muffler in good working order. Impact to noise levels will be minimized by limiting construction activities that occur during early morning or late evening hours.

Biological Resources	The Agencies will consult with USFWS, who is the regulatory authority, on any actions that have the potential to affect biological resources including Threatened and Endangered species and will include measures to avoid or minimize potential impacts. Coordination will include measures to avoid or minimize potential impacts as grant conditions. This includes migratory birds and raptors.
Biological Resources	Fill material must not come from nor be deposited in threatened and/or endangered species habitat.
Biological Resources	The Agencies will coordinate with MT DEQ concerning guidelines regarding impacts to State species of interest. Coordination may include measures to avoid or minimize potential impacts as grant conditions. This includes migratory birds and raptors.
Cultural Resources	Unless a project is covered under a programmatic agreement exemption all other ground disturbing projects must consult with the SHPO or THPO under Section 106 of the NHPA. The absence of cultural property documentation in the area does not mean they do not exist, but rather may reflect the absence of any previous cultural resource inventory in the area. If during the course of any ground disturbance related to this project, cultural materials are inadvertently discovered, the project would be immediately stopped and the SHPO/THPO and Agency notified.
Cultural Resources	To avoid impacts to cultural resources from material borrow source, borrow material source will be reviewed and approved by SHPO or THPO prior to use.
Cultural Resources	The Agencies will consult with the State/Tribal Historic Preservation Office on project specific activities for any project that has the potential to affect previously undisturbed areas or historic properties.

SECTION SIX | SUMMARY OF IMPACTS

The following table summarizes the potential impacts of each alternative on the resource areas discussed in SECTION FOUR | AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES. Table 6-1 is organized by each resource area for each alternative. Permits and conditions are summarized, as well as best construction practices.

Table 6-1: Summary of Impacts

Resource Area	Alternative 1: No Action	Alternative 2: Replacement	Permits and Conditions Required	Best Construction Practices	Conditions
Physical Resources	This alternative does not include any federal action. Alternative 1 has potential to pose safety threats, permanently displace residents, further economic strains on the State of Montana, alter drainage and flow rates, and change land use if watersheds are not restored to functional capacity. Loss in residential, commercial, agricultural, or recreational land use may occur.	This alternative applies to restoration or replacement of watershed features and as such, a hydrologic and hydraulic study will be used to determine the best redistribution for watersheds. Although this will affect the physical environment, the "No Action" alternative is expected to alter stream corridors at a more significant rate than the proposed actions. Watershed features are expected to remain within the previous ROW so no changes in land use are anticipated.	USACE Permit	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	The applicant is responsible for verifying and compliance with all permit requirements, including permit conditions, pre-construction notification requirements and regional conditions as provided by the US Army Corps of Engineers (USACE). The applicant is responsible for implementing, monitoring, and maintaining all Best Management Practices (BMP's) and Pre-Construction Notification (PCN) conditions of applicable Nation-Wide Permits (NWP). This is to include any requirements per the MT DEQ 401 Water Quality Certification for Clean Water Act permits. To the extent possible, keep equipment and construction within previously disturbed area and ROW.
Transportation Facilities	This alternative does not include any federal action. Immediate threats would persist unless actions to restore watershed function would be provided by the State and/or local	Alternative 2: Watershed Resiliency Activities This alternative applies to restoration or replacement of existing watershed elements in the existing location, or relocation of transportation facilities. Short term impacts	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to transportation facilities.

	municipalities. This alternative may result in significant adverse impacts due to increased travel times and traffic volumes, as damages to transportation facilities would remain.	would be expected during construction as traffic delays and alternate routes may be required. No significant adverse long-term impacts are expected to the transportation volume, capacity, and time of transit. The transportation facilities would be more resilient and less likely to experience substantial damage from future severe weather events.		Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	
Safety and Occupational Health	This alternative does not include any federal action. Residents, communities, and properties would be left susceptible to significant future damages. Materials could be washed downstream impacting other structures. These materials may have the potential to cause both lead and asbestos exposure. A "No Action" alternative may also result in restricted access for emergency, police and fire services causing the potential for significant delay. The "No Action" alternative provides a significant adverse safety affect to residents of the State Montana.	Alternative 2 would have no significant impact to public safety or occupational health. Communities are expected to benefit from watershed resiliency activities. Removal or redistribution of materials with painted surfaces or containing asbestos may be required and construction workers are required to follow OSHA regulations to provide appropriate asbestos abatement and avoid release of lead from paint. Construction workers and equipment operators are required to wear appropriate personal protective equipment (PPE) and be properly trained for the work being performed. All solid or hazardous wastes that might be generated during restoration or replacement must be removed and disposed of at a permitted facility or designated collection point (e.g., for solid waste, a utility or construction company's own dumpster). Standard construction traffic control measures will be used to protect workers, residents, and the travelling public.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	For any "Asbestos Containing Material", lead-based paint and/or other hazardous materials found during remediation or repair activities, the applicant must comply with all Federal, State, and local abatement and disposal requirements. Applicants are responsible for ensuring contracted removal of hazardous debris also follows these guidelines.
Socioeconomic and Environmental Justice	This alternative does not include any federal action. There is no requirement for compliance with Executive Orders (EO) 12898:	During the construction period, this alternative may provide some short-term benefits by providing construction jobs and a multiple effect of increased expenditures in the local	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to low income and minority populations.

	Environmental Justice and 13045: Protection of Children from Environmental Health Risks and Safety Risks since there are no federal actions. "Alternative 1" has potential to result in significant adverse impact to socioeconomics of a community if watershed elements are left in disrepair leaving infrastructure and private property vulnerable to major disaster events. Residents may be isolated from their homes and businesses by roadway damages. The "No Action" alternative may cause significant damages to property and compromise infrastructure.	economy. There may be major effects to populations during construction periods due to road detours, to provide access to watershed features. Efforts would be made during any construction to minimize short-term disruption to the local transportation system. Low income and minority populations may benefit during the construction process through the provision of construction jobs and multiplier effects of expenditures in the local economy. Any adverse impacts to low income or minority populations are expected to be short-term and not significant.		Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	
Air Quality	This alternative does not include any federal action. Vehicle emissions may increase due to alternative transportation routes.	Watershed resiliency actions will require heavy construction equipment to reshape watershed elements. During construction there may be temporary increases in equipment exhaust emissions and fugitive dust. However, the temporary increase in equipment exhaust is expected to be negligible as long as the equipment is well maintained, and idling is minimized. All necessary measures must be taken to minimize fugitive dust emissions created during construction activities. Any complaints that may arise are to be dealt with in an efficient and effective manner. The contractor would be required to keep all equipment in good working order to minimize air pollution. Where bank stabilization/construction within the stream corridor is required there would be some short-term increase in fugitive dust and vehicular emissions. Mitigation of fugitive dust, if necessary, can be accomplished by periodic watering of the demolition site. After construction, there would be no change in air quality as this alternative would not change roadway length, and therefore would not change the amount of vehicle emissions.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to air quality. The contractor should keep all equipment in good working order to minimize air pollution.

Noise	This alternative does not include any federal action. There is the potential that overall noise levels in the immediate area may increase due to locally funded temporary construction. However, noise impacts are not expected to be significant.	Watershed resiliency activities are anticipated to carry a similar noise level to that which existed at pre-disaster damage levels. Noise from construction activities may have short term adverse effects on persons who live near the construction area. Noise levels can be minimized by ensuring that construction equipment is equipped with a recommended muffler in good working order. Noise impacts on residences can also be minimized by ensuring that construction activities are not conducted during early morning or late evening hours. Noise levels of construction equipment (70 to 72 dBA) at the distance in which affected parties would likely be located (>200 feet/60 meters) will not be of a duration to be significant.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	Applicant shall, to the extent possible, follow best construction practices to minimize noise impacts.
Public Services and Utilities	This alternative does not include any federal action. Alternative one has the potential to affect public services and utilities, as watershed hazards can undermine, damage, or destroy facilities in subsequent events if not removed. Fire, emergency, law enforcement, and school services would be delayed as a result of continued inaccessibility of the route, due to closed roads or bridges. Depending on the length of detour required, these services could be significantly impacted. In addition, utility repair crews may not be able to reach damaged utility lines, resulting in lengthy service outages.	During construction, delays in fire, emergency, law enforcement and school services may continue, but these impacts would be short-term. Once completed, public services would be restored to pre-disaster levels. Utilities that cross or run along the watershed may be temporarily interrupted, but this would be a short-term impact. No long-term impacts would occur under this alternative.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	Applicant shall, to the extent possible, follow best construction practices to minimize any impacts on public services and utilities.
Biological Resources	Under the “No Action” alternative, no localized or regional effects to threatened or endangered species are	The actions under this alternative may have the potential to affect sensitive biological resources, wetlands, or natural waterways due	Consultation with USFWS may be necessary to assess	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to any species.

	expected. This alternative does not include any action. Therefore, the applicants would not be required to consult with USFWS to comply with the ESA, Migratory Bird Treaty Act (MBTA), Fish and Wildlife Coordination Act (FWCA), or state laws. Damaged structures left in the stream may cause a flow impediment, potentially causing impacts to species habitats and individuals.	to construction activities; a review of available information on the potential for species and critical habitat occurrence in the area will be conducted. The proposed action requires the redistribution or removal of hazards, materials, and possibly structures from the waterway. Embankment work and in-water work will occur. Federal Agencies will coordinate with USFWS and will review the project and make a determination of effect. If an Agency determines that a project has the potential to affect sensitive biological resources it will initiate the review process under Section 7 of the ESA, MBTA, or FWCA, the results of this consultation with USFWS would be documented in a memorandum to this PEA or in a SEA. If work occurs on U.S. Forest Service (USFS) or Bureau of Land Management (BLM) land additional coordination with these agencies will be required. Because migratory birds nest on many substrates (e.g., ground, shrubs, trees, utility boxes), should the proposed work occur during the breeding season (May 1st to August 15th) , the Service recommends: the required cutting of trees or shrubs occur between August 16th and April 30th to remove potential nesting surfaces prior to project commencement; and the removal of swallow nests as they are built, but prior to egg laying, from the utility structures that are to be removed; and/or netting of the affected structures or implementation of other measures to prevent swallow nesting prior to the breeding season. In addition, some migratory birds are known to nest outside of the aforementioned primary nesting season period. For example, raptors can be expected to nest during February 1 through July 15. For actions within 0.5 mile of occupied eagle nests coordination with USFWS should occur as a Bald and Golden	permanent and temporary impacts.	Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	Should any threatened or endangered species be discovered during construction work in the subject area shall be halted and the applicant should contact USFWS for further guidance. Proposed work should not occur during the avian breeding season (April 1st to August 30th), the Service recommends: the required cutting of trees or shrubs occur between August 30th and April 1st to remove potential nesting surfaces prior to project commencement; the removal of swallow nests as they are built, but prior to egg laying, from the bridge structures that are to be removed; and/or netting of the affected bridge structures to prevent swallow nesting prior to the breeding season.

		Eagle Protection Act (BGEPA) permit may be required. Implementation of the National Bald Eagle Management Guidelines would be applied as necessary. If a nest or bird is taken outside the specified timeframe, that take is considered a violation of the MBTA. Watershed restoration and replacement activities have the potential to affect federally listed threatened and endangered (T&E) species and their habitat. In order to avoid and minimize potential impacts applicants should implement conservation measures provided by USFWS to the extent possible. Conservation measures include, but are not limited to: Locate access routes, staging areas, etc. within previously disturbed areas Avoid disturbing or burying any existing riparian (streamside) habitat Implement local BMPs for control of erosion and sedimentation Incorporate consideration of fish passage into project design Restore any disturbed areas using native riparian plant species to prevent erosion Integrate native vegetation into rip rap slope protection Avoid fragmenting or isolating riparian corridors or wetlands Identify areas of ground disturbance and conservation measures implemented Contact U.S. Fish and Wildlife Service immediately by telephone at (303) 236–4773 if any T&E species is found alive, dead, injured, or hibernating within the project area.			

Water Resources	In the no action alternative watershed resiliency activities would not be completed. No work would occur in water, thus there would be no direct impact to water resources due to the proposed action. Hazards may cause a flow impediment, potentially causing significant impacts to stream and floodplain hydraulics and function.	Under this alternative watershed resiliency activities will be performed within waterways and floodplains. Excavation, redistribution, and fill materials may be necessary for the proposed project thus impacting waters of the U.S. Discharge into surface water may provide a temporary alteration of surface water quality including but not limited to temperature, dissolved oxygen, or turbidity. Watershed resiliency activities include bioengineering inspired bank stabilization (Figure 4 3), utilization of engineering woody debris (Figure 4 4 and Figure 4 5), re-vegetation, and in-stream grade control (Figure 4 6) that does not restrict aquatic species passage. Additionally, watershed resiliency activities are composed primarily of multi-objective design projects such as reactional usages for floodplains. Activities that result in hardened channelization or the creation of new impervious surfaces are not covered in this alternative. For examples of the types of biologically inspired engineering covered in alternative two, see Mitigation Best Practices | FEMA.gov and Appendix F: Engineering with Nature | Alternative Techniques to Riprap Bank Stabilization.	The applicant must coordinate with USACE and MTDEQ to obtain and comply with all appropriate permits.	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	The applicant is responsible for verifying and compliance with all permit requirements, including permit conditions, pre-construction notification requirements and regional conditions as provided by the US Army Corps of Engineers (USACE). The applicant is responsible for implementing, monitoring, and maintaining all Best Management Practices (BMP's) and Pre-Construction Notification (PCN) conditions of applicable Nation-Wide Permits (NWP). This is to include any requirements per the MT DEQ 401 Water Quality Certification for Clean Water Act permits. Applicants must coordinate with local floodplain administrator to obtain and comply with the appropriate floodplain management permits.
Cultural Resources	No federal action would occur under this alternative. However, new impacts to historic resources are possible as exposed or otherwise disrupted cultural resources would remain vulnerable to future events and accelerated deterioration.	This alternative has the potential to affect historic or cultural resources. Destruction or alteration of any site, structure, or object of historic, prehistoric, or paleontological importance may occur as a result of watershed resiliency activities. Redistribution of alluvium or other watershed elements may have exposed areas of high archaeological sensitivity. Physical change could affect unique cultural values. There could be effects on existing religious or sacred uses of a site or area and archeological resources may be present. For non-tribal lands any agencies that have entered into Programmatic Agreements with the	Consultation with the SHPO and/or THPO may be necessary to identify potential impacts for projects that do not fit into a Programmatic Agreement	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat;	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to any cultural resources. Should any historic or archaeological materials be discovered during construction, all activities on the site would be halted immediately and the applicant should contact the SHPO for further guidance.

		Montana State Historic Preservation Office (SHPO) or a Tribal Historic Preservation Office (THPO) will determine if a project meets any outlined programmatic allowances. If so, The Agencies would consider the project to be in compliance with Section 106 of NHPA and no further review would occur. If a project does not fall within an allowance, or a Programmatic Agreement does not exist, The Agencies will make a determination of effect in accordance with NHPA section 106 and consult with the SHPO. Additional archaeological surveys of ground disturbing activities or architectural surveys of projects impacting built environments may be required depending on consultation with Tribal Historic Preservation Office (THPO) and SHPO. Wealth of section 106 compliance resources are available at history.sd.gov and by contacting Montana State Historical Society staff members.		restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	
Hazardous Materials	The "No Action" alternative would not disturb any hazardous materials or create any potential hazard to human health.	The proposed action would not disturb any known hazardous materials or create any potential hazard to human health. If hazardous constituents are encountered during the proposed construction operations, appropriate measures for the proper assessment, remediation and management of the contamination would be initiated in accordance with applicable federal, state, and local regulations. The contractor would take appropriate measures to prevent, minimize, and control the spill of hazardous materials.	MTDEQ permits	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	Hazardous Materials must be appropriately separated and disposed of in an approved disposal site or landfill. Asphalt must be recycled as a blended base material or appropriately separated and disposed of in an approved disposal site or landfill in accordance with the MTDEQ authorized waste management regulations. For any "Asbestos Containing Material", lead-based paint and/or other hazardous materials found during remediation or repair activities, the Applicant must comply with all Federal, State, and local abatement and disposal requirements. Applicants are responsible for ensuring contracted removal of hazardous debris also follows these guidelines.

SECTION SEVEN | PUBLIC INVOLVEMENT

7.1 PUBLIC NOTICE OF AVAILABILITY

Public Notice of Availability Comment

The following document was released for a 30-day public comment period spanning (Pending Public Comment)

NOTICE OF AVAILABILITY FOR PUBLIC REVIEW OF A PROGRAMMATIC ENVIRONMENTAL ASSESSMENT (PEA) FOR WATERSHED RESILIENCY PROJECTS IN MONTANA

The Federal Emergency Management Agency (FEMA) is providing notice that a Programmatic Environmental Assessment (PEA) to evaluate proposed watershed resiliency projects in the State of Montana is available for public review and comment. We issue this notice to provide the opportunity for other Federal and State agencies, Native American tribes, non-governmental organizations, and the public to comment on the proposed PEA. These actions are part of our effort to comply with the general provisions of the National Environmental Policy Act (NEPA); NEPA regulations; other Federal laws, regulations, and Executive Orders; and our policies for compliance with those laws and regulations including 44 C.F.R. Part 9, 36 C.F.R. Part 800, and FEMA Directive 108-1 & Instruction 108-1-1.

The PEA focuses on a variety of comprehensive watershed resiliency actions in Montana that require river restoration, bank stabilization, demolition, relocation, or alteration of buildings and infrastructure, and hydraulic capacity mitigation measures for restoring watershed function. Projects may be funded through FEMA's Public Assistance (PA) Program for damages sustained during disaster events, through FEMA's Hazard Mitigation Assistance (HMA) grant programs, as well as other FEMA grant programs. Other Federal agencies may adopt the PEA under their own authorities in accordance with the Unified Federal Review (UFR) process.

The recurring disaster events in Montana have has resulted in hundreds of millions of dollars in damage due to the inundation of facilities, including roads, utilities, land, and homes. In an effort to restore these facilities or mitigate from future events, FEMA and other agencies may provide funds for restoration and upgrades of watershed hydraulic capacity and floodplain function. The purpose of the PEA is to provide an assessment of the expected environmental impacts associated with implementing these types of projects. It addresses the purpose and need of the proposed projects, project alternatives

considered, affected environment, environmental consequences, and impact of mitigation measures. The PEA would not address site-specific impacts, which would be evaluated on a project-specific basis. All Federally funded projects will be completed in compliance with applicable Federal, tribal, state, and local laws, regulations, Executive Orders, etc. Some specific items of work may include, but are limited to:

- Nature-based and biologically inspired mitigation measures such as bank stabilization using natural materials and re-vegetation in combination with hard armoring, referred to as bioengineering;
- Multi-objective project design of hydraulic control elements such as fish-passage friendly drop structures, energy dissipating fish ladders or the creation of recreational open space to preserve watershed functions;
- Demolition, relocation, or transfer of function for structures, including public utilities and roads, that currently impede or threaten to impede watershed functions; and
- Watershed restoration and mitigation including channel shaping or re-profiling, floodplain construction, overflow channel construction, riparian re-vegetation, and in-stream habitat improvement.

The comment period for the draft PEA will remain open for thirty days following publication of this notice. After gathering public comments, the draft PEA will become final in accordance with FEMA Directive 108-1 & Instruction 108-1-1, FEMA's implementing procedures for NEPA.

You can provide comments or obtain more detailed information about the proposed PEA by contacting Richard Myers, FEMA Region VIII, Deputy Regional Environmental Officer at richard.myers2@fema.dhs.gov.

SECTION EIGHT| LIST OF PREPARERS

This PEA was prepared by:

FEMA Region VIII, Denver, CO

- Steven Hardegen – FEMA Regional Environmental Officer
- Richard Myers – FEMA Deputy Regional Environmental Officer
- Kyle Cheeseman – FEMA Environmental Protection Specialist

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[xxxiii] U.S. Fish and Wildlife Service (USFWS) Bald & Golden Eagle Information. 2015. https://www.fws.gov/birds/management/managed-species/bald-and-golden-eagle-information.php. Accessed 08/21/2022.

[xxxiv] Montana Field Guide. 2022. https://fieldguide.mt.gov/Invasives.aspx. Accessed 08/21/2022.

[xxxv] Montana State Historic Preservation Office (MT SHPO) Montana Antiquities Database., 2019. http://svc.mt.gov/adsams. Accessed 08/21/2022.

[xxxvi] National Park Service (NPS) National Register Database and Research., 2019. https://www.nps.gov/subjects/nationalregister/database-research.htm. Accessed 08/21/2022.

Appendix A: Finding (Pending public comment)

Appendix B: Figures, Tables, Maps

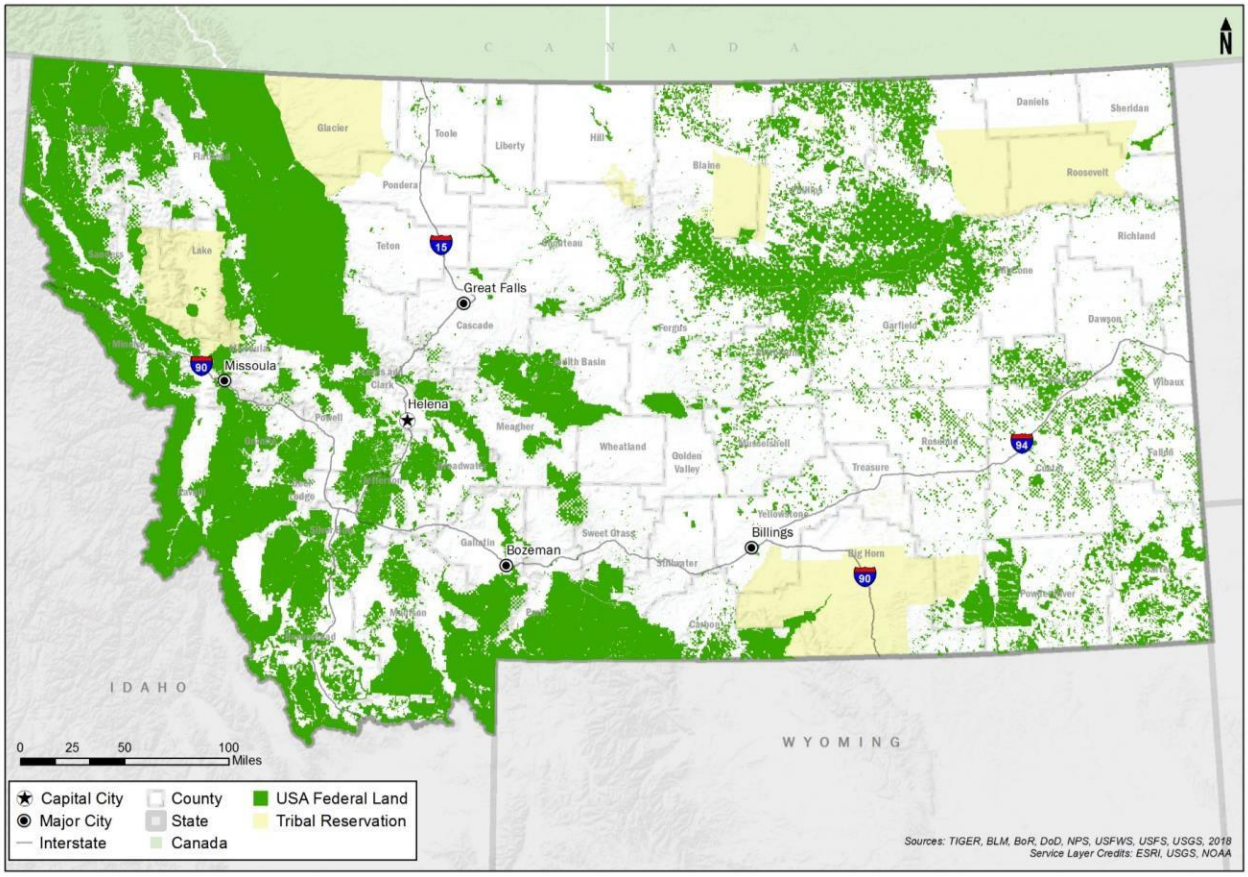


Figure 1-1: Montana State Map

Table 4-1: Land Cover of Montana

Land Cover Class	Acres	Percent of Land
Agricultural & Developed Vegetation	15,700,187	16.68%
Desert & Semi-Desert	18,776,603	19.95%
Developed & Other Human Use	1,413,087	1.50%
Forest & Woodland	23,491,815	24.69%
Introduced & Semi Natural Vegetation	1,690,885	1.80%
Nonvascular & Sparse Vascular Rock Vegetation	13,078	0.01%
Open Rock Vegetation	2,404,196	2.55%
Open Water	885,317	0.94%
Polar & High Montane Scrub, Grassland & Barrens	764,453	0.81%
Recently Disturbed or Modified	1,776,037	1.89%
Shrub & Herb Vegetation	27,189,827	28.89%
State Total	**94,105,485**	**100%**

Source: USGS 2011

Table 4-2: Land by Ownership in Montana

Landowner	Percentage and Acres
Percent Federal Land	**29.0%**
U.S. Bureau of Land Management	**8,022,852**
U.S. Bureau of Reclamation	**125,044**
U.S. Fish and Wildlife Service	**653,097**
National Park Service	**1,214,193**
U.S. Forest Service	**17,186,331**
U.S. – Other Federal Land	**82,075**
Percent State Land	**6.0%**
Montana State Trust Land	**5,182,439**
Montana Fish, Wildlife, and Parks	**405,817**
Montana University system	**35,727**
Montana Dept of Corrections	**35,426**
Montana --Other State Land	**28,227**
Local Government	**23,749**
Percent Indian Trust and BIA Land	**5.3%**
Tribal and BIA Land	**4,997,717**
Percent Private Land	**58.7%**
Private Land	**55,015,683**
Private Conservation Land	**227,154**
Percent Water	**0.8%**
Water	**779,337**

Source: CRS 2020

Table 4-3: Reservation and Off-Reservation Trust Land Statistics

Reservation	Population	Median Household Income	Unemployment Rate
Blackfeet Reservation and Off-Reservation Trust Land	10,772	$26,264	**10%**
Crow Reservation and Off-Reservation Trust Land	7,184	$47,454	**15.3%**
Flathead Reservation	29,717	$42,154	**6.4%**
Fort Belknap Reservation and Off-Reservation Trust Land	3,187	$30,875	**31.1%**
Fort Peck Reservation and Off-Reservation Trust Land	10,319	$36,786	**14.2%**
Northern Cheyenne Reservation and Off-Reservation Trust Land	4,931	$46,300	**22.4%**
Rocky Boy's Reservation and Off-Reservation Trust Land (MT part)	3,634	$28,897	**10.7%**
Little Shell Tribe (No Census Bureau Information)	5,300	N/A	**N/A**
Turtle Mountain Reservation and Off-Reservation Trust Land, MT-ND-SD (MT part)	24	$30,625	**$31,875**

Source: USCB 2018

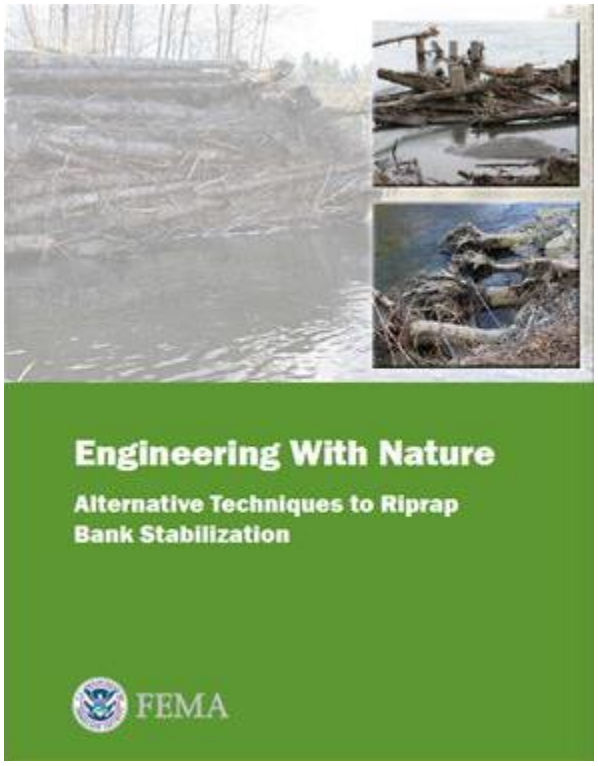


Figure 4-1: Engineering with Nature Publication

Figure 4-2: Bioengineering Using Engineered Woody Debris

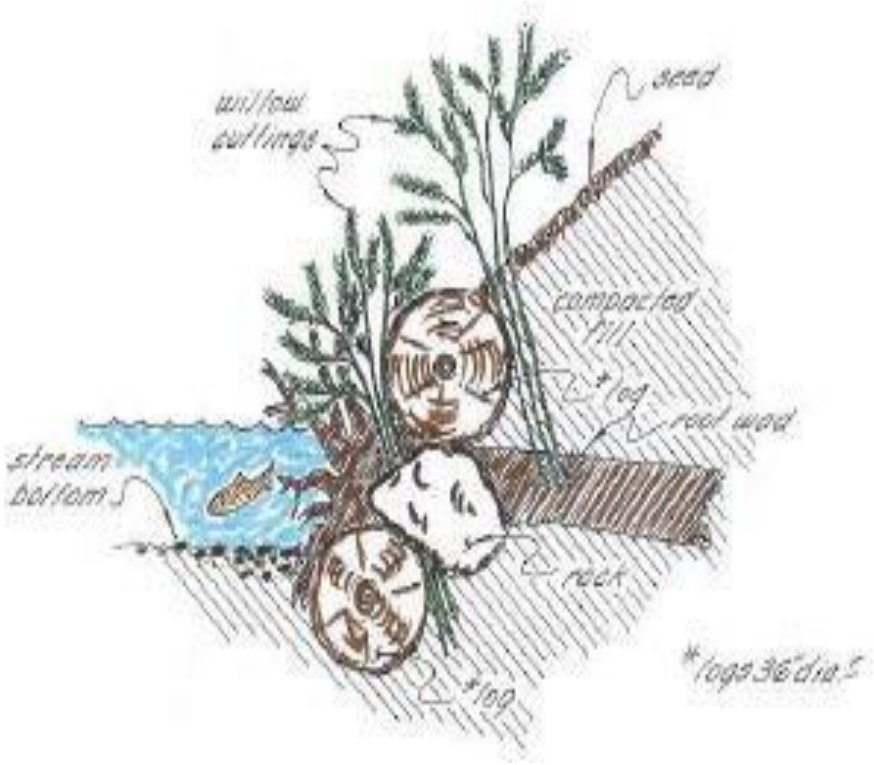


Figure 4-3: Woody Debris Bank Stabilization Cross-Section

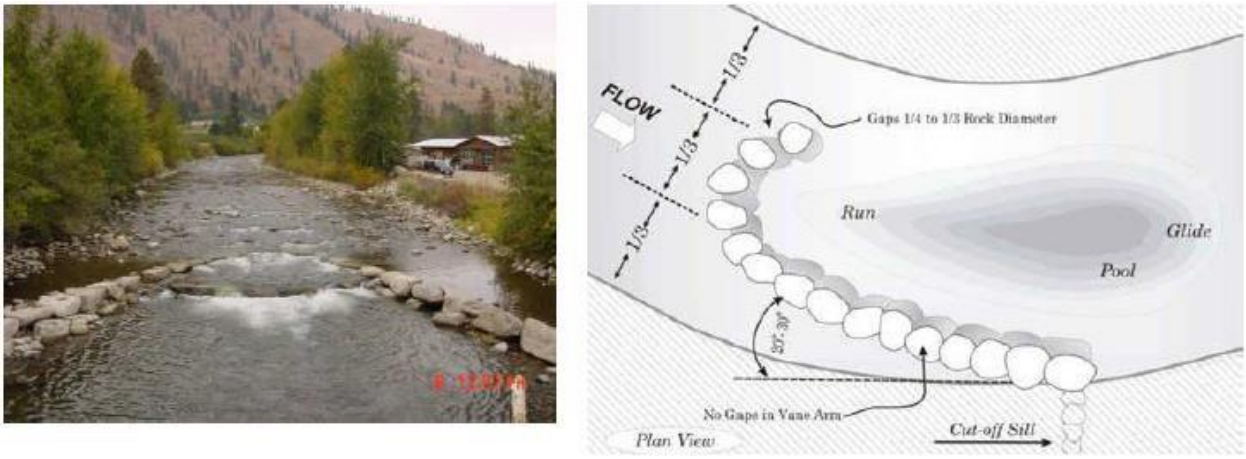


Figure 4-4: Grade Control

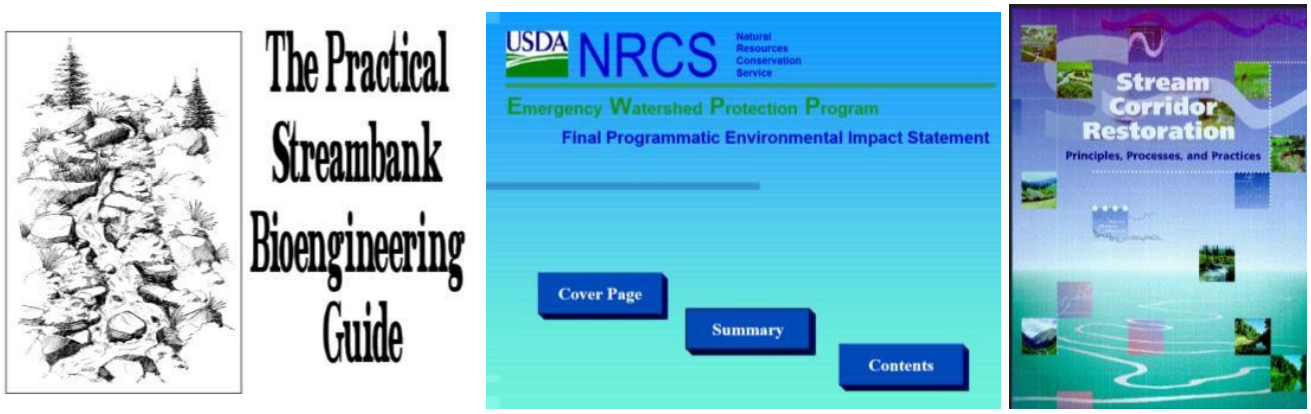


Figure 4-5: Bioengineering Resources

Table 4-4: Federally Listed Threatened, Endangered and Candidate Species in Montana

Status	Species/Listing Name
	Mammals
E	Black-footed ferret (Mustela nigripes)
EXPN	Black-footed ferret (Mustela nigripes)
T (CH)	Canada Lynx (Lynx canadensis)
T	Grizzly bear (Ursus arctos horribilis)
P, T	North American Wolverine (Gulo luscus)
T	Northern Long-Eared Bat (Myotis septentrionalis)
	Birds
T (CH)	Piping Plover (Charadrius melodus)
T	Red Knot (Calidris canutus rufa)
E	Whooping crane (Grus americana)
T	Yellow-billed Cuckoo (Coccyzus americanus)
	Fishes
T (CH)	Bull Trout (Salvelinus confluentus)
E	Pallid sturgeon (Scaphirhynchus albus)
E	White sturgeon (Acipenser transmontanus)
	Insects
T	Meltwater Lednian Stonefly (Lednia tumana)
C	Monarch butterfly (Danaus plexippus)
T	Western glacier stonefly (Zapada glacier)
	Flowering Plants
T	Spalding's catchfly (Silene spaldingii)
T	Ute ladies'-tresses (Spiranthes diluvialis)
	Conifers and Cycads
P, T	Whitebark Pine (Pinus albicaulis)

Source: ECOS 2022

Table 5-1: Mitigation Measures by Resource Area

Resource Area	Mitigation Measure
Physical Resources, Water Resources	For projects where wetland areas will be impacted, The Agencies will evaluate individual and cumulative impacts and implement avoidance, minimization and/or mitigation measures as necessary to reduce impacts below level of significance.
Physical Resources, Water Resources	For projects in which soil erosion potential is determined to be significant, a project erosion control plan to minimize soil loss, including the use of Best Management Practices, to isolate the construction site and minimize adverse effects of soil loss and sedimentation on soil and water resources will be implemented.
Physical Resources, Water Resources	To mitigate for impacts to floodplain, a hydrology and hydraulics study will be completed to ensure the flow of flood waters. The project must not serve as a dam or otherwise impede water movement thus aggravating flooding upstream of the roadway.
Physical Resources, Water Resources	The Agencies will consult with US Fish and Wildlife Service and/or Natural Resources Conservation Service for any project which extends outside of the original right of way and has the potential to affect land use, including Fish and Wildlife Service easements, prime farmland, or farmland of state/local significance.
Safety and Occupational Health	To minimize any potential to occupation health and safety, construction workers and equipment operators are required to wear appropriate PPE and to be properly trained for the work being performed, including removal and disposal of asbestos and lead-based paint for demolition projects.
Safety and Occupational Health	All waste material associated with the project must be disposed of properly and not placed in identified floodway or wetland areas or in habitat for threatened or endangered species. All hazardous material resulting from demolition activities, including asbestos and lead paint will be disposed of in hazardous waste landfill.
Air Quality	To mitigate for fugitive dust during construction periodic watering of active construction areas, particularly in areas close to sensitive receptors (e.g., hospitals, senior citizen homes, and schools) will be implemented.
Noise	Construction noise levels will be minimized by ensuring that construction equipment is equipped with a recommended muffler in good working order. Impact to noise levels will be minimized by limiting construction activities that occur during early morning or late evening hours.
Biological Resources	The Agencies will consult with USFWS, who is the regulatory authority, on any actions that have the potential to affect biological resources including Threatened and Endangered species and will include measures to avoid or minimize potential impacts. Coordination will include measures to avoid or minimize potential impacts as grant conditions. This includes migratory birds and raptors.
Biological Resources	Fill material must not come from nor be deposited in threatened and/or endangered species habitat.
Biological Resources	The Agencies will coordinate with MT DEQ concerning guidelines regarding impacts to State species of interest. Coordination may include measures to avoid or minimize potential impacts as grant conditions. This includes migratory birds and raptors.

Cultural Resources	**Unless a project is covered under a programmatic agreement exemption all other ground disturbing projects must consult with the SHPO or THPO under Section 106 of the NHPA. The absence of cultural property documentation in the area does not mean they do not exist, but rather may reflect the absence of any previous cultural resource inventory in the area. If during the course of any ground disturbance related to this project, cultural materials are inadvertently discovered, the project would be immediately stopped and the SHPO/THPO and Agency notified.**
Cultural Resources	**To avoid impacts to cultural resources from material borrow source, borrow material source will be reviewed and approved by SHPO or THPO prior to use.**
Cultural Resources	**The Agencies will consult with the State/Tribal Historic Preservation Office on project specific activities for any project that has the potential to affect previously undisturbed areas or historic properties.**

Table 6-1: Summary of Impacts

Resource Area	Alternative 1: No Action	Alternative 2: Replacement	Permits and Conditions Required	Best Construction Practices	Conditions
Physical Resources	This alternative does not include any federal action. Alternative 1 has potential to pose safety threats, permanently displace residents, further economic strains on the State of Montana, alter drainage and flow rates, and change land use if watersheds are not restored to functional capacity. Loss in residential, commercial, agricultural, or recreational land use may occur.	This alternative applies to restoration or replacement of watershed features and as such, a hydrologic and hydraulic study will be used to determine the best redistribution for watersheds. Although this will affect the physical environment, the "No Action" alternative is expected to alter stream corridors at a more significant rate than the proposed actions. Watershed features are expected to remain within the previous ROW so no changes in land use are anticipated.	USACE Permit	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	The applicant is responsible for verifying and compliance with all permit requirements, including permit conditions, pre-construction notification requirements and regional conditions as provided by the US Army Corps of Engineers (USACE). The applicant is responsible for implementing, monitoring, and maintaining all Best Management Practices (BMP's) and Pre-Construction Notification (PCN) conditions of applicable Nation-Wide Permits (NWP). This is to include any requirements per the MT DEQ 401 Water Quality Certification for Clean Water Act permits. To the extent possible, keep equipment and construction within previously disturbed area and ROW.
Transportation Facilities	This alternative does not include any federal action. Immediate threats would persist unless actions to restore watershed function would be provided by the State and/or local municipalities. This alternative may result in significant adverse impacts due to increased travel times and traffic volumes, as damages to transportation facilities would remain.	Alternative 2: Watershed Resiliency Activities This alternative applies to restoration or replacement of existing watershed elements in the existing location, or relocation of transportation facilities. Short term impacts would be expected during construction as traffic delays and alternate routes may be required. No significant adverse long-term impacts are expected to the transportation volume, capacity, and time of transit. The transportation facilities would be more resilient and less likely to experience substantial damage from future severe weather events.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion,	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to transportation facilities.

				integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	
Safety and Occupational Health	This alternative does not include any federal action. Residents, communities, and properties would be left susceptible to significant future damages. Materials could be washed downstream impacting other structures. These materials may have the potential to cause both lead and asbestos exposure. A "No Action" alternative may also result in restricted access for emergency, police and fire services causing the potential for significant delay. The "No Action" alternative provides a significant adverse safety affect to residents of the State Montana.	Alternative 2 would have no significant impact to public safety or occupational health. Communities are expected to benefit from watershed resiliency activities. Removal or redistribution of materials with painted surfaces or containing asbestos may be required and construction workers are required to follow OSHA regulations to provide appropriate asbestos abatement and avoid release of lead from paint. Construction workers and equipment operators are required to wear appropriate personal protective equipment (PPE) and be properly trained for the work being performed. All solid or hazardous wastes that might be generated during restoration or replacement must be removed and disposed of at a permitted facility or designated collection point (e.g., for solid waste, a utility or construction company's own dumpster). Standard construction traffic control measures will be used to protect workers, residents, and the travelling public.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	For any "Asbestos Containing Material", lead-based paint and/or other hazardous materials found during remediation or repair activities, the applicant must comply with all Federal, State, and local abatement and disposal requirements. Applicants are responsible for ensuring contracted removal of hazardous debris also follows these guidelines.
Socioeconomic and Environmental Justice	This alternative does not include any federal action. There is no requirement for compliance with Executive Orders (EO) 12898: Environmental Justice and 13045: Protection of Children from Environmental Health Risks and Safety Risks since there are no federal actions. "Alternative 1" has potential to result in significant adverse impact to socioeconomics of a community if watershed elements are left in disrepair leaving infrastructure and private property vulnerable to major	During the construction period, this alternative may provide some short-term benefits by providing construction jobs and a multiple effect of increased expenditures in the local economy. There may be major effects to populations during construction periods due to road detours, to provide access to watershed features. Efforts would be made during any construction to minimize short-term disruption to the local transportation system. Low income and minority populations may benefit during the construction process through the provision of construction jobs and multiplier effects	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to low income and minority populations.

	disaster events. Residents may be isolated from their homes and businesses by roadway damages. The "No Action" alternative may cause significant damages to property and compromise infrastructure.	of expenditures in the local economy. Any adverse impacts to low income or minority populations are expected to be short-term and not significant.		riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	
Air Quality	This alternative does not include any federal action. Vehicle emissions may increase due to alternative transportation routes.	Watershed resiliency actions will require heavy construction equipment to reshape watershed elements. During construction there may be temporary increases in equipment exhaust emissions and fugitive dust. However, the temporary increase in equipment exhaust is expected to be negligible as long as the equipment is well maintained, and idling is minimized. All necessary measures must be taken to minimize fugitive dust emissions created during construction activities. Any complaints that may arise are to be dealt with in an efficient and effective manner. The contractor would be required to keep all equipment in good working order to minimize air pollution. Where bank stabilization/construction within the stream corridor is required there would be some short-term increase in fugitive dust and vehicular emissions. Mitigation of fugitive dust, if necessary, can be accomplished by periodic watering of the demolition site. After construction, there would be no change in air quality as this alternative would not change roadway length, and therefore would not change the amount of vehicle emissions.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to air quality. The contractor should keep all equipment in good working order to minimize air pollution.
Noise	This alternative does not include any federal action. There is the potential that overall noise levels in the immediate area may increase due to locally funded temporary construction. However,	Watershed resiliency activities are anticipated to carry a similar noise level to that which existed at pre-disaster damage levels. Noise from construction activities may have short term adverse effects on persons who live near the construction area. Noise levels can be minimized by ensuring	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified	Applicant shall, to the extent possible, follow best construction practices to minimize noise impacts.

	noise impacts are not expected to be significant.	that construction equipment is equipped with a recommended muffler in good working order. Noise impacts on residences can also be minimized by ensuring that construction activities are not conducted during early morning or late evening hours. Noise levels of construction equipment (70 to 72 dBA) at the distance in which affected parties would likely be located (>200 feet/60 meters) will not be of a duration to be significant.		Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	
Public Services and Utilities	This alternative does not include any federal action. Alternative one has the potential to affect public services and utilities, as watershed hazards can undermine, damage, or destroy facilities in subsequent events if not removed. Fire, emergency, law enforcement, and school services would be delayed as a result of continued inaccessibility of the route, due to closed roads or bridges. Depending on the length of detour required, these services could be significantly impacted. In addition, utility repair crews may not be able to reach damaged utility lines, resulting in lengthy service outages.	During construction, delays in fire, emergency, law enforcement and school services may continue, but these impacts would be short-term. Once completed, public services would be restored to pre-disaster levels. Utilities that cross or run along the watershed may be temporarily interrupted, but this would be a short-term impact. No long-term impacts would occur under this alternative.	none	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	Applicant shall, to the extent possible, follow best construction practices to minimize any impacts on public services and utilities.
Biological Resources	Under the "No Action" alternative, no localized or regional effects to threatened or endangered species are expected. This alternative does not include any action. Therefore, the applicants would not be required to consult with USFWS to comply with the ESA, Migratory Bird Treaty Act	The actions under this alternative may have the potential to affect sensitive biological resources, wetlands, or natural waterways due to construction activities; a review of available information on the potential for species and critical habitat occurrence in the area will be conducted. The proposed action requires the redistribution or removal of hazards, materials, and possibly	Consultation with USFWS may be necessary to assess permanent and temporary impacts.	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to any species. Should any threatened or endangered species be discovered during construction work in the subject area shall be halted and the applicant should

	(MBTA), Fish and Wildlife Coordination Act (FWCA), or state laws. Damaged structures left in the stream may cause a flow impediment, potentially causing impacts to species habitats and individuals.	structures from the waterway. Embankment work and in-water work will occur. Federal Agencies will coordinate with USFWS and will review the project and make a determination of effect. If an Agency determines that a project has the potential to affect sensitive biological resources it will initiate the review process under Section 7 of the ESA, MBTA, or FWCA, the results of this consultation with USFWS would be documented in a memorandum to this PEA or in a SEA. If work occurs on U.S. Forest Service (USFS) or Bureau of Land Management (BLM) land additional coordination with these agencies will be required. Because migratory birds nest on many substrates (e.g., ground, shrubs, trees, utility boxes), should the proposed work occur during the breeding season (May 1st to August 15th) , the Service recommends: the required cutting of trees or shrubs occur between August 16th and April 30th to remove potential nesting surfaces prior to project commencement; and the removal of swallow nests as they are built, but prior to egg laying, from the utility structures that are to be removed; and/or netting of the affected structures or implementation of other measures to prevent swallow nesting prior to the breeding season. In addition, some migratory birds are known to nest outside of the aforementioned primary nesting season period. For example, raptors can be expected to nest during February 1 through July 15. For actions within 0.5 mile of occupied eagle nests coordination with USFWS should occur as a Bald and Golden Eagle Protection Act (BGEPA) permit may be required. Implementation of the National Bald Eagle Management Guidelines would be applied as necessary. If a nest or bird is		Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	contact USFWS for further guidance. Proposed work should not occur during the avian breeding season (April 1st to August 30th), the Service recommends: the required cutting of trees or shrubs occur between August 30th and April 1st to remove potential nesting surfaces prior to project commencement; the removal of swallow nests as they are built, but prior to egg laying, from the bridge structures that are to be removed; and/or netting of the affected bridge structures to prevent swallow nesting prior to the breeding season.

		taken outside the specified timeframe, that take is considered a violation of the MBTA. Watershed restoration and replacement activities have the potential to affect federally listed threatened and endangered (T&E) species and their habitat. In order to avoid and minimize potential impacts applicants should implement conservation measures provided by USFWS to the extent possible. Conservation measures include, but are not limited to: Locate access routes, staging areas, etc. within previously disturbed areas Avoid disturbing or burying any existing riparian (streamside) habitat Implement local BMPs for control of erosion and sedimentation Incorporate consideration of fish passage into project design Restore any disturbed areas using native riparian plant species to prevent erosion Integrate native vegetation into rip rap slope protection Avoid fragmenting or isolating riparian corridors or wetlands Identify areas of ground disturbance and conservation measures implemented Contact U.S. Fish and Wildlife Service immediately by telephone at (303) 236–4773 if any T&E species is found alive, dead, injured, or hibernating within the project area.			

Water Resources	In the no action alternative watershed resiliency activities would not be completed. No work would occur in water, thus there would be no direct impact to water resources due to the proposed action. Hazards may cause a flow impediment, potentially causing significant impacts to stream and floodplain hydraulics and function.	Under this alternative watershed resiliency activities will be performed within waterways and floodplains. Excavation, redistribution, and fill materials may be necessary for the proposed project thus impacting waters of the U.S. Discharge into surface water may provide a temporary alteration of surface water quality including but not limited to temperature, dissolved oxygen, or turbidity. Watershed resiliency activities include bioengineering inspired bank stabilization (Figure 4 3), utilization of engineering woody debris (Figure 4 4 and Figure 4 5), re-vegetation, and in-stream grade control (Figure 4 6) that does not restrict aquatic species passage. Additionally, watershed resiliency activities are composed primarily of multi-objective design projects such as reactional usages for floodplains. Activities that result in hardened channelization or the creation of new impervious surfaces are not covered in this alternative. For examples of the types of biologically inspired engineering covered in alternative two, see Mitigation Best Practices | FEMA.gov and Appendix F: Engineering with Nature | Alternative Techniques to Riprap Bank Stabilization.	The applicant must coordinate with USACE and MTDEQ to obtain and comply with all appropriate permits.	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	The applicant is responsible for verifying and compliance with all permit requirements, including permit conditions, pre-construction notification requirements and regional conditions as provided by the US Army Corps of Engineers (USACE). The applicant is responsible for implementing, monitoring, and maintaining all Best Management Practices (BMP's) and Pre-Construction Notification (PCN) conditions of applicable Nation-Wide Permits (NWP). This is to include any requirements per the MT DEQ 401 Water Quality Certification for Clean Water Act permits. Applicants must coordinate with local floodplain administrator to obtain and comply with the appropriate floodplain management permits.
Cultural Resources	No federal action would occur under this alternative. However, new impacts to historic resources are possible as exposed or otherwise disrupted cultural resources would remain vulnerable to future events and accelerated deterioration.	This alternative has the potential to affect historic or cultural resources. Destruction or alteration of any site, structure, or object of historic, prehistoric, or paleontological importance may occur as a result of watershed resiliency activities. Redistribution of alluvium or other watershed elements may have exposed areas of high archaeological sensitivity. Physical change could affect unique cultural values. There could be effects on existing religious or sacred uses of a site or area and archeological resources may be	Consultation with the SHPO and/or THPO may be necessary to identify potential impacts for projects that do not fit into a Programmatic Agreement	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any	Applicant shall, to the extent possible, follow best construction practices to minimize impacts to any cultural resources. Should any historic or archaeological materials be discovered during construction, all activities on the site would be halted immediately and the applicant should contact the SHPO for further guidance.

		present. For non-tribal lands any agencies that have entered into Programmatic Agreements with the Montana State Historic Preservation Office (SHPO) or a Tribal Historic Preservation Office (THPO) will determine if a project meets any outlined programmatic allowances. If so, The Agencies would consider the project to be in compliance with Section 106 of NHPA and no further review would occur. If a project does not fall within an allowance, or a Programmatic Agreement does not exist, The Agencies will make a determination of effect in accordance with NHPA section 106 and consult with the SHPO. Additional archaeological surveys of ground disturbing activities or architectural surveys of projects impacting built environments may be required depending on consultation with Tribal Historic Preservation Office (THPO) and SHPO. Wealth of section 106 compliance resources are available at history.sd.gov and by contacting Montana State Historical Society staff members.		existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or isolating riparian corridors or wetlands, and identify areas of ground disturbance	
Hazardous Materials	The "No Action" alternative would not disturb any hazardous materials or create any potential hazard to human health.	The proposed action would not disturb any known hazardous materials or create any potential hazard to human health. If hazardous constituents are encountered during the proposed construction operations, appropriate measures for the proper assessment, remediation and management of the contamination would be initiated in accordance with applicable federal, state, and local regulations. The contractor would take appropriate measures to prevent, minimize, and control the spill of hazardous materials.	MTDEQ permits	Use vegetative stabilization measures/bioengineered alternatives to rip rap/armoring whenever possible Assess impacts to endangered species, historic buildings or cultural resources as specific projects are identified Consult with individual agencies including USFWS, USACE, EPA, etc. as needed on individual projects Implement USFWS conservation measures: locate access routes, staging areas, etc. within previously disturbed areas; avoid disturbing or burying any existing riparian (streamside) habitat; restore any disturbed areas using native riparian plant species to prevent erosion, integrate native vegetation into rip rap slope protection, avoid fragmenting or	Hazardous Materials must be appropriately separated and disposed of in an approved disposal site or landfill. Asphalt must be recycled as a blended base material or appropriately separated and disposed of in an approved disposal site or landfill in accordance with the MTDEQ authorized waste management regulations. For any "Asbestos Containing Material", lead-based paint and/or other hazardous materials found during remediation or repair activities, the Applicant must comply with all Federal, State, and local abatement and disposal

				isolating riparian corridors or wetlands, and identify areas of ground disturbance	requirements. Applicants are responsible for ensuring contracted removal of hazardous debris also follows these guidelines.

Appendix C: Comments Received (Pending public comment)

APPENDIX D: COMPLIANCE CHECKLIST

Upon completion please submit this checklist and all attachments to Rick Myers (Richard.Myers2@fema.dhs.gov), FEMA Region VIII, Deputy Regional Environmental Officer, and FEMA-R8EHP@fema.dhs.gov for the purpose of tracking cumulative impacts.

Watershed resiliency activities generally involve one or more of the following:

- General construction activities within previously defined right of ways (ROW).
- Creation of access and staging areas when needed to move trucks and heavy equipment.
- De-watering to allow operations in-stream.
- Use of heavy equipment within a floodplain, stream bank or in-stream position.
- Establishment of temporary low-flow channels.
- Grading, shaping, and re-vegetation of watersheds by seeding or planting.
- Use of rip rap or other hard armoring in combination with nature-based bioengineering for erosion control.
- Restoration of floodplain dimension, pattern, and profile.

General Project Conditions:

1. In the event that archeological deposits, including any Native American pottery, stone tools, bones, or human remains, are uncovered, the project shall be halted and the Applicant shall stop all work immediately in the vicinity of the discovery and take reasonable measures to avoid or minimize harm to the finds. All archeological findings will be secured and access to the sensitive area restricted. The Applicant will inform FEMA immediately and FEMA will consult with the State or Tribal Historic Preservation Office(s) and Tribes; work in sensitive areas cannot resume until consultation is completed and appropriate measures have been taken to ensure that the project is in compliance with the National Historic Preservation Act.
2. Unusable equipment, debris, and material shall be disposed of in an approved manner and location. In the event significant items (or evidence thereof) are discovered during implementation of the project, Applicant shall handle, manage, and dispose of petroleum products, hazardous materials, and toxic waste in accordance to the requirements and to the satisfaction of the governing Federal, state, and local Agencies.
3. Applicant must obtain any required elevation certificate from the local floodplain administrator before work begins. Elevation must meet applicable Federal, state, and local requirements.
4. If any asbestos containing materials, lead based paint, and/or other hazardous materials are found during remediation or repair activities, the Applicant must comply with all Federal, state, and local abatement and disposal requirements under the National Emissions Standards for Hazardous Air Pollutants.
5. The Applicant is required to obtain and comply with all Federal, state, and local permits, approvals, and requirements prior to initiating work on this project.
6. Changes, additions, and/or supplements to the approved listed properties and the scope of work which alter the existing scope of work, including additional work not funded by FEMA but performed substantially at the same time, will require re-submission of the application prior to construction to FEMA for re-evaluation under the National Environmental Policy Act.

Part I

POST-DISASTER **Watershed Resiliency Projects in the State of Montana**	Date:	Project Code:
Assessment under the **Watershed Resiliency Projects Programmatic Environmental Assessment (PEA) for MT and Finding of No Significant Impact (FONSI) (August 2022)**		
Disaster Description and Date:		
Project Name and Location: Include address and coordinates.		
Name and Contact Information of Project Primary Point of Contact:		
Comprehensive Project Description:		
Name and Date of Hydraulic Study (attach a copy to this checklist):		

I. PEA Alternative Used (Check all that apply)

☐ Alternative 1 – No Action Alternative

☐ Alternative 2 – Watershed Resiliency Activities

II. Evaluation

ENVIRONMENTAL IMPACT ASSESSMENT:
Document impacts to human, socioeconomic, or natural environment for environmental setting or circumstances.

Setting/Resource/Circumstance	Are Impacts Consistent with Descriptions in PEA? (Yes/No)	Are There Additional Impacts? (Yes/No)	Date Reviewed	Are Site Specific Study Documents Attached? (Yes/No)
Geology, Soils and Land Use				
Transportation Facilities				
Safety and Occupational Health				
Socioeconomics and Environmental Justice				
Air Quality				
Noise				
Public Services and Utilities				
Water Resources				
Biological Resources				
Cultural Resources				

REGULATORY CHANGES:
Document changes to laws, regulations, and/or guidelines since signature of PEAFONSI:

IMPACTS ASSESSMENT:
For items checked as having additional impacts: assess the affected natural and socio-economic environment, impacts and new issues/concerns which may now exist:

MITIGATION:
List specific mitigation measures for each resource impacted (both impacts from PEA or additional impacts):

III. Public/Agency Involvement (if any)

Document any public meetings, notices, & websites, and/or document agency coordination. For each provide dates, and coordination:

IV. Permits

List required permits and status of permit:

V. Attachments Listed

List maps, studies, background data, permits, etc.

VI. Conclusion and Recommendation

☐ The project is consistent with the alternatives and impacts as described in the PEA.

☐ The project generally is consistent with the alternatives and impacts as described in the PEA, but includes some minor impacts not described in the PEA which are documented in this checklist.

☐ The project requires a Supplemental Environmental Assessment or Environmental Impact Statement because (1) creates impacts not described in the PEA; (2) creates impacts greater in magnitude, extent, or duration than those described in the PEA; or (3) requires additional mitigation measures that are not described in the PEA to keep impacts below significant levels.

Applicant or Responsible Entity Signature Date

Funding Agency Date

Upon completion, please submit this checklist and all attachments to Rick Myers (Richard.Myers2@fema.dhs.gov), FEMA Region VIII, Deputy Regional Environmental Officer, and FEMA-R8EHP@fema.dhs.gov for the purpose of tracking cumulative impacts.

Appendix E: Additional Resources

1. 42 United States Code [USC] 55 parts 4321 et seq., 2000

2. 40 Code of Federal Regulations [CFR] 30 parts 1500 et seq., 2004

3. 44 Code of Federal Regulations [CFR] Ch. I Part 10, and 23 CFR 771., 2013

4. See Sections 4.8 and 4.9 of this PEA and Appendix F: *Engineering with Nature*

5. See Sections 4.8 and 4.9 of this PEA and https://www.fema.gov/emergency-managers/risk/hazard-mitigation-planning/best-practices and Appendix F: *Engineering with Nature*. Another useful, though dated, resource is *Using Multi-Objective Management to Reduce Flood Losses in Your Watershed* prepared by the Association of State Floodplain Managers Inc (ASFPM), in 1996. https://cdn.ymaws.com/floodplain.org/resource/resmgr/old_website_files/Using_MOM_in_Watershed.pdf

6. Solid & Hazardous Waste - Wyoming Department of Environmental Quality: https://deq.wyoming.gov/shwd/

7. See Sections 4.8 and 4.9 of this PEA and https://www.fema.gov/emergency-managers/risk/hazard-mitigation-planning/best-practices and Appendix F: *Engineering with Nature* for more information on the types of bank stabilization and fish passage required by this alternative.

8. Plant Materials Program | Riparian and Bioengineering | Natural Resources Conservation Service: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/plantmaterials/technical/publications/?cid=stelprdb1043002

9. Code of Federal Regulations [CFR] 23 Part 772., 2010

10. Public Law 90-542; 16 U.S. Code. 1271 et seq: Congressional declaration of policy., 1968

11. Another useful, though dated, resource is Using Multi-Objective Management to Reduce Flood Losses in Your Watershed prepared by the Association of State Floodplain Managers Inc (ASFPM), in 1996. https://cdn.ymaws.com/floodplain.org/resource/resmgr/old_website_files/Using_MOM_in_Wate rshed.pdf

12. U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov/wps/portal/nrcs/detail/plantmaterials/technical/publications/?cid=stelprdb1043002

13. U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/quality/?cid=stelprdb1044707

14. U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/quality/?cid=stelprdb1043244

15. U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/ecosciences/ec/?cid=nrcs143_008451

16. Environmental Protection Agency: Storm Water Pollution Prevention Plans for Construction Activities: https://www.epa.gov/npdes/stormwater-discharges-construction-activities

17. Environmental Protection Agency: Clean Water Action Section 404 Permits to Discharge Dredge or Fill Material: https://www.epa.gov/cwa-404

18. 401 Water Quality Certification -Montana Department of Environmental Quality: https://deq.mt.gov/water/assistance

19. Storm Water Permitting -Montana Department of Environmental Quality: https://deq.mt.gov/water/assistance

20. U.S. Fish and Wildlife Service: National Wetlands Inventory: http://www.fws.gov/wetlands/data/mapper.HTML

21. Federal Emergency Management Agency (FEMA) Map Service Center (MSC) - https://msc.fema.gov/

22. Federal Emergency Management Agency: Eight Step Planning Process for Floodplain/Wetland Management: https://www.fema.gov/pdf/plan/ehp/final_e.pdf

23. 16 U.S. Code [U.S.C] 668 et seq.

24. U.S. Fish and Wildlife Service | National Bald Eagle Management Guidelines, https://www.fws.gov/migratorybirds/pdf/management/nationalbaldeaglenanagementguidelines.pdf

25. Bald Eagle Guidelines | https://www.fws.gov/migratorybirds/pdf/management/nationalbaldeaglenanagementguidelines.pdf

26. 40 Code of Federal Regulations [CFR] Section 1500-1508

27. 42 United States Code [USC] Section 4321

28. 40 Code of Federal Regulations [CFR] Section 1508.7

Engineering With Nature

Alternative Techniques to Riprap Bank Stabilization

FEMA

Engineering With Nature

Alternative Techniques to Riprap Bank Stabilization

Contents

Introduction

We have always endeavored to harness and manipulate our environment. Efforts to shape or restrict nature often involve mechanically or artificially forcing our surroundings to bend to our will. Sadly, many of these activities have serious effects. Clear cutting forests, pollution, endangering entire species or simply driving them to extinction are just some of the major impacts. As we grow and develop technologically and as a society, we often overlook just what we are doing to the land around us, frequently until it is too late.

Over the past century, the Pacific Northwest has seen a significant amount of development in the areas of agriculture, housing, urbanization and population. The 12 counties spanning the area of Puget Sound in Washington State alone have seen growth in numbers of up to 4 million people since the 1950s. This continuing expansion has put increased pressure on the multitude of rivers, streams and other bodies of water that festoon the region, and growing presence is having a marked impact on those waters.

The more development this area undergoes, the more we are forced to restrict and inhibit the environment, in particular the varying and numerous waterways that surround us. While land erosion, stream migration and even flooding are natural processes, they can cause havoc when occurring near human populations. This has led to the creation of a number of measures to control or eliminate such hazards. Unfortunately, while many of these techniques solve the immediate problem, they are not always the safest or most environmentally conscious choice for the long-term.

Riprap, or hard armoring, is the traditional response to controlling and minimizing erosion along shorelines or riverbanks. As demonstrated by past multiple disasters in Washington State, the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) has provided funding assistance for the repair to these riprap facilities.*[1] The very nature of having to repair these facilities counters the popular engineering belief that riprap is the best solution for mitigating stream bank erosion.

1* Funding is contingent upon eligibility criteria established under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended

Riprap

Put simply, riprap is the layering of rocks (angular rocks generally being preferred,) along a threatened area to counteract the constant wearing away of land brought about by repetitive hydrologic activity. Whenever waves or moving waters meet unprotected soil, there will always be erosion. Covering exposed soil with rock helps protect it from being washed away, securing an embankment against further erosion.

Problems arise because the effects of riprap do not stop at the point of installation. When positioned along a section of riverbank, for example, riprap has a number of negative impacts on the surrounding environment. Riprap tends to increase the speed of water flow along an armored reach, as the water has no points of friction to come up against and nothing to slow it down. This additional strength of flow presents issues further downstream from a riprap protected bank, as water is deflected off the riprap and directed at other points of riverbank. The increased strength and speed of the water only increases erosion suffered at these new locations, the typical result of which is the necessity of installing additional armoring, which merely moves the problem further down the stream.

Riprap impedes the natural functions of a riverbank or shoreline, as it interrupts the establishment of the riparian zone, or the point of interface between land and flowing water. A properly functioning riparian zone is important for a number of reasons; it can reduce stream energy and minimize erosion; filter pollutants from surface runoff via biofiltration; trap and hold sediments and woody debris, which assists in replenishing soils and actually rebuilding banks and shorelines; and it provides habitat diversity and an important source of aquatic nutrients. Not to mention, a naturally functioning riparian zone simply looks better.

Another aspect of riprap is its considerable effect on wildlife, specifically fish that live in and utilize streams and rivers where eroding banks have undergone armoring. While erosion can cause potential problems for fish, especially in high-silt locations, the installation of riprap leads to other, more significant, issues. When riprap is the primary or only form of riverbank stabilization measure, the end result is typically a uniform, smooth channel, with no complexity. This means that there are no areas of vegetation either in or overhanging the water, leaving fish at risk from predation. In addition, a lack of riverbank diversity denies fish a place to seek refuge during periods of high-water, which often results in their being washed out of a fast moving system during flooding.

Riprap causes other, albeit less significant, problems as well. In areas of low vegetation, when exposed to direct sunlight, the rocks that comprise riprap can reflect light into

the water, which increases water temperatures to an unhealthy degree for fish. Riprap also tends to suffer from structural integrity issues during and after high-water events. Losing rocks to high water or fast flows, a riprap structure will soon begin to fail in its purpose. Once the soil that the riprap is designed to protect is exposed, the damage continues as before its installation. This possibility requires constant monitoring and maintenance, which ultimately becomes expensive and problematic.

Alternative Techniques

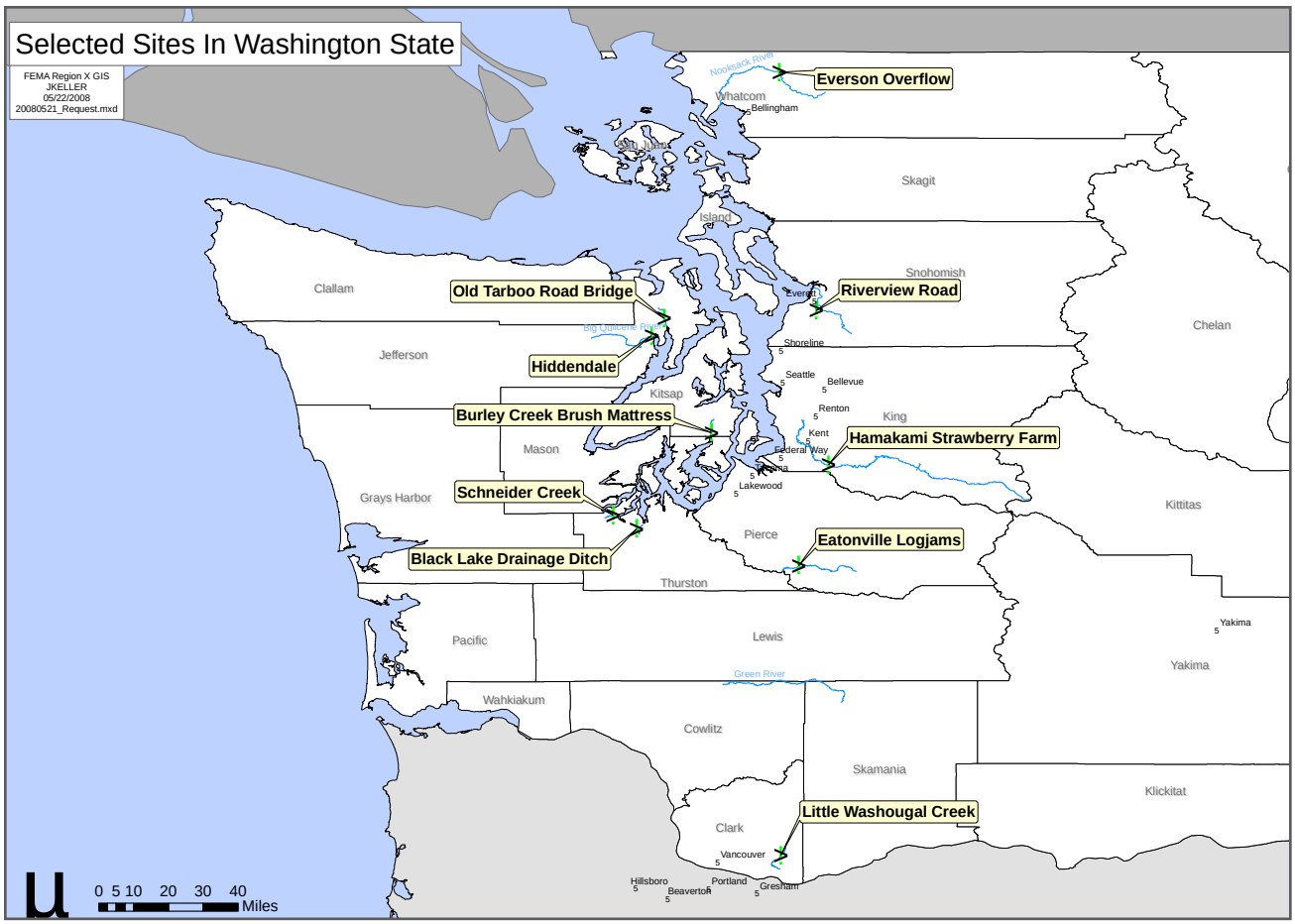
The old saying goes "the more things change, the more they stay the same." This adage, in many ways, can be applied to the discussion of riverbank stabilization. As technologies and techniques have advanced in finding ways to secure our land from the constant ravages of erosion, we begin to see that perhaps modernizing these efforts might not be the only way to approach these issues.

Nature has always been capable of taking care of itself. Long before we began manipulating our environment, nature has run its own course. Is it possible, then, that we can look to nature for examples to follow in making life near eroding or flood-prone waterways less risky while leaving as minimal a footprint as possible? Proponents of environmentally conscious and responsible construction believe so.

As the realities and consequences of riprap and hard armoring riverbanks and shorelines have come to light, there are those who have begun to work towards changing the traditional approaches to erosion and flood control. New and old engineering techniques are being introduced regularly that incorporate natural functionality with modern technology and design. Bio-engineering, hydro-seeding, controlled planting and the construction of engineered logjams are just some of the many efforts being taken to demonstrate the successful options that exist in the pursuit of land preservation and increased safety.

Purpose

Standard engineering calls for hard armoring an eroding bank. Lately, the tide has turned on the accepted practice of hard armoring due to public conscience of the eroding environment we live in. The 10 stories in this booklet represent a handful of successful alternatives to riverbank stabilization that have been taken throughout Western Washington. While this collection is in no way complete, it offers a comprehensive look at some of the varied techniques that are available for consideration. These best practices illustrate the fact that we can manipulate streams and rivers without completely overriding nature's design, that indeed, it is possible to work hand in hand with nature to make living by the water not only viable, but much safer and secure in the long run.



Hamakami Strawberry Farm:
Adding Roughness to River Keeps Farm Running Smoothly

In 1994, King County built a bioengineered bank stabilization project on the Middle Green River at the site of John Hamakami's Strawberry Farm. The site was designed at a time when the Washington State Department of Fish and Wildlife, the Muckleshoot tribal fisheries groups, and King County ecologists were realizing that the continued placement and replacement of riprap was harming fish and their habitat. Hamakami Strawberry Farm became a demonstration site for the positive effects of using natural elements, particularly wood and vegetation, as opposed to hard armoring in a high energy river environment.

"We started looking at how river hydraulics were interacting with wood," said Andy Levesque, a King County senior engineer, who works in the River and Floodplain Management Unit. "We wanted to see how wood could be used constructively without destabilizing banks, while actually helping to direct the river flow to make the banks more stable if possible. The actual design and construction work was overseen by Jeanne Stypula, one of our engineers, working with a consulting biologist, Alan Johnson."

"We wanted to see how wood could be used constructively without destabilizing banks." - Andy Levesque

Numerous logs are placed along the toe of the riverbank.

In 1990, the Middle Green River created a whole new quarter mile meander bend in just over one day. In the process, the river demolished 150 feet of rock lined levee, a dozen maple trees and a couple acres of the Hamakami Strawberry farm. Historically on the Green River, rock riprap was used to prevent embankment scour. On such an alluvial floodplain as the Hamakami property, with an abundance of silt and sand, however, slumping is the primary cause of bank failure. Fine grained materials do not provide bank resistance, so in a high energy event, like the one that occurred at the Hamakami site in 1990, the Green River was able to move laterally at a very rapid pace.

During flooding additional woody debris is recruited by the original logs.

Recruited vegetation lends cohesion to the riverbanks.

The 1990 flood event left a steep 10 to 15-foot high raw embankment along the Hamakami Strawberry Farm. As a result, over the following years, the farm lost a significant amount of land to the river meander that was moving rapidly through the property. In fact, strawberries from the farm were literally falling into the river channel.

In 1994, King County stabilized 500 feet of the rapidly eroding riverbank using bioengineering measures. Over 60 logs were placed along the river's toe and secured to the bank with coir fabric, soil wraps and vegetation. The logs were placed in groups of three every 20-25 feet and buried into the embankment. As a demonstration project, the idea was to show that installing natural elements added roughness to the channel, which increased flow resistance and slowed the river down.

"We used wood and vegetation to slow the river processes down," said Levesque. "When the wood that showed up in the next flood landed, it started forming a jam. The jam evolved and recruited sediment, and the sediment recruited vegetation. That slowed the water down enough to deposit the gravels upstream, which caused the river to cut multiple channels across the bar that it had previously built. Now we've got 100-fold the habitat edge, variety, complexity, structure, interaction, and process that we did right after the flood event. We counted fish at the site, before our installation, and there were four of them. Now there are five different species at ten different times of year."

The Hamakami site exemplifies that if a bank stabilization design can jump-start channel processes, ecological rehabilitation will occur. The logs placed by the county now have wood, debris, sediment, and vegetation surrounding them. As a result of the project, several side channels have been created which distribute the system's energy, allowing sediments to disperse and vegetation to thrive. In total, the site's ecological productivity is greatly improved.

"This type of technique is what I would advocate even in a high energy environment," said Levesque. "It can be done with wood. It can be done with vegetation. There are some precautions that have to be taken depending on the landscape. If the river meander has basically cut itself to the edge of where it's going to go, just respect that meander belt and add some structure back into it. Get things jump-started. You get your process back. You get things reshaped and you get environmental benefits."

"Now we've got 100-fold the habitat edge, variety, complexity, structure, interaction, and process that we did right after the flood event." - Andy Levesque

Riverview Road:
Several Steps to Safety in Snohomish County

Riverview Road in Snohomish County, Washington runs beside a section of the Snohomish River. The road was built by landowners in the late 1800s and then expanded and improved in the early 1900s. It primarily serves the local farming communities as both a thoroughfare and as the base of a flood control levee system. At the time of its construction, these levees were created with drag lines which pulled soil from the river bottom and deposited it on the top of the riverbank. The material was then flattened for use. The pulled river soil is described as alluvial sediment and is composed of fine grained, porous material.

Problems arise when such material is subject to inundation. Over the years, as the County developed, modern surfacing was laid over the old roadway originally built from the river alluvium. During periods of high water resulting from floods on the Snohomish River, the road embankment becomes saturated. When the water recedes, the material tends to compact, and the saturated soils begin to slide down towards the river. This process often compromises the stability of the riverbank, undermining the integrity of the road itself.

"This is happening at a number of places where there are levees on the lower Snohomish River," said Jeffrey Jones, an Engineering Geologist for Snohomish County's Public Works Department. "Every time the water comes up and goes back down, we find new problem sites."

The Riverview Road area of the Snohomish River is a migration corridor for Chinook salmon and Bull trout, both listed under the Endangered Species Act (ESA). The increase of sedimentation from the collapsing embankment into the river was regarded as potentially harmful to fish, as sedimentation can negatively impact oxygen levels, suffocate salmon eggs and decrease visibility for feeding. Because riprap reduces cover, increases temperature and eliminates access to spawning areas, it can have a negative impact on habitat. Based on these potential effects the team sought out other alternatives.

Jones, working with Dave Lucas, a River Engineer for the Snohomish County Surface Water Management Department, designed a system of embankment stabilization. This environmentally-friendly design incorporated wood and vegetative plantings. The design was successful because it kept the road from collapsing and avoided placing major amounts of rock into the river.

Since the embankment along Riverview Road is so steep, typical stabilization techniques were impractical. Jones and his team of Snohomish County Road Maintenance workers built a structural earth wall (SEW) composed of a number of soil wraps placed in a step-like fashion starting from the waterline and climbing to the top of the embankment. Each step is created by laying down a 13-foot wide roll of polypropylene or polyethylene geo-grid fabric. The grids are

The offsetting of the soil wraps comprising the structural earth wall (SEW) give it its step-like appearance. The logs anchored to the toe of the embankment protect the structure from fast flowing woody debris and provide habitat for migrating fish during high water.

Dave Lucas and Jeff Jones standing atop their structural earth wall on Riverview Road.

The willow cuttings planted throughout the embankment lend root cohesion and stability to the structural earth wall.

weighted down by layers of compacted gravel-borrow taken from a local quarry. The geo-grid is folded over, and another layer of gravel is used to weigh it down further. As each wrap is completed, the following one is offset by at least one foot, creating the step-like appearance. The outer face of the wall is covered with a layer of heavy coir fabric, and topsoil which is then hydro-seeded. This allows the geo-grid to lock in place and secure the embankment without threat of degradation from exposure to ultraviolet light. Finally, the entire embankment is planted with live willow cuttings which ultimately take root. As the trees grow, their root structures add to the stability of the embankment.

According to Lucas, Snohomish County utilizes a native plant program to assist in habitat restoration projects such as the Riverview Road effort. Not only are they able to determine which plants and trees are appropriate for a particular location, they also incorporate a holding facility that grows the plants to be used. With advance notice of upcoming projects, the holding facility personnel can have the plants ready and perform the recommended planting.

"In the toe of the embankment we anchored a continuous row of logs," said Jones. "They're about 20 or 30 feet long, with the root wads still attached. We use "Manta Ray" type anchors, vertical anchors and horizontal anchors to hold them in place."

The Snohomish River at this location is tidally influenced, which means the logs are not in the water at all times. During high tide the logs provide necessary shelter for migrating fish. They also act as a shield, preventing larger woody debris from puncturing the base of the soil wraps during periods of high water or flooding. Over time, additional woody debris is recruited by the logs and absorbed into the shoreline, further enhancing the establishment of habitat.

The first stage of the Riverview Road stabilization project was completed over four years ago, just down the road from the most recent construction. At this point in its progression, the first area has assumed a completely natural appearance. The planted vegetation has grown and continues to develop a functioning root system that further strengthens the embankment. The logs on the waterline have recruited additional woody debris, incorporating them into the habitat, and the surface of the project is overgrown by the hydro-seeded grass and planted vegetation. The geo-grids holding the embankment in place are now completely invisible.

When speaking about the success of the project, Lucas was confident in its long-term value.

"Overall, this type of design will require less ongoing maintenance than riprap," said Lucas. "It secures the riverbank against erosion, and it helps to meet our commitment towards maintaining salmon habitat, a stated goal of Snohomish County. When we can add those elements together and stabilize a County road in a habitat friendly manner, I think the project speaks for itself."

Eventually the coir fabric and the structural earth wall itself will be completely overgrown with hydro-seeded grass and other vegetation.

The completed project, a short distance down the road, is now fully vegetated and looks entirely natural.

Eatonville Logjams:
Engineered Logjams Protect Banks on Mashel River

Four of the engineered logjams designed by Herrera Environmental Consultants on the Mashel River outside of Eatonville, WA.

On the Mashel River, just outside of the town of Eatonville, Washington, Smallwood Park contains a pond utilized by the town's residents for their annual fishing derby. Every few years the Mashel River is subject to flooding and the park, along with the pond, becomes inundated with floodwaters. The river embankment by this pond has begun to erode, and with each new flood event, the park, and the County road nearby, are potentially threatened with damage.

Following a major flood in 1996, the Army Corps of Engineers funded the installation of a riprap structure on the threatened riverbank. That area of the river happened to be a straight channel providing no complexity to slow the river's flow, or for fish habitat. As is often the case with riprap, the speed of the river in that reach accelerated, and increased the threat of erosion on banks further downstream. In addition, the riprap itself ultimately began to fail, with the rocks that comprised the bank protection falling into the river.

To address the problem, a private company, Herrera Environmental Consultants was contracted to install several engineered logjams along a number of reaches in the river along the Smallwood Park bank. The intent was for the logjams to slow down water flow, while providing long-missing habitat for fish that utilized the Mashel for spawning and migration.

"One of the main limiting factors of that area of the river was that it had been very simplified by prior human activity," said Jose Carrasquero, a Fisheries Biologist and Project Manager for Herrera. "Logging and removal of wood had negative effects on the riparian areas, and left no complexity to the stream. There were very few pools for juvenile salmon to utilize for rearing, or off-channel habitat for much-needed protection during high flows. Spawning habitat for returning adult salmon was also lacking. The area had also been cut off from its floodplain, and therefore, it conveyed water during high flows very fast, which was effectively flushing the fish out of the system."

Another important consideration was that the riprap installed by the Corps was having an impact on the levee on the opposite bank of the river where erosion had also started to occur. Behind the levee was another pond that sat beside an old mill site. There was concern that the water from this other pond was contaminated by pollutants left over from the mill, and that, if the bank collapsed and the levee was breached during a flood, those pollutants would be released into the water.

Funding for the installation of the logjams was provided by the Salmon Recovery Funding Board (SRFB), which gives money to a number of different organizations throughout Washington State for the restoration of salmon fish habitat. The South Puget Sound Salmon Enhancement Group, one of the groups that received money from the SRFB, then contracted with Herrera to have the logjams installed in 2005.

The initial funding provided by the Salmon Enhancement Group allowed for the removal of the riprap along that section of the river and the construction of 11 logjams. The logjams were modeled in detail at the Herrera offices, and then meticulously constructed on site.

"We needed to figure out what we could do to help fix the riverbank and change the flow characteristics of the river without accelerating flow through the reach," said Ian Mostrenko, a Civil and Environmental Engineer for Herrera. "We looked at potential hydraulic effects, calculated potential scouring, and determined how big the structures needed to be to accomplish our goal. Typically, natural logjams are stabilized by very large pieces of wood. We couldn't get natural 36-inch diameter, 120-foot long logs to the site, so we had to simulate that stability in other ways. In this case, we used a combination of vertical log pile structures and gravity structures. We put in vertical log piles for lateral stability, and then we built what are called gravity structures, which hold the structures in place through their height and weight."

The logs comprising the base of the logjam structures are driven deep into the riverbank, some as much as 15-30 feet in depth. A criss-crossed pattern of logs forms the core, which is likened to that of an elevator shaft. The logs interlock in place underground, lending the entire structure strength. The outer face of the jams extend into the river approximately 10-15 feet, creating the roughness elements necessary to not only slow the river flow down, but preserve the river banks from erosion, and form the pools that establish vital fish habitat.

While vegetation was not included in the original budget for the logjam construction, the Salmon Enhancement Group chose to address that issue on its own. In collaboration with the town of Eatonville, as well as the Nisqually Indian Tribe (who are involved with the project as stakeholders and eager participants,) they utilized volunteers and initiated a vegetation planting program on the logjam sites.

"We propose planting as an important component to the process," said Carrasquero. "You want that root cohesion to be a structural element of the logjam as well as the river banks. It's not ornamental. It will also provide habitat. From the restoration perspective, and the structural perspective, we see that as a critical element of the stability of the structures."

During the November 2006 flood (which was listed as a 25-year event) the sites suffered no damage, and no logjams were lost to high water. Additionally, the jams performed their intended function of providing protection, and no evidence of erosion was reported on either bank of the river.

"We needed to figure out what we could do to help fix the riverbank and change the flow characteristics of the river without accelerating flow through the reach." - Ian Mostrenko

The complexity added by the logjams is important for slowing down water flow on the river.

The pools established behind each jam provide much needed habitat and refuge for migrating fish.

The installation of the original 11 logjams, which covered three reaches of the river, totaled approximately $400,000. The logjams have proven so successful that the Salmon Enhancement Group contracted with Herrera for the construction of two additional jams, bringing the number of Herrera-designed structures on the Mashel to 13.

In the year since the logjams have been in place, a three-fold increase in salmon numbers has been observed. The South Puget Sound Salmon Enhancement Group has performed snorkeling surveys to monitor fish utilization of the river. Data from these tests demonstrates that there is considerably less usage by fish in riprapped sections of the river, compared to banks that have been treated with wood.

"Obviously, development is going to continue," said Carrasquero, "but it can be done in a way that's restorative of habitat functions so that it can be sustainable. I think this type of technique is demonstrative of that. In a situation where you have constraints; infrastructure to be protected, a major transportation thoroughfare to consider, a recreational area that has to be maintained, you have to come up with concepts that will meet all those expectations. I think, so far, that riprap has demonstrated that it can't do all that. We live in a time in society where people have really started to care more about the environment. Right now, our water is one of our most important resources, and we need to protect it. I think this type of natural approach is more protective of that important resource."

Herrera Environmental Consultant employees Leonard Ballek, Jose Carrasquero, Ian Mostrenko and Chris Brummer stand firmly behind (and on) their design.

Burley Creek Brush Mattress:
Natural Armor Protects Bank in Mason County

In October of 2006, a property owner along Burley Creek contacted the Kitsap County Conservation District for assistance. The landowner was dealing with a stream that was eroding his backyard. When the embankment adjacent to his shed began to fail, the landowner sought outside help.

Upon evaluation of the site, Rich Geiger, District Engineer for Mason Conservation District, identified the site's significant problem areas. Although Burley Creek is a small system, its alluvial soils easily erode, making it a significant cause for concern.

"There were two issues," said Geiger. "First was the severity of the bend. Second was the ease at which these soils were being eroded. They had no internal strength."

Because coho salmon utilize this section of Burley Creek for spawning, choosing an embankment stabilization method was a complex matter. In addition, the site required immediate management. However, the embankment failure occurred in the Fall, which is spawning season for coho salmon. At that time of year, it is almost impossible to install stabilization measures without negatively affecting fish habitat.

Geiger's solution was to design a brush mattress along 77 feet of the creek. The mattress was built by tying 6-foot long Douglas fir and Grand fir tree tops to 4-foot long, 2-inch by 2-inch cedar stakes, driven in a 1-foot by 2-foot pattern into the stream bank. The tree tops are placed with the butt upstream, with each piece tied to at least three separate stakes, and shingled so the upstream tree overlaps two-thirds

Rich Geiger standing by the brush mattress as it develops.

of the downstream tree. After placement, additional living tree stakes are driven through the brush mattress to promote root growth for soil retention. In this case, a natural fiber geotextile was placed against the bare soils, and the stakes were driven through the fabric for additional soil retention. As the structure is composed entirely of natural materials, it is much more expedient to pass through the permitting process than a hard-armoring embankment stabilization project.

"It was during a period when the Fish and Wildlife Department would normally not allow you to do any kind of work in this stream," said Geiger. "However, these types of structures can be installed with just about zero sedimentation. This qualified us for the streamlined Hydraulic Project Approval, which takes a much shorter time to permit, and eliminates the

The eroding property prior to the start of the project.

Construction of the brush mattress underway.

requirement to get local permits. Since the structure is 100-percent wood, the Corp of Engineers does not consider it fill and therefore they don't require a permit. If we had used more traditional techniques, we would have had to wait for permitting."

Geiger explained that the brush mattress technique can be adapted to the specific water velocities at alternate sites.

"You can vary the strength of this based on the length and diameter of the stakes and the tensile strength of the rope used to tie down the trees," said Geiger. "You then determine how much shear stress this installation will be able to resist based on those parameters."

"This is a very easy armor to install, and in short order you can have an area protected." -Rich Geiger

Four months after it was installed, the brush mattress structure at Burley Creek withstood the February 2007 100-year-flood, suffering minimal damage in the event.

In sensitive ecosystems, when emergency management is needed for stream bank erosion control, brush mattresses can inhibit erosion without threatening habitat and requiring costly mitigation measures at a later time. Installing the brush mattress does not significantly disturb fish spawning habitat and once installed, the structure provides complex habitat for fish and other aquatic species.

Cedar stakes driven into the creek bank provide additional soil retention.

The added vegetation to the creek provides habitat and cover for fish.

"The reason that we are allowed to do this work is that Washington State Fish and Wildlife considers it an enhancement to the stream," said Geiger. "It simulates a heavily vegetated stream bank. Fish just love it. We've actually seen fish using it as we are installing it. They get right in there and use it for cover and so forth. It was pretty surprising."

The average longevity for brush mattresses is yet to be determined. Even though the Kitsap County Conservation District originally installed these structures as a temporary measure, many of the original structures installed over four years ago are still functioning today. The key to the brush mattress' long term success is to plant through the stakes with vegetation.

Characteristic of bioengineering techniques that work with nature, the brush mattress will completely biodegrade and integrate into its surroundings. The planted vegetation strengthens the bank's soils after the mattress decomposes and provides the root system and brush necessary for future stabilization. Root mass, soil strengthening properties, hydraulic drag, and compatibility with the natural environment are all characteristics to consider when choosing vegetation to incorporate into a brush mattress installation.

"If you need to do something right away and you don't want to be facing a heavy mitigation requirement after the project is installed, then this is a good technique," said Geiger. "This is a very easy armor to install, and in short order you can have an area protected."

Everson Overflow:
Keeping Floodwaters in Check on the Nooksack River

One of the scour holes being stabilized by the Overflow project. Woody debris has begun to collect and will be incorporated into the riverbank.

The Everson Overflow, located outside the town of Everson in Whatcom County, Washington, has wide-reaching affects during high water events. The overflow is a high ground divide situated between the Nooksack River Basin and the Fraser River Basin. During significant flood events at this site, water tends to overtop the right bank of the Nooksack River and spill into the Everson Overflow. It can then surge into the Johnson Creek floodplain, flowing north, and ultimately reaching the Fraser River Basin in British Columbia, Canada. In the aftermath of one such occurrence in 1990, the Trans-Canada highway was closed for several days and millions of dollars of damage occurred. To address this trans-boundary flooding issue, an international taskforce assembled consisting of a number of agencies and technical experts from both Canada and the U.S.

Recently, several flood events occurred in Whatcom County that necessitated emergency management measures along the Everson Overflow. To forestall another disaster, the County, from 2003 to 2006, implemented four temporary rock riprap projects stabilizing two large scour holes within the project reach. In 2006, the County was permitted to construct a permanent bank stabilization design. In accordance with the Lower Nooksack River Flood Hazard Management Plan, which recommends protocols for flood management problems pertinent to the Everson Overflow, the County's objective was to sustain the Nooksack River's current bank elevations along the Everson Overflow.

"Our management approach now is to maintain the existing geometry," said James Lee an engineer with Whatcom County's Public Works Department. "We do not want to increase or decrease water flow over the bank, we just want to make the banks as stable as possible. By lowering or raising this bank elevation you alter how much flow leaves the Nooksack River Basin and heads north, ultimately reaching the Fraser River Basin in British Columbia during a significant flood event. By maintaining the existing bank elevations we are not changing this dynamic, known as the Everson Overflow."

Whatcom County's engineers designed a bank stabilization project with the intent of halting the chronic failure occurring along 1400 feet of the lower main stem Nooksack's right bank. The project was initially funded through the Whatcom Flood Control Zone District and the local Sumas-Nooksack-Everson River Subzone. Additional grant funding was later made available through the Federal Emergency Management Agency's (FEMA) public assistance program.

The project involved a combination of hard and soft armoring measures focused on halting further erosion of the scour holes, securing the embankment's toe, and stabilizing the slope. Providing for fish habitat was integral to both the design and the permitting process.

"The lower main stem Nooksack is an important river for a number of species," said Lee. "It is a migratory reach for Chinook and coho salmon, as well as steelhead trout. Bull trout, which are listed under the

The timber piling structures capture woody debris, which provides roughness to the river, and ultimately establishes additional habitat.

Endangered Species Act (ESA), can also be using it anytime of year in their different life stages, and it is used by Pink salmon in odd number years."

The county placed timber piling structures in the outside edge of the pools created by the two main scour holes. The decision to keep the two large scour holes along the embankment's edge is a primary benefit for fish. The scallop-shaped holes interrupt the linearity of the bank, creating irregularities perfect for fish habitat.

"The fisheries biologists don't want to see a straight smooth bank," said Lee. "Those irregularities are areas of slack-water back currents where the fish can go to get out of the main current."

The piling structures further enhance the habitat complexity which shelters the fish and stabilizes the river channel during large flows. In addition, the pilings recruit debris flowing through the channel during high water events.

"In terms of the bank stabilization project, the timber pilings are a stand-alone component," said Lee. "This means that if some of the timber piling structures are damaged, the integrity of the entire bank stabilization design is not compromised. At the same time, there are bank stability benefits provided by these structures. They provide an incredible amount of roughness along the portions of the riverbank where they are located. This slows the water along the bank behind them, promoting deposition and the establishment of vegetation, which helps to further stabilize these areas."

Along the linear portions of the embankment, the county laid large limestone rock up to the ordinary high water mark. Seventy-five pieces of large woody debris were then placed along the project length with their root wads facing outward toward the flow. The debris provides asymmetry to the otherwise straight-edged sections of the channel, and the root wads create scour that diverts energy away from the toe, thus decreasing the likelihood that the rock toe will fail.

The County reconstructed the slope of the upper bank with coir fabric, soil lifts, and live willow cuttings.

"The fisheries biologists don't want to see a straight smooth bank. Those irregularities are areas of slack water back currents where the fish can go to get out of the main current." - James Lee

"Using three-quarter-inch plywood that was eight feet long and 12 inches high, we built forms to aid in the construction of over a couple miles of soil lifts," said Lee. "Basically, we laid down the coir fabric, planted the willow cuttings, and placed the dirt. The wooden form provided something for the dirt to push up against as you ran over it with the walk-behind compactor. Otherwise, if you just simply had coir fabric holding back the soil when you put the compactor on it, the fabric would bulge out and likely rupture. The forms allowed us to build the soil lifts in a uniform manner. As the crews got proficient, we started to make excellent production numbers per day. It really worked well."

Because the coir fabric eventually decays, the live stakes are the source of long-term stability for the slope. For the Everson Overflow project, the Whatcom County Public Works Department planted 10,000 thriving willow cuttings. In addition, a twenty-foot wide buffer was designated along the top length of the project. The buffer is planted with a mix of native tree species such as cedar, fir and alder, providing a great improvement to this section of the bank which had previously been overgrown with an invasive, non-native blackberry species.

"Engineers would be well-served to come out and look at some of these projects," said Lee. "I've stood out here at flood flows and seen the ferocity of the flows and the amount of water and the debris that comes down the system. When the water recedes and you see that the project has held up well, it is solid evidence that these techniques can work if designed and built properly. People need to keep their minds open. It does what we need from the flood hazard perspective, but it also goes further to benefit the salmon recovery effort."

Coir fabric covers the upper bank.

Hiddendale:
Combining Wood and Rock to Protect Property

In Quilcene, Washington, the small community of Hiddendale sits beside the Big Quilcene River. Development of Hiddendale began in the 1960s, and to protect the houses under construction, the developer built a dike several hundred yards long using material from the river. Immediately, problems began when flooding occurred because the material used to create the dike was not strong enough to form an effective barrier against rising water. Within a short time, the dike had begun to erode.

In 1996, engineers from Agua Tierra Environmental Engineering were looking for an area to conduct a riparian demonstration project utilizing bio-engineering. The community of Hiddendale was chosen, as the dike had reached a critical point of potential failure. Portions of it had actually disappeared due to chronic erosion from periodic high water on the Big Quilcene, and several homes were threatened.

"The first step was to pull the dike back about 40 feet and make a little more room for the river to occupy," said Al Latham, District Manager for the Jefferson County Conservation District. "They then installed three rock groins into the river along a 200- foot section of the Hiddendale riverbank, the outer edges of which were approximately at the edge of the prior levee's location. Then the entire area was heavily planted with willows and other vegetation."

Downed trees claimed by the Forest Service provide the skeleton for the rock groin structure.

The rock groins were carefully designed with several considerations in mind. Calculations were taken into account for such factors as the river's width, water flow during average and flood stages, as well as impact of the structures to the overall area.

The first step in installing the groins involved temporarily blocking the river from entering the construction site. Since the project was undertaken while the river was at a seasonally reduced level, only a small area had to be coffered off with sandbags. Once the construction site was secured, three trenches extending 25 feet back into the bank were dug, and tapered down into the river channel. Multi-sized rocks similar to that used in riprap design were then carefully layered into the trenches.

Planted willows, dogwoods, conifers and other trees will create a mat of roots to help stabilize the riverbank.

Al Latham stands on top of one the groins extended into the river.

The National Forest Service donated almost forty 25 to 30-foot long logs, several with root wads still attached, which the Forest Service retrieved from areas of blow-down during previous storms. The logs were laid within the trenches, several logs to a trench, with the root wads sticking out into the river. To lock the structures in place, the logs were integrated with the rocks. Additional rocks were then piled on top of the logs, giving the structures strength and stability.

Hundreds of branch cuttings from several different species of local trees were laid within the trenches before they were filled in with the final layer of rocks, and then topped with soil. The intertwining of the various root systems provided by the cuttings as they grow plays an integral part in the success of the project.

"We planted a lot of willow in there," said Latham. "Along with red ochre dogwood, alder, some conifers, as well as Douglas firs and cedars. By the time the logs decay, which is a long way off, there will be such a mat of roots from the vegetation that it's going to make the banks really stable."

By the time the logs decay, which is a long way off, there will be such a mat of roots from the vegetation that it's going to make the banks really stable."
- Al Latham

The Big Quilcene River serves as migration reach and spawning ground for several species of fish, including coho, Chinook and King salmon, as well as steelhead and cutthroat trout. Prior to the setback of the dike and the introduction of the rock groins to the river, the channel was essentially a straight passage with a minimal amount of woody debris, offering limited habitat diversity for migrating fish. With the rock groins installed, root wads extended into the river and the vegetation established throughout the area, the habitat provided for the fish is far more extensive than ever before.

The Hiddendale bank stabilization project was funded through a $50,000 grant from Washington State's Flood Control Assistance Account Program, which provides money for a number of different flood control activities throughout the state. Additional assistance was made available by the Department of Natural Resource's Jobs for the Environment program, which provides funding to hire displaced logging professionals to perform restoration activities.

Since the introduction of the rock groins to the Hiddendale area 13 years ago, the Big Quilcene River has been subjected to several high water flood events. According to Latham, the groins have withstood the floods, sustaining no damage and no significant impact to their stability. They have also provided invaluable protection for migrating fish and, best of all, the properties once threatened by the river have remained completely safe.

"The typical approach before we did this would have been to line the banks with riprap, using the same size material we used in the groins," said Latham. "The thing is, when you go that way, currents accelerate along riprap, and you're just sending the problem downstream. You don't get any improved habitat or channel diversity. It's just a rock wall. With these three small groins, it didn't establish a big footprint, but it's really kept the thalweg, or the main part of the river, well out beyond the bank, preventing any further erosion. It also created all this habitat in between each groin. Now the bank has been stabilized as well or better than riprap ever could do it."

In the background stands one of the Hiddendale properties protected by the project.

Old Tarboo Road Bridge:
New Bridge Design Eliminates Flooding

Old Tarboo Road in Jefferson County, Washington crosses Tarboo Creek, which is a small, steady stream running from its spring-fed headwaters in the hills east of the Olympic Mountains down to Tarboo Bay. The stream is used for migration and spawning by coho and fall chum salmon, as well as steelhead, sea run and resident cutthroat trout. Juvenile summer chum salmon and Chinook salmon rear in the estuary of Tarboo-Dabob Bay about two miles downstream. Three of these species; steelhead trout, summer chum and Chinook salmon are listed as threatened under the Endangered Species Act (ESA).

The county road was originally built in the 1890s, and numerous forms of crossings have been utilized over the years, including wooden bridges and various forms of culverts. In the 1970s, a six-foot wide, 40-foot long culvert was installed under the road. During especially high water events, such as the flood of 1996, water would back up and overtop the creek banks and cover the road. Directly downstream of the culvert, the creek flowed into a straight ditch approximately eight-feet deep with steep banks. Over the years, this led to problems of bank erosion and flooding as well as impeding travel of some of the weaker species of fish that could not traverse the culvert.

"There was riprap on either end of the culvert, as well as some downstream where the channel had eroded the banks," said Peter Bahls, an aquatic ecologist, fish biologist and Director of the Northwest Watershed Institute. "When a large amount of water goes through a culvert, it acts as a fire hose, and it can cause a lot of impacts further downstream as well."

In 2004 the Northwest Watershed Institute, in partnership with Jefferson County, pulled the culvert from under the road and built a bridge over Old Tarboo Creek. Removing the culvert opened up passage for the creek, significantly reducing the threat of ongoing erosion while also reestablishing a migration route for fish that had been cut-off from traditional spawning waters for over 20 years. An added benefit of the project was the reconnection of the creek to the local floodplain.

During construction of the bridge, the designers took the opportunity to lower the gradient of the creek, reducing it to less than one-half a percent under the bridge for a length of approximately 100 feet. This had the effect of slowing water flow throughout the reach, further reducing erosion and making it easier for migrating fish to traverse.

"When a large amount of water goes through a culvert, it acts as a fire hose, and it can cause a lot of impacts further downstream as well." -Peter Bahls

Wood positioned downstream of the bridge slows water flow and provides habitat for fish and other wildlife.

Coir matting and planted vegetation stabilize the creek banks under the bridge.

The bridge was installed with the use of concrete pilings driven approximately 20 feet into the ground, removing the threat of instability due to possible undercutting. Though the channel width was only 13 feet at its maximum, they designed the bridge to span over 40 feet in length.

The extra wide design of the bridge ensures adequate room for water flow during flood conditions.

"The main mistake in bridge construction, and the reason you often have problems with bridges and flooding is because the span is not long enough," said Bahls. "They don't leave enough room for flood and scour flow. We made sure our bridge was long enough to handle the flow spreading out under the bridge, without causing scour along the banks."

Bahls also stated that, as a rough rule of thumb, the width of the floodplain under the bridge (including the stream channel,) should be at least twice the bankfull channel width of the stream from bank to bank. At the Old Tarboo Bridge, the bankfull channel is approximately 12 feet wide and the total floodplain width was designed to be approximately 20 feet. With the addition of sloping banks up to the bridge this required a 40-foot long bridge.

A floodplain bench was built under the bridge on each side of the creek and extending 30 feet up and downstream, starting with large, rounded river rock laid in a single row along each stream bank. Soil was then infilled behind the rock for the floodplain bench. The rock was laid atop a layer of heavy coir fabric which was then pulled over the rock, wrapping around it and securing it to the bank. The coir creates a layer of strengthening material to hold the bank together and prevent further erosion.

"The rock is holding down the coir, and providing stabilization from below," said Bahls. "And now you can't even see the rock because the floodplain is actually acting the way it's supposed to, and has started to accumulate sediment."

Another portion of the bank stabilization and habitat complexity involved the addition of wood in the creek immediately past the bridge, as well as further downstream. The wood establishes important habitat for fish traversing the stream, and causes flow to slow down considerably during periods of high water, further adding to the protection against erosion.

"All the wood is put in naturally, with natural log placements," said Bahls. "Along with specifically placing it, we bury the wood from one-half to two-thirds of its length into the banks. A lot of the wood that is seen in this area is actually buried way back into the earth. We use different sizes, different types of wood and different positioning to secure the logs."

Planting of native vegetation also comprises an important part of the bank stabilization, as active and healthy root systems lend strength to the creek banks.

"We're starting to get some alder and willow growth in the riparian area," said Bahls. "This will get more shaded as the trees grow in, and we're hoping that they'll take over and shade out some of the non-native, invasive species of vegetation that often move into any new restoration site."

Interestingly, the land around Old Tarboo Road had been purchased for conservation use by famed ecologist Aldo Leopold's granddaughter, Susan, and her husband, Scott Freeman. According to Bahls, the Freemans worked with Jefferson County vigorously to reestablish the area ecologically.

Many of the logs are actually buried in the banks.

"They've been great, active participants in the restoration," said Bahls. "They do a lot of the planting and cutting back of invasive plants, and they've worked with us the entire time of the project."

The entire area is now covered by a conservation easement held by the Jefferson Land Trust, which protects the land from any form of development or use other than as an ecological preserve.

In addition to funding from Jefferson County and the Northwest Watershed Institute, money for the project was also provided by the National Fish & Wildlife Foundation, the National Oceanic and Atmospheric Administration (NOAA) and the Community-based Restoration Program. The cost of the installation of the bridge totaled approximately $150,000, while the downstream re-meander came to an additional $100,000, bringing the total cost of the Old Tarboo Road Bridge and stream restoration project to $250,000.

When speaking about the advantages of utilizing more naturalistic techniques than riprap and hard armoring, Bahls was definitive in his preference.

"It can be done," he said. "If you design the bridge right, holistically in context of the stream reach, get the gradient of the stream correct, and make the bridge span long enough, you don't need to worry about slapping a bunch of riprap on. In fact, riprap is counter-productive because not only does it not protect the banks over a long period, but it will ultimately fall into the creek and cause problems behind it. The riprap also constricts your channel, so you end up with less floodway under the bridge for the water to flow through. If you can take pressure off your banks by leaving more floodway and reducing the gradient under the bridge a little, adding wood downstream and stabilizing the banks with planting, that's better for your stream in the long run. We've had some major floods here in the past three years, and because of this design, we've had no bank erosion near the bridge, and the flood flows have stayed safely under the bridge instead of flowing over the road."

Peter Bahls, director of the Northwest Watershed Institute.

The entire area is protected as an ecological preserve.

Black Lake Drainage Ditch:
Live Crib Wall Increases Options for City of Olympia

In 2004, Craig Tosomeen, an engineer with the City of Olympia, faced the challenge of stabilizing eroding stream embankments on Percival Creek at the Black Lake Drainage Ditch on RW Johnson Drive. The culvert running under the road was rated as the number one fish barrier in Thurston County. A four-foot drop in stream grade prevented Endangered Species Act (ESA) listed fish, such as Chinook and coho salmon, as well as other protected species like cutthroat trout, from migrating through the ditch. The decision was made to replace the original culvert with a bottomless arch culvert similar to a bridge. Tosomeen was tasked with designing a fish-friendly plan for controlling erosion on the vertical earthen bank. both up and downstream of the removed culvert.

Craig Tosomeen beside the Black Lake Drainage Ditch.

Black Lake Drainage Ditch is a human-made channel characterized by steep embankments and high stream velocities. Because of this, the option of setting the bank back to lower the slope gradient was not available. To meet the recommended 2:1 to 3:1 ratio for bank setback, the 20-foot vertical embankment on RW Johnson Drive would have to be moved back 40 to 60 feet. Not only would this action have caused difficult "right of way" issues, but it would have also required the removal of a large stand of Douglas fir trees.

"There was no point making the culvert for fish passage if that habitat doesn't remain," Tosomeen commented.

Preserving the riparian shading provided by the Douglas firs benefited fish habitat, and was key to facilitating fish passage.

Tosomeen considered several techniques to halt embankment erosion, including sheet pile weirs, a concrete wall, and a live crib wall. Experience, however, had taught Tosomeen that streams can erode concrete structures.

"I've seen a lot of concrete-lined ditch failures," said Tosomeen. "Once the water starts to get underneath the structure, concrete has nothing it can do but break and become a further obstruction, diverting more water into where it shouldn't be going."

Unlike the other options considered, live crib walls meet Washington State Department of Fish and Wildlife's fish habitat criteria. They also provide structural support to sheer embankments, and with maturation they ecologically integrate into their surroundings. Live crib walls are constructed with interlocking, untreated logs and live stems. The logs are anchored into the slope, forming the wall, and vegetation is initially used to tie the logs together.

Long-term stability to the slope is further developed with the vegetation's root growth. With time, the logs naturally degrade and the vegetation becomes the structure itself.

Dogwood and willows were the primary types of vegetation used in the wall design. Willows are hardy and thrive well in harsh, wet environments. Traditional live crib walls are built as gravity mass walls, but because of the embankment's 20-foot height, Tosomeen designed this structure as a retaining wall. Steel anchors bolt the log wall into the vertical embankment and provide security to the wall until the vegetation is established. In addition, the most critical point at the bottom of the live crib wall is secured with a solid riprap toe. To remedy the stream's four-foot drop in grade log weirs were placed in 6-inch increments over the project length.

Overexposure to sunlight can inhibit the establishment of a live crib wall. The vegetation needs plenty of shading to thrive. To ensure that the crib wall does not dry out, it is also important to choose appropriate backfill.

"If you pick too granular of a soil, the wall dries out and the stakes die," said Tosomeen. "Sun exposure is critical. You might have to consider watering if you have a lot of sun exposure and/or you use very granular backfill. One section of our wall got a lot of sun exposure. It took a lot longer to establish than the section that was shaded by the big trees and not facing direct sunlight. That section had perfect establishment straight away."

"Once the water starts to get underneath the structure, concrete has nothing it can do but break and become a further obstruction, diverting more water into where it shouldn't be going."
-Craig Tosomeen

The restructured channel is now far easier for fish to traverse during migration.

The crib wall will overgrow with vegetation, which will ultimately become the structure itself when the logs finally decay.

The success of the project has been far-reaching. The live crib wall has stabilized the sheer embankments both up and downstream of the removed culvert. Over a mile of previously blocked fish passage leading into Black Lake, (the largest lake in the Olympia area,) is now accessible to fish. In addition, the site and adjacent walking trails have become a community gathering place. The City of Olympia has taken advantage of this educational environment and incorporated other ecologically friendly structures. Porous concrete, which allows rain water to absorb directly into the earth and improves water quality of streams by reducing storm water runoff, has been used to create bicycle lanes and sidewalks in the grounds surrounding the site.

Structural revetments require periodic inspections to ensure that they are working. A live crib wall engineered with nature becomes part of the natural processes and does not demand the same amount of maintenance. For erosion to destroy a live crib wall, water must undermine the entire structure. As the live crib wall develops, it becomes a natural part of the riparian corridor.

"The ability for nature to heal itself, to take up the long term maintenance for us is huge," said Tosomeen. "You know if the design isn't perfect, nature will tell you. It is very unforgiving, so to be able to make up for that with a structure that can be forgiving and can accommodate and grow and adapt to the changing environmental conditions is really the only way to go."

Little Washougal Creek:
Woody Debris Catcher Prevents Erosion and Protects Bridge

The Lower Columbia Fish Enhancement Group (LCFEG) is a nonprofit organization that receives funding for stream restoration projects from the Washington State Recreation and Conservation Office Salmon Recovery Board. The LCFEG works closely with local communities on habitat restoration within Lower Columbia's watersheds. When a local landowner on the Little Washougal Creek in Clark County sought counsel from the LCFEG about a land erosion problem, a collaborative opportunity arose.

In October 2003, the Little Washougal began encroaching upon a bridge that provided access to six properties. Erosion along the approach to the bridge endangered residents' access to their homes. Riprap, which was placed upstream of the bridge in the aftermath of a large flood event in 1996, accelerated the erosion threatening the bridge. To amend the problem, the LCFEG designed and installed a woody debris catcher. The bank stabilization structure successfully diverted the Little Washougal Creek away from the bridge, preventing further embankment erosion along the bridge's approach and mitigating future damage to the bridge.

The success of a woody debris catcher largely depends on how it is anchored and how the surrounding embankment is vegetated. At this particular site, the work crew laced, and then bolted, a large number of logs together. At points where two logs crossed, steel bolts were drilled into the wood, and the upper layers of logs were then bolted to a log frame which was buried in the ground.

Debris catchers are a practical choice in hydraulic systems that carry a large abundance of wood.

"A rock-based design is inappropriate for river systems in Western Washington that transport large amounts of woody debris," said Tony Meyer, Executive Director for the LCFEG. "Often, as debris comes downstream it will hit the stacked rocks, knocking them off, and destroying the shape of the vane."

Re-vegetation is the key to the longevity of any woody debris project aimed at bank stabilization. Ultimately, as the wood decays, the vegetative root system replaces its function by providing cohesion to the stream bank. To ensure the success of the vegetation stage of their projects, the LCFEG follows the protocols of Jeff Whittler, an Environmental Services Manager with Clark County Public Utilities District.

The porous design of the debris catcher allows fish to swim through the structure unimpeded.

Steel bolts lock the log frames together providing stability and strength to the structure.

"Whittler's goal is to close the canopy within three years," Meyer commented. "To close the canopy you have to have your spacing very close together, but once the sunlight is taken out from the ground, nothing else can grow. The key is to go in there, maximize the native species, and wipe out the nonnative species. Give those native species time to get up and close the canopy."

In addition to providing bank stability, the woody debris catcher impedes erosion by slowing down the creek-water's velocity. This is accomplished by reconnecting the watercourse to its adjacent flood plain. During the first major flood event, as a result of the debris catcher's installation, the river was redirected onto the opposite side of a gravel point bar, giving the Little Washougal access to side channels that had previously dried up.

"Because the structure is porous, water is able to flow underneath it, maximizing the ability for fish and aquatic organisms to live inside the structure itself and be secure from predation." - Tony Meyer

Essentially, this watercourse shift reduced the power of the stream by taking it out of a confined environment and allowing it to spread out among many smaller courses.

"As soon as the river exceeds that bankfull height and spreads out into the flood plain, the excess water has no velocity, so it doesn't harm anything," said Meyer. "When the river moved onto the other side of the gravel bar, it increased the interval in which it will go out into the flood plain and take the energy out of the system."

Creating access for the Little Washougal to disperse into side channels has demonstrated the benefits of the bioengineered debris catcher to landowners. The river is no longer threatening the bridge and the access to the landowner's property is protected. During periods of high water, the river flows into side channels and the concentrated destructive energy of the system is dissipated. This increase in off-channel area has created fish-rearing habitat. The nutrients deposited during high flows have stimulated the growth of plants and aquatic organisms.

The woody debris catcher also enhances fish habitat by providing shelter. As the debris catcher recruits wood from mature trees, complex habitat for fish and other aquatic organisms develops. In fact, the catcher provides ecological benefits that exceed State permitting requirements. The significance of this is that the Little Washougal provides spawning habitat for winter steelhead trout, coho and Chinook salmon, which are all listed under the Endangered Species Act (ESA).

"A woody debris catcher is a very porous structure," explained Meyer. "When the current runs into the structure, its debris load gets trapped. Because the structure is porous, water is able to flow underneath it, maximizing the ability for fish and aquatic organisms to live inside the structure itself and be secure from predation."

In November 2006, the biggest flood in the area's recent history hit the Little Washougal and the site was subjected to severe high water conditions. Throughout the event, the woody debris catcher remained stable, and no damage was experienced at the site. The watercourse continued to flow on the opposite side of the gravel point bar away from the approach to the bridge. As a result, residents were able to easily cross the bridge and access their homes.

Tony Meyer, executive director for the Lower Columbia Fish Enhancement Group.

Schneider Creek:
Adding Wood to Water Wins Over Rock

Wood added to the banks of Schneider Creek slows water flow and improves habitat diversity.

On Schneider Creek in Thurston County, Washington, landowner Sonny Bridges' property has been threatened with increasing erosion. Since buying the property several years ago, Mr. Bridges watched his land steadily erode at a rate of approximately 5 feet per year. In total, an estimated 2000-square feet of the Bridges' property has been lost along the banks of the creek.

Growing concerned with the constant loss of his property, Mr. Bridges contacted the South Puget Sound Salmon Enhancement Group for assistance. Schneider Creek serves as a migratory channel for at least five species of fish, including chum, Chinook and coho salmon, as well as steelhead and cutthroat trout, which made the problem and its solution very pertinent to the Salmon Enhancement Group.

"This is a very significant salmon spawning stream," said Mike Kuttel Jr., a Habitat Specialist for the Thurston Conservation District. "It flows into Totten Inlet, near the mouth of Kennedy Creek, which is one of the biggest chum salmon spawning streams in the area. Also, both the Chinook salmon and steelhead trout are listed under the Endangered Species Act (ESA), making their protection critical."

The Salmon Enhancement Group partnered with the Thurston Conservation District to initiate a project to halt the erosion of the Bridges' property, while creating habitat for migrating fish. Mr. Bridges did not want this to be done through the use of hard armoring, and requested that the project remain as true to natural processes as possible.

Anchor Environmental, LLC was the company contracted by the Salmon Enhancement Group to design the project. Pat Powers, the engineer for Anchor, implemented two of the recommended techniques from Washington State's Integrated Streambank Protection

Mike Kuttel surveys the successfully completed project on the Bridges' property.

Guidelines to stabilize the Bridges' creek bank. The project was approached almost as a case study, with both techniques being examined for their feasibility.

On the upper portion of the creek, they installed several engineered woody debris logjams. Anchored to the creek bank, the jams are extended into the water, creating roughness elements which reduce Schneider Creek's flow speeds along this reach. The reduced water flow eases the pressure on impacted banks, significantly cutting down on erosion and protecting the Bridges' property.

"They use a vertical log that's sharpened like a pencil," said Kuttel. "They load the logs up and jackstraw them together. Then they take the sharpened log and drive it down into the bank through the middle of the other logs, pinning them all in place. Then they further secure the entire structure with rebar. It all worked very well."

In addition to preserving the bank integrity throughout the impacted area, the logjams also provide habitat for migrating fish. The introduction of the wood into the creek creates many areas for the fish to hide in and rest, as well as giving them protection from fast-moving floodwaters.

The second portion of the project involved the introduction of rock cobbling to the lower portion of the creek on the Bridges' property, which was intended to reduce the velocity of the water, while covering the unprotected sediment that had been exposed by the constant erosion. Unfortunately, during the flooding of November 2006, the cobble was blown out by high, fast water, which continued the threat of further erosion.

The logjams are extended into the water providing needed roughness.

To address the problem, instead of replacing the destroyed cobble with additional rock, it was decided to add several new logjams to the creek. In subsequent flood events, (specifically the high water of December 2007,) the logjams were completely successful and held the banks in place, while protecting migrating fish by slowing down the water flow throughout the stream.

"It's ultimately better that they switched to using all wood for this project," said Kuttel. "The logjams stabilize the toe of the bank and improve the in-stream habitat. There used to be just a vertical bank with no shade and no place for the fish to hide. Historically, armoring eroding banks with riprap (angular basalt rock) was the method-of-choice to stop bank erosion. Unfortunately, the rock gathers heat, reflecting it out into the water, which is really bad for the fish. Not to mention, there's no habitat diversity when you do it that way. The logjams used on this project provide habitat diversity and give fish many places to hide."

The entire bank is covered with willow cuttings for root strength.

In addition to the introduction of logjams to Schneider Creek, the project design also called for a widespread series of plantings. Willow cuttings positioned throughout the bank area are taking root, and once grown to significant size, the root structures will lend the bank further strength and stability. The intent is to recreate a riparian zone along the bank, which has virtually ceased to exist due to the constant erosion.

Though it takes years for the plantings to grow, the designers prefer to use smaller willow cuttings, approximately 24-inches in height, to start. Once the

willow tree roots have taken hold and begun to reinforce the strength of the bank, they will go back to the site to perform additional rooted plantings with conifer trees and other larger species to further the strengthening process.

"I know that some people like to go in right away and use the really big ball and burlap plants," said Kuttel. "The problem is they're so expensive in terms of transportation and equipment to get them in the ground. A lot of the time they can die because of the transplant shock. You can plant a lot of small trees and keep them in good shape for the same cost of one big tree. It may take longer for the small trees to grow and do what you need them to, but if that one big, expensive tree dies, you're basically out of all that money."

The Schneider Creek bank stabilization was funded by a grant of $20,000 provided by the National Fish & Wildlife Foundation. The wood for the logjams was provided by the contractor who performed the installations at no additional cost, and from donations by the Washington Department of Transportation, which considerably reduced the total cost of the project.

"The whole site is a lot more ecologically functional for fish and wildlife habitat now, not to mention the banks being protected" said Kuttel. "When you use plant materials, it actually slows the water down. When you armor a bank, it is protected from erosion, but the energy is often redirected to the opposite bank downstream, causing damage to someone else's property. Then the next landowner has to do it, and then the next, just to protect their property. When you use something like willow cuttings, the water just lays them down and the energy is dissipated instead of tearing the banks all apart."

The logs in the jams are secured to each other with rebar.

"When you armor a bank, it is protected from erosion, but often times the energy is redirected to the opposite bank downstream, causing damage to someone else's property." - Mike Kuttel Jr.

Conclusion

As the stories in this booklet illustrate, there are numerous options when it comes to the complex issues of riverbank stabilization. These examples merely scratch the surface, highlighting only some of the basic alternative measures successfully used. As technology advances, and our knowledge of the effects we have on our environment increases, it is inevitable that even more of these techniques will be discovered and improved upon and that the traditional approach of riprap or hard armoring a bank will no longer be the norm.

We tend to leave a large footprint in our interactions with our environment. As we manipulate and attempt to control the water we so love and depend upon, we need to look at the long-term effects we have on our immediate surroundings. Finding methods of restricting riverbank erosion while allowing natural processes to function normally is just one important step in achieving equilibrium with our environment and investing smartly for our future.

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