National Park Service
U.S. Department of the Interior

Glacier National Park
Waterton-Glacier International Peace Park
Montana

McDonald Creek Bank Stabilization at Milepost 19.25 on the Going-to-the-Sun Road

Environmental Assessment

August 2008

Slumping of shoulder at MP 19.25, November 2007

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Environmental Assessment

Bank Stabilization on McDonald Creek

Glacier National Park • Montana

SUMMARY

The purpose of this document is to evaluate a bank stabilization project on the Going-to-the-Sun Road (GTSR) along McDonald Creek at Milepost 19.25 (MP 19.25). This project is needed to protect the historic road at this location. In November 2006, the park experienced a rain on snow event that caused damage throughout the west side of the park. Emergency repair took place on several sections of the GTSR. At MP 19.25, soil nails were installed as an emergency repair to stabilize unconsolidated soils along the bank of McDonald Creek. This was a temporary action to prevent further damage to the road and keep it intact for visitor traffic the following year. At this time, permanent stabilization of the bank is necessary to ensure that further slumping does not occur (leading to loss of the GTSR at this location) and to protect natural resources along the bank and in McDonald Creek.

This Environmental Assessment (EA) evaluates three alternatives including a no action alternative. The alternatives address factors associated with bank stabilization such as erosion and sedimentation, bull trout rearing habitat, protecting the historic GTSR, and stream hydraulics. Alternative I, the no action alternative, would entail leaving the soil nails and letting the site revegetate naturally. No other actions would be taken to prevent further erosion. Alternative II would place two rock barbs in the creek to decrease velocity by reducing speed and deflecting water from eroding the bank, vegetation would be planted and rock riprap would be used for bank stabilization. Vegetation would be incorporated into the riprap. Alternative III, the preferred alternative, would stabilize the bank by using rock riprap only (no barbs) and would incorporate vegetation into the riprap. The park considered but eliminated from further study the alternative that would realign the GTSR at this location due to the roads historic status and the use of engineered log jams to deflect water and decrease the stream velocity. While the engineered log jams would improve fish habitat, the park determined they would not be a long-term, permanent solution. Impact topics evaluated in the EA include soils, vegetation, wildlife species (including aquatic species, threatened species and endangered species, and species of concern), visitor use and experience, visual resources, cultural resources, water quality, and floodplain.

The environmental assessment has been prepared in compliance with the National Environmental Policy Act (NEPA) to analyze the environmental impacts and assist the NPS in selecting the best alternative. It 1) analyzes a reasonable range of alternatives to meet the purpose and need of the proposal, 2) evaluates potential issues and impacts to resources and values, and 3) identifies mitigation measures to lessen the degree or extent of these impacts. This EA is being prepared in cooperation with the Federal Highway Administration (FHWA). Stabilization efforts, as proposed in the preferred alternative, result in minor, beneficial and adverse, site specific and long-term impacts to soil resources. Loss of vegetation along the bank where riprap would be installed would result in minor, long-term adverse impacts to vegetation. And above the bank full line where vegetation would be planted, there would be minor, beneficial impacts to vegetation, partially mitigating the adverse impact. Terrestrial wildlife species would experience minor, adverse, and short-term impacts. Impacts to aquatic resources would be minor, adverse short and long-term as a result of construction activities and permanent changes to conditions in the stream channel. Though there would be increased human activity in the area near the project site from actions proposed in the preferred alternative, grizzly bear would be preparing for hibernation and or denning during construction at higher elevations than the project site; therefore negligible to minor, adverse short-term

impacts to grizzly bears would be expected. Actions proposed would result in negligible to minor, adverse short-term impacts to Canada lynx and gray wolves due to the incidental use of the project area by these species. Any disturbance that generates fine sediment in the form of bedload is unlikely to reach any bull trout or bull trout critical habitat during construction activities. Suspended fine sediment would likely reach the lower portions of upper McDonald Creek but this sediment would be diluted considerably at this point, therefore impacts to bull trout and rearing habitat would be negligible to minor, adverse, and short-term. Impacts from actions proposed in the preferred alternative would be negligible to harlequin duck. Sediment generation and permanent changes to habitat conditions would result in minor, adverse, short-term impacts to west slope cutthroat trout. The project area is in an established ungulate winter range and construction activity would be scheduled for late fall or early winter which would have minor, adverse, short-term impacts to wolverines and fishers. Impacts to water resources would be moderate, adverse and short-term from excavation in the stream and the installation of rock barbs and riprap but long-term impacts would be minor and beneficial. Proposed actions would have result in both adverse impacts, due from altered natural process, and beneficial impacts, due to maintaining the floodplain process northwest of the creek and negligible to minor, site-specific, and long-term impacts to floodplains due to the likelihood the stream would retreat a few feet to maintain the effective channel width, bank erosion that would occur immediately upstream of the barbs, and sediment deposition upstream of the barbs. Actions proposed for the preferred alternative would have negligible to minor, adverse short-term impacts and moderate, both adverse and beneficial, long-term impacts for visual resources and visitor experience. Impacts to cultural resources would be minor, long-term, site specific and adverse due to the slight change to the visual character of the GTSR, which is a cultural landscape of the Going-to-the-Sun Road Historic District. For purposes of Section 106, the finding of effect would be no historic properties affected. All other resource topics were dismissed because the project would result in "no effect" or negligible impacts for those resources. No major effects are anticipated because of this project. Public scoping was conducted to assist with the identification of resources that could be impacted and to identify additional alternatives. Alternative II would have the same impacts as described for the preferred alternative for most all impact topics except vegetation, water resources, floodplains and aquatic resources. Vegetation would experience minor, beneficial impacts from alternative II because the stabilization efforts would remove less existing vegetation along the creek in order to properly install the revetment. Water resources would have moderate impacts under Alternative II because of the instream work that would need to occur when installing the rock barbs. The floodplain in the project area would experience a greater change from Alternative II because the rock barbs would direct water towards the other side of the creek which would cause a slight erosion of the point bar opposite of the project area. And aquatic species might have a slight long-term benefit from Alternative II as the barbs would create deep pools that could be use for habitat.

How to Comment

Comments on this environmental assessment can be provided directly through the Park's planning website (http://parkplanning.nps.gov/parkHome.cfm?parkId=61) by selecting this project. Or write to: Superintendent, Glacier National Park, Attn: *MilePost 19.25 EA,* PO Box 128, West Glacier, Montana 59936. This environmental assessment will be on public review for 30 days. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review and we try to accommodate such requests, we cannot guarantee that we will be able to do so. We will always make submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

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PURPOSE and NEED

Introduction

Glacier National Park (GNP, Glacier or the park) is located on the Canadian border in the northwestern section of Montana. The park is in the northern Rockies, and contains the rugged mountains of the Continental Divide. Together with Canada's Waterton Lakes National Park, it forms the Waterton-Glacier International Peace Park, which is listed as a World Heritage Site and an International Biosphere Reserve. Outstanding natural and cultural resources are found in both parks.

Glacier National Park is an investment in the heritage of America. Its primary mission is the preservation of natural and cultural resources, ensuring that current and future generations have the opportunity to experience, enjoy, and understand the legacy of Waterton-Glacier International Peace Park.

The purpose of GNP is to:

- preserve and protect natural and cultural resources unimpaired for future generations (1916 Organic Act);
- provide opportunities to experience, understand, appreciate, and enjoy Glacier National Park consistent with the preservation of resources in a state of nature (1910 legislation establishing Glacier National Park); and
- celebrate the on-going peace, friendship, and goodwill among nations, recognizing the need for cooperation in a world of shared resources (1932 International Peace Park legislation).

The significance of GNP is explained relative to its natural and cultural heritage:

- Glacier's scenery dramatically illustrates an exceptionally long geological history and the many geological processes associated with mountain building and glaciation;
- Glacier offers relatively-accessible, spectacular scenery and an increasingly rare primitive wilderness experience;
- Glacier is at the core of the "Crown of the Continent" ecosystem, one of the most ecologically intact areas remaining in the temperate regions of the world;
- Glacier's cultural resources chronicle the history of human activities (prehistoric people, Native Americans, early explorers, railroad development, and modern use and visitation) and show that people have long placed high value on the area's natural features; and
- Waterton-Glacier is the world's first international peace park.

The proposed project would occur on the bank of McDonald Creek at MP 19.25 along the Going-to-the-Sun Road (GTSR). The GTSR is a national historic landmark and McDonald Creek is the main, stream drainage for the Westside of the park. Both resources are extremely important to the park and visitor enjoyment as natural and cultural resources. In order to protect both resources, the park is obligated to permanently stabilize the bank at this location.

Purpose and Need

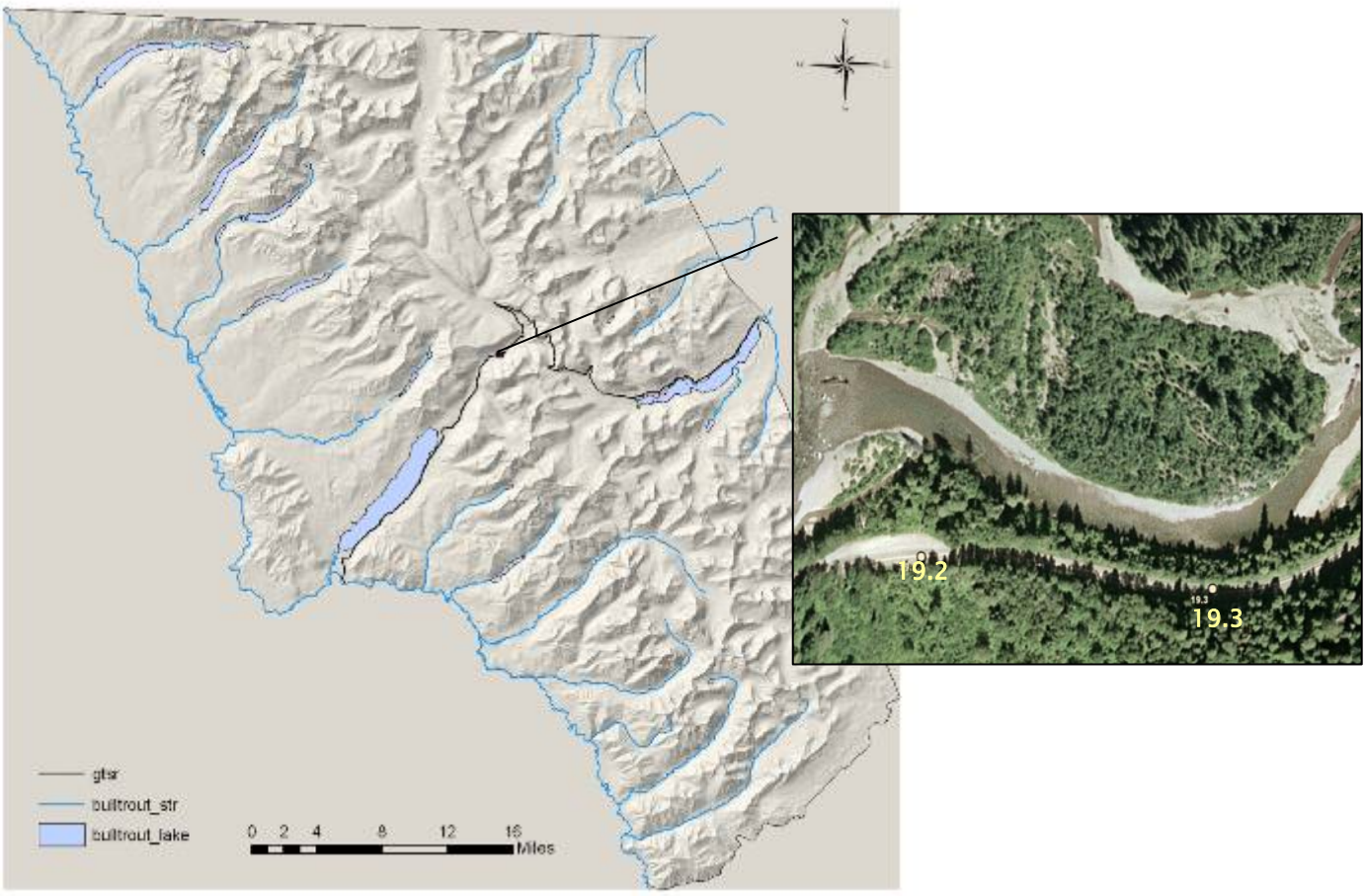
In November 2006, a rain on snow event caused severe flooding on the west side of the park causing damage to the GTSR, and several bridges, culverts and streambeds. In the spring of 2007, the park identified a portion of stream bank that had sloughed off into McDonald Creek and installed temporary measures to stabilize the bank and prevent further damage to the road. The site needs to be permanently fixed to ensure protection of the park's natural and cultural resources.

The purpose of this proposal is to evaluate alternative ways to stabilize the bank at this location (see Map 1) to prevent additional sedimentation in the creek and undercutting of the road. Peak run off for streams along the GTSR corridor usually occurs during fall rain on snow events, during the spring in response to snowmelt, or during summer thunderstorms. The GTSR limits the movement of McDonald Creek to the east allowing flooding to only occur on the western stream bank or, in high water events, undercut the road. The GTSR is a national historic landmark and has an average of 1.9 million visitors accessing opportunities to experience the park each season (based on the last ten years, NPS files). Stream banks maintain important aquatic habitat characteristics by providing shade that results in cooler water temperatures, suspending sediment, and offering cover for hiding.

The following objectives would be met by this project:

- Minimize impacts on aquatic species, water quality and vegetation
- Protect a national historic landmark road
- Maintain visitors' access and experiences across the park
- Prevent impairment and unacceptable impacts to park resources and values

This EA and Statement of Findings is being prepared in cooperation with the FHWA.



Map 1. Location Map of Bank Stabilization Efforts

Relationship of the Proposed Action to Other Plans

Current plans and policy that pertain to this proposal include the *Going-to-the-Sun Road Rehabilitation Plan/ Final Environmental Impact Statement* (GTSR FEIS) (NPS 2003) and the *Glacier National Park General Management Plan (*GMP*)* (NPS 1999). The GMP provides overall guidance and direction for the park and the GTSR FEIS analyzed the entire rehabilitation project for the Going-to-the-Sun Road.

Appropriate Use

Sections 1.4 and 1.5 of *Management Policies* (2006) direct that the National Park Service must ensure that park uses that are allowed would not cause impairment of, or unacceptable impacts on, park resources and values. A new form of park use may be allowed within a park only after a determination has been made in the professional judgment of the park manager that it will not result in unacceptable impacts.

Section 8.1.2 Of *Management Policies* (2006), *Process for Determining Appropriate Uses*, provides evaluation factors for determining appropriate uses. All proposals for park uses are evaluated for

- consistency with applicable laws, executive orders, regulations, and policies;
- consistency with existing plans for public use and resource management;
- actual and potential effects on park resources and values;
- total costs to the service; and
- whether the public interest will be served.

Park managers must continually monitor all park uses to prevent unanticipated and

unacceptable impacts. If unanticipated and unacceptable impacts emerge, the park manager must engage in a thoughtful, deliberate process to further manage or constrain the use, or discontinue it. More information on the definition of unacceptable impacts as cited in §1.4.7.1 of *Management Policies* (2006) can be found in the Affected Environment and Environmental Consequences section.

The park reviewed several alternatives to evaluate bank stabilization options this location to prevent the road and stream bank from deteriorating at this location. Proper installation of bank stabilization measures would ensure that unacceptable impacts to park resources and values would not occur. The proposed management action is consistent with the park's general management plan and other related park plans. With this in mind, the NPS finds that armoring the bank at MP 19.25 is an acceptable use at Glacier National Park.

Scoping and Public Involvement

Scoping is an early and open process to determine the breadth of environmental issues and alternatives to be addressed in an environmental assessment. Glacier National Park conducted both internal scoping with National Park Service staff and external scoping with the public and interested and affected groups and agencies. The scoping process identified potential alternatives issues, cumulative actions, what resources would be affected and the relationship, if any, of the preferred alternative to other planning efforts in the park.

Public scoping began with a press release and a mailed scoping brochure on January 30, 2008. Scoping brochures were sent to people on the park's environmental assessment mailing list that included members of the public along with federal, state and tribal agencies. The scoping brochure was also placed on the National Park Service's Planning Internet site. The public scoping period was completed February 29, 2008.

In accordance with 36 CFR800.8(c), GNP also notified the Montana State Historic Preservation Office (SHPO) of the undertaking.

Two letters were received during the scoping. One comment letter agreed the need for stabilizing the bank was apparent (opposed to no action or moving the road) but would like to wait until the environmental assessment is prepared before commenting further. The other commenter wondered why we are not utilizing the cooperation already in place with Federal Highway Administration and what the public could contribute to FHWA road design to accomplish the tasks proposed in this project. Scoping is the first step in the early planning process of the National Environmental Protection Act (NEPA) and is used to ensure all possible alternatives and effects to resources are considered. Even though the FHWA may be considered an "expert" by the commenter, as cooperator with the park and a federal agency they must also follow federal laws and regulations; including NEPA. FHWA and the NPS developed the alternatives analyzed in this EA and Statement of Findings.

Impact Topics

Issues and concerns affecting the proposed action were identified by the public, other federal and state agencies, and specialists in the National Park Service. Impact topics are identified by determining what resources could be affected by the r alternatives analyzed. The following impact topics were identified based on federal laws, regulations, orders, and National Park Service *Management Policies*, 2006, and input from the Montana State Historic Preservation Officer. A brief rationale for the selection of each impact topic is given below, as well as the rationale for dismissing other impact topics from further consideration.

Impact Topics Selected for Detailed Study

Soils

The NPS preserves the soil resources of parks and protects those resources by preventing unnatural erosion, physical removal, or contamination (NPS 2006). Soil disturbance would likely occur either naturally or because of stabilization efforts.

Vegetation

The NPS strives to maintain all components and processes of naturally evolving park unit ecosystems, including the natural abundance, diversity, and ecological integrity of plants (NPS 2006). Impacts to vegetation are expected.

Wildlife and Aquatic Species

The NPS is charged with maintaining native wildlife as an integral component of natural ecosystems. Wildlife species occupy the project area and therefore might be affected by actions proposed. Actions proposed in this project would involve instream work; therefore aquatic species are included in the analysis.

Threatened and Endangered Species and Species of Concern

The NPS protects and attempts to recover all native species that are listed under the Endangered Species Act of 1973. Both the *Management Policies* (2006) and *Director's Order 77 – Natural Resources Management Guidelines* require the NPS to examine and minimize the impacts of projects on federal candidate species as well as federally listed threatened, endangered, and candidate, and state listed rare, declining, and sensitive species. In accordance with Endangered Species Act, Section 7, and National Park Service *Management Policies* 4.4.2.3, Glacier National Park is required to conduct consultation with the U.S. Fish and Wildlife Service (USFWS) regarding the determination of "may affect, not likely to adversely affect" on threatened and endangered species.

Federally Listed Species

Gray Wolf (*Canis lupus*) – Endangered. Gray wolves might pass through the project area while following prey species during the winter months as part of their wide-ranging nature and their distribution being tied to their prey. There are no documented dens or rendezvous sites in the project area, and it is highly unlikely they would occur due to the high level of human presence though the area contains suitable habitat for denning (Trapp 2004). Home-ranges of packs found in GNP generally do not include the project area, but wolves have been documented in the McDonald valley and might make temporary and sporadic use of the area especially during the winter months looking for prey and there is a decrease in human activity.

Grizzly Bear (*Ursus arctos horribilis*) –Threatened. GNP was placed into grizzly bear management "situations" in accordance with the Grizzly Bear Recovery

Plan (USFWS 1993). Over 1 million acres of the park (recommended wilderness) are established as Management Situation 1, in which management decisions would favor the needs of the grizzly bear when grizzly habitat and other land-use values compete, and grizzly-human conflicts would be resolved in favor of grizzlies, unless a bear is determined to be a nuisance. The remainder of the park, which is developed front-country, is established as Management Situation 3, in which grizzly habitat maintenance and improvement are not the highest management considerations, grizzly bear presence would be actively discouraged, and any grizzly involved in a grizzly-human conflict would be controlled. The project site is in Management Situation 3.

Canada Lynx (*Lynx canadensis*). Threatened. No surveys have been conducted in the immediate project area, but there have been incidental sightings and track records in the general area. A preliminary map of lynx habitat in the park does not include the project area because it is low elevation but is moist conifer forest. Little is known about lynx habitat use in the park and these criteria are general in nature. The amount of development and human presence in the project areas makes it unlikely that lynx frequent the area but since tracks have been observed, lynx would be evaluated.

Bull Trout (*Salvelinus confluentus*). Bull trout is listed as a threatened species under the Endangered Species Act and is also a state listed "Species of Special Concern". Although bull trout can be found in Lower McDonald Creek and Lake McDonald, no bull trout have been observed by park biologists in Upper McDonald Creek above McDonald Falls, located approximately one half mile above the mouth of Upper McDonald Creek. Though bull trout have not been observed in this area, erosion and sediment from the project might affect bull trout rearing habitat downstream at the mouth of the lake.

Species of Concern

Harlequin duck (*Histrionicus histrionicus*) use McDonald Creek during the breeding season from April to September and possibly nearby Logan Creek during the spring. Upper McDonald Creek has been identified as one of the most important areas for breeding harlequin ducks in Montana. The project might affect harlequin ducks.

Westslope cutthroat trout (*Oncorhynchus clarki lewisi*) have been found in Upper McDonald Creek and its tributaries such as nearby Avalanche Creek and Logan Creek. The project might affect the westslope cutthroat trout.

Wolverines (*Gulo gulo*) are wide-ranging carnivores that might pass through the project area in search of carrion, and probably make only temporary and sporadic use of the area; it is unlikely that the project area supports dens because of human activity during the denning period. Wolverines appear to require large, isolated tracts of wilderness supporting a diverse prey base. They use a range of habitats including alpine areas, mature forest, ecotonal areas, and riparian areas. Wolverines exhibit a distinct seasonal elevation pattern moving to lower elevations during the winter where they search for carrion in ungulate winter ranges which might include the project area.

Fisher (*Martes pennanti*) also likely make only temporary and sporadic use of the area, though little is known about the distribution and movements of either of these elusive carnivores in the project area. Fishers inhabit moist coniferous forests and prefer mature stands with abundant small mammal prey. They

generally frequent drainage bottoms, lower slopes, and riparian areas. Fishers have been observed near the project area.

Water Resources
NPS policies require protection of water quality in accordance with the Clean Water Act. The purpose of the Clean Water Act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The US Army Corps of Engineers (COE) has been charged with evaluating federal actions that result in potential degradation of waters of the United States and issuing permits for actions consistent with the Clean Water Act. The US Environmental Protection Agency (EPA) also has responsibility for oversight and review of permits and actions, which affect waters of the United States. Water quality and water resources might be affected by this project.

Floodplains
Executive Order 11988 Floodplain Management requires all federal agencies to avoid construction within the 100-year floodplain unless no other practicable alternative exists. The NPS is guided by the 2006 *Management Policies* and *Director's Order 77-2 Floodplain Management* which provides guidance on how to implement *Executive Order 11988*. The service will strive to preserve floodplain values and minimize hazardous floodplain conditions. According to *Director's Order 77-2*, the impacts of proposed actions within the 100-year floodplain must be addressed in a separate Statement of Findings document that is attached to this environmental assessment.

Visual Resources and Visitor Experience
The Going-to-the-Sun Road is a primary visitor experience and provides access to most of the Park. Construction traffic on the road affects visitors' experience. Actions proposed for this project would be completed during the "shoulder season" behind a closed gate and would not have substantial impacts to visitor use. However, the results of actions proposed for bank stabilization would be visible from the GTSR; therefore impacts to visual resources and visitor experience are analyzed.

Historic Structures and Cultural Landscapes
Within the area of potential effect (APE) of the proposed project is the Going-to-the-Sun Road (GTSR) Historic District. The road is listed in the National Register of Historic Places (1983) and is a designated National Historic Landmark (1997) (24GL0136 and 24FH0161). The GTSR is a cultural landscape significant for its engineering features and as an example of National Park Service landscape design. Impacts to cultural resources might occur because of actions proposed in this project; therefore, this topic is analyzed.

Natural Soundscapes
The NPS 2006 *Management Policies* state that the service will preserve the natural soundscapes of parks. Natural soundscapes are defined as the variety of natural sounds comprising an ecosystem including the physical capacity for transmitting those natural sounds and the interrelationships among park natural sounds of different frequencies and volumes. The degradation of natural soundscapes by impacts from human activities will be minimized or eliminated where possible. The actions proposed in this project would be completed during the "shoulder season" but might disturb cross-country skiers, snowshoe-ers, or others who choose to use the road during the implementation period.

Impact Topics Eliminated from Detailed Study

Some impact topics have been dismissed from further consideration, as listed below. During internal scoping, the park's interdisciplinary team conducted a preliminary analysis of resources to determine the context, duration, and intensity of effects that the proposal may have on those resources. If the magnitude of effect was determined to be at the negligible or minor level, there is no potential for significant impacts, and further impact analysis is unnecessary, then the resource is dismissed as an impact topic. If however, during internal scoping and further investigation, resource effects still remain unknown, or are more at the minor to moderate level of intensity, and the potential for significant impacts is likely, then the analysis of the resource as an impact topic is carried forward.

For purposes of this section, an impact of negligible intensity is one that is "at the lowest levels of detection, barely perceptible, and not measureable." An impact of minor intensity is one that is measureable or perceptible, but is slight, localized, and would result in a limited alteration or a limited area." The rational for dismissing the specific topics is stated for each resource.

Air Quality

The Clean Air Act provides for special protection of air quality and air resources in all National Park Service units. *Section 118* of the *Clean Air Act* requires parks to meet all federal, state, and local air pollution standards. Glacier is classified as a mandatory Class I area under the Clean Air Act, where emissions of particulate matter and sulfur dioxide are to be restricted. Air quality is considered good in Glacier National Park. There are no metropolitan areas within 125 miles of the park, and no regional smog typical of highly populated areas with a high amount of vehicle traffic. Air quality would not be measurably affected by any of the alternatives; therefore impacts to air quality would be negligible.

Threatened and Endangered Species and Species of Concern

The NPS protects and attempts to recover all native species that are listed under the *Endangered Species Act* of *1973*. Both the *Management Policies (2006) and Director's Order 77 – Natural Resources Management Guidelines* require the NPS to examine and minimize the impacts of projects on federal candidate species as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species.

While present in Flathead County, there are no known locations of the threatened Spalding's catchfly (*Silene spaldingii*) or the threatened water howellia (*Howellia aquatilis*) within GNP; consequently, there would be no effect to Spalding's catchfly or water howellia from the proposed project. However, if locations of listed plant species become known within the vicinity of the project area, the plants would be avoided.

Species of Concern. These alternatives are not expected to have any impact on the following species of concern as they have not been documented in the project area during the period in which the project is planned or no impacts on these species are anticipated.

Bald eagle (*Haliaeetus leucocephalus*) The *Montana Bald Eagle Management Plan* recommends restrictions on human activity within 0.25 miles (400 meters) of bald eagle nesting, roosting and primary foraging areas during specific stages of the nesting cycle (Montana Bald Eagle Working Group 1994). The nearest bald eagle nest is over seven miles (>11 km) downstream of the project site at the head of Lake McDonald, and the Lake McDonald inlet, over six miles (>9 km) from the project area, is a primary foraging area; nesting bald eagles are rarely observed in the project area. Therefore there would be no effect to bald eagles as a result of the actions proposed.

Golden Eagle (*Aquila chrysaetos*) nest sites are documented on the cliffs along the upper McDonald Creek corridor at three different locations nearby: Crystal Point, Red Rocks, and Avalanche Creek; breeding territories encompass the entire upper McDonald Creek Valley. The golden eagle nesting period occurs between April and September, with most chicks fledging by early to mid August. The project is not expected to measurably impact golden eagles and would have a negligible impact.

Wetlands
The definition of wetlands under the *Clean Water Act* is "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." Executive Order 11990 Protection of Wetlands requires federal agencies to avoid, where possible, adversely impacting wetlands. Further, *Section 404* of the *Clean Water Act* authorizes the USACE to prohibit or regulate the discharge of dredged material, fill material, or excavation within US waters. NPS policies for wetlands as stated in 2006 *Management Policies* and *Director's Orders 77-1 Wetlands Protection* strive to prevent the loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In accordance with *DO 77-1*, the potential adverse impacts of proposed actions must be addressed in a separate Statement of Findings document. There are no wetlands in the vicinity of the project area that would be affected from actions proposed; therefore this impact topic was eliminated from further study.

Human Health and Safety
The NPS *Management Policies* (2006) states the safety and health of all people are core service values. Public health is addressed in *Director's Order 83 Public Health and Vector-borne and Zoonotic Disease* and employee health is addressed in Director's *Order 50 B Occupational Health and Safety Program*. These policies address risk recognition and early prevention for a safe work and recreational environment. The NPS is committed to eliminating and reducing health and safety risk when they are identified, no health and safety risks are expected from the actions proposed in this project.

Socioeconomic Resources
Socioeconomic resources would not be changed by the alternatives as the road construction and long term maintenance operation would continue as planned, therefore, socioeconomic resources would not be affected and are dismissed from further analysis.

Archaeological Resources
No archaeological resources were identified in the project area during a 1994 archaeological survey (Reeves 1996). The area has been heavily disturbed over the years. Subsequent surveys of the Lake McDonald Valley have found sites to be "few in number and small in size (Reeves 2003).

Only previously disturbed ground would be affected by the proposed project. However, if cultural resources are discovered during construction the project would be halted until the resources can be evaluated by an archaeologist. Neither the Blackfeet Tribal Business Council, nor the Confederated Salish and Kootenai Tribal Council expressed concerns during scoping for the project. This topic was dismissed from further consideration because archaeological resources would not be impacted.

Ethnographic Resources
Director's Order 28: Cultural Resource Management defines ethnographic resources as any site, structure, object, landscape, or natural resource feature assigned traditional, legendary,

religious, subsistence, or other significance in the cultural system of a group traditionally associated with it. *DO-28* and *Executive Order 13007 – Indian Sacred Sites*, charge the NPS with the preservation and protection of ethnographic resources. An ethnographic study of GNP was completed in 2001 (Reeves and Peacock 2001). No ethnographic resources have been identified by the Confederated Salish and Kootenai Tribes or the Blackfeet Tribal Business Council in the project area and no concerns were raised during scoping for this project. However, GNP recognizes that the tribes hold a body of knowledge that may result in the identification of ethnographic resources in the area in the future. If ethnographic resources are identified, consultation would occur in accordance with federal legislation and regulations and NPS policy. This topic was dismissed from further analysis.

Museum Collections
According to the NPS *Management Policies* (2006) *Director's Order 24 – Museum Collections*, the NPS requires consideration of impacts on museum collections (historic artifacts, natural specimens, and archival and manuscript materials). NPS policy defines museum collections management including policy, guidance, standards, and requirements for preservation, protection, documentation, access, and use. Museum collections would not be affected by this project.

Prime and Unique Farmlands
The *Farmland Protection Policy Act* of *1981*, as amended, requires federal agencies to consider adverse effects to prime and unique farmlands that would result in the conversion of these lands to non-agriculture uses. There are no prime and unique farmlands located within Glacier National Park (NPS 1999).

Environmental Justice
Executive Order 12898 – General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Disproportionate health or environmental effects on minorities or low-income populations or communities as defined in the *Environmental Protection Agency's Environmental Justice Guidance* (1998) would not occur from actions proposed in the preferred alternative. Therefore, environmental justice was dismissed from further analysis.

Recommended Wilderness
Glacier National Park completed a wilderness suitability study and environmental impact statement in 1973 to comply with the 1964 Wilderness Act. That document recommended that over 90% of the park be designated as wilderness. President Nixon forwarded the recommendation to Congress on June 13, 1974. A bill was subsequently introduced to designate the selected lands as wilderness. The bill has not been enacted, but since that time, the lands have been defined as recommended wilderness and managed as designated wilderness by the NPS. NPS policy requires the management of proposed or recommended wilderness as designated wilderness until the land is either formally designated or rejected. Amendments to the original proposal made in 1984 and 1994 increased the amount of recommended wilderness to 95 % of the park's total area. Wilderness in GNP is defined as lands that are essentially undeveloped or are natural in character and lie at least 200 feet from established roadways or development zones. The proposed activities for this project would have no effect on recommended wilderness as actions would not intrude on the wilderness boundary; there fore this topic was dismissed from further analysis.

ALTERNATIVES

Alternative I: No Action Alternative

Under this alternative, McDonald Creek would continue to function in its current semi-natural state. The GTSR forms the east boundary of the stream channel in most areas limiting the streams ability to move across the valley bottom, deposit sediment and channelize in a natural state. The soil nails, erosion netting and jersey concrete barriers would remain in place (see cover photo). The paved widening on the ditch-side of the road would also remain in order to provide adequate travel lane width. The road and bank would be monitored and appropriate safety measures would be implemented if the road became hazardous to drive.

Alternative II: Stabilize the bank and install barbs in McDonald Creek

Under this alternative, the following actions would be taken to stabilize approximately 150 feet of the bank and prevent further erosion and sedimentation. Large (class V and VII riprap, 2 – 5 feet in diameter), angular rock would be used to create "barbs" and armor the slope from the toe of the slope to the shoulder of the road. The temporary soil nails would be removed and riprap would be placed for about 160 feet along the bank below high water line (see appendix A, figure 1). The site would be accessed by excavating that portion of the GTSR down to almost stream level. Access might also occur by driving an excavator up McDonald Creek from the pullout below this location, along the open gravel banks and occasionally crossing the stream. If the stream access is selected, the excavator would only make one trip up to the site and one trip down. If the access road is selected, the area of impact would extend the length of the treatment area (approximately 300ft) and would be within the road prism. Temporary construction pads, made of rock, would be located at the base of the slope to provide a landing for the construction equipment above the water line (see appendix A, figure 4).

The riprap and barbs (see appendix A, figure 2) would require excavation into the natural channel substrate to install a large rock "toe" that would ensure high flows do not compromise the structural integrity of the stabilized bank. In-channel work would involve the excavation of approximately 3,000 ft^3 of native streambed material, which would be replaced with riprap to form the toe of the slope and footer material for the barbs. Most of the streambed material would be hauled away. A small amount would be incorporated into the riprap to promote growth of vegetation. Project work would occur during low water times in the late fall/early winter.

Two barbs would be placed in the creek. One barb would be placed immediately upstream and one barb downstream of the sloughed bank area. Barbs are sloping stone sills, angled upstream and used to reduce bank erosion by re-directing currents away from the bank. The barbs would be about 30 feet long total and extend about 15 feet from the bank, angled upstream 25 degrees, counter sunk in the streambed about 3 to 4 feet, and keyed into the eroding bank. The barbs would be about 25 feet wide at the bank end and slope down from a 6 to 7-foot wide center crest into the stream bed. They would be about 5 feet in height above the stream bottom at the bank end and level with the stream bottom at the stream end (not including the countersinking). Consequently, they would have a low profile with only the segment next to the stream bank visible during most of the visitor season. During low water periods about one-half to one-third of the barbs would be exposed. The barbs would be designed based on a 50-year flood event depth and velocity.

Stone riprap revetment and vegetation would be used to armor the bank above the high water line. The riprap would ensure long-term stabilization at the site. It would extend approximately 100 feet from the stream edge of the eroding slope to the road shoulder currently being held by soil nails. A geotextile would be installed between the riprap and the subgrade. An additional 8-foot wide riprap – toe would be buried in the streambed.

Vegetation would be used to stabilize the upper portion of the bank and along the shoulder of the road. Restoration would include incorporating native species (such as dogwood, cottonwood and willows seedlings) into the riprap revetment between four and ten feet above the stream bottom. The seedlings would further stabilize the stream bank as they sprout and take root. The seedlings would be planted in the soil and then riprap would be placed around them (see appendix A, figure 4) and planting pockets would be incorporated into the upper portions of the riprap. No planting would be done on the barbs. Final touches, revegetation and project cleanup would most likely occur in early summer after spring runoff. McDonald Creek would not be diverted during the project.

Alternative III: Riprap only (preferred)

Under this alternative, large (Class VII), angular riprap would be placed over the sloughed streambank area as well as up and downstream in order to armor the bank; totaling approximately 300 lateral feet. As described in Alternative II, the riprap revetment would extend from the stream edge to the shoulder of the GTSR and instream work would be required to place the riprap at the toe of the slope (see appendix A, figure 3). To reduce scour along the revetment a 6-foot by 3-foot toe would be installed at or slightly below stream bottom. The riprap would require excavation into the natural channel substrate and creation of a rock "toe" to ensure high flows do not compromise the structural integrity of the stabilization. The armored bank toe would extend 100 feet upstream of the riprap revetment and approximately 65 feet downstream and would rise 10 feet about the stream bottom. In-channel work would involve the excavation of approximately 3,000 ft^3 of native streambed material, which would be replaced with riprap to form the toe of the slope. Access, riprap installation and streambed material removal would be the same as described in Alternative II.

Project work would be started during low water times in the fall and would take about two months to complete. The amount of excavation would be similar to Alternative II but would not involve the rock barbs. Vegetation would be incorporated into the riprap as described in Alternative II. Materials storage and staging would occur at the project site or at nearby pull-outs or Logan Pit which were already identified for staging and storage in previous planning documents (NPS 2003, and 2008).

Mitigation Measures

The following mitigation measures as appropriate would be taken to protect natural resources at each site:

Soils

- All activities would be confined to areas defined by the drawings and specifications. Stone, soil, or other materials displaced into un-cleared areas would be removed by the contractor.
- No diversion dike would be installed, because removal of the diversion would release a large amount of sediment at one time that would have more harmful effects downstream than if sediment is slowly released during construction.
- Deposit excavated material where it would not erode into nearby watercourses by surface runoff or high stream flows.
- Loose, granular materials from project site would be stored in well-drained area on solid surfaces to prevent mixing with foreign matter. Granular stored materials would be covered with secured tarps at all times.
- Local mulch would be used to stabilize soil and fill slopes as appropriate.

- Design and construct surface runoff features in a non-erosive manner.

Vegetation

- Best Management Practices would be implemented to prevent wind and water erosion.
    - Disturbance to vegetation and ground would be avoided as much as possible and be contained to as small of footprint as possible while meeting project objectives.
- Landscaping design features would be used to minimize visual impacts and to aid in creating suitable site conditions for revegetation.
- A restoration analysis would be completed to decide if revegetation is necessary throughout the life of the project. If it were determined to be necessary the following mitigation measures would apply:
    - Soil amendments, mulches, organic matter and other measures would be applied as appropriate to facilitate revegetation.
    - Native vegetation would be used to revegetated disturbed areas.
    - Native species from genetic stocks originating in the park would be used for revegetation seeding and planting efforts. Plant species density, abundance, and diversity would be restored as nearly as possible to prior conditions for non-woody species.
- Vegetation cover would be monitored and evaluated and contingency and maintenance plans would be developed if vegetation cover is not similar to original ground cover.
- A vegetation management plan would be prepared for the project.
- Aggressive noxious weed control measures would occur and noxious weed populations would be controlled along the GTSR.
- Riprap, gravel, and topsoil sources would be inspected prior to use, and material currently supporting invasive exotic plants would be avoided.
- Construction vehicles would be inspected and washed to prevent the import of noxious weeds from tires and mud on the vehicles.
- Fertilizers that might favor weeds over native species would be limited or prohibited.
- Periodic inspections and spot controls would occur to prevent noxious weed establishment. If noxious weeds invade an area, an integrated noxious weed management process to selectively combine management techniques to control the particular noxious weed species would be used.

Wildlife and Aquatic Resources

- A stormwater management plan would be prepared to minimize erosion and the introduction of sediments to aquatic habitat.
- Drainage improvements would be used to control runoff and reduce erosion.
- No food garbage or items that would be considered attractants to wildlife would be stored on site.
- Equipment would be inspected for hydraulic fluid, antifreeze and oil leaks prior to use at staging and stockpiling sites, and materials would be kept on site for clean up of any motor vehicle or heavy equipment fluid spills that might occur (such fluid spills are potential unnatural attractants to wildlife species).
- The amount and duration of instream work, as well as the number of live water equipment crossings would be limited as much as possible.
- Broadcast seed and mulch would be distributed on any disturbed ground to reduce erosion immediately following construction.
- Any damage to stream banks or habitat as a result of equipment access to the work site would be addressed.
- Incorporate a woody vegetation component into revegetation efforts where appropriate.

Threatened and Endangered Species and Species of Concern

- Measures to reduce potential for bear-human conflicts would be implemented.
- Regulations that prohibit feeding of wildlife and that require proper food storage would be enforced.
- Adequate portable restroom facilities for construction workers to eliminate human waste as a wildlife attractant at construction sites would be provided.
- Best management erosion and sediment control measures to prevent sedimentation of aquatic habitats used by westslope cutthroat trout would be used.
- Minimize fine sediment generation in project area.

Water Quality

- Filter barriers would be installed (silt fences, certified weed seed free straw bales, coir logs)
- Fuel, heavy equipment, and hazardous materials would be stored at least 100 feet from the stream channel, where any spill of fuel and lubricants cannot reach flowing water.
- An emergency fuel spill kit on-site during staging and construction would be maintained.
- Clean angular riprap would be used.
- Work would be completed prior to potential flood periods, rain-on-snow events, and spring/early summer.

Floodplain

- Work would be completed during the fall at low water times such that any impact to the floodplain would be remediated by spring floods.

Alternative Summaries

Table 1 summarizes the major components of the four alternatives, and compares the ability of these alternatives to meet the project objectives (as identified in the Purpose and Need). As shown, the No Action Alternative only achieves one of the project objectives while the Preferred Alternative achieves all the project objectives.

Table 1. Alternative summary and extent to which each alternative meets project objectives

Objectives	Alternative I – No Action	Alternative II – Riprap and Rock Barbs	Alternative III – Riprap Only (Preferred)
Minimize impacts on aquatic species, water quality and vegetation.	Meets project objective as stream would be allowed to function in its most natural state.	Meets project objective for the long-term. Short-term impacts would be adverse, minor to moderate to water quality and aquatic species but impacts to vegetation would be beneficial.	Meets project objective for the long-term. Short-term impacts would be adverse, minor to moderate to water quality and aquatic species. Aquatic species would not have beneficial affects.
Protect a national historic landmark road.	Does not meet objective as continued erosion would have the potential to undermine the road possibly destroying it and resulting in a re-alignment.	Meets project objective as permanent bank stabilization measures would be installed; protecting the road from further erosion.	Meets project objective as permanent bank stabilization measures would be installed; protecting the road from further erosion.
Maintain visitors' access and experiences across the park	Does not meet objective because McDonald Creek would still threaten to undermine and eventual destroy the GTSR at this location. Thus preventing visitors' ability to drive across the park.	Meets project objective because permanent bank stabilization measures would be installed, preventing future needs for repairs at this location.	Meets project objective because permanent bank stabilization measures would be installed, preventing future needs for repairs at this location.
Prevent impairment and unacceptable impacts to park resources and values	Meets project objective as the stream bank has been temporarily stabilized by soil nails through emergency stabilization efforts.	Meets project objectives as none of the park's resources and values would be subjected to major or unacceptable impacts.	Meets project objective as none of the park's resources and values would be subject to major or unacceptable impacts.

Alternatives Considered But Eliminated from Further Study

Re-route the GTSR:

Relocating the GTSR was considered to move it further away from the bank of McDonald Creek. In order to relocate this section of road, the road would need to be straightened between two curves that are immediately adjacent to the project area. The realignment would have been approximately 1100' long and approximately 1.3 acres of forested habitat would be removed. This would significantly move the road outside of its historic alignment. This alternative was dismissed from further study because of the significant major adverse impact to the National Historic Landmark characteristics of the GTSR and major adverse impacts to the forest in this area, which includes western red cedar, Engelmann spruce, and subalpine fir with black cottonwood and paper birch.

Stabilize the bank using engineered log jams:

The use of up to three engineered log jams (ELJ) placed in the creek and riprap on the slope to stabilize approximately 45 feet of the bank and prevent further erosion along McDonald Creek was considered. Mimicking natural woody debris build up along the bank would provide quality habitat for fish and wildlife while reducing stream velocity and shear stress to the eroding bank. Large rock riprap protection would be needed immediately upstream and downstream of each of the ELJs to prevent scour. Scour would result from the complex nature of the structure (and movement patterns of water as it encounters the structure and flows over and through the structure), and future debris build up. This alternative was eliminated from further study because it would not be permanent as more and more debris gets caught up in the jams each year, they could be washed down stream.

Environmentally Preferred Alternative

The Council on Environmental Quality defines the environmentally preferred alternative as "…the alternative that will promote the national environmental policy as expressed in the National Environmental Policy Act's §101." Section 101 of the National Environmental Policy Act states that "… it is the continuing responsibility of the Federal Government to …

1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

The no action alternative does not fulfill the environmental evaluation criteria. Deterioration of the road at MP 19.25 would inhibit visitors from safe access to the park and eventually would prevent visitors' ability to enjoy the cultural and natural resources, thus criteria 1, 2, 3 and 5 would not be met. Without taking action to permanently stabilize the bank, by redirecting the currents from the bank and fortifying the slope, could lead to deterioration of the Going-to-the-Sun Road, a national historic landmark, thus criteria 4 would not be met. Criteria 6 is neither achieved nor not achieved by the no action alternative.

The Alternative II and Alternative III (Preferred) address 1 – 5 of the evaluation criteria; criteria 6 is neither achieved nor not achieved by the alternatives. By permanently stabilizing the bank along the GTSR at MP 19.25, the park continues to provide access to visitors with the least amount of impact on natural and cultural resources. Implementing Alternative III would have less of an impact to water resources; therefore it best allows the park to fulfill evaluation criteria 3, as compared to the other alternatives, while preserving an important historic landscape (criteria 4).

AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

Methodology

The effects of each alternative are assessed for direct, indirect, and cumulative impacts on selected topics. Actions are first analyzed for their direct and indirect effects. Direct effects are impacts that are caused by the alternatives at the same time and in the same place as the action. Indirect effects are impacts caused by the alternatives that occur later in time or are farther in distance from the action. For example, construction grading may result in the direct removal of vegetation and soil from a site and result indirectly in increased erosion at the site later when it rains, and to water quality off-site. Effects to historic properties listed in or eligible for listing in the *National Register of Historic Places* also have been described in accordance with *Section 106* of the *National Historic Preservation Act* of *1966*, as amended, and its implementing regulations, *36 CFR 800*.

Potential impacts are described in terms of type, spatial context, duration, and intensity.

- **Type**: impacts are either *beneficial* or *adverse*. A resource may be affected both beneficially and adversely (e.g., one wildlife species may benefit while another is harmed), however an overall impact for the resource as a whole is determined.
- **Spatial Context**: impacts are 1) *site-specific* at the location of the action, 2) *local* on a drainage- or district-wide level, 3) *widespread* throughout the park, or 4) *regional* outside of the park.
- **Duration**: impacts are short-term or long-term. The definitions for these periods depend upon the impact topic and are described in Table 2.
- **Intensity**: the impacts are *negligible*, *minor*, *moderate*, or *major*. Definitions of intensity vary by impact topic and are provided in Table 2.

Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations, which implement the *National Environmental Policy Act* of *1969* (42 USC 4321 et seq.), require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined 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 non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and preferred alternatives.

Cumulative impacts were determined by combining the impacts of the alternative with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects in Glacier National Park and, if applicable, the surrounding region. The following are past, present and reasonably foreseeable future actions that have and could occur in the vicinity of the project area:

Past Actions

- Utilization of Logan Pit as a staging and stockpiling site
- Emergency work at Haystack Creek
- Emergency repair work at MP 23.3
- Emergency sediment removal at Logan Creek

On-going Actions

- Going-to-the-Sun Road rehabilitation
- Going-to-the-Sun Road general maintenance
- Utilization of Logan Pit as a staging and stockpiling site

Future Actions

- Logan Creek Bridge rehabilitation and addressing flood potential
- Continued use at Logan Pit
- The park would perform emergency and likely temporary stabilization efforts as needed.

Impairment of Park Resources or Values

The fundamental purpose of the National Park Service, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, actions that would adversely affect park resources and values. NPS *Management Policies* (NPS 2006) require analysis of potential effects to determine whether actions would impair park resources or values.

These laws give the NPS the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise.

The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute impairment. Impairment may result from NPS activities in managing the park, from visitor activities, or from activities undertaken by concessionaires, contractors, and others operating in the park. An impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's *General Management Plan* (NPS 1999) or other relevant NPS planning documents.

Each alternative was analyzed to determine if impacts constituted impairment to park resources and values.

Unacceptable Impacts

The impact threshold at which impairment occurs is not always readily apparent. Therefore, the Park Service applies a standard that offers greater assurance that impairment will not occur by avoiding unacceptable impacts. These are impacts that fall short of impairment, but are still not acceptable within a particular park's environment. Park managers must not allow uses that would cause unacceptable impacts; they must evaluate existing or proposed uses and determine whether the associated impacts on park resources and values are acceptable.

Virtually every form of human activity that takes place within a park has some degree of effect on park resources or values, but that does not mean the impact is unacceptable or that a particular use must be disallowed. Therefore, for the purposes of these policies, unacceptable impacts are impacts that, individually or cumulatively, would

- be inconsistent with a park's purposes or values, or
- impede the attainment of a park's desired future conditions for natural and cultural resources as identified through the park's planning process, or
- create an unsafe or unhealthful environment for visitors or employees, or
- diminish opportunities for current or future generations to enjoy, learn about, or be inspired by park resources or values, or
- unreasonably interfere with
    - park programs or activities, or
    - an appropriate use, or
    - the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park.
    - NPS concessioner or contractor operations or services.

In accordance with *Management Policies*, park managers must not allow uses that would cause unacceptable impacts to park resources. To determine if unacceptable impact could occur to the resources and values of Glacier National Park, the impacts of alternatives in this environmental assessment were evaluated based on the above criteria. A determination on unacceptable impacts is made in the Conclusion section for each of the resource topics.

Table 2. Impact thresholds for intensity and duration

Impact Topic	Negligible	Minor	Moderate	Major	Duration
Soils	Soil productivity or soil fertility would not be affected or the effect would be below or at the lower end of detection. Any effects to soil productivity or soil fertility would be slight and not measurable.	The effects to soil productivity or soil fertility would be detectable, but small. The area affected would be local.	The effect to soil productivity or soil fertility would be readily apparent. Effects would result in a change in soils over a relatively wide area or multiple locations.	The effect on soil productivity or soil fertility would be readily apparent and would substantially change the character of soils over a large area.	Short-term: After implementation, would recover in less than 3 years. Long-term: After implementation, would take more than 3 years to recover or effects would be permanent.
Vegetation	Vegetation would not be affected or the changes would be so slight that they would not be of any measurable or perceptible consequence to the species' population.	Some individual native plants would be affected over a relatively small area, but the effects would be localized, and would be of little consequence to the species' population.	Some individual native plants would be affected over a relatively wide area or multiple sites and would be readily noticeable. A sizeable segment of a species' population could be affected.	A considerable effect on native plant populations would occur over a relatively large area.	Short-term- After implementation, would recover in less than 3 years. Long-term- After implementation, would take more than 3 years to recover or effects would be permanent.

Impact Topic	Negligible	Minor	Moderate	Major	Duration
Wildlife and Aquatic Resources	Effects would be at or below the level of detection and the changes would be so slight that they would not be of any measurable or perceptible consequence to the wildlife or aquatic species' population.	Effects on wildlife and aquatic species would be detectable, although the effects would be localize and would be small and of little consequence to the species' population.	Effects on wildlife and aquatic species would be readily detectable and widespread, with consequences at the population level.	Effects on wildlife and aquatic resources would be obvious and would have substantial consequences to species populations in the region.	Short-term: After implementation, would recover in less than 1 year. Long-term: After implementation, would take more than 1 year to recover or effects would be permanent.
Threatened, Endangered, and Species of Concern	The alternative would affect an individual of a listed species or its critical habitat, but he change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population. Negligible effect would equate with a "no effect" determination in U.S. Fish and Wildlife Service terms.	An individual(s) of a listed species or its critical habitat would be affected, but the change would be small. Minor effect would equate with a "may affect, not likely to adversely affect" determination for the species in U.S. Fish and Wildlife Service terms and would require informal consultation.	An individual or population of a listed species, or its critical habitat would be noticeably affected. The effect could have some long-term consequence to individuals, populations, or habitat. Moderate effect would equate with a "may affect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely…" or "not likely to adversely affect" the species and would require either informal or formal consultation.	An individual or population of a listed species, or its critical habitat, would be noticeably affected with a vital consequence to the individual, population, or habitat. Major effect would equate with a "may affect, likely to adversely affect" or "not likely to adversely affect" determination in U.S. Fish and Wildlife Service terms and would require formal consultation.	Short-term—After implementation, would recover in less than 1 year. Long-term— After implementation, would take more than 1 year to recover or effects would be permanent.

Impact Topic	Negligible	Minor	Moderate	Major	Duration
Water Resources	Neither water quality nor hydrology would be affected, or changes would be either non-detectable or if detected, would have effects that would be considered slight and non-measurable.	Changes in water quality or hydrology would be measurable, although the changes would be small and the effects would be localized.	Changes in water quality or hydrology would be measurable but would be noticeable on a widespread scale.	Changes in water quality or hydrology would be readily measurable, would have substantial consequences and would be noticed on a regional scale.	Short-term – After implementation, recovery would take less than 1 year. Long-term – After implementation, recovery would take more than 1 year or effects would be permanent.
Floodplain	Floodplains would not be affected, or changes would be either non-detectable or if detected, would have effects that would be slight and non-measurable. The change would have barely perceptible consequences to riparian habitat function.	Changes in floodplains would be measurable, although the changes would be small and the effects would be localized. The action would affect a few individual plants or wildlife species within an existing riparian area.	Changes in floodplains would be measurable, long term and on a localized scale. Plant and wildlife species within the existing riparian area would experience a measurable effect, but all species would remain indefinitely viable.	Changes in floodplains would be readily measurable and have substantial consequences to floodplain dynamics and would be noticed on a localized scale within the watershed.	Short-term – After implementation, recovery would last less than one year. Long-term – After implementation, recovery would last more than one year

Impact Topic	Negligible	Minor	Moderate	Major	Duration
Visual Resources and Visitor Experience	Visitors would not be affected or changes in visitor experience would be below or at the level of detection. The visitor would not likely be aware of the effects associated with the alternative.	Changes in visitor experience would be detectable, although the changes would be slight. The visitor would be aware of the effects associated with the alternative, but the effects would be slight to visitor experience and changes to the existing viewshed would be slightly perceptible.	Changes in visitor experience would be readily apparent. The visitor would be aware of the effects associated with the alternative and changes to the existing character of the viewshed would be readily apparent.	Changes in visitor experience would be readily apparent and have important consequences. The visitor would be aware of the effects associated with the alternative. Effects would be highly noticeable or would change the character of the viewshed by adding human-made features into a mostly undeveloped area or by removing most human-made features from a developed area.	Short-term - Occurs only during project implementation or one month. Long-term – Occurs for more than one month or is permanent.
Historic Structures and Cultural Landscapes	Impact is at the lowest levels of detection – barely perceptible and not measurable. For purposes of Section 106, the determination of effect would be no adverse effect.	Treatment would affect the character defining features of a National Register of Historic Places eligible or listed resource, but is in accordance with the Secretary of the Interior's Standards. For purposes of Section 106, the finding of effect would be no adverse effect.	Treatment would alter a character defining feature(s) diminishing the integrity of the National Register of Historic Places eligible or listed resource to the extent that it is no longer eligible for listing in the National Register. For purposes of Section 106, the finding of effect would be adverse effect.	The impact would alter a character defining feature(s) of the National Register of Historic Places eligible or listed resource, diminishing the integrity of the resource to the extent that its designation is threatened. For purposes of Section 106, the determination of effect would be adverse effect.	Short-term – Effects extend only through the period of bank stabilization efforts. Long-term – Effects extend beyond the period of bank stabilization efforts.

Impact Topic	Negligible	Minor	Moderate	Major	Duration
Natural Soundscape	There would be no introduction of artificial noise into the park.	A short-term introduction of artificial noise would occur at localized sites. The effect would be readily detectable, but would not adversely affect visitors or wildlife.	A widespread introduction of artificial noise would be readily detectable and would adversely affect nearby visitors and wildlife.	A long-term introduction of artificial noise would occur that would adversely affect visitors and wildlife.	Short-term – Effects extend only through the period of stabilization efforts. Long-term – Effects extend beyond the period of bank stabilization efforts.

Table 3 summarizes the anticipated environmental impacts for each alternative. Only those impact topics that have been carried forward for further analysis are included in this table. Refer to the "Affected Environment and Environmental Consequences" section for further description of the impacts.

Table 3. Summary Comparison of Impacts by Alternative

Impact Topic	Alternative I – No Action	Alternative II – Riprap and Rock Barbs	Alternative III – Riprap Only (preferred)
Soils	Minor, adverse, long-term, site specific	Minor, beneficial and adverse, long-term, site specific	Minor, beneficial and adverse, long-term, site specific
Vegetation	Minor, adverse, long-term, site specific	Minor, beneficial, long-term, site specific	Minor, adverse short-term and beneficial, long-term, site specific
Wildlife and Aquatic Species	Terrestrial wildlife species: negligible; Aquatic species: negligible to minor, beneficial and adverse, short and long-term	Terrestrial species: minor, adverse and short-term; Aquatic species: minor, adverse short-term and beneficial long-term	Terrestrial species: minor, adverse and short-term; Aquatic species: minor, adverse short and long-term
Threatened, Endangered, and Species of Concern	Negligible impacts on grizzly bears, Canada lynx, gray wolves, wolverines, fishers and harlequin ducks; Negligible to minor short and long -term beneficial and adverse impacts on bull trout and westslope cutthroat trout,	Negligible to minor, adverse short-term impacts to gray wolves, grizzly bears and Canada lynx, westslope cutthroat trout, wolverines, and fishers. Negligible to minor, adverse, short-term impacts to bull trout rearing habitat; Negligible impacts to harlequin ducks.	Negligible to minor, adverse short-term impacts to gray wolves, grizzly bears and Canada lynx, westslope cutthroat trout, wolverines, and fishers. Negligible to minor, adverse, short-term impacts to bull trout rearing habitat; Negligible impacts to harlequin ducks.
Water Resources	Minor, adverse short-term impacts, and negligible to minor, beneficial long-term	Moderate, adverse short-term, and minor, beneficial long-term	Minor to moderate, adverse short-term, and minor, beneficial long-term
Floodplains	No more than minor, adverse, long-term, site specific	Minor, adverse, long-term, site specific	Negligible to minor, adverse, long-term, site specific
Visual Resources and Visitor Experience	Minor, adverse, short and long-term	Negligible to minor, adverse short-term and moderate, both adverse and beneficial, long-term	Negligible to minor, adverse short-term and moderate, both adverse and beneficial, long-term
Historic Structures and Cultural Landscapes	Negligible to minor, long-term, site specific, adverse Section 106: No Historic Properties Affected	Minor, long-term, site specific, adverse Section 106: No Adverse Effect	Minor, long-term, site specific, adverse Section 106: No Adverse Effect
Natural Soundscape	No effect, localized	Negligible to minor, short-term adverse and long-term beneficial, and localized	Negligible to minor, short-term adverse and long-term beneficial, and localized

Soils

Affected Environment

Alluvial and wet soils are found immediately adjacent to McDonald Creek. Composition of alluvial soils varies widely, but is generally characterized by coarse textures and unconsolidated coarse fragments from periods of deposition. These soils may support riparian deciduous vegetation, coniferous forest, or transitional shrubs and grasses. The erosion potential is high to moderate (depending on slope) and subject to periodic flooding. Productivity and revegetation potential is low where well-drained coarse soils are present, such as the west side of the creek, and high where finer textured material with high organic matter is present, such as on the east side of the creek. Wet soils are found where the water table is shallow adjacent to McDonald Creek. These soils are rich in organic matter and have loamy to silty textures. Vegetation on wet soils may include sedges, willows, cottonwoods, and other riparian species. Erosion potential is low; productivity and revegetation potential is high on wet soils.

Glacial, landslide and mixed soils formed in glacial deposits contain a mixture of semi-round rock and cobble. These soils are found along the McDonald Creek drainage. Soil textures include silty clay loams, sandy loams, and clay loams. Soils within this group vary widely over short distances due to mixing and landslides. Coniferous forest covers most of these soils. Erosion potential is high when these soils are disturbed due to the loamy and silty surface soil textures and limited rock content. Productivity and revegetation potential varies from low to high depending on soil texture, rock content and water and nutrient holding capacity (Dutton et al. 2001).

Impact Analysis

Methodology

The affected environment for soils is limited to bank site and the area immediately adjacent to it.

Negligible: Soil productivity or soil fertility would not be affected or the effect would be below or at the lower end of detection. Any effects to soil productivity or soil fertility would be slight and not measurable.

Minor: The effects to soil productivity or soil fertility would be detectable, but small. The area affected would be local.

Moderate: The effect to soil productivity or soil fertility would be readily apparent. Effects would result in a change in soils over a relatively wide area or multiple locations.

Major: The effect on soil productivity or soil fertility would be readily apparent and would substantially change the character of soils over a large area.

Short-term: After implementation, would recover in less than 3 years.

Long-term: After implementation, would take more than 3 years to recover or effects would be permanent.

Impact Analysis of Alternative I – No Action

Soils in the project area would continue to be susceptible to further erosion and slumping. To some extent, this is a result of natural processes associated with natural stream movements and flood events. The park is committed to the preservation of the historic GTSR, and as a result, the park cannot allow McDonald Creek to function entirely unimpeded where it threatens stability of the road. For this reason, it is desirable to maintain the soils in place along this bank, even though erosion events might be natural in some cases.

The park would continue to implement temporary measures to prevent bank undermining in this location. There is no guarantee that the soil nails and erosion netting could entirely protect the bank's stability during high water events. Soils would remain at risk for slumping, erosion, and being carried down stream. Because it is our objective to maintain the soils in place at this location, further erosion would be considered a minor (due to the small area involved), adverse, long-term impact. Soil losses could be repaired to improve road stability, but the natural soil characteristics would take many years to regenerate.

Cumulative Impacts of Alternative I – No Action

Past, on-going, and future actions that have had or might have impact on soils include utilization of Logan Pit as a staging and stockpiling site, emergency road repairs at Haystack Creek, MP 23.3 and MP 33.23, as well as general maintenance and mitigation for, and rehabilitation of, the GTSR, and addressing flood potential at Logan Creek Bridge. It is possible that global climate change could increase the frequency of winter rain on snow events and the potential for future floods throughout the northwest, including Glacier National Park. There is inconclusive evidence as to whether the rapid extent of global climate change is a natural occurrence or human caused but computer generated weather models indicate global warming is occurring (IPCC 2007). These activities have and might result in soil compaction, loss, fertility degradation, and disturbance in a number of locations. Because some sites are relatively large, such as Logan Pit, the combined impact on soil resources of the no action alternative in combination with past, on-going, and future activities would be moderate, adverse, and long-term.

Conclusion

There would be little direct effect on soils resulting from the no action alternative, but the potential for indirect impacts from erosion and soil loss within the project area exists due to lack of adequate protection for the bank. While the impacts of this alternative would be minor in scope, the cumulative impact on soil resources in conjunction with past, present, and future activities would be moderate, adverse, and long-term.

Because the no action alternative would not result in major adverse impacts to soil resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park soil resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Impact Analysis of Alternative II

Under Alternative II, the soil would be armored in place and buried under Class VI and VII riprap. In order to key in the riprap, soil would be excavated over the entire area of bank erosion and extend 50 feet up and down stream. The stone riprap and vegetation used to armor the bank would effectively stabilize the bank and prevent further loss of soil at this site. Soil disturbance along with vegetation, litter and top soil removal and the riprap would decrease the natural condition of the site and would have an adverse impact to soil resources. Once established, the vegetation would contribute to improved soil fertility near the road shoulder and along the bank. Because the park's objective is to maintain the stream bank at this location, these treatments would result in a minor, beneficial and adverse, long-term impact on the soil resource at this location.

Cumulative Impacts of Alternative II

The cumulative impacts of Alternative II would be the same as those described for Alternative I.

Conclusion

Alternative II would both directly and indirectly protect the soil resource from further erosion

in this localized area. This minor benefit, in combination with all past, present, and future activities in the lake McDonald Valley would result in cumulative impacts to soil resources that over-all would be moderate, adverse, and long-term.

Because Alternative II would not result in major adverse impacts to soil resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park soil resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III – THE PREFERRED

In Alternative III, riprap would be installed to protect the bank, both upstream and downstream of the area proposed in Alternatives II. Riprap would be placed over some areas that are currently vegetated which would destroy the present vegetation. This would serve the purpose of protecting the soil bank from further erosion and slumping but it would reduce soil fertility and function over a larger area than the other two action alternatives. Though the area of impact would be larger than the other alternatives, it would not be large enough to exceed minor impacts to soil resources. The riprap would hold the remaining soil in place reducing additional impacts and would prevent future stabilization needs which might require auxiliary soil compaction in the project area. Action proposed in this alternative would result in both beneficial and adverse, minor, long-term impacts on soil resources in the project area.

Cumulative Impacts of Alternative III

Cumulative soil impacts of Alternative III would be similar as those described for Alternative I.

Conclusion

Alternative III would result in direct beneficial impacts by protecting the soil from erosion and indirect impacts of reduced soil fertility due to reduced vegetative cover. The effects of Alternative III in combination with all past, present, and future activities in the Lake McDonald Valley would result in cumulative impacts to soil resources that over-all would be moderate, adverse, and long-term.

Because Alternative III would not result in major adverse impacts to soil resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park soil resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Vegetation

AFFECTED ENVIRONMENT

Within the vicinity of the project area along McDonald Creek, riparian vegetation is present. Common riparian forest trees include western red cedar, Engelmann spruce, and subalpine fir with black cottonwood and paper birch in the overstory. Understory plants include mountain maple, snowberry, red-osier dogwood, alder, willow, serviceberry, kinnikinnick, sedges, goldenrod and mosses. The herbaceous understory is currently sparse due to recent slumping of the bank. Species that might be expected in a less disturbed situation would include thimbleberry, spirea, wild rose, twinflower, bunchberry, prince's pine, queencup beadlily, fairy bells, sarsaparilla, bedstraw, oakfern, starry false Solomon's seal, foam flower, trillium, and violets. Some non-native species are present along the road shoulder, in particular the noxious

weed, spotted knapweed.

IMPACT ANALYSIS

METHODOLOGY

The methodology used to analyze the potential impacts on vegetation is an analysis of expected changes to the vegetation under the different alternatives. Changes in surface disturbance and vegetation productivity are assessed. The affected environment for vegetation is limited to the bank site and the areas immediately adjacent.

Negligible: Vegetation would not be affected or the changes would be so slight that they would not be of any measurable or perceptible consequence to the species' population.

Minor: Some individual native plants would be affected over a relatively small area, but the effects would be localized, and would be of little consequence to the species' population.

Moderate: Some individual native plants would be affected over a relatively wide area or multiple sites and would be readily noticeable. A sizeable segment of a species' population could be affected.

Major: A considerable effect on native plant populations would occur over a relatively large area.

Short-term: After implementation, would recover in less than 3 years.

Long-term: After implementation, would take more than 3 years to recover or effects would be permanent.

IMPACT ANALYSIS OF ALTERNATIVE I - NO ACTION

Under the no action alternative, some natural regeneration of vegetation on the slumped area is possible, but due to the steep nature of the slope, recovery would be extremely slow. The jersey barriers and paved widening east of the road would also preclude vegetation establishment along the road shoulders. If soil must be imported to mitigate for future slumping, the potential for introduction of non-native plants would be increased. Overall, anticipated impacts on vegetation from the no action alternative would be minor, adverse, and long-term.

Cumulative Impacts of Alternative I – No Action

Past, on-going, and future actions that have had or might have impact on vegetation include utilization of Logan Pit as a staging and stockpiling site, emergency road repairs at haystack, MP 23.3.and MP 33.23, as well as general maintenance and mitigation for and rehabilitation of the GTSR, and addressing flood potential at Logan Creek Bridge. These activities have and might result in loss of vegetation, degradation of soil quality, which affects vegetation, introduction of weed propagules, and disturbance which facilitates weed spread. The likelihood of additional slope failure prior to vegetation establishment would be fairly high. There would also be a high probability of additional slope failure up and downstream from the current slope that would result in additional vegetation loss. The combined impact on vegetation resources of the no action alternative in combination with past, on-going, and future activities would be minor, adverse, and long-term.

Conclusion

The no action alternative combined with past, on-going, and future actions would cause direct loss of vegetation and introduction of weed propagules. Indirectly, vegetation could be impacted by degradation in soil quality and disturbance which creates opportunities for weed invasion. The overall impacts of the no action alternative on vegetation resources would be minor, adverse, and long-term.

Because the no action alternative would not result in major adverse impacts to vegetation resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park vegetation resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE II

Under Alternative II, there would be a delayed response, if not permanent loss, of vegetation along the bank where riprap is installed, an adverse impact. Above the high water line, stone riprap would be used to armor the bank, and cottonwood or dogwood bundles and other vegetation would be planted to help with the soil stabilization process. These actions could help prevent additional slumping of soil and loss of vegetation up and downstream from the project area. These impacts would be beneficial. The result would be a minor, beneficial, long-term impact to vegetation.

Cumulative Impacts of Alternative II

Cumulative impacts to vegetation of Alternative II would be similar as those described in Alternative I but the addition of vegetation during restoration efforts would eventually lead to beneficial impacts to vegetation resources.

Conclusion

A combination of beneficial and adverse impacts would result both directly and indirectly from the proposed action in combination with past, on-going, and future actions. The overall cumulative impact on vegetation resources within the Lake McDonald Valley would be minor, adverse, and long-term due mainly to the extent of disturbance and weed vectors found at the Logan Pit staging and stockpiling area. This alternative would provide mitigation for some vegetation loss.

Because Alternative II would not result in major adverse impacts to vegetation resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park vegetation resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III – THE PREFERRED

The area in which riprap would be installed along the bank would be roughly three times that proposed in Alternatives II. A larger area of vegetation would be removed, resulting in delayed vegetation growth or permanent loss over a greater area than alternative II. Otherwise the impacts would be most similar to Alternative II. Further vegetation and soil slumping would not be expected beyond the project area. Because of the increase in area of vegetation loss, the impacts of Alternative III are expected to be minor, adverse, short-term impacts and beneficial, long-term impacts.

Cumulative Impacts of Alternative III

Cumulative impacts to vegetation of Alternative III would be similar as those described in Alternative II but area of impact would be larger than the alternative, though not large enough to exceed minor impacts to vegetation resources.

Conclusion

A combination of beneficial and adverse impacts would result both directly and indirectly from

Alternative III in combination with past, on-going, and future actions. The overall cumulative impact on vegetation resources within the Lake McDonald Valley would be minor, adverse, and long-term.

Because Alternative III would not result in major adverse impacts to vegetation resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park vegetation resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Wildlife and Aquatic Species

Affected Environment

Over 300 species of terrestrial wildlife occupy Glacier National Park either seasonally or year-round, and an unknown number of aquatic species inhabit park waters. The McDonald Valley, which extends from the southern end of Lake McDonald to Flattop Mountain between the Lewis and Livingston Ranges, provides a diversity of year-round habitats valuable for wildlife. Of particular interest to many species of wildlife are riparian areas, travel corridors, avalanche chutes, shrublands, meadows, bogs, snags, burns, aspen parklands, old-growth forests, floodplains, mineral licks, birthing areas, hibernacula, den sites, roosts, caves, and cliffs. Mammal species include red squirrels, Columbian ground squirrels, red-tailed chipmunks, moose, elk, mule and white-tail deer, black and grizzly bear, cougar, lynx, fisher, wolverine, marten, and long-tailed weasels; seven of the eight species of reptiles and amphibians that occur in the park are found in the McDonald Valley. The McDonald Valley also contains nesting habitat for bald eagles, golden eagles, osprey, pileated woodpeckers, and barred owls. Biannual raptor migration is a significant event in the park. In the McDonald Valley over 3,000 raptors, primarily golden eagles, were observed from a single location in 1996 (Yates et al. 2001). There are three golden eagle (*Aquila chrysaetos*) nest sites on the cliffs along the upper McDonald Creek corridor at Crystal Point, Red Rocks, and Avalanche Creek, with nesting territories encompassing the project area. The golden eagle nesting period occurs between April and September, with most chicks fledging by early to mid August. Fledglings remain in the area for another few weeks and are still dependent upon adult eagles for food. Resident adult and young golden eagles forage in the project area. Other raptor species likely nesting in the area includes the red-tailed hawk, northern goshawk, Cooper's hawk, osprey and northern pygmy owl. During spring and fall migration, some of the thousands of golden and bald eagles (as well as a wide variety of other diurnal raptors) that fly over the upper McDonald Valley near the project area might pause to forage on carrion or prey on fish or small mammals.

Moose and elk, primarily adult males, spend most of the winter near the project site. Both species make seasonal movements through the McDonald Valley, with calving occurring during May and June. Mountain goats are year-round residents on the Garden Wall east of the project.

Presently, the streams and lakes along the GTSR corridor west of the Continental Divide support 11 known native fish species including: westslope cutthroat trout, bull trout, mountain whitefish, pygmy whitefish, redside shiner, peamouth, northern pike minnow, longnose sucker, largescale sucker, slimy sculpin, and shorthead sculpin. Five non-native fish species are still present west of the Continental Divide in the park: rainbow trout, eastern brook trout, kokanee salmon, lake whitefish, and lake trout.

In addition to the fisheries (see section on TES and species of concern for bull trout and westslope cutthroat trout discussion), aquatic insects were collected in Upper McDonald Creek in 1978 by the USFWS and reported in "Fishery Investigations Glacier National Park 1980

Progress Report". The report identified 28 total taxa in 4 Orders: Plecoptera (stoneflies), Ephemeroptera (mayflies), Trichoptera (caddisflies), and Diptera (true flies).

Tailed frogs *(Ascaphus truei)* are also present and known to inhabit cold, high gradient streams in the Middle Fork Flathead River watershed, including the McDonald Creek drainage (Marnell 1997). In general, aquatic species and species found in the hyporheic zone are not well known throughout the park.

IMPACT ANALYSIS

METHODOLOGY

The methodology used to analyze the potential impacts on wildlife is an analysis of expected changes to wildlife under the different alternatives that is or would be present in the project area. Glacier National Park wildlife databases and current research or monitoring were used to determine wildlife habitat and use in the project area. Changes in behavior, movement patterns, and disturbance are assessed. The following levels of impacts were defined.

Negligible: Effects would be at or below the level of detection and the changes would be so slight that they would not be of any measurable or perceptible consequence to the wildlife and aquatic species' population.

Minor: Effects on wildlife and aquatic species would be detectable, although the effects would be local; would be small and of little consequence to the species' population.

Moderate: Effects on wildlife and aquatic species would be readily detectable and widespread, with consequences at the population level.

Major: Effects on wildlife and aquatic species would be obvious and would have substantial consequences to wildlife populations in the region.

Short-term: After implementation, would recover in less than 1 year.

Long-term: After implementation, would take more than 1 year to recover or effects would be permanent.

IMPACT ANALYSIS OF ALTERNATIVE I – NO ACTION

Terrestrial wildlife impacts of the no action alternative would be negligible since there would be no instream work and little activity in this area of the road in addition to routine road maintenance activities.

The no action alternative would have negligible to minor, beneficial and adverse, short and long-term impacts to aquatic wildlife. The current situation is having minimal impacts on aquatic resources in McDonald Creek. In the absence of the GTSR, this area would likely go untreated. Slides are sources of large wood debris recruitment to stream channels. Wood debris provides fish habitat, stores and sorts sediment and provides organic input to the channel. This organic input is important in streams with relatively low productivity, such as many of the streams on the west side of GNP. Extreme contributions of fine and coarse sediment might impair biological and physical functions of stream channels, but this slide is relatively small and localized. If left untreated, fine sediment contribution from this area would not have a measurable impact on aquatic resource production due to the large, relatively undisturbed watershed area located upstream of the site.

Cumulative Impacts of the No Action Alternative

Cumulative impacts considered include recently completed emergency stabilization at MP 23.3 and 33.23, as well as ongoing stream work at the Logan Creek Bridge and continued use at

Logan Pit. Ongoing rehabilitation and maintenance of the GTSR, future emergency stabilization and maintenance on McDonald Creek are also considered.

There are other sediment sources contributing both fine and coarse sediment to McDonald Creek, but stream survey data is not available to quantify these levels. From a cumulative effects standpoint, it is not likely that fine sediment is limiting aquatic species production in upper McDonald Creek. Continued additional fine sediment from the slide area is likely to have a minimal impact on aquatic resources in upper McDonald Creek due to the size of the slide relative to the size of the drainage. However, it is readily apparent that Logan Creek, located upstream of the slide area is contributing large amounts of coarse bedload to McDonald Creek. McDonald Creek is currently having difficulty routing the excessive sediment supply from Logan Creek, as evidenced by mid-channel bars and channel braiding in McDonald Creek downstream from Logan Creek. McDonald Creek appears to have aggraded immediately downstream of Logan Creek, due to excess sediment input from Logan Creek. This excess coarse sediment supply can potentially adversely impact the ability of the channel to form and maintain pool habitat, an important habitat feature for aquatic species in McDonald Creek. The additional coarse sediment input from the slide area is only likely to have minor cumulative effects on aquatic resources due to the relatively small size of the slide area, and existing upstream coarse sediment sources.

Emergency bank stabilization in the form of riprap might also occur. Previously installed riprap exists along the McDonald Creek, upstream of Lake McDonald. Cumulative effects of riprap on aquatic species are not well studied or evaluated in that area (Schmetterling et al. 2001a). Long-term impacts to aquatic species can stem from habitat alteration associated with replacing natural bank materials, such as riparian tree species, with large rock. Actions proposed in this alternative, combined with past, ongoing, and future actions, would result in minor, adverse short and long-term impacts to aquatic species.

Cumulative impacts to terrestrial wildlife from the no action alternative would be negligible to moderate short to possibly long-term since construction activity could occur at any time during the year and ensue for an indeterminable amount of time in addition to routine road maintenance activities, or past, on-going, and future actions.

Conclusion

By allowing McDonald Creek to function in a semi-natural state, aquatic species would experience negligible to minor, beneficial and adverse, short and long-term impacts. Terrestrial wildlife species would experience negligible to moderate, adverse short and possibly long-term impacts at the project site since there would be minimal construction activity. The no action alternative combined with past, on-going and future actions would result in minor, adverse short and long-term impacts to aquatic resources due to habitat alterations and the chance of additional sediments sources. Terrestrial wildlife species would incur negligible to moderate, adverse short and possibly long-term cumulative impacts. Cumulative impacts to wildlife from the No Action alternative would be negligible to moderate short to possibly long-term since construction activity could occur at any time during the year and ensue for an indeterminable amount of time in addition to routine road maintenance activities, or past, on-going, and future actions.

Because the no action alternative would not result in major adverse impacts to wildlife and aquatic resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park wildlife and aquatic resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS

Management Policies 2006.

IMPACT ANALYSIS OF ALTERNATIVE II

Impacts of this alternative on terrestrial wildlife species would be minor since the work would be accomplished during a less sensitive period of the year for most species (autumn and winter when nesting and natal periods have concluded and most migrant bird species will have departed), and would be limited to a relatively small area. If work persists well into winter, impacts might increase for moose, elk, mule deer, or white-tailed deer that might be limited to valley areas near the creek and road and other secretive species, especially carnivores, found in this environment. During late winter, animals are already stressed by physiological and environmental factors. Human caused displacement of these animals from their traditional winter ranges would cause them to use their depleted or depleting energy reserves; decreasing their chance for survival. Work at any time would have some impact on species like mink or dippers that live in or near aquatic habitats; displacement would be for the duration of the project during work periods. And negligible impacts to golden eagles as some migrants might pause to forage on carrion in the area but are not continually present. Actions proposed in this alternative would have minor, adverse short-term impacts on wildlife species.

Disturbance associated with actions proposed under this alternative would generate excess sediment (see water quality section). Additional sediment would increase turbidity and might cause reduced dissolved oxygen levels and block sun light. It is likely that aquatic species populations are currently controlled by stream productivity in McDonald Creek, and perhaps by over-winter habitat conditions. It is likely that this alternative would not have any more than minor impacts on aquatic resources and aquatic habitat in upper McDonald Creek. Actions proposed in this alternative would have minor, adverse short-term and beneficial long-term impacts on aquatic species.

Cumulative Impacts of Alternative II

Cumulative impacts considered include recently completed emergency stabilization at MP 23.3 and 33.23, as well as ongoing repairs to the Logan Creek Bridge. Ongoing rehabilitation and maintenance, future emergency stabilization and maintenance on McDonald Creek are also considered.

GTSR parallels McDonald Creek above the falls for approximately half of its stream length. The upper watershed remains largely unroaded except for GTSR and a few minor spur roads. Riprap and rock barbs would be replacing woody vegetation that would naturally be found at the site on the stream banks until the willows matured, thus delaying periodically recruitment of large woody debris to the stream channel. This might result in lower productivity due to reduced allochthonous input, as well as localized reduced habitat diversity and quality. Any potential for undercut banks to provide fish habitat would be eliminated from the riprap area. However, given the size of the impact area relative to the size of the drainage, the impact to productivity and fish habitat is likely to be minor on populations of aquatic species. In addition, qualitative assessment of the stream channel reveals large rock as a regular structural component of the McDonald Creek stream channel. The barbs would provide some fish habitat in the form of eddy's behind the barbs, and the interstitial spaces in the riprap would provide habitat for juvenile salmonids. However, the habitat provided by the rock barbs and riprap would lack the complexity and diversity that natural wood provides. Actions proposed in this alternative, combined with past, ongoing, and future actions, would result in minor, adverse short-term and minor, beneficial and adverse long-term impacts to aquatic species.

The cumulative impacts on terrestrial wildlife species would be minor adverse short-term due to the relatively small area affected and duration of the project.

Conclusion

Disturbance associated with actions proposed under this alternative would generate excess sediment (see water quality section). It is likely that aquatic species populations are currently controlled by stream productivity in McDonald Creek, and perhaps by over-winter habitat conditions. Actions proposed in this alternative would have minor, adverse short-term and beneficial long-term impacts on aquatic resources. Impacts to terrestrial wildlife species would be minor since work would be accomplished during less sensitive periods of the year for most species. However, if construction activities persist into the winter, impacts to wildlife in the valley would increase. Actions proposed in this alternative combined with past, ongoing, and future actions would result in minor, adverse short-term and minor, beneficial and adverse long-term impacts to aquatic resources and minor short-term impacts to terrestrial wildlife species.

Because the Preferred Alternative would not result in major adverse impacts to wildlife and aquatic resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park wildlife and aquatic resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III – THE PREFERRED

Impacts of Alternative III on terrestrial wildlife species would be the same as described in Alternative II.

This alternative would have minor, adverse short and long-term impacts on aquatic resources because it would require additional conversion (approximately 300 feet) of streambank from native woody vegetation to rock riprap, and therefore has a larger footprint along the stream bank. The degree of physical disturbance to the site would be a similar or slightly higher than Alternatives II. The primary short-term impacts would include temporary increases in channel turbidity associated with excavating the channel bed for installation of the rock riprap toe. These impacts are anticipated to be short in duration, and anticipate clear water refugia in the near bank area downstream of Avalanche Creek. This alternative would have minor short-term impacts to fish feeding or behavior from the project. It is likely that fish populations and other aquatic populations are controlled by stream productivity in McDonald Creek, and perhaps by over-winter habitat conditions.

Cumulative Impacts of Alternative III

Cumulative impacts considered include recently completed emergency stabilization at MP 23.3 and 33.23, as well as ongoing repairs to the Logan Creek Bridge. Ongoing rehabilitation and maintenance, future emergency stabilization and maintenance on McDonald Creek are also considered.

Existing and future riprap along McDonald Creek has the potential to reduce overall stream channel complexity/diversity in the system. Rock riprap would be replacing woody vegetation that would naturally be found at the system, and periodic recruitment of large woody debris into the stream channel would decrease. This might result in lower productivity due to reduced allochthonous input, as well as localized reduced habitat diversity and quality. Any potential for undercut banks to provide fish habitat would be eliminated at bank stabilization locations, however a qualitative assessment of the stream channel reveals large rock as a regular structural component of the upper McDonald Creek stream channel.

However, most of the McDonald Creek drainage is immediately adjacent to GTSR. Considering the size of the drainage relative to the size of the project site, any cumulative impacts to aquatic

resources from this alternative would likely be minor, adverse short-term and beneficial long-term impacts to aquatic resources. Cumulative impacts on wildlife species would be the same as described in Alternative II.

Conclusion

Both direct and cumulative impacts to wildlife and aquatic species would be the same for Alternative III as described for Alternative II.

Because Alternative III would not result in major adverse impacts to wildlife and aquatic resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park wildlife and aquatic resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Federally Threatened, Endangered, and State Listed Species of Concern

Affected Environment

Three of the five threatened species (Grizzly bear, Canada lynx, and bull trout (critical habitat) and one endangered species (gray wolf) listed by the U.S. Fish and Wildlife Service (FWS) in Glacier National Park make use of the project area. Gray wolves (*Canis lupus*), a federally listed endangered species (as of July 28, 2008; status pending litigation), are not known to occupy the Going-to-the-Sun Road corridor, but their principle prey winter in the vicinity of the project area. The threatened grizzly bear (*Ursus arctos horribilis*) has been documented within the project area and the threatened Canada lynx (*Lynx canadensis*) has been documented in the Granite park area, approximately 3 miles (5 km) from the project area and likely travels through or forages near the site. The threatened bull trout (*Salvelinus confluentus*) has not been found near the project area but McDonald Creek contains bull trout rearing habitat near the mouth at Lake McDonald.

Gray Wolf

Gray Wolves (*Canis Lupus*) are wide-ranging and their distribution is tied primarily to that of their principal prey (deer, elk and moose). Important components of wolf habitat are 1) a sufficient, year-round prey base of ungulates and alternate prey; 2) suitable and somewhat secluded denning and rendezvous sites; and 3) sufficient space with minimal exposure to humans (USFWS 1987). Low elevation river bottoms that are relatively free from human influence provide important winter range for ungulates and wolves. Wolves are especially sensitive to disturbance from humans at den and rendezvous sites. Pups are born in late March to early May and remain near the den through most of the summer (USFWS 1987). Human activity near den sites can lead to pack displacement or physiological stress perhaps resulting in reproductive failure or pup mortality (Mech et al. 1991). Rendezvous sites are resting and gathering areas occupied by wolf packs during summer and early fall after the natal den is abandoned. Indirectly, wolves support a wide variety of other species; common ravens, eagles, coyotes, wolverines, mountain lions, and bears feed on the remains of animals killed by wolves. As apex predators, wolves also help regulate the populations of their prey ensuring healthy ecosystems and greater biodiversity (Terborgh 1988, Ripple and Beschta 2003, Hebblewhite et al. 2005).

The population dynamics of recolonizing wolves are extremely variable. Inadequate prey densities and a high level of human persecution are the two most important factors that can limit

wolf distribution and prevent a complete recovery of wolf populations in the Northern Rocky Mountains (USFWS 1987). GNP's predominantly natural landscape contains some of the most secure and productive wolf habitat in the western part of its range. Despite fluctuating wolf numbers since 1986, the Park's established wolf population continues to serve as a source for natural recolonization in northwest Montana and southern Canada (Boyd-Heger 1997).

Management and recovery of wolves in the Northwest Montana Recovery Zone, of which Glacier National Park is a part, is directed by the *Northern Rocky Mountain Gray Wolf Recovery Plan* (USFWS 1987). Glacier National Park's predominately-natural landscape contains some of the most secure and productive wolf habitat in the Northwest Montana Recovery Zone. Despite fluctuating wolf numbers since 1986, Glacier's established wolf population continues to serve as a source for natural recolonization in northwest Montana and southern Canada (Boyd-Heger 1997). Wolves have been reported along every major drainage in the park during recent years including the McDonald Creek drainage (NPS files).

Grizzly Bear

Grizzly bear habitat is found throughout the park and ranges from the lowest valley bottoms to the summits of the highest peaks. Grizzly bears require large areas of undeveloped habitat (including a mixture of forests, moist meadows, grasslands, and riparian habitats) and have home ranges of 130 to 1,300 square kilometers. (Claar et al. 1999). A radio-collared female grizzly, with cubs, was documented using 220 square kilometers as a home range in 1998 and 1999 in the McDonald Valley of Glacier National Park (NPS files). Grizzly bear seasonal movements and habitat use are tied to the availability of different food sources.

In spring, grizzly bears feed on dead ungulates and early greening herbaceous vegetation at lower elevations (Martinka 1972). During the summer, some bears move to higher elevations in search of glacier lilies and other roots, berries, and army cutworm moths (*Euxoa auxiliaris*). During the huckleberry (*Vaccinium* sp.) season (late summer and fall), bears often concentrate in the Apgar Mountains, Belton Hills, Snyder Ridge, the Many Glacier Valley, the Two Medicine Valley, and other areas. Avalanche chutes provide an important source of herbaceous forage for grizzly bears in the early summer and fall (Mace and Waller 1997). During the winter, grizzly bears hibernate in dens away from human disturbance, typically at higher elevations on steep slopes where wind and topography cause an accumulation of deep snow. The denning season in the western portion of the NCDE usually begins in early October, and females might linger near dens until late May (Mace and Waller 1997). Den entry in the Swan Mountains occurred from mid October to mid December.

In addition to diverse foraging habitat, grizzly bears require natural habitat that provides connectivity, or travel corridors, between foraging sites. Examples of these types of travel corridors are found at the foot and head of lakes in the McDonald, Two Medicine, and Many Glacier Valleys. Grizzlies also require a substantial amount of solitude from human interactions (USFWS 1993).

Research-based habitat modeling shows that the entire upper McDonald Creek riparian corridor contains high value grizzly bear foraging habitat during the spring and early summer (until mid-July). During late summer and autumn (after mid-July), portions of the corridor continue to contain high value grizzly bear foraging habitat from Logan Creek to Packer's Roost and the West Tunnel. Grizzly bear breeding season occurs from May 1 until July 1. Breeding bears are likely to be moving through the upper McDonald Creek corridor during this time. Early morning, evening, and night are especially critical times for grizzly bears to travel or forage in the corridor as visitor traffic on the Going-to-the-Sun Road is considerably lower than during the main part of the day. Bears are less likely to be disturbed, displaced, human habituated or injured by moving vehicles during these critical times.

Canada Lynx

In April 2000, Canada lynx was listed as a threatened species in the coterminous United States. The U.S. Fish and Wildlife Service concluded that the population was threatened by human alteration of forests, low numbers as a result of past overexploitation, expansion of the range of competitors, and elevated levels of human access into lynx habitat. To date, critical habitat for the species has not been designated or proposed (USDA/USDI 2000).

Canada lynx (lynx) habitat generally is described as climax boreal forest with a dense undercover of thickets and windfalls (Ruediger et al. 2000). Advanced successional stages of forests and dense conifer stands often are preferred habitats of lynx for denning and foraging respectively. Lynx generally forage in young conifer forests especially where their primary prey, snowshoe hare (*Lepus americanus*), is abundant. Other prey includes squirrels, grouse, martens, and voles; though snowshoe hares consistently comprise the preponderance of lynx diet. They also forage in dense, multi-storied mature conifer forest, especially during winter. Travel corridors are thought to be an important factor in lynx habitat because of their large and variable home ranges, generally 8-738 square kilometers (Ruediger et al. 2000). Lynx are most susceptible to disturbance during the denning period and while newborns are developing (May–August) (Claar et al. 1999).

Historically, lynx were considered "more or less common" throughout the park (Bailey and Bailey 1918). Documented sightings declined during the 1970s and 1980s but have increased in recent years (NPS files); however, sightings might not be particularly sensitive to population changes and should be interpreted with caution.

Although no lynx den sites have been documented in the park, lynx family groups have been observed through remote camera stations and winter tracking indicating resident lynx population in the Many Glacier, Two Medicine, North Fork and Middle Fork Valleys and elsewhere on the east side of the Continental Divide. Den sites, in other regions, have been documented in older regeneration stands and mature coniferous and mixed-coniferous stands with the requisite component of coarse woody debris that provide thermal and hiding cover for kittens (Ruediger et al. 2000).

Bull Trout

Bull trout have not been observed in the waters above the waterfalls on McDonald Creek, and no critical habitat exists for bull trout in this area. The nearest critical habitat for bull trout is located approximately 8 km downstream of the project area, in the lower approximately 400 meters of McDonald Creek (between the lake inlet and the falls). Occasional use of lower McDonald Creek below the falls by bull trout probably occurs, but has not been documented in recent surveys and habitat for spawning and rearing appears marginally suitable (Wade Fredenberg, USFWS, personal communication). Both juvenile and adult bull trout have been captured further downstream, in Lake McDonald itself (Fredenberg 2000, Glacier National Park, unpublished data).

Bull trout exhibit three distinct life-history forms – resident, fluvial, and adfluvial. Resident bull trout spend their entire lives in small tributaries, whereas fluvial and adfluvial forms hatch in small tributary streams then migrate into larger rivers (fluvial) or lakes (adfluvial). Migratory adult bull trout generally move upstream to spawning or staging areas from May through July, although some fish wait until the peak spawning time of September and October before entering spawning streams (Fraley and Shepard 1989; Schill et al. 1994; Downs and Jakubowski 2006). Spawning typically occurs in third and fourth order streams between late August and early November (USFWS 1998), but more commonly in September and October in the Flathead Lake system (Block 1953; Fraley and Shepard 1989). Eggs over-winter in spawning streams until the following spring, when newly hatched fry emerge from the gravel. Age-0 bull trout can often be found in side-channels and along channel margins following emergence (Fraley and Shepard 1989). Adfluvial juvenile bull trout typically migrate out of natal streams between the ages of 1

and 5, and outmigration of juveniles occurs in two pulses in some systems, one in the spring and another in late fall (Downs et al. 2006). Age-0 outmigrants have been reported in some adfluvial populations, but these outmigrants do not appear to survive well to adulthood (Downs et al. 2006).

Bull trout egg incubation success has been inversely correlated to increasing levels of fine sediment (<6.35 mm diameter) in spawning nests (redds) (Montana Bull Trout Scientific Group 1998). Spawning site selection has been related to areas of strong intragravel flow exchange (both upwelling and downwelling) (Baxter and Hauer 2000). Juvenile bull trout abundance has been positively correlated with low summer maximum water temperatures (below 14^0C) and with the number of pocket pools in stream reaches (Saffel and Scarnecchia 1995). Unembedded cobble substrate is an important overwinter habitat type for juvenile bull trout (Thurow 1997; Bonneau and Scarnecchia 1998). Excess fine sediment holds the potential not only to reduce egg and embryo survival, but might also limit juvenile bull trout abundance in streams by reducing the amount of interstitial spaces available for overwinter habitat. Channel stability, habitat complexity, and connectivity are all important components in bull trout population persistence (Rieman and McIntyre 1993).

Bull trout have experienced substantial population declines in Lake McDonald, as well as in most of the large lakes on the west side of Glacier National Park. This decline has been attributed to an increasing abundance of lake trout *(Salvelinus namaycush)* in the system (Fredenberg 2002). Non-native brook trout (*S. fontinalis)* are also present in the Lake McDonald system and have the potential to hybridize with adult, and compete with juvenile bull trout, but to date, no spawning areas for bull trout have been documented in the Lake McDonald system.

Recent evaluation of genetic relationships suggests a high degree of population structuring between bull trout populations in waters on the west side of Glacier National Park. Lake McDonald was most similar to Kintla Lake, as well as tributaries to the N. Fk. Flathead River known to be used primarily by bull trout migrating from Flathead Lake (Meeuwig et al. 2007). The data suggests a greater degree of genetic exchange between these populations than other populations in the system.

Species of Concern. State listed species of concern to Glacier National Park are those species that are rare, endemic, disjunctive, vulnerable to extirpation, in need of further research, or likely to become threatened or endangered if limiting factors are not reversed. Likewise, a species may be of concern because of characteristics that make them particularly sensitive to human activities or natural events. In addition, species of concern may also include big game, upland game birds, waterfowl, carnivores, predators, and furbearers whose populations are protected in the park but subject to hunting and trapping outside of the park.

Upper McDonald Creek, above the inlet of Lake McDonald, has been identified as the single most important **harlequin duck** (*Histrionicus histrionicus*) breeding stream in Montana with about 10 to 20 nesting pairs, annual production for the eight mile section form Lake McDonald to Logan Creek varying between two and over 40 young harlequins. Twenty-six juveniles were recorded during surveys in 2007. The harlequin duck is listed as a Montana “Species of Concern” and a US-Forest Service and Bureau of Land Management “Sensitive” species. Breeding pairs inhabit Upper McDonald Creek from late April through early mid-June and brood during July, August and early September. Females and juveniles generally leave the area in September. Harlequins are most likely to be disturbed by construction noise and activity especially in areas in or near McDonald Creek. Research and monitoring indicates that harlequin ducks are sensitive to human disturbance, especially during breeding and brood-rearing seasons as they can be displaced from important foraging sites thus potentially reducing the production and survival of their young.

Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) is listed as a Montana "Species of Concern" and a sensitive species by U.S. Forest Service and Bureau of Land Management. Westslope cutthroat (WCT) in the Flathead drainage might be adfluvial, fluvial, or resident. Adfluvial fish occupy lakes (e.g. Lake McDonald) and spawn in tributaries (e.g. Fish Creek, a tributary to Lake McDonald). Fluvial fish reside in rivers or large streams and utilize tributaries for spawning and rearing. All three life history forms might occur in the Lake McDonald basin. Headwater reaches of large river basins, like the Flathead, are typically dominated by resident and fluvial forms, but tributaries to lakes support adfluvial fish using the these habitats for rearing as well. WCT have evolved in the cold, low-productivity waters of the park, and as such, are particularly well adapted to their habitat.

Mature adfluvial fish move into tributaries in the spring, with spawning occurring in May and June (Shepard et al. 1984). Spawning has been observed in the Blackfoot River drainage occurring as peak flows subside, on the descending limb of the hydrograph (Schmetterling 2001). They typically spawn at age four or five, from March to July at water temperatures near 10^0C (Shepard et al. 1984). Resident fish complete their life history in tributaries and seldom exceed 300 mm in length. Resident westslope cutthroat males begin mature between the ages of two and four, with females maturing between age three and five (Downs et al. 1997). Downs (1995) reported a maximum age of eight years for 32 isolated headwater populations of westslope cutthroat trout in Montana.

Spawning habitat had been characterized as gravel substrates with particle sizes ranging from 2 to 75 mm, mean depths ranging from 17 to 20 cm, and mean velocities ranging from 0.3 to 0.4 m/s (Shepard et al. 1984). WCT are thought to spawn mainly in small first and second order tributaries. Migratory forms might spawn in the lower reached of streams used by resident fish. Slow water habitats (i.e. pools) are an important overwinter habitat feature for westslope cutthroat trout (Jakober et al. 1998).

Non-native fish species can have adverse impacts on native westslope cutthroat trout. Brook trout are believed to compete with westslope cutthroat trout for food and space in waters where they both occur. Rainbow trout (*Oncorhynchus mykiss*) also might compete with westslope cutthroat trout for food and space, but also pose a threat from hybridization. Hitt et al. (2003) described hybridization between rainbow and westslope cutthroat trout in the Flathead River system, and concluded it was spreading in an upstream direction. This spreading hybridization poses a threat to Glacier National Park westslope cutthroat trout in waters accessible to migratory fish from the Flathead River system.

Westslope cutthroat trout have been found in Upper McDonald Creek. In 2004, westslope cutthroat trout were identified in Avalanche Creek and Logan Creek (Dux and Guy 2004). Both of these creeks flow into Upper McDonald Creek. Although no quantitative data are available for WCT in the McDonald Creek drainage, spawning and rearing activity likely occurs in most major tributary streams. Marnell (1987) reported the presence of both genetically pure westslope cutthroat trout (introduced into Avalanche Lake), as well as non-native Yellowstone cutthroat trout *(O.c.bouvieri)* (introduced into Hidden Lake) in the drainage. The westslope cutthroat trout genetic status of McDonald Creek and its tributaries remains unknown.

Wolverine (*Gulo gulo*) is a rarely seen resident of coniferous forests and alpine meadows on both sides of the Continental Divide. They utilize a range of habitats including alpine areas, mature forests, ecotonal areas, and riparian areas. Having completed a five-year research project, the GNP Wolverine Project captured 28 wolverines and instrumented 27 wolverines which provided over 30,000 relocations, and gave a better understanding of population status and trends in the park (Copeland and Yates 2008, preliminary results). Home ranges, mortality, denning characteristics, dispersal and habitat information were calculated. Two wolverines were captured near Avalanche Creek which is about three miles south of the project area. Wolverines

exhibit a distinct seasonal elevation pattern moving to lower elevations during the winter where they search for carrion in ungulate winter ranges. The park is considered to have very high quality wolverine habitat due to its extensive alpine areas, rugged topography, remoteness, and diverse ungulate populations.

Fishers (*Martes pennanti*) inhabit coniferous forests and riparian areas; frequenting drainage bottoms, lower slopes, and riparian areas (USFS 1994). Fishers have been documented on both sides of the Continental Divide in the park, including McDonald Drainage. Observations of fishers were recorded in the park's WORF database within one mile of the project area. Fishers were once thought to be extirpated from northwestern Montana, and populations were augmented.

IMPACT ANALYSIS

METHODOLOGY

This section is intended to augment the impact analysis for natural systems and processes, by analyzing specific impacts of the proposed management alternatives upon federally listed threatened, endangered, and other sensitive species (species of concern). The predicted intensity of adverse impacts is articulated according to the following criteria:

Negligible: The alternative would affect an individual of a listed species or its critical habitat, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population. Negligible effect would equate with a "no effect" determination in U.S. Fish and Wildlife Service terms.

Minor: An individual(s) of a listed species or its critical habitat would be affected, but the change would be small. Minor effect would equate with a "may affect, not likely to adversely affect" determination for the species in U.S. Fish and Wildlife Service terms and would require informal consultation.

Moderate: An individual or population of a listed species, or its critical habitat would be noticeably affected. The effect could have some long-term consequence to individuals, populations, or habitat. Moderate effect would equate with a "may affect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely…" or "not likely to adversely affect" the species and would require either informal or formal consultation.

Major: An individual or population of a listed species, or its critical habitat, would be noticeably affected with a vital consequence to the individual, population, or habitat. Major effect would equate with a "may affect, likely to adversely affect" or "not likely to adversely affect" determination in U.S. Fish and Wildlife Service terms and would require formal consultation.

Short-term: After implementation, would recover in less than 1 year.

Long-term: After implementation, would take more than 1 year to recover or effects would be permanent.

IMPACT ANALYSIS OF THE NO ACTION ALTERNATIVE

Gray Wolf

Wolves have been observed in the area but do not den or have rendezvous site within the vicinity of the project area. The no action alternative would have negligible impacts on grey wolves. However, the project would occur in an ungulate winter range for big game which makes up the prey base for wolves; therefore wolves might be passing through the area during construction

but would not remain in the area for a substantial amount of time. As a result, activities proposed under the no action alternative would have no effect on gray wolves.

Grizzly Bear
The no action alternative would have negligible impacts on grizzly bears since there would be no work in the riparian area and little activity in this area of the road in addition to routine road maintenance activities. As a result, activities proposed under the no action alternative would have no effect on grizzly bears.

Canada Lynx
Canada lynx tracks have been observed in the area and given their tendency to feed on carrion in the winter months and that the project area is in an ungulate winter range, it is highly likely that Canada lynx would be present at some point. The chances of disturbing lynx during construction times are low but still might occur, however, lynx are known to habituate to human activities therefore actions proposed in this alternative, would result in negligible impacts since there would be no work in the riparian area and little activity in this area of the road in addition to routine road maintenance activities. As a result, activities proposed under the no action alternative would have no effect on Canada lynx

Bull Trout
The eroding/sliding area comprises roughly 45 feet of eroding stream bank out of tens of kilometers of high-quality stream habitat. The current situation of the existing slide is having negligible to minor impacts on bull trout rearing habitat in McDonald Creek. In the absence of the GTSR, this area would likely go untreated. Extreme contributions of fine and coarse sediment can impair biological and physical functions of stream channels, but this slide is relatively small and localized. If left untreated, it is doubtful fine sediment contributions from this area would have negligible impacts on bull trout rearing habitat due to the large, relatively undisturbed watershed area located upstream of the site.

Negligible to minor short and long -term positive and adverse impacts on bull trout would result from actions proposed in this alternative. Therefore, the no action alternative may affect, but is not likely to adversely affect bull trout.

Species of Concern
The no action alternative would be negligible for **harlequin ducks, wolverines, and fishers** since there would be no instream work and little activity in this area of the road in addition to routine road maintenance activities.

Westslope Cutthroat Trout. If the GTSR was not immediately adjacent to the stream, this area would likely go untreated. Slides are sources of large woody debris recruitment to stream channels. Woody debris provides fish habitat, stores and sorts sediment, and provides organic input to the channel. This organic input is important in streams with relatively low productivity, such as many of those on the west side of Glacier National Park. Extreme contributions of fine and coarse sediment can impair biological and physical functions of stream channels, but this slide is relatively small and localized. If left untreated, it is doubtful fine sediment contributions from this area would have any measurable adverse impact on westslope cutthroat trout production due to the large, relatively undisturbed watershed area located upstream of the site.

The slide area is fairly localized, and this impact would not raise above a minor long-term impact aquatic resources in McDonald Creek. Negligible to minor short and long -term positive and adverse impacts on westslope cutthroat trout would result from actions proposed in this alternative.

Cumulative Impacts of the No Action Alternative

Cumulative impacts considered include recently completed emergency stabilization at MP 23.3 and 33.23, as well as ongoing repairs to the Logan Creek Bridge. Future rehabilitation,

maintenance and emergency stabilization/maintenance on the banks of McDonald Creek are also possible along the GTSR.

Gray wolf
Actions proposed in the no action alternative combined with past, on-going and future actions would result in negligible to minor, adverse, short and long-term impacts to **wolves**. The project area occurs in established ungulate winter range, which wolves prey on. Continual disturbance might displace these species long-term but given their wide-ranging tendencies, availability of alternative habitat and no known den site occur in the area, impacts would not exceed minor.

Grizzly Bear
Actions proposed combined with past, on-going, and future actions would result negligible to moderate, adverse short and long-term impacts to grizzly bears as the continual and on-going presence of humans might habituate and displace grizzly bears from the area near the project area. Stabilization efforts would last for an indeterminate length of time making impacts difficult to assess. Traffic might be delayed or stopped at the project site in order to implement emergency stabilization needs by closing one lane of traffic. Grizzly bears might be disturbed or displaced during construction activities if emergency stabilization efforts were to occur during late-spring or through the summer. Increased human activity at the project site might increase the probability of human/bear interaction which could lead to habituation and possibly bear mortality.

Canada Lynx
Cumulative effects to Canada lynx would result in negligible to minor, adverse short-term impacts as lynx are known to habituate to human activities actions proposed in this alternative, combined with past, on-going and future activities. Stabilization efforts would last for an indeterminate length of time making impacts difficult to assess. Canada lynx might be disturbed or displaced during construction activities for emergency bank stabilization efforts.

Bull Trout and Westslope Cutthroat Trout
There are other sediment sources contributing both fine and coarse sediment to McDonald Creek, but stream survey data is not available to quantify these levels. From a cumulative effects standpoint, it is not likely that fine sediment is limiting aquatic species production in upper McDonald Creek. Continued additional fine sediment from the slide area is likely to have a minimal impact on aquatic resources in upper McDonald Creek due to the size of the slide relative to the size of the drainage. However, it is readily apparent that Logan Creek, located upstream of the slide area is contributing large amounts of coarse bedload to McDonald Creek. McDonald Creek is currently having difficulty routing the excessive sediment supply from Logan Creek, as evidenced by mid-channel bars and channel braiding in McDonald Creek downstream from Logan Creek. McDonald Creek appears to have aggraded immediately downstream of Logan Creek, due to excess sediment input from Logan Creek. This excess coarse sediment supply might adversely affect the ability of the channel to form and maintain pool habitat, an important habitat feature for aquatic species in McDonald Creek. The additional coarse sediment input from the slide area, while undesirable from a fish habitat perspective, is only likely to have minor cumulative effects on aquatic resources due to the relatively small size of the slide area, and existing upstream coarse sediment sources.

Any emergency stabilization (such as riprap) that results in response to continued erosion of the streambank at this location would also have negligible to minor impacts on bull trout, largely because it would not involve any significant instream work. Emergency bank stabilization in the form of riprap might also occur under this alternative. This would reduce fine and coarse sediment contributions and thus potentially benefit bull trout rearing habitat. It would however, reduce the potential for future re-establishment of native vegetation, and reduce the potential for future recruitment of large woody debris to the stream channel from the site. However, the

slide area is fairly localized, and this impact would not raise above a minor long-term impact aquatic resources in McDonald Creek. Previously installed riprap exists along the McDonald Creek, upstream of Lake McDonald. Cumulative effects of riprap on aquatic resources are an area that is not well studied or evaluated (Schmetterling et al. 2001). Long-term impacts to aquatic resources can stem from habitat alteration associated with replacing natural bank materials, such as riparian tree species, with large rock.

Low overhead cover in the form of undercut banks would be eliminated in the riprap portion of the project reach if emergency riprap stabilization is implemented. Habitat would potentially be simplified due to the loss of large-woody debris and shade might be reduced due to the loss of riparian plant species. Recruitment of spawning gravel might be reduced due to reduction of bank erosion. Impacts would vary based on the life-stage of the resource. For example, there might be local habitat quality reduction for young-of-the-year salmonids who might desire low velocity channel margin habitat. At the same time, there might be no effect or local increases on age-1 and older juvenile or adult salmonids in the riprap area due to the presence of appropriately sized cover adjacent to good feeding areas.

However, the proposed project site only impacts approximately 45' of stream bank immediately adjacent to GTSR. Most of the McDonald Creek drainage is unroaded, and the potential need for bank armoring is limited to certain areas immediately adjacent to GTSR. Considering the size of the drainage relative to the size of the project site, any cumulative impacts to bull trout and westslope cutthroat trout from emergency stabilization would likely be minor, short and long-term, beneficial and adverse impacts on aquatic resources.

Harlequin Ducks. The no action alternative would have negligible to moderate impacts on harlequin ducks dependant on the time of year emergency stabilization efforts would occur. Stabilization efforts would last for an indeterminate length of time making impacts difficult to assess. Harlequin ducks are very susceptible to disturbance during the summer months (June, July and August); if construction activities occurred during these period moderate impacts would be expected. However, harlequin ducks might be present in the project area from mid-April through mid-September. If construction activities occurred during this period, given the small size of the project area minor impacts would be expected since duck could relocate up or downstream easily.

Actions proposed in the no action alternative combined with past, on-going and future actions would result in negligible to minor, adverse, short and long-term impacts to **wolverines** and **fishers**. The project area occurs in established ungulate winter range, which these species prey on. Continual disturbance might displace these species long-term but given their wide-ranging tendencies, availability of alternative habitat and no known den site occur in the area, impacts would not exceed minor.

Conclusion

All threatened, endangered, and species of concern would experience negligible impacts from actions proposed in the no action alternative. The no action alternative would not introduce additional disturbances and would not alter any habitat from its current condition.

The no action alternative combined with past, on-going, and future actions would allow large woody debris to naturally accumulate in McDonald Creek; creating fish habitat. Sediment generation might increase if further slides were to occur but given the impacts and the need to protect the GTSR further emergency stabilization efforts would occur minimizing the potential for increased turbidity in McDonald Creek. The overall impacts of the no action alternative on bull trout and westslope cutthroat trout would be negligible to minor, short and long-term, beneficial and adverse.

Because the no action alternative would not result in major adverse impacts to threatened,

endangered or species of concern resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park threatened, endangered or species of concern resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE II

Gray Wolf

The project area is in an established ungulate winter range. Wolves depend on ungulates for food, especially during the winter. Since construction activity is scheduled for late fall/early winter, it would have minor, adverse impacts on these species. The duration of construction activities would be short and would not permanently alter habitat for this species. There are no known dens or rendezvous sites in the vicinity of the project area. The permanent stabilization effort would ensure construction activities would be reduced in the project area. Therefore, impacts from this alternative would be minor, adverse and short-term.

Grizzly Bear

Impact to grizzly bears from this alternative would be minor due to displacement of bears from a relatively small area of seasonal habitat during the autumn; bears would be denning during winter months when part of this project might be accomplished, so there would be no impact during that time except to a few mostly adult male bears that might linger out of the den into December or later. Actions proposed would result in negligible to minor, adverse short-term impacts to grizzly bears and therefore are determined to "may affect, but not likely to adversely affect" grizzly bears. This determination is based on 1) construction activity would occur in non-denning habitat, 2) the timing of construction, 3) the potential for increased attractants (provided by humans) and 4) the slight increase of mortality from construction. Conservation measures would be implemented during rehabilitation to minimize effects to grizzly bears (see mitigation measures).

Canada Lynx

Lynx tracks have been observed near the project area during winter months, and therefore the possibility exists that lynx would be temporarily displaced during construction. No den sites or evidence of denning activity has been observed along the road corridor. Otherwise, little is known about Canada lynx use of this area, but displacement would likely be temporary and limited in extent, since lynx are known to habituate to human activities (Ruediger et al 2000). Proposed actions would not alter habitats or human us patterns in or near areas that might be used as den sites in the future. Construction activity would not take place during the denning period (May to August). Prey species trends or distribution would not be altered by proposed actions but prey species might be displaced from established winter range during construction. Therefore actions proposed would result in negligible to minor, adverse short-term impacts to Canada lynx.

Bull Trout

The riprap and barbs would require excavation into the natural channel substrate to install a large rock "toe" ensure high flows do not compromise the structural integrity of the stabilization. In-channel work would involve the excavation of approximately 3,000 ft^3 of native streambed material, which would be replaced with riprap to form the toe of the slope, and footer material for the barbs. Removed streambed material would be transported from the project site by reaching down from the GTSR and hauled away.

The use of an excavator would result in the release of some fine sediment to the channel, but it is anticipated to be minimal because the work would be conducted during the low flow periods of

fall and early winter. The initial approach to the creek would involve driving into the stream over the streambank, but it is anticipated the excavator would be able to stay in the channel as it moves upstream to the project area minimizing sediment generation.

The nearest potential bull trout and bull trout critical habitat is located in the lower portion of upper McDonald Creek, but below the falls (approximately 8 km downstream of the project area). Any disturbance that generates fine sediment in the form of bedload is unlikely to reach any bull trout or bull trout critical habitat during construction (low flow periods of fall and winter) due to the distance between the project area and critical habitat. Some suspended fine sediment would likely reach the lower portions of upper McDonald Creek, but we anticipate this sediment to be considerably diluted at this point, and largely pass into McDonald Lake.

The primary short-term impacts would include temporary increases in channel turbidity associated with excavating the channel bed for installation of the rock riprap toe and barbs. These impacts are anticipated to be short in duration, and anticipate clear water refugia in the near bank area downstream of Avalanche Creek. Actions proposed in this alternative would result in negligible to minor, adverse, short-term impacts to bull trout rearing habitat.

Species of Concern

Harlequin Ducks. Impacts to the harlequin duck would be negligible since work would begin after females with broods have left the area (males leave in June), thus there would be no risk of displacement. There might be some residual impact if the instream work has any affect on aquatic prey organisms that persists into the following spring when the ducks return, but that is unlikely and would be negligible (see aquatic resources section).

Westslope Cutthroat Trout. The crossings would result in the release of some fine sediment to the channel, but it is anticipated to be minimal because the work would be conducted during the low flow periods of fall and early winter. The initial approach to the creek would involve driving into the stream over the streambank, but it is anticipated the machine would be able to stay in the channel as it moves upstream to the project area. The machine would avoid travelling in the water to the greatest extent possible by making use of existing dry gravel bars.

The primary short-term impacts would include temporary increases in channel turbidity associated with excavating the channel bed for installation of the rock riprap toe and barbs. These impacts are anticipated to be short in duration, and anticipate clear water refugia in the near bank area downstream of Avalanche Creek.

Instream work is proposed to occur in the fall and early winter, after westslope cutthroat trout spawn and emerge from the gravel. Any fine sediment generated and stored locally in the project reach would likely be transported out of the area during the following spring runoff. Therefore, there would be negligible to minor impacts to spawning and fry survival for westslope cutthroat trout. Fish might be using the project area for summer/fall feeding sites, and might be temporarily displaced during construction. Some fish would likely be moving into overwinter habitats due to declining water temperatures during this period, and the slide itself occurred immediately adjacent to a “run” habitat type. Although the project would extend upstream into deeper-water habitat, the run habitat type at the center of the project is not likely used for overwintering for westslope cutthroat trout. Native plant revegetation within/near the riprap could also provide some mitigation relative to primary productivity and aesthetics. Riprap and rock barbs would be replacing woody vegetation that would naturally be found at the site on the stream banks until the willows matured, thus delaying periodically recruitment of large woody debris to the stream channel. Although, qualitative assessment of the stream channel reveals large rock as a regular structural component of the McDonald Creek stream channel. As a result, disturbance of overwintering fish would also be minor. Actions proposed would have minor, adverse, short-term impacts to west slope cutthroat trout.

Wolverines and Fishers. The project area would be in an established ungulate winter range. These species depend on ungulates for food, especially during the winter. Since construction activity is scheduled for late fall/early winter, it would have minor, adverse impacts on these species. The duration of construction activities would be short and would not permanently alter habitat for these species. The permanent stabilization effort would ensure construction activities would be reduced in the project area. Therefore, impacts from this alternative would be minor, adverse and short-term.

Cumulative Impacts of Alternative II

Cumulative impacts considered include recently completed emergency stabilization at MP 23.3 and 33.23, as well as ongoing repairs to the Haystack Creek and Logan Creek crossings. Future rehabilitation, maintenance and emergency stabilization/maintenance on McDonald Creek are also possible along the GTSR.

Gray Wolf

Continual disturbance along the GTSR, from rehabilitation, maintenance and emergency construction efforts, would possibly displace prey species from the area during winter months, which would result in the temporary to long-term displacement of the gray wolves that feed in the area. Cumulative impacts of the actions proposed in Alternative II combined with past, on-going, and future actions would result in negligible to moderate, short and long-term, adverse impacts to these species.

Grizzly Bear

Impacts to grizzly bear would be minor due to the relatively temporary and limited extent of the project and its occurrence during denning. Grizzly bears hibernate in late winter in dens away from human disturbance, typically at higher elevations on steep slopes when the actions propose in Alternative II would occur. Cumulative impacts to grizzly bears would be minor to moderate due to the increase level of human/bear interaction could increase habituation of bears.

Canada Lynx

Given the limited information on Canada lynx in GNP, cumulative impacts for Alternative II would be the same as described in the no action alternative.

Bull Trout

Action proposed for this alternative in combination with past, ongoing and future actions would generate additional sediment in McDonald Creek. The nearest potential bull trout and bull trout critical habitat is located below the falls in the lower portion of upper McDonald Creek (approximately 8 km downstream of the project area). Any disturbance that generates fine sediment in the form of bedload is unlikely to reach any bull trout or bull trout critical habitat during construction (low flow periods of fall and winter) due to the distance between the project area and critical habitat. Some suspended fine sediment would likely reach the lower portions of McDonald Creek, but we anticipate this sediment to be significantly diluted at this point, and largely pass into McDonald Lake. Cumulative impacts on bull trout and bull trout critical habitat would be negligible to minor, adverse, and both short and long-term.

Species of Concern

Harlequin Ducks. Impacts to the harlequin duck would be negligible since work would begin after females with broods have left the area (males leave in June), thus there would be no risk of displacement. There might be some residual impact if the instream work has any affect on aquatic prey organisms that persists into the following spring when the ducks return, but that is unlikely and would be negligible (see aquatic resources section).

Westslope Cutthroat Trout. Action proposed for this alternative in combination with past, ongoing and future actions would generate additional sediment in McDonald Creek and prevent the natural meandering of the creek as the GTSR is protected. Low overhead cover in the form

of undercut banks would be eliminated in project areas the utilize riprap for that portion of the project reach. Habitat would potentially be simplified due to the loss of large-woody debris and shade might be reduced due to the loss of riparian plant species. Recruitment of spawning gravel might be reduced due to reduction of bank erosion (Schmetterling 2001). Impacts would vary based on the life-stage of the resource. For example, there might be local habitat quality reduction for young-of-the-year salmonids who might desire low velocity channel margin habitat. At the same time, there might be no effect or local increases on age-1 and older juvenile or adult salmonids in the riprap area due to the presence of appropriately sized cover adjacent to good feeding areas.

Cumulative effects from existing and future bank stabilization efforts along McDonald Creek have the potential to reduce fish habitat quality, as well as overall productivity in the system. Riprap can homogenize stream banks and reduce habitat complexity by replacing large woody debris, and eliminating future recruitment potential. Riprap does not provide the diversity of habitat that is afforded from a well vegetated streambank. However, most of the McDonald Creek drainage is unroaded, and the potential need for bank armoring is limited to certain areas immediately adjacent to GTSR. Considering the size of the drainage relative to the size of the project site, any cumulative impacts to westslope cutthroat trout from this alternative would likely be minor, adverse, and both short and long-term.

Wolverines and Fishers. Continual disturbance along the GTSR, from rehabilitation, maintenance and emergency construction efforts, would possibly displace prey species from the area during winter months, which would result in the temporary to long-term displacement of the wolverines and fishers that feed in the area. Cumulative impacts of the actions proposed in Alternative II combined with past, on-going, and future actions would result in negligible to moderate, short and long-term, adverse impacts to these species.

Conclusion

Alternative II would have minor, short-term impacts to grizzly bears, negligible short and long-term impacts for Canada lynx, negligible to minor, adverse, short-term impacts to bull trout rearing habitat, negligible impacts to harlequin ducks, and minor, adverse, short-term impacts to westslope cutthroat trout, wolverines, fisher, and gray wolves. This alternative combined with past, on-going, and future actions would result in negligible to minor, adverse short-term impacts to grizzly bears; in negligible to minor, adverse short-term impacts to Canada lynx; negligible impacts to harlequin ducks work would begin after females with broods have left the area (males leave in June), thus there would be no risk of displacement.

This alternative combined with past, on-going, and future actions would increase turbitity in McDonald Creek, prevent natural recruitment of large woody debris, and decrease fish habitat for westslope cutthroat trout in the vicinity of the project. Natural meandering of McDonald Creek is limited by the GTSR and would be prevented in order to protect the road. The overall impacts of Alternative II on bull trout and westslope cutthroat trout would be negligible to minor, short and long-term, and adverse.

Because this alternative would not result in major adverse impacts to threatened, endangered or species of concern resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park threatened, endangered or species of concern resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III – THE PREFERRED

Gray wolf
Impacts of Alternative III for gray wolves would be the same as those described in Alternative II.

Grizzly Bear
Impacts of Alternative III for grizzly bears would be the same as those described in Alternative II.

Canada Lynx
Impacts of Alternative III for Canada lynx would be the same as those described in Alternative II.

Bull Trout
The impacts of Alternative III for bull trout and bull trout critical habitat would be the same as those described in Alternative II.

Species of Concern.
Harlequin Duck, Wolverines, and Fishers. Action proposed for this alternative would be the same as those described in Alternative II.

Westslope Cutthroat Trout. Impacts associated with actions proposed in Alternative IV would be similar to Alternative II (minor, short and long-term adverse impacts). However, this alternative has a larger level of disturbance. Stream bank disturbance would include removal of an additional 50 feet of vegetation, which would be converted to riprap and 50 feet of instream disturbance.

Cumulative Impacts of Alternative III

Cumulative impacts considered include recently completed emergency stabilization at MP 23.3 and 33.23, as well as ongoing repairs to the Haystack Creek and Logan Creek crossings. Future rehabilitation, maintenance and emergency stabilization/maintenance on McDonald Creek are also possible along the GTSR.

Gray Wolf
Actions proposed for this alternative, in combination with past, ongoing and future actions would result in the same impacts for gray wolves as those described in Alternative II.

Grizzly Bear
Actions proposed for this alternative in combination with past, ongoing and future actions would result in the same impacts as those described in Alternative II.

Canada Lynx
Actions proposed for this alternative in combination with past, on-going, and future actions would result in the same impacts as those described in Alternative II.

Bull Trout
Actions proposed for this alternative in combination with past, ongoing and future actions would result in the same impacts as those described in Alternative II.

Species of Concern
Harlequin Duck, Wolverines, and Fishers. Action proposed for this alternative in combination with past, ongoing and future actions would result in the same impacts as those described in Alternative II.

Westslope cutthroat trout. Action proposed for this alternative in combination with past, ongoing and future actions would result in the same impacts as those described in Alternative II.

Conclusion

Due to the timing of construction, the permanent solution for bank stabilization and the short

duration of construction to implement actions proposed, Alternative III would have minor, short-term impacts to grizzly bears, negligible short and long-term impacts for Canada lynx, negligible impacts to harlequin ducks, and minor, adverse, short-term impacts to westslope cutthroat trout, wolverines, fisher, and gray wolves. Negligible to minor, adverse, short-term impacts to bull trout rearing habitat would be expected since the closest fish rearing habitat is 8 km downstream. Alternative III combined with past, on-going, and future actions would result in the same impacts for all threatened, endangered or species of concern described in this analysis. Actions would increase turbidity in McDonald Creek, prevent natural recruitment of large woody debris, and decrease fish habitat for westslope cutthroat trout in the vicinity of the project. Natural meandering of McDonald Creek is limited by the GTSR and would be prevented in order to protect the road. The overall impacts of Alternative IV on bull trout and westslope cutthroat trout would be negligible to minor, short and long-term, and adverse. Action proposed for this alternative in combination with past, ongoing and future actions would result in the same impacts as those described in Alternative II for threatened, endangered or species of concern.

Because Alternative III would not result in major adverse impacts to threatened, endangered or species of concern resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park threatened, endangered or species of concern resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Water Resources

Affected Environment

The headwaters of the McDonald Creek system originate near the peaks of the Continental Divide. The 89,166 acre (36,085 ha) McDonald Creek, a fourth-order stream, drains approximately 7,235 acres (2,928 ha) of lake surface area and 230 miles (370.5 km) of streams. Mean annual discharge is 16.4 m^3/s; an annual maximum discharge is approximately 75-130 m^3/s while annual minimum discharge is approximately 1 – 3 m^3/s (Hauer et al. 2002). Most of the drainage is in recommended wilderness with the lower portion bisected by the GTSR, which forms the east boundary of the stream channel in most areas.

Arising at a 6,080 foot (1,853 m) elevation, McDonald Creek flows 25.8 miles (41.5km) from its headwaters to its mouth, and contains 8.8 miles (14.2 km) of lake habitat. McDonald Creek drains into the Middle Fork of the Flathead River at an elevation of 3,151 feet (960 m). The creek flows in a southeasterly direction, and then turns at the Glacier Wall and flows southwesterly, cascading into Lake McDonald.

Lake McDonald is the largest lake in Glacier National Park with a surface are of 6,823 acres (2,761 ha) and contains 2,055,376 acre feet in volume. With a maximum depth of 464 feet (146 m) the lake is the deepest in the park. Mean depth is 301 feet (92 m). Below the lake, Lower McDonald Creek, a fifth order tributary, flows for approximately 3,200 feet (975 m) before entering the Middle Fork of the Flathead River. Bull trout are known to inhabit Lake McDonald. Occasional use of lower McDonald Creek upstream of the lake but below the falls by bull trout probably occurs, but has not been documented in recent surveys. Habitat for spawning and rearing appears marginally suitable (Wade Fredenberg, USFWS, personal communication). Bull trout are physically unable to access the portions of McDonald Creek adjacent to the project area due to several waterfalls that occur immediately upstream of the lake

(about 200-300 m upstream of the lake inlet). The project area is located approximately 8 km upstream of the lake.

The project area is approximately half way down the McDonald Creek drainage with approximately two-thirds of the drainage area above the site. GTSR parallels McDonald Creek above the falls for approximately half of its stream length. The watershed remains largely un-roaded except for GTSR and a few minor spur roads. Results of HEC-RAS modeling of the project area are in table 4.

Major streams flowing into McDonald Creek above the area include Mineral, Alder, Haystack, and Logan Creeks. The head of Lake McDonald is located approximately at MP 14.5, Avalanche Creek is at MP16.2, and Logan Creek is at MP 20.5.

In general, the waters of Glacier National Park are low in productivity. Soluble reactive phosphorous is usually < 1µg/l, while nitrate nitrogen is also typically low (Hauer 1988).

Table 4. HEC-RAS model output for McDonald Creek, site conditions for the project area.

Flood Event	Discharge	Maximum Channel Flow Depth	Average Channel Flow Velocity
2-year	3,000 ft^3/sec	5.5 ft	6.7 ft/sec
50-year	5,700 ft^3/sec	8 ft	8.7 ft/sec
100-year	7,600 ft^3/sec	9.2 ft	9.7 ft/sec

IMPACT ANALYSIS

METHODOLOGY

The methodology used to analyze potential impact to water quality is based on modeling techniques to establish stream characteristics that might be affected by project actions, proximity of project actions to streams and lakes, and planned mitigation measures to control runoff and prevent sedimentation. The affected environment and impact analysis for water quality is limited to the site along the GTSR at MP 19.25.

Negligible: Neither water quality nor hydrology would be affected, or the changes would be either non-detectable or if detected, would have effects that would be considered slight and non-measurable.

Minor: Changes in water quality or hydrology would be measurable, although the changes would be small and the effects would be localized.

Moderate: Changes in water quality or hydrology would be measurable but would be noticeable on a widespread scale.

Major: Changes in water quality or hydrology would be readily measurable, would have substantial consequences and would be noticed on a regional scale.

Short-term: After implementation, recovery would take less than one year.

Long-term: After implementation, recovery would take more than one year or effects would be permanent.

IMPACTS OF ALTERNATIVE I – NO ACTION ALTERNATIVE

Based on the wilderness character of the drainage, it is highly likely that all water quality parameters are currently functioning within the normal range of variability for an unimpaired watershed in the existing geographic, geologic, and climatic setting.

Under the no action alternative, the stream would possibly continue to seasonally erode into the terrace supporting the GTSR until it reached a point of natural equilibrium. During spring runoff, pulses of coarse and fine sediment would be contributed to the channel along with large woody debris. Sediment would be expected to be routed further downstream with each subsequent high-water event. Turbidity would increase each spring as slide material was contributed to the channel and entrained in the flow, however, turbidity levels in McDonald Creek would already be elevated in the channel from other existing sediment sources. The addition of coarse and fine sediment might have a minor adverse impact habitat conditions for aquatic species, as it appears the stream channel immediately upstream of the project site is having difficulty routing its sediment supply. This is evidenced by mid-channel gravel bars and channel braiding in some locations. Excess coarse and fine sediment might fill pools and interstitial spaces within the substrate, both of which provide important habitats for aquatic species. However, due to the size of the drainage, existing upstream sediment sources (e.g. Logan Creek), and the relatively small overall area impacted by the instability, it is likely that there would only be minor effects on water quality prior to stabilization. There would be negligible impacts anticipated in key water quality parameters such as water temperature or pH as a result of the no action alternative.

Nutrients appear to be at low levels in McDonald Creek. This is based on the visibly low levels of primary productivity in McDonald Creek. Woody debris provides fish habitat, stores and sorts sediment, and provides organic input to the channel. This organic input is valuable in streams with relatively low productivity, such as many of those on the west side of Glacier National Park. However, due to the relative size of the area proposed for treatment, impacts to stream nutrients are negligible.

The presence of contaminants is likely negligible in the project area due to the undeveloped nature of the watershed. However, recent air quality and mercury testing in fish in the park has revealed airborne contamination in the form of mercury, historic-use pesticides, and current-use pesticides in park waters, including mercury in the McDonald Creek watershed. The No Action Alternative would have no anticipated effects on metals or other toxic compounds.

There is a small chance that chemical contamination (hydraulic fluid, gasoline/diesel fuel, motor oil) could occur in the event of mechanical failure during any emergency stabilization work. All machines, engines, hoses, and fittings would be inspected prior to commencement of activities. The risk of failure is low, based on past experience, and is discountable. Under the no action alternative, minor, adverse short-term impacts, and negligible to minor, beneficial long-term impacts to water resources would occur.

Cumulative Impacts of the No Action Alternative

Cumulative impacts to water quality considered include recently completed emergency stabilization at MP 23.3 and 33.23, as well as ongoing maintenance and repairs at the Haystack and to the Logan Creek crossings. Future rehabilitation and maintenance and emergency stabilization on McDonald Creek associated with GTSR maintenance is also possible.

Lateral migration of stream channels and resulting bank erosion are often a natural part of fluvial processes that shape streams. Patterns of rivers are developed to provide for the dissipation of the energy of moving water, and the transportation of sediment (Rosgen 1996). This erosion can have both positive (i.e. providing large woody debris and spawning gravel recruitment) and adverse impacts (i.e. pool filling, fine sediment in spawning gravel) on water

quality, as well as aquatic species and their habitat. From a cumulative impact perspective, the additional suspended sediment and bedload generated by the existing slide would have minor impacts on water quality due to the size of the impact site relative to the size of the drainage.

During emergency stabilization, impacts to water quality would be minor to moderate. We would anticipate the generation of relatively small amounts of fine sediment. Following any emergency stabilization sediment contributions (and impacts on water quality) from the site would cease or be reduced to the point that they were negligible. However, additional erosion might continue both upstream and downstream of the immediate slide area, and additional emergency stabilization might need to occur in future years.

Extensive armoring of streambanks can have adverse and unintended consequences for fluvial processes in rivers and streams. Extensive armoring, of streambanks banks with riprap or other structures/material, impacts the ability of streams to respond to changes in sediment and water supply, or other upstream perturbations through lateral migration. The inability of streams to laterally migrate can lead to increased channel gradient, and vertical adjustments in the channel where bed material allows. Such vertical adjustments can lead to abandonment of floodplains due to channel downcutting, increased bank erosion rates, lowering of the water table, and changes in riparian vegetative community (Schmetterling 2001). Riprap might also result in increased erosion downstream of the project site. Although vertical adjustments might occur in finer grained stream systems in response to bank stabilization efforts, it is unlikely to occur in McDonald Creek due to the coarse nature of the bed, as well as bedrock inclusions that serve as grade control.

Most of the McDonald Creek drainage has no roads, and the potential need for bank armoring is limited to certain areas immediately adjacent to GTSR. Other water quality parameters would remain largely unchanged in the cumulative effects analysis. Therefore, it is unlikely that cumulative impacts to water quality associated with streambank stabilization under Alternative I would have no impacts beyond minor. Under the no action alternative, minor, adverse short-term impacts, and minor, beneficial long-term impacts to water resources would occur.

Conclusion

The actions proposed in the no action alternative would result in minor, adverse short-term impacts to water resources as the creek continued to erode the bank until it reached a stabile point. And negligible to minor, beneficial long-term impacts to water resources once the stream has stabilized. The no action alternative combined with past, ongoing, and future actions would allow McDonald Creek to migrate somewhat naturally until channel changes threatened the GTSR and more intensive emergency control measures were instated. Given the high quality of the headwaters to McDonald Creek, cumulative impacts would remain largely unchanged from the overall condition of the creek. The overall impacts of the No Action Alternative on water resources would be minor, adverse short-term impacts, and negligible to minor, beneficial long-term impacts.

Because the no action alternative would not result in major adverse impacts to water resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park water resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACTS OF ALTERNATIVE II

Based on the wilderness character of the drainage, it is highly likely that all water quality parameters are currently functioning within the normal range of variability for an unimpaired

watershed in the existing geographic, geologic, and climatic setting.

Installation of the rock toe and barbs would have moderate short-term adverse impacts to water quality due to the need to work in the active stream channel and the 3,000 ft^3 of stream channel excavation needed to install the rock toe and barbs. Construction activities would increase turbidity as the active channel bed is excavated for toe rock and barb installation. Any suspended sediment would be transported downstream to the lower reaches of McDonald Creek and Lake McDonald, where it would be diluted and settle out. It is anticipated that only minor contributions of fine sediment associated with the placement of the riprap itself would occur. There would be no long term impacts beyond minor to water quality associated with Alternative II.

The excavator would need to enter the stream several times, as it crossed from gravel bar to gravel bar, in order to drive up the creek to the work site, as one of the access points is located a short distance downstream of the work site. Each crossing would generate relatively minor amounts of turbidity in the stream, and the access point would result in bank damage. Bank, as well as any channel damage caused by excavator travel would be repaired when the equipment leaves the site.

Nutrients appear to be at low levels in McDonald Creek. This is based on the visibly low levels of primary productivity in McDonald Creek. Woody debris provides fish habitat, stores and sorts sediment, and provides organic input to the channel. This organic input is valuable in streams with relatively low productivity, such as many of those on the west side of Glacier National Park. However, due to the relative size of the area proposed for treatment, impacts to stream nutrients are negligible.

The presence of contaminants is likely negligible in the project area due to the undeveloped nature of the watershed. However, recent air quality and mercury testing in fish in the park has revealed airborne contamination in the form of mercury, historic-use pesticides, and current-use pesticides in park waters, including mercury in the McDonald Creek watershed. Alternative II would have no anticipated effects on metals or other toxic compounds.

There is a small chance that chemical contamination (hydraulic fluid, gasoline/diesel fuel, motor oil) could occur in the event of mechanical failure during any emergency stabilization work. All machines, engines, hoses, and fittings would be inspected prior to commencement of activities. The risk of failure is low, based on past experience, and is discountable.

Under Alternative II, moderate short-term adverse impacts to water resources would occur and minor beneficial long-term impacts to water resources would also occur.

Cumulative Impacts of Alternative II

Cumulative impacts to water resources considered include recently completed emergency culvert stabilization at MP 23.3 and 33.23, as well as ongoing maintenance and repairs at the Haystack and to the Logan Creek crossings. Future emergency stabilization on McDonald Creek associated with GTSR maintenance is also possible.

Lateral migration of stream channels and resulting bank erosion are often a natural part of fluvial processes that shape streams. Patterns of rivers are developed to provide for the dissipation of the energy of moving water, and the transportation of sediment (Rosgen 1996). This erosion can have both positive (i.e. providing large woody debris and spawning gravel recruitment) and adverse impacts (i.e. pool filling, fine sediment in spawning gravel) on water quality, as well as aquatic species and their habitat.

Extensive armoring of streambanks can have adverse and unintended consequences for fluvial processes in rivers and streams. Continued extensive armoring of streambanks banks with riprap or other structures/material impacts the ability of streams to respond to changes in

sediment and water supply, or other upstream perturbations through lateral migration. The inability of streams to laterally migrate can lead to increased channel gradient, and vertical adjustments in the channel where bed material allows. Such vertical adjustments can lead to abandonment of floodplains due to channel downcutting, increased bank erosion rates, lowering of the water table, and changes in riparian vegetative community (Schmetterling 2001). Riprap might also result in increased erosion downstream of the project site. Although vertical adjustments might occur in finer grained stream systems in response to bank stabilization efforts, it is unlikely to occur in McDonald Creek due to the coarse nature of the bed, as well as bedrock inclusions that serve as grade control.

Most of the McDonald Creek drainage has no roads and the potential need for bank armoring is limited to certain areas immediately adjacent to GTSR. Other water quality parameters would remain largely unchanged in the cumulative effects analysis. Therefore, it is unlikely that cumulative beneficial impacts to water quality associated with streambank stabilization under Alternative II would have impacts beyond minor. Actions proposed in this alternative, combined with past, on-going and future actions, would result in moderate short-term adverse impacts to water resources and minor beneficial long-term impacts to water resources.

Conclusion

Under Alternative II, moderate short-term adverse impacts to water resources would occur due to construction activities associated with the rock barb installation. Minor, beneficial, long-term impacts to water resources would also occur from the permanent stabilization of the bank. Cumulative impacts would result in moderate short-term adverse impacts to water resources would occur and minor beneficial long-term impacts to water resources would also occur.

Because the alternative would not result in major adverse impacts to water resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park water resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III – THE PREFERRED

Based on the wilderness character of the drainage, it is highly likely that all water quality parameters are currently functioning within the normal range of variability for an unimpaired watershed in the existing geographic, geologic, and climatic setting.

Alternative III would have moderate short term adverse impacts to water quality due to the need to work in the active stream channel and 3,000 ft^3 of stream channel excavation needed to install the rock toe. Turbidity would locally increase during construction as the active channel bed is excavated for toe rock and barb installation. Any suspended sediment transported downstream to the lower reaches of McDonald Creek and Lake McDonald, would be diluted and settle out. Only minor contributions of fine sediment associated with the placement of the riprap itself would occur. There would be no long-term adverse impacts beyond minor to water quality associated with Alternative III.

Several live stream crossings would be required for an excavator to drive up the creek to the work site, as the most appropriate access is located a short distance downstream of the work site. Each crossing would generate relatively minor amounts of turbidity in the stream, and the access point would result in bank damage. Bank, as well as any channel damage caused by excavator travel would be repaired when the equipment leaves the site.

Nutrients appear to be at low levels in McDonald Creek. This is based on the visibly low levels of primary productivity in McDonald Creek. Woody debris provides fish habitat, stores and sorts

sediment, and provides organic input to the channel. This organic input is valuable in streams with relatively low productivity, such as many of those on the west side of Glacier National Park. However, due to the relative size of the area proposed for treatment, impacts to stream nutrients are negligible.

The presence of contaminants is likely negligible in the project area due to the undeveloped nature of the watershed. However, recent air quality and mercury testing in fish in the park has revealed airborne contamination in the form of mercury, historic-use pesticides, and current-use pesticides in park waters, including mercury in the McDonald Creek watershed. Alternative III would have no anticipated effects on metals or other toxic compounds.

There is a small chance that chemical contamination (hydraulic fluid, gasoline/diesel fuel, motor oil) could occur in the event of mechanical failure during any emergency stabilization work. All machines, engines, hoses, and fittings would be inspected prior to commencement of activities. The risk of failure is low, based on past experience, and is discountable. Under Alternative III, minor to moderate short-term adverse impacts to water resources would occur and minor beneficial long-term impacts to water resources would also occur.

Cumulative Impacts of Alternative III

Cumulative impacts to water quality considered include recently completed emergency culvert stabilization at MP 23.3 and 33.23, as well as ongoing maintenance and repairs at the Haystack and to the Logan Creek crossings. Future emergency stabilization on McDonald Creek associated with GTSR maintenance is also possible.

Lateral migration of stream channels and resulting bank erosion are often a natural part of fluvial processes that shape streams. Patterns of rivers are developed to provide for the dissipation of the energy of moving water, and the transportation of sediment (Rosgen 1996). This erosion can have both positive (i.e. providing large woody debris and spawning gravel recruitment) and adverse impacts (i.e. pool filling, fine sediment in spawning gravel) on water quality, as well as aquatic species and their habitat.

Extensive armoring of streambanks can have adverse and unintended consequences for fluvial processes in rivers and streams. Continued extensive armoring of streambanks with riprap or other structures/material affects the ability of streams to respond to changes in sediment and water supply, or other upstream perturbations through lateral migration. The inability of streams to laterally migrate can lead to increased channel gradient, and vertical adjustments in the channel where bed material allows. Such vertical adjustments can lead to abandonment of floodplains due to channel downcutting, increased bank erosion rates, lowering of the water table, and changes in riparian vegetative community (Schmetterling 2001). Riprap might also result in increased erosion downstream of the project site. Although vertical adjustments might occur in finer grained stream systems in response to bank stabilization efforts, it is unlikely to occur in McDonald Creek due to the coarse nature of the bed, as well as bedrock inclusions that serve as grade control.

Most of the McDonald Creek drainage has no roads, and the potential need for bank armoring is limited to certain areas immediately adjacent to GTSR. Other water quality parameters would remain largely unchanged in the cumulative effects analysis. Therefore, it is unlikely that cumulative impacts to water quality associated with streambank stabilization under Alternative III would have any impacts beyond minor. Actions proposed under Alternative III, combined with past, on-going and future actions would have moderate short-term adverse impacts to water resources as well as minor beneficial long-term impacts to water resources.

Conclusion

Actions proposed for Alternative III would result in moderate, short-term, adverse impacts to water resources due to the sediment generation during the installation of riprap. Minor,

beneficial, long-term impacts to water resources would occur from the permanent stabilization of the bank. Cumulative impacts would have moderate, short-term, adverse impacts to water resources as well as minor, beneficial, long-term impacts to water resources.

Because Alternative III would not result in major adverse impacts to water resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park water resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Floodplain

Affected Environment

Floodplains are a very important component of a river's natural processes. They slow and disperse the energy of floodwaters, providing diverse habitat for wildlife and plants that thrive on flood disturbance. Large woody debris and fine river sediment collects in floodplains increasing biodiversity in these areas. Information on floodplain boundaries along the Upper McDonald Creek in the Going-to-the-Sun Road corridor is incomplete, but previous studies and inferences based on terrain and observations during flood events provide an indication of the 100-year floodplain areas, of which the project area is inclusive. Peak run off for streams along the Going-to-the-Sun Road corridor usually occurs during fall rain-on-snow events, during the spring in response to snow melt or during summer thunderstorms.

The available water holding capacity of floodplains is usually very low. Productivity and revegetation potentials are generally low, but are improved where shallow seasonal groundwater occurs near the surface. Erosion potential is generally moderate (but high for sandy, rock-free layers) and would occur whenever surface vegetation and plant litter is removed or soil is disturbed. This soil type is highly susceptible to weed infestation when disturbed, due to a combination of frequent soil disturbance from flooding (and, in this case, staging operations), rocky, sandy, soil textures, open canopy conditions, available weed seed source, and low elevation. Flooding, very rapid permeability and seasonal high ground water limit sewage disposal options on these sites (Dutton et al. 2001).

Impact Analysis

Methodology

Methodology use to analyze impacts to floodplain is based on an analysis of expected changes to the floodplain under the different alternatives. Changes in water distribution and floodplain dynamics are assessed. The affected environment and impact analysis for floodplain is limited to areas within the high water zone within the project area on both side of the creek and slightly downstream.

Negligible: Floodplains would not be affected, or changes would be either non-detectable or if detected, would have effects that would be slight and non-measurable. The change would have barely perceptible consequences to riparian habitat function.

Minor: Changes in floodplains would be measurable, although the changes would be small and the effects would be localized. The action would affect a few individual plants or wildlife species within an existing riparian area.

Moderate: Change in floodplains would be measurable, long-term and on a localized scale.

Plant and wildlife species within the existing riparian area would experience a measurable effect, but all species would remain indefinitely viable.

Major: Changes in floodplains would be readily measurable and have substantial consequences to floodplain dynamics and would be noticed on a localized scale within the watershed.

Short-term: After implementation, recovery would last less than one year.

Long-term: After implementation, recovery would last less than one year.

IMPACTS OF ALTERNATIVE I – NO ACTION

Future flood events could potentially alter the current configuration of the floodplain, but these would be a result of natural processes. The park would continue attempts to maintain the stability of the bank at MP 19.25 and the integrity of the road. Because of the park's objective to protect the road, any floodplain changes southeast of the creek would be considered a threat to the road and, therefore, adverse. Otherwise, natural changes in the floodplain would not be impeded or considered detrimental for the protection of the road. Slight alterations of the floodplain would cause no more than minor, adverse, long-term impacts.

Cumulative Impacts

Past, on-going, or future actions that have had or might have some impact on floodplains in the McDonald Creek Valley include utilization of Logan Pit as a staging and stockpiling site and rehabilitation and addressing flood potential at Logan Creek Bridge. While materials have been stored within the floodplain, soils compacted, and foreign soil materials added to the floodplain, the activity has not had appreciable impact on floodplain dynamics at the site. Depending on the selected alternative for mitigating flood hazards at Logan Creek Bridge, channelizing or redirecting the creek could result in minor to moderate impacts of floodplains in the McDonald Creek Valley. These impacts combined with impacts of the No Action Alternative would result in minor to moderate, adverse, long-term impacts to floodplain resources.

Conclusion

The direct, indirect and cumulative impacts of the no action alternative on floodplain resources would be minor to moderate, adverse, and long-term.

Because the no action alternative would not result in major adverse impacts to floodplain resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park floodplain resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE II

As a result of actions proposed in Alternative II, the front edge of the point bar directly across and immediately downstream of the barbs would likely retreat a few feet to maintain an effective channel width. Bank erosion immediately upstream of the barbs would be reduced as stream flow energy is dissipated and the flow is redirected across the stream. Sediment would also deposit upstream of the barbs. Scour holes would develop immediately downstream of the barb points. Natural adjustments to accommodate flow on the opposite side of the creek are expected to occur and would help maintain natural floodplain processes, and beneficial, resulting from maintaining the floodplain process northwest of the creek. These effects to floodplains from Alternative II are expected to be minor and long-term.

Cumulative Impacts of Alternative II
Cumulative impacts of Alternative II on floodplains would be the same as those described in Alternative I.

Conclusion
The direct, indirect and cumulative impacts of Alternative II on floodplain resources would be minor to moderate, adverse, and long-term overall.

Because Alternative II would not result in major adverse impacts to floodplain resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park floodplain resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Impact Analysis of Alternative III
Impacts of Alternative III on floodplain resources would be similar to those described in Alternative I. Armoring of the bank toe, as proposed in this alternative, would reduce the risk of accelerated stream bank erosion and undermining the GTSR because it extends further up and downstream, as compared to alternative II. Changes to the floodplain relative to existing conditions would be unlikely or negligible to minor.

Cumulative Impacts of Alternative III
Cumulative impacts of Alternative III on floodplain would be the same as those described in Alternative I.

Conclusion
The direct, indirect, and cumulative impacts of Alternative III on floodplain resources would be minor to moderate, adverse, and long-term, primarily as a result of the cumulative impacts of other projects.

Because Alternative III would not result in major adverse impacts to floodplain resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park floodplain resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Visual Resources and Visitor Experience

Affected Environment
The Going-to-the-Sun Road is a key component of a complex and dramatic visual landscape. Spectacular views of mountains, lakes, streams, and forestland well beyond the roadway corridor can be seen; making it a primary visitor destination. Important cultural landscapes such as historically significant engineering features are observable throughout the road. The panoramic views of the natural environment provided by the road are complemented by the excellent examples of craftsmanship and unique engineering used in the GTSR construction. Views of Lake McDonald from the road initiate visitors to a journey up the McDonald Valley winding through the visitor use zone, catching views of McDonald Creek along the way. McDonald Creek and its tributaries have mostly remained unaltered from human caused

influences making it one of the pristine watersheds in the nation. Bridge and drainage structures have been installed but in-stream work has been minimized to emergency repair work to these structures and bank stabilization.

IMPACT ANALYSIS

METHODOLOGY

Potential impacts to visitors associated with travel through the park was evaluated based on staff knowledge of visitor travel patterns and use levels and previous analysis in the *Going-to–the-Sun Road Rehabilitation Plan/Final Environmental Impact Statement*, April 2003.

Negligible: Visitors would not be affected, or the changes in visitor experience would be below or at the level of detection. The visitor would not likely be aware of the effects associated with the alternative and changes to the existing viewshed would not be perceptible.

Minor: Changes in visitor experience would be detectable, although the changes would be slight. The visitor would be aware of the effects associated with the alternative, but the effects would be slight to visitor experience and changes to the existing viewshed would be slightly perceptible.

Moderate: Changes in visitor experience would be readily apparent. The visitor would be aware of the effects associated with the alternative and changes to the existing character of the viewshed would be readily apparent.

Major: Changes in visitor experience would be readily apparent and have important consequences. The visitor would be aware of the effects associated with the alternative. Effects would be highly noticeable or would change the character of the viewshed by adding human-made features into a mostly undeveloped area or by removing most human-made features from a developed area.

Short-term: Occurs only during project implementation or one month.

Long-term: Occurs for more than one month or is permanent.

IMPACTS OF ALTERNATIVE I – THE NO ACTION

Under the No Action Alternative, visitors would be affected by the continued presence of the concrete jersey barriers and visible soil nail wall. Not all visitors driving the road would notice the soil nails. However, these features are not natural and visitors who did view them would experience minor adverse long term impact for both experience and visual resources.

Cumulative Impacts of the No Action Alternative

The no action alternative combined with past, on-going, and future actions would result in minor to moderate, short and long-term adverse impacts to visitor experience from continued streambank maintenance at MP 19.25 along the road. Visual resources would have adverse, moderately impacted from the presence of construction equipment for temporary stabilization techniques for short periods.

Conclusion

The no action alternative would result in minor long-term adverse impacts on visitor experience and visual resources. Combined with past, on-going, and future construction and operational activities within the GTSR corridor visitors would cumulatively experience minor to moderate, short and long-term adverse impacts and adverse, moderate, short-term impacts to visual resources.

Because this alternative would not result in major adverse impacts to visual resources and visitor

experience, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park visual resources and visitor experience resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts for visual resources and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE II

Under Alternative II, impacts to visitors would include the visual, permanent presence of human-made structures (the rock barbs) in McDonald Creek. All visitors might not notice the structures. Construction would occur after this section of the road has closed to vehicle traffic for the winter therefore only a small number of visitors who travel on foot beyond the winter gate would be impacted by machinery. Actions in this alternative would provide permanent stabilization of the GTSR and further repair at this site are not anticipated. Therefore, under this alternative negligible to minor, adverse short-term impacts and moderate, both adverse and beneficial, long-term impacts are expected.

Cumulative Impacts of Alternative II

The actions proposed for Alternative II combined with past, on-going and future actions would have minor to moderate, adverse long-term impacts to visual resources. However, permanent stabilization work would have both beneficial and adverse long-term impacts to visitor experience as the GTSR would remain intact but the rock barbs would remain visible.

Conclusion

Actions proposed in Alternative II would have negligible to minor, adverse short-term impacts and moderate, both adverse and beneficial, long-term impacts on visual resources and visitor experience. Cumulative impacts would result in moderate, adverse long-term impacts to visual resources and both beneficial and adverse long-term impacts to visitor experience as the GTSR would remain intact but the rock barbs would remain visible.

Because Alternative II would not result in major adverse impacts to visual resources and visitor experience, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park visual resources and visitor experience resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts for visual resources and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III

Potential impacts and cumulative impacts to visual resources and visitor experience under Alternative III would be the same as under Alternative II.

Because Alternative III would not result in major adverse impacts to visual resources and visitor experience, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park visual resources and visitor experience resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts for visual resources and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Cultural Resources

Affected Environment

Glacier National Park is home to a wide array of significant cultural resources. The National Historic Preservation Act (NHPA) defines five cultural resource property types: districts, sites, buildings, structures, and objects. The National Environmental Protection Act uses the term cultural resources and defines them as archaeological resources, cultural landscapes, structures, ethnographic resources, and museum objects. As of 2006, 344 archaeological sites, more than 350 historic buildings and structures, and one cultural landscape have been documented within the park. Most of the buildings and structures are listed in the National Register of Historic Places. Six buildings and the one documented cultural landscape, the Going-to-the-Sun Road, also are designated National Historic Landmarks. The park has prepared an ethnographic overview documenting the importance of the landscape and features to the Blackfeet and Kootenai tribes (Reeves and Peacock 2001).

The National Historic Preservation Act of 1966, as amended (NHPA), and its implementing regulations (36 CFR § 800) require federal agencies, such as the NPS, to identify potentially significant cultural resources with in the area of potential effect (APE) of an agency's proposed undertaking and to consider the effects of the undertaking on cultural resources before taking any action. The APE includes the geographic area within which an undertaking might directly or indirectly cause alterations in the character or use of a cultural resource.

The NHPA and its implementing regulations, require that the NPS consult with the State Historic Preservation Office (SHPO), Tribal Historic Preservation Offices (THPO), interested Native American Tribes, and other interested parties to identify cultural resources within the APE, Assess the undertakings effects, and seek ways to avoid, minimize, or mitigate any adverse effects on cultural resources.

Historic Structures and Cultural Landscapes

Within the area of potential effect (APE) of the proposed project is the Going-to-the-Sun Road Historic District (24GL0136 and 24FH0161). The federal government and others recognize the historical significance of the GTSR. The GTSR was listed in the National Register of Historic Places in 1983; designated a National Historic Civil Engineering Landmark in 1985; documented by the Historic American Engineering Record (HAER) in 1990; and was designated a National Historic Landmark by the Secretary of the Interior in 1997. The latter distinction is the most noteworthy and restrictive, and affords the road and its component features the highest possible level of federal protection. The road is considered significant for its history, landscape design, and engineering. As an early example of a major national park roadway, the GTSR represents a pioneering federal attempt to design and construct an automobile road that both harmonized with its environment and showcased its natural surrounding. These design philosophies, as embodied in the road, became a model for future parkway projects to follow. The engineering and landscape architecture techniques used in the road further reflected this design philosophy, featuring well-crafted stonework, gentle curves, and rounded and replanted cut slopes that blend perfectly with the spectacular natural setting. Both the National Register and National Historic Landmark nominations include the length of the road from the foot of Lake McDonald to the park boundary at St. Mary. Important individual structures that are part of the road – primarily bridges and tunnels – are listed as contributing to the road's significance.

IMPACT ANALYSIS

METHODOLOGY

In this environmental assessment (EA), impacts to cultural resources are described in terms of type, context, duration, and intensity, which is consistent with the regulations of the Council on Environmental Quality (CEQ) that implement the National Environmental Policy Act (NEPA). These impact analyses are not intended, however, to comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA). The Advisory Council on Historic Preservation's regulations implementing Section 106 of the NHPA (36 CFR Part 800, Protection of Historic Properties), require a level of documentation for findings of effect sufficient to understand its basis, i.e. design development drawings for building modifications, which are not available at this time. The park is coordinating compliance with Section 106 and the steps taken to meet the requirements of this EA. This coordination includes public participation, State Historic Preservation Office and Tribal Historic Preservation office consultation, and the identification of historic properties requirements. Findings of effect, however, would be made independently of the NEPA process. A preliminary Section 106 finding of effect is included in the impact analysis sections under the preferred alternative for cultural resource topics.

The preliminary finding of effect was made in accordance with the Advisor Council on Historic Preservation's regulations. Effects to historic properties were identified and evaluated by (1) determining the area of potential effect(s); (2) identifying cultural resources present in the area of potential effects that were either listed in or eligible to be listed in the National Register of Historic Places; (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed in the National Register; and (4) considering ways to avoid, minimize or mitigate adverse effects.

Under the Advisory Council's regulations, a determination of either adverse effect or no adverse effect must also be made for affected National Register eligible cultural resources. An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register (e.g. diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, be farther removed in distance or be cumulative (36 CFR Part 800.5, Assessment of Adverse Effects). A determination of no adverse effect means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the National Register.

CEQ regulations and the National Park Service's Conservation Planning, Environmental Impact Analysis and Decision-making (Director's Order 12) also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact, e.g. reducing the intensity of an impact from major to moderate or minor. Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. It does not suggest the level of effect as defined by Section 106 is similarly reduced. Although adverse effects under Section 106 may be mitigated, the effect remains adverse.

Negligible: Impact is at the lowest levels of detection – barely perceptible and not measurable. For purposes of Section 106, the determination of effect would be no adverse effect.

Minor: Treatment would affect the character defining features of a National Register of Historic Places eligible or listed resource, but is in accordance with the Secretary of the Interior's Standards. For purposes of Section 106, the finding of effect would be no adverse effect.

Moderate: Treatment would alter a character defining feature(s) diminishing the integrity of the National Register of Historic Places eligible or listed resource to the extent that it is no longer eligible for listing in the National Register. For purposes of Section 106, the finding of effect would be adverse effect.

Major: The impact would alter a character defining feature(s) of the National Register of Historic Places eligible or listed resource, diminishing the integrity of the resource to the extent that its designation is threatened. For purposes of Section 106, the determination of effect would be adverse effect.

Short-term: Effects extended only through the period of bank stabilization efforts.

Long-term: Effects extended beyond the period of bank stabilization efforts.

IMPACTS OF ALTERNATIVE I – NO ACTION

The no action alternative would not result in any changes to existing conditions, the soil nails and jersey barriers would remain. Therefore impacts would be negligible to minor, long-term, site-specific adverse impacts due to the slight visible changes to the National Historic Landmark characteristics of the GTSR (see photo 1).

Section 106: For purposed of Section 106 the finding effect would be no historic properties affected.

Cumulative Impacts of the No Action Alternative

Of the projects identified for consideration of cumulative impacts, several have had, or would have, detectable impacts on historic structures and cultural landscapes. The GTSR/FEIS identified the preferred rehabilitation alternative as having negligible to moderate, short-term adverse and long-term beneficial impacts to cultural resources (NPS 2003). These impacts included changes in the historic setting caused by construction activities and rehabilitation work meeting the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR Part 67). The FEIS recognized the potential for adverse impacts resulting from the construction of modern visitor use improvements at several locations within the road corridor. All rehabilitation work, whether under the GTSR/FEIS or newly identified improvements (emergency and general maintenance) is being undertaken in conformance with the Secretary's Standards in order to avoid adverse effects under Section 106 of the National Historic Preservation Act. However, maintaining the temporary stabilization efforts could result in eventual loss of the road at this location. This could be a major, long-term, site-specific adverse impact to the National Historic Landmark characteristics of the GTSR and might result in an Adverse Effect under Section 106 of the National Historic Preservation Act.

Conclusion

In conclusion under no action alternative the impacts would be negligible to minor, localized and adverse impacts to historic structures or cultural landscapes. However, if the road is washed out in the future major, localized and adverse impacts to historic structures or cultural landscapes may result. Cumulative impacts would range from negligible to major, short-term to long-term, localized and adverse.

Because the no action alternative would not result in major adverse impacts to cultural resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would not be an impairment of park cultural resource values related to this alternative. The no action alternative also could make a major contribution to cumulative impacts on historic structures or cultural resources in the project area. Implementation of this alternative could result in unacceptable impacts and is not consistent

with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE II

Under Alternative II stone riprap and vegetation would be used to armor the bank from the water line to the road shoulder for approximately 100 feet. Stone stream barbs would extend approximately 35 feet to either side of the riprap, but only partially up the creek bank. The proposed work would not be visible from the road to those traveling east (see Photo 1). The proposed work would be visible to those traveling west at a pullout approximately two-tenths of a mile distance (see Photo 2). As travelers pass the pullout, the forest-lined corridor again closes, and the proposed work would not be visible on approach. The proposed work is consistent with historic construction methods used along McDonald Creek (see Photos 3 and 4) where much of the road was constructed on cut-and-fill requiring protection of the creek-side road bank. Some of this has since been covered with vegetation, while in other areas the riprap would still clearly visible. The new riprap would cause a slight change to the visual character of the road at this location. The impact on the road would be minor, long-term, site-specific and adverse.

Section 106: For the purpose of Section 106, the finding of effect would be no adverse effect

Photo 1. View of McDonald Creek bank stabilization site to visitors traveling east.
(Project site is at jersey barriers on left side of road)

Photo 2. View of McDonald Creek bank stabilization site to visitors traveling west.
(View is from pullout approximately two-tenths of a mile above site.)

Cumulative Impacts of Alternative II

Of the projects identified for consideration of cumulative impacts, several have had, or would have, detectable impacts on historic structures and cultural landscapes. The GTSR/FEIS identified the preferred rehabilitation alternative as having negligible to moderate, short-term, adverse, and long-term beneficial impacts to cultural resources (NPS 2003). These impacts included changes in the historic setting caused by construction activities and rehabilitation work meeting the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR Part 67). The FEIS recognized the potential for adverse impacts resulting from the construction of modern visitor use improvements at several locations within the road corridor. All rehabilitation work, whether under the GTSR/FEIS or newly identified improvements (emergency and general maintenance) is being undertaken in conformance with the Secretary's Standards in order to minimize and mitigate potential adverse effects under Section 106 of the National Historic Preservation Act.

Overall cumulative impacts on historic structures and cultural landscapes would be negligible to moderate, long-term localized and adverse to beneficial. Under Section 106, the finding would not meet the criteria of adverse effect.

Conclusion

Alternative II would result in visual changes to the Going-to-the-Sun Road. However, the proposed work is consistent with historic construction methods used along McDonald Creek (see Photo 3). The proposed work, therefore, meets the Secretary of the Interior's Standards for the Treatment of Historic Properties. Impacts would be minor, long-term, localized and adverse to historic structures and cultural landscapes. Cumulative impacts would range from negligible to minor, short-term, localized and adverse. Under Section 106, the finding would not meet the criteria of adverse effect.

Photo 3. McDonald Creek bank stabilization with riprap along the Going-to-the-Sun Road, 1934 (GNP Digital Image Database Accession Number 11616)

Photo 4. Typical road bank appearance along McDonald Creek in areas of cut-and-fill

Because Alternative II would not result in major adverse impacts to cultural resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park cultural resource values related to this alternative. Alternative II also would make a negligible contribution to

cumulative impacts on cultural resources in the project area. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III

Under Alternative III stone riprap and vegetation would be used to armor the bank from the water line to the road shoulder for approximately 100 feet. Rip rap armored toes would extend 100 feet to the east and 65 feet to the west. Impacts would be similar to those described for Alternative II. The new riprap would cause a slight change to the visual character of the road at this location. The impact on the road would be minor, long-term, site-specific and adverse.

Section 106: For the purpose of Section 106, the finding of effect would be no adverse effect.

Cumulative Impacts of Alternative III

Of the projects identified for consideration of cumulative impacts, several have had, or would have, detectable impacts on historic structures and cultural landscapes. The GTSR/FEIS identified the preferred rehabilitation alternative as having negligible to moderate, short-term, adverse, and long-term beneficial impacts to cultural resources (NPS 2003). These impacts included changes in the historic setting caused by construction activities and rehabilitation work meeting the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR Part 67). The FEIS recognized the potential for adverse impacts resulting from the construction of modern visitor use improvements at several locations within the road corridor. All rehabilitation work, whether under the GTSR/FEIS or newly identified improvements (emergency and general maintenance) is being undertaken in conformance with the Secretary's Standards in order to minimize and mitigate potential adverse effects under Section 106 of the National Historic Preservation Act.

Overall cumulative impacts on historic structures and cultural landscapes would be negligible to moderate, long-term localized and adverse to beneficial. Under Section 106, the finding would not meet the criteria of adverse effect.

Conclusion

Alternative III would result in visual changes to the Going-to-the-Sun Road. However, the proposed work is consistent with historic construction methods used along McDonald Creek (see Photo 1). The proposed work, therefore, meets the Secretary of the Interior's Standards for the Treatment of Historic Properties. Impacts would be minor, long-term, localized and adverse to historic structures and cultural landscapes. Cumulative impacts would range from negligible to minor, short-term, localized and adverse. Under Section 106, the finding would not meet the criteria of adverse effect.

Because Alternative III would not result in major adverse impacts to cultural resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park cultural resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Natural Soundscape

AFFECTED ENVIRONMENT

An important policy of the NPS is 'to preserve, to the greatest extent possible, the natural soundscapes of parks" (NPS 2006). NPS strives to preserve the natural sounds associated with the biological resources of the Glacier National Park. Natural soundscapes can be transmitted in

a mixture of all nature's elements and in a wide audible range. They are an important resource and have intrinsic value as a part of the unique environment of the park. Natural sounds of wind, water, animals and other natural phenomena predominated through most of the park. Natural quiet exists when the sound of these natural components of the park prevail.

The project area and all areas along the lower section of the GTSR experienced artificial noises from human activities, particularly related to construction, overflights and visitor activities. Therefore noises associated with truck traffic, equipment and loading is common place in this area. Natural sounds are more apparent during the winter when park access is restricted to the public at Avalanche Campground and visitor use has been reduced substantially.

The backcountry is dominated by natural quiet. About 95% of the park is proposed wilderness where natural quiet is considered an important resource. The GTSR corridor is surrounded by backcountry where natural sounds dominate.

IMPACT ANALYSIS

METHODOLOGY

Natural soundscapes are defined as the variety of natural sounds comprising an ecosystem including the physical capacity for transmitting those natural sounds and the interrelationships among park natural sounds of different frequencies and volumes. Potential impacts, to the natural soundscape within the park associated with permanently stabilizing the bank at MP 19.25, were evaluated based on anticipated noise typical for similar types of construction work that is occurring and has occurred in the park.

Negligible: There would be temporary introduction of artificial noise; however effects would not be perceptible.

Minor: An introduction of artificial noise would occur temporarily at localized sites. The effects would be readily detectable, but may cause minor disturbance to Glacier National Park visitors, concessionaires, or wildlife.

Moderate: An introduction of artificial noise would be readily detectable for longer periods of time over a widespread area and would affect nearby visitors, concessionaires, and/or wildlife

Major: Continuous, loud, disruptive noise occurring daily, throughout the day, affecting visitors, concessionaires, and wildlife.

Short-term: Effects extend only through the period of the GTSR rehabilitation project.

Long-term: Effects extend beyond the GTSR rehabilitation project.

IMPACTS OF ALTERNATIVE I – NO ACTION ALTERNATIVE

Artificial noise from construction would not be generated as no new construction is proposed. There would be no impacts to natural soundscapes under the no action alternative.

Cumulative Impacts of the No Action Alternative

Continued use of the Logan Pit site combined with the GTSR rehabilitation project and visitor and park staff traffic on the GTSR would continue to adversely impact natural sounds near the project area. After the road rehabilitation project was completed noise levels would be reduced in the project area. At times some noise from these operations might be heard in the backcountry both in the area of the Garden Wall and in the backcountry surrounding the GTSR corridor. Cumulative impacts to natural sounds from the no action alternative combined with on-going and future actions from equipment, loading and unloading and traffic would be minor, short and long-term, adverse and mostly localized though for short periods during the day could

be heard in the backcountry and thus be widespread.

Conclusion

The no action alternative would not have impacts on natural sounds. While noise impacts could be widespread at times during the day from on-going road rehabilitation, this is anticipated to have minor, short and long-term, adverse and mostly localized though for short periods during the day could be heard in the backcountry and thus be widespread.

Because the no action alternative would not result in major adverse impacts to natural soundscapes resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park natural soundscapes resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Impact Analysis of Alternative II

Artificial noise would be present to visitors who recreate and wildlife that use low elevation riparian areas in the park during the winter months. Natural sound would be altered for approximately two months by heavy equipment hauling and placing materials in the stream and along the bank. Since the action would occur when visitor use is low and backcountry access is limited, it is not expected to be widespread. Once the permanent stabilization efforts were completed the park would not have to revisit the site and therefore reduce the need for future impacts to natural soundscapes. Therefore, the preferred alternative would have localized, negligible to minor, short-term adverse and long-term beneficial impacts to natural soundscapes.

Cumulative Impacts of the Preferred Alternative

Continued use of the Logan Pit site combined with the GTSR rehabilitation project and visitor and park staff traffic on the GTSR would continue to adversely impact natural sounds near the project area. After the road rehabilitation project was completed noise levels would be reduced in the project area. At times some noise from these operations might be heard in the backcountry both in the area of the Garden Wall and in the backcountry surrounding the GTSR corridor. Cumulative impacts to natural sounds from the preferred alternative combined with on-going and future actions from equipment, loading and unloading and traffic would be minor, short and long-term, adverse and mostly localized though for short periods during the day could be heard in the backcountry and thus be widespread.

Conclusion

This alternative would have localized, negligible to minor, short-term adverse and long-term beneficial impacts on natural sounds. Actions proposed combined with on-going and future actions from equipment, loading, and increased traffic, noise impacts could be widespread at times during the day, this is anticipated to have minor, short and long-term, adverse and mostly localized though for short periods during the day could be heard in the backcountry and thus be widespread.

Because Alternative II would not result in major adverse impacts to natural soundscapes resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park natural soundscapes resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE III – THE PREFERRED

Artificial noise would be present to visitors who recreate and wildlife that use low elevation riparian areas in the park during the winter months. Natural sound would be altered for approximately two months by heavy equipment hauling and placing materials in the stream and along the bank.

Cumulative Impacts of Alternative III

Cumulative impacts of Alternative III would be the same as described for the preferred alternative.

Conclusion

Alternative III would have localized, negligible to minor, short-term adverse and long-term beneficial impacts on natural sounds. Actions proposed combined with on-going and future actions from equipment, loading, and increased traffic, noise impacts could be widespread at times during the day, this is anticipated to have minor, short and long-term, adverse and mostly localized though for short periods during the day could be heard in the backcountry and thus be widespread.

Because Alternative III would not result in major adverse impacts to natural soundscapes resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park natural soundscapes resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

COMPLIANCE REQUIREMENTS

National Environmental Policy Act (NEPA) and Regulations of the Council on Environmental Quality – The National Environmental Policy Act applies to major federal actions that may significantly affect the quality of the human environment. This generally includes major construction activities that involve the use of federal lands or facilities, federal funding, or federal authorizations. This EA meets the requirements of the NEPA and regulations of the Council on Environmental Quality in evaluating potential effects associated with activities on federal lands. If no significant effects are identified a finding of no significant impacts (FONSI) would be prepared. If significant effects are identified a notice of intent (NOI) would be filed for preparation of an environmental impact statement (EIS).

Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) – Section 7 of the Endangered Species Act is designed to ensure that any action authorized, funded, or carried out by a federal agency likely would not jeopardize the continued existence of any endangered or threatened plant or animal species. If a federal action may affect threatened or endangered species, then consultation with the U.S. Fish and Wildlife Service is required. The NPS determined that the proposed action would "**may affect, not likely to adversely affect" gray wolves, grizzly bears, and Canada lynx**, under Section 7. The biological assessment (February 13, 2003) prepared for the *2003 Going-to-the Sun Road Rehabilitation Plan, FEIS* covers this action. A Biological Opinion was issued by the US Fish and Wildlife Service on July 30, 2003 concurring with the park's determination. This Environmental Assessment and an accompanying letter to inform the USFWS the actions proposed in this document are within the determinations made for the GTSR/FEIS will be submitted for their review and concurrence. The NPS determined that the proposed action "**may affect, not likely to adversely affect**" the threatened bull trout, therefore a Fisheries BA will be submitted for review and concurrence under Section 7.

Clean Water Act (CWA) and Montana Stream Protection Act – The U.S. Army Corps of Engineers (COE) is responsible for authorizing the placement of fill into waters of the U.S. and filling of wetlands under Section 404 of the Clean Water Act. No wetlands would be filled from project implementation. The Montana Stream Protection Act and the State's responsibility under the Clean Water Act are responsible for dredging and removal of materials from streams. Necessary permits from the COE, Montana Department of Fish, Wildlife and Parks and the Department of Environmental Quality would be obtained.

Executive Order 11990, Protection of Wetlands – This order requires federal agencies to avoid, where possible, impacts to wetlands. The NPS is guided by the 2006 *Management Policies* and Director's Order 77-1: *Wetland Protection*. No wetlands would be affected by this project.

Executive Order 11988, Floodplain Management – Executive Order 11988 *Floodplain Management* requires all federal agencies to avoid construction within the 100-year floodplain unless no other practicable alternative exists. The NPS is guided by the 2006 *Management Policies* and Director's Order 77-2: *Floodplain Management*. The service will strive to preserve floodplain values and minimize hazardous floodplain conditions. The impacts of the proposed action within the 100-year floodplain are discussed and analyzed in a separate Statement of Findings document that is attached to this environmental assessment.

Montana Floodplain and Floodway Management Act – The Montana Department of Natural Resources of local floodplain administrator regulates construction activities in the 100-year floodplain. The park would apply for a Floodplain Development Permit if necessary.

National Historic Preservation Act of 1966, as amended (16 U.S.C. 470, et. seq.)— Section 106 of the National Historic Preservation Act of 1966 (as amended) requires all federal agencies to consider effects from any federal action on cultural resources eligible for or listed on the

National Register of Historic Places (NHRP), prior to initiating such actions. For Section 106 purposes, the park finds that the undertaking will have no effect (no historic properties affect) upon historic properties.

CONSULTATION/COORDINATION

PREPARERS

Tara Carolin, Ecologist; Soils, Vegetation, and Floodplain Reports

Chris Downs, Fisheries Biologist; Aquatic Species and Water Resource Reports

Jack Gordon, Landscape Architect*,* Alternatives Design

Steve Gniadek, Wildlife Biologist; Wildlife and Threatened, Endangered, and Species of Concern Reports

Lon Johnson, Historical Architect/Cultural Resource Specialist; Cultural Resources Report and SHPO consultation

Mary Riddle, Environmental Protection and Compliance Specialist; project description, alternatives, and document compilation, editing, formatting, supervision, quality review, coordinates internal and regional reviews and agency consultation.

Karen Stockmann, Biological Science Technician (Compliance); assists with project description, alternatives, editing, formatting, compilation

CONSULTANTS

Adam Ahola, Federal Highway Administration

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Keith Wong, Federal Highway Administration

AGENCIES/ TRIBES/ ORGANIZATIONS/ INDIVIDUALS CONTACTED (EA RECIPIENTS)

Federal and International

Advisory Council on Historic Preservation
Max Baucus, United States Senate
Jon Tester, United States Senate
Dennis Rehberg, United States House of Representatives
Flathead National Forest (Kalispell, Hungry Horse)
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service (Helena and Creston)
U.S. Geological Survey, Biological Resources Division
U.S. Department of the Interior, Office of the Solicitor
Waterton Lakes National Park, Canada
Premier of the Province of Alberta, Honorable Ed Stelmach
Western Federal Lands Highway Administration

State

Environmental Quality Council, Director, Helena
Montana Department of Environmental Quality, Board of Environmental Review
Montana Department of Environmental Quality Permitting & Compliance, Helena
Montana Department of Environmental Quality, Water Protection Bureau
Montana Department of Environmental Quality, Air Quality Division
Montana Department of Natural Resources and Conservation
Montana Fish, Wildlife, and Parks, Region One Supervisor, Kalispell
Montana State Historic Preservation Office
Brian Schweitzer, Governor of Montana
Stillwater State Forest

Tribes

Willie A. Sharp, Jr., Chair, Blackfeet Tribal Business Council w/copies to Tribal Council and the Blackfeet Tribal Historic Preservation Office
James Steele, Chair, Confederated Salish and Kootenai Tribes of the Flathead Reservation w/copies to Tribal Council and Confederated Salish and Kootenai Tribal Historic Preservation Department

County and City

Chair, Flathead County Board of Commissioners
Glacier County Commissioners
Mayors and City Councils of Browning, Kalispell, Columbia Falls, and Whitefish, MT
Public Libraries: Bigfork, Columbia Falls, Kalispell, Whitefish, MT

Private

Friends of the Wild Swan
Glacier National Park Fund
Glacier Natural History Association
Glacier Park Inc.
Glacier Park Foundation
Glacier Raft Company
Glacier Waterton NP Visitor Association
Great Northern Whitewater Resort
Montana Preservation Alliance
Montana Raft Company
Montana Wilderness Association
National Parks Conservation Association
National Trust for Historic Preservation, Mountain/Plains Office
Wilderness Watch
Wild River Adventures

Individuals

A complete list is available upon request

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APPENDIX A: Alternative Concept Designs

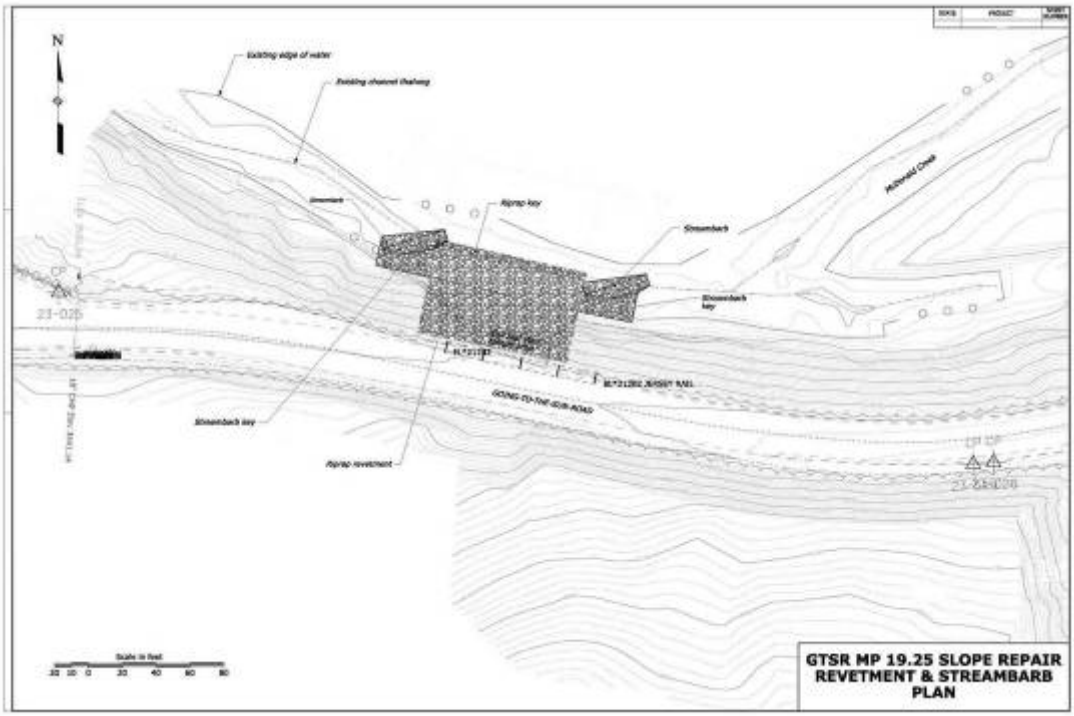

Figure 1. General design layout of Alternative II, revetment and rock barbs

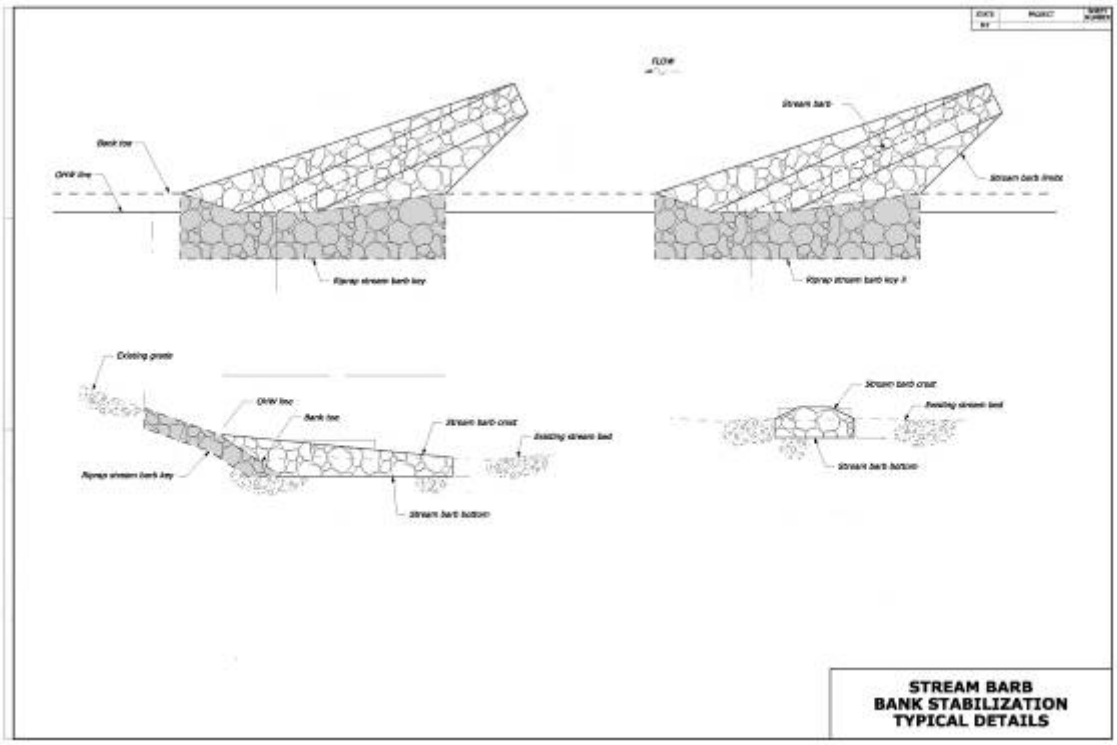

Figure 2. General design layout of rock barbs for Alternative II

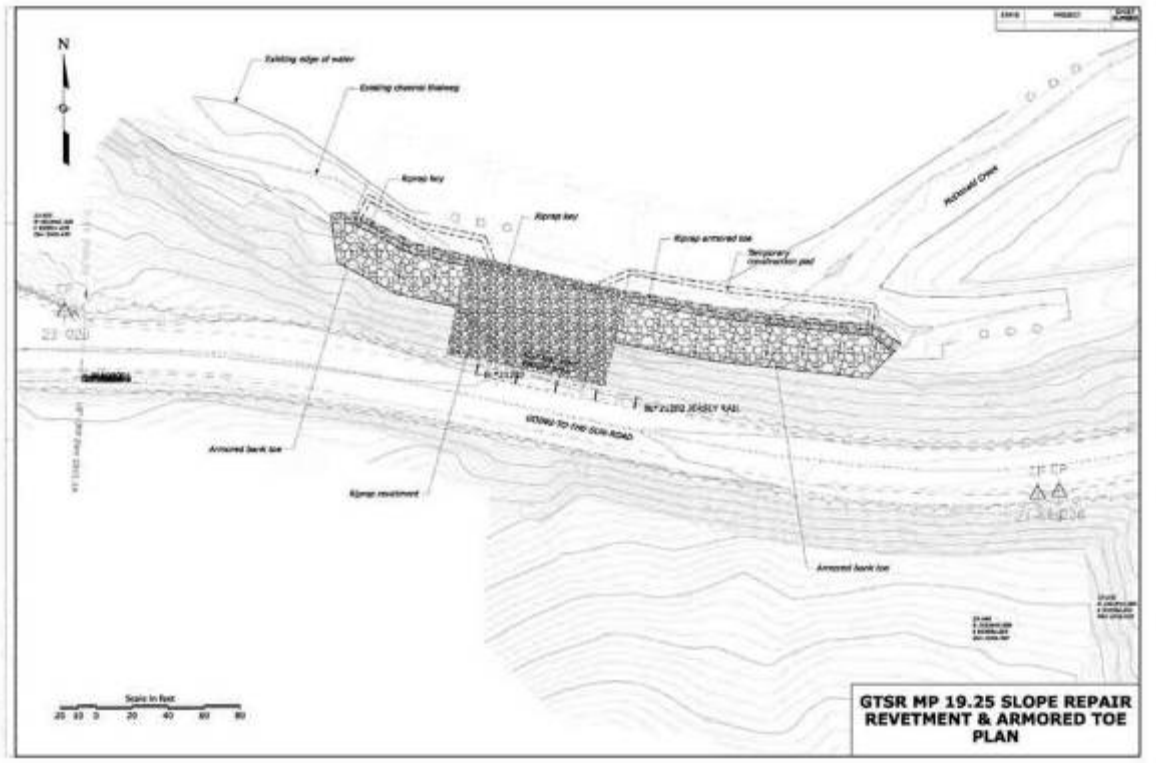

Figure 3. General design layout of Alternative III, revetment and armored toe

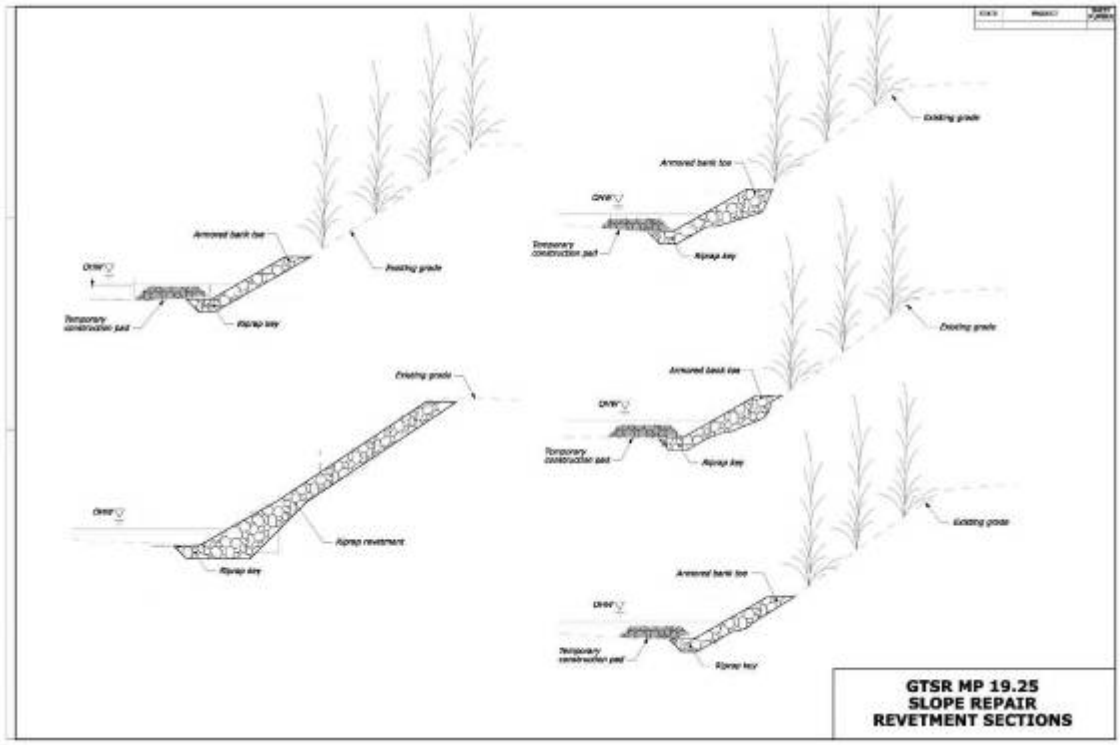

Figure 4. General design layout of revetment with vegetation incorporated for both action alternatives

Statement of Findings for Floodplains

McDonald Creek Bank Stabilization at Milepost 19.25 on the Going-to-the-Sun Road

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Glacier National Park, Montana

INTRODUCTION

Glacier National Park (GNP) has prepared and made available an Environmental Assessment (EA) analyzing bank stabilization techniques for McDonald Creek at Milepost 19.25 (MP 19.25) along the Going-to-the-Sun Road (GTSR) in order to prevent the road and stream bank from further deteriorating at this location. In November 2006, the park experienced a rain on snow event that caused damage throughout the west side of the park. Emergency repair took place on several sections of the GTSR. At MP 19.25, emergency road repair involved the installation of "soil nails" which were used to stabilize unconsolidated soils along the bank of McDonald Creek. This was intended to be a temporary action to keep the road open to visitor traffic. No vegetation was planted or stream improvements were made. Permanent stabilization of the bank is necessary to ensure that further slumping does not occur (leading to loss of the GTSR at this location) and to protect natural resources.

Executive Order 11988 ("Floodplain Management") requires the National Park Service and other agencies to evaluate the likely impacts of actions in floodplains. NPS Director's Order #77-2: Procedural Manual 77-2: Floodplain Management provides NPS policies and procedures for complying with EO 11988. This Statement of Findings (SOF) has been prepared in accordance with these NPS floodplain management procedures.

PROPOSED ACTION

The preferred alternative would take the following action to stabilize approximately 100 feet of the bank and prevent further erosion. Stone riprap, and vegetation would be used to armor the bank above the high water line. The riprap would ensure long-term stabilization at the site while the vegetation would further stabilize the bank.

Large (Class VII), angular riprap would be placed over the sloughed streambank area as well as up and downstream in order to armor the bank toe; totaling approximately 300 lateral feet. The riprap revetment would extend from the stream edge to the shoulder of the GTSR and instream work would be required to place the riprap at the toe of the slope. The riprap would ensure long-term stabilization at the site. It would extend laterally approximately 90 feet from the stream edge of the eroding slope to the road shoulder currently being held by soil nails. A geotextile would be installed between the riprap and the subgrade. Additional armoring of the bank toe would be buried in the streambed to reduce scour along the toe a 6-foot by 3-foot would be installed at or slightly below stream bottom. The armored bank toe would require excavation into the natural channel substrate and creation of a rock "toe" to ensure high flows do not compromise the structural integrity of the stabilization. The armored bank toe would extend 100 feet upstream of the riprap revetment and approximately 65 feet downstream and would rise 10 feet about the stream bottom. In-channel work would involve the excavation of approximately 3,000 ft^3 of native streambed material, which would be replaced with riprap to form the toe of the slope (see figure 1).

The site would be accessed by excavating that portion of the GTSR down to almost stream level. Access might also occur by driving an excavator up McDonald Creek from the pullout below this location, along the open gravel banks and occasionally crossing the stream. If the stream access is selected, the excavator would only make one trip up to the site and one trip down. If the access road is selected, the area of impact would extend the length of the treatment area (approximately 300ft) and would be within the road prism. Temporary construction pads, made

of rock, would be located at the base of the slope to provide a landing for the construction equipment above the water line.

Vegetation would be used to stabilize the upper portion of the bank and along the shoulder of the road. Restoration would include incorporating native species (such as dogwood, cottonwood and willows seedlings) into the riprap revetment between four and ten feet about the stream bottom (see figure 2). The seedlings would further stabilize the stream bank as they sprout and take root. The seedlings would be planted in the soil and then riprap would be placed around them and planting pockets would be incorporated into the upper portions of the riprap.

Final touches, revegetation and project cleanup would most likely occur in early summer after spring runoff. McDonald Creek would not be diverted during the project. Project work would be started during low water times in the fall and would take about two months to complete.

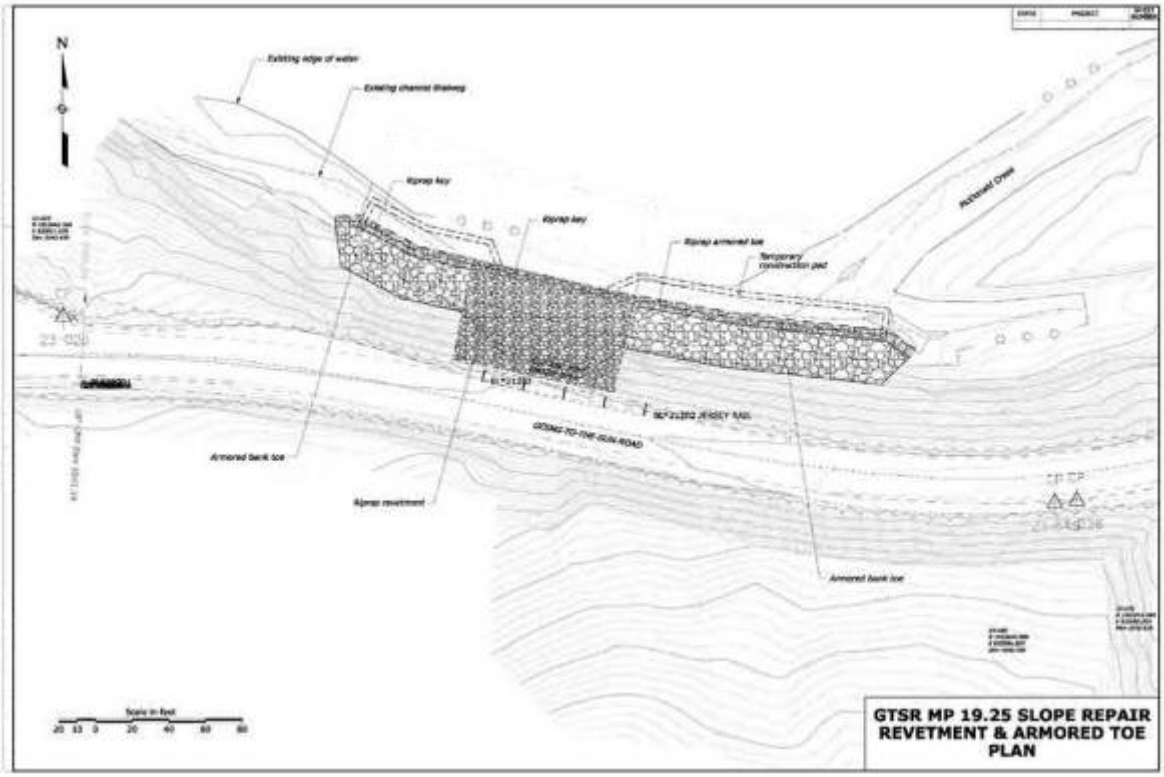

Figure 1. General design layout, revetment and armored toe

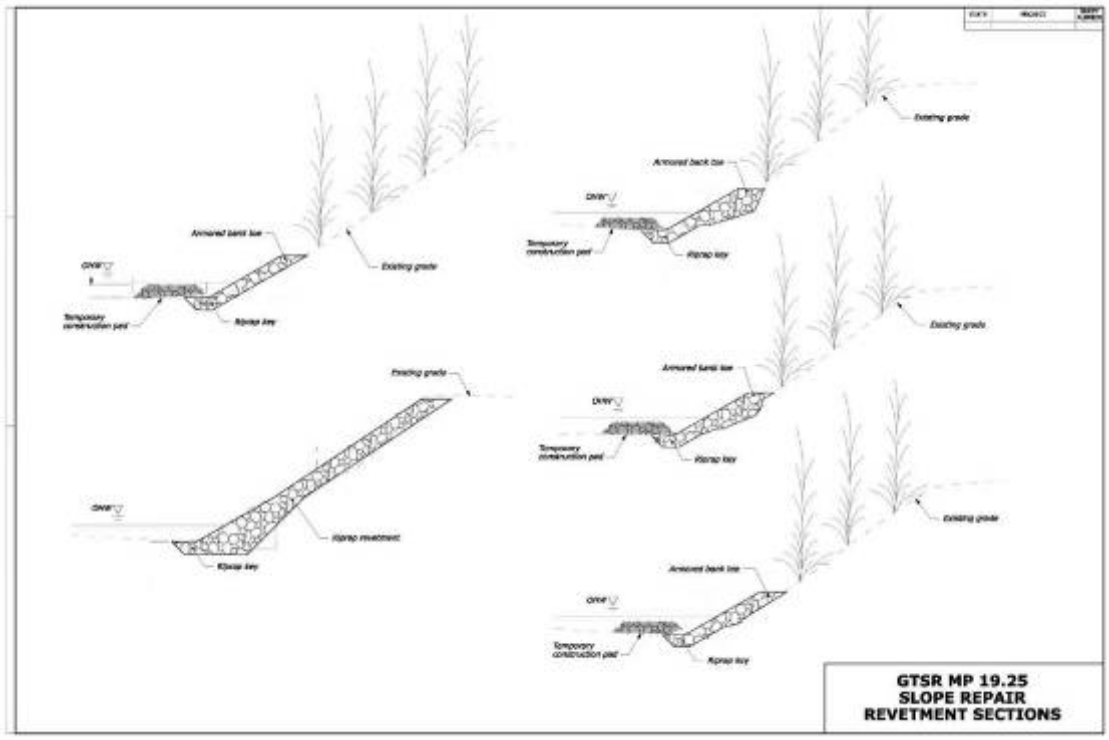

Figure 2. General design layout of revetment with vegetation incorporated

SITE DESCRIPTION

FLOODPLAIN

Arising at a 6,080 foot (1,853 m) elevation, McDonald Creek flows 25.8 miles (41.5km) and contains 8.8 miles (14.2 km) of lake and drains into the Middle Fork of the Flathead River at an elevation of 3,151 feet (960 m). The creek flows in a southeasterly direction, and then turns at the Glacier Wall and flows southwesterly, cascading into Lake McDonald. The Going-to-the-Sun Road forms the east boundary of the stream channel in most areas. Bull trout are known to inhabit Lake McDonald and rear in the lower portion of upper McDonald Creek but are physically unable to access the portions of McDonald Creek adjacent to the project area due to several waterfalls that occur between spawning grounds and the project area. Information on floodplain boundaries along Going-to-the-Sun Road corridor is incomplete, but previous studies and interpretation based on terrain and observations during flood events provide an indication of the 100-year floodplain areas, of which the project site is inclusive. The project site is approximately half way down the McDonald Creek drainage with approximately two-thirds of the drainage area above the location (see map 1). Major streams flowing into McDonald Creek above the site include Mineral, Alder, Haystack, and Logan Creeks. The head of Lake McDonald is located approximately at MP 14.5, Avalanche Creek is at MP16.2, and Logan Creek is at MP 20.5.The watershed remains largely un-roaded except for GTSR and a few minor spur roads. Results of HEC-RAS modeling of the project area are in table 1.

Table 1. HEC-RAS model output for McDonald Creek, site conditions for the project area.

Flood Event	Discharge	Maximum Channel Flow Depth	Average Channel Flow Velocity
2-year	3,000 ft^3/sec	5.5 ft	6.7 ft/sec
50-year	5,700 ft^3/sec	8 ft	8.7 ft/sec
100-year	7,600 ft^3/sec	9.2 ft	9.7 ft/sec

Alluvial and wet soils are found immediately adjacent to McDonald Creek. Composition of alluvial soils varies widely, but is generally characterized by coarse textures and unconsolidated coarse fragments from periods of deposition. These soils may support riparian deciduous vegetation, coniferous forest, or transitional shrubs and grasses. The erosion potential is high to moderate (depending on slope) and subject to periodic flooding. Productivity and revegetation potential is low where well-drained coarse soils are present, such as the west side of the creek, and high where finer textured material with high organic matter is present, such as on the east side of the creek. Wet soils are found where the water table is shallow adjacent to McDonald Creek. These soils are rich in organic matter and have loamy to silty textures. Vegetation on wet soils may include sedges, willows, cottonwoods, and other riparian species. Erosion potential is low; productivity and revegetation potential is high on wet soils.

Glacial, landslide and mixed soils formed in glacial deposits contain a mixture of semi-round rock and cobble. These soils are found along the McDonald Creek drainage. Soil textures include silty clay loams, sandy loams, and clay loams. Soils within this group vary widely over short distances due to mixing and landslides. Coniferous forest covers most of these soils. Erosion potential is high when these soils are disturbed due to the loamy and silty surface soil textures and limited rock content. Productivity and revegetation potential varies from low to high depending on soil texture, rock content and water and nutrient holding capacity.

Within the vicinity of the project area along McDonald Creek, riparian vegetation is present. Common riparian forest trees include western red cedar, Engelmann spruce, and subalpine fir with black cottonwood and paper birch in the overstory. Understory plants include mountain maple, snowberry, red-osier dogwood, alder, willow, serviceberry, kinnikinnick, sedges, goldenrod and mosses. The herbaceous understory is currently sparse due to recent slumping of the bank. Species that might be expected in a less disturbed situation would include thimbleberry, spirea, wild rose, twinflower, bunchberry, prince's pine, queencup beadlily, fairy bells, sarsaparilla, bedstraw, oakfern, starry false Solomon's seal, foam flower, trillium, and violets. Some non-native species are present along the road shoulder, in particular the noxious weed, spotted knapweed.

WETLAND

Since the proposed project would be conducted in the stream channel and would not disturb the area beyond the stream channel, park personnel did not conduct a wetland determination.

JUSTIFICATION FOR USE OF THE FLOODPLAIN

The purpose of this project is to evaluate alternative ways to permanently stabilize the bank of McDonald Creek along the GTSR at milepost 19.25 (see Map 1) in order to reduce sedimentation in the creek and avoid undercutting of the road. Peak run off for streams along

the GTSR corridor usually occurs during fall rain on snow events, during the spring in response to snowmelt, or during summer thunderstorms. The GTSR limits the eastern side of McDonald Creek near the project area allowing flooding to only occur on the western stream bank or undercutting the road. The GTSR is a national historic landmark and allows an average of 1.9 million visitors to access the park each season (based on the last ten years, GNP files).

Well-vegetated stream banks perform a variety of functions important to aquatic species. They provide shade to maintain cool water temperatures, provide thermal cover to minimize the development of anchor ice on stream-bottoms in winter months, provide low-overhanging hiding cover, provide sources of productivity and food, and provide a source of large-woody (LWD) debris for the stream channel. Healthy riparian corridors provide habitat for wildlife as well as stream stability through lateral enhancement and stable meander patterns.

In order to meet the purpose and needs of the project and to minimize adverse impacts to natural and cultural resources the following objectives would be addressed in the project:

- Minimize impacts on aquatic species, water quality and vegetation
- Protect a national historic landmark road
- Maintain visitors' access and experiences across the park

The preferred alternative would have the least impacts to natural resources and protect the cultural resource near the site, including the floodplain. Mitigation measurers ensure immediate impacts would not adversely affect the environment (see Mitigation section).

INVESTIGATION OF ALTERNATIVE SITES

Alternative sites are not available as this project is a site-specific action based on a need to stabilize the bank on a portion of McDonald Creek in order to protect a portion of the GTSR that is threatened. However, in addition to the preferred alternative, a no action and an action alternative were analyzed.

ALTERNATIVES NOT SELECTED

No Action

Under the no action alternative, McDonald Creek would continue to function in its current semi-natural state. The GTSR forms the east boundary of the stream channel in most areas limiting the streams ability to move across the valley bottom, deposit sediment and channelize in a natural state. The soil nails and jersey concrete barriers would remain in place. The paved widening on the ditch-side of the road would also remain in order to provide adequate travel land width. The road and bank would be monitored and appropriate safety measures would be implemented if the road became hazardous to drive.

Stabilize the Bank Riprap and Rock Barbs

Under this alternative, the following actions would be taken to stabilize approximately 150 feet of the bank and prevent further erosion and sedimentation. Large (class V and VII riprap, 2 – 5 feet in diameter), angular rock would be used to create "barbs" and armor the slope from the toe of the slope to the shoulder of the road. The temporary soil nails would be removed and riprap would be placed for about 160 feet along the bank below high water line (see figure 3). The site would be accessed as is described for the preferred alternative (riprap only).

The riprap and barbs would require excavation into the natural channel substrate to install a

large rock "toe" that would ensure high flows do not compromise the structural integrity of the stabilized bank. In-channel work would involve the excavation of approximately 3,000 ft^3 of native streambed material, which would be replaced with riprap to form the toe of the slope and footer material for the barbs. Most of the streambed material would be hauled away. A small amount would be incorporated into the riprap promote growth of vegetation. Project work would occur during low water times in the late fall/early winter.

Two barbs would be placed in the creek. One barb would be placed immediately upstream and one barb downstream of the sloughed bank area. Barbs are sloping stone sills, angled upstream and used to reduce bank erosion by re-directing currents away from the bank. The barbs would be about 30 feet long total and extend about 15 feet from the bank, angled upstream 25 degrees, counter sunk in the streambed about 3 to 4 feet, and keyed into the eroding bank. The barbs would be about 25 feet wide at the bank end and slope down from a 6 to 7-foot wide center crest into the stream bed. They would be about 5 feet in height above the stream bottom at the bank end and level with the stream bottom at the stream end (not including the countersinking). Consequently, they would have a low profile with only the segment next to the stream bank visible during most of the visitor season. During low water periods about one-half to one-third of the barbs would be exposed. The barbs would be designed based on a 50-year flood event depth and velocity.

Stone riprap revetment and vegetation would be used to armor the bank above the high water line. The riprap would ensure long-term stabilization at the site. It would extend approximately 100 feet from the stream edge of the eroding slope to the road shoulder currently being held by soil nails. A geotextile would be installed between the riprap and the subgrade. An additional 8-foot wide riprap – toe would be buried in the streambed.

Vegetation would be used to stabilize the upper portion of the bank and along the shoulder of the road. Restoration would include incorporating native species (such as dogwood, cottonwood and willows seedlings) into the riprap revetment between four and ten feet about the stream bottom. The seedlings would further stabilize the stream bank as they sprout and take root. The seedlings would be planted in the soil and then riprap would be placed around them (see appendix A, figure 4) and planting pockets would be incorporated into the upper portions of the riprap. No planting would be done on the barbs. Final touches, revegetation and project cleanup would most likely occur in early summer after spring runoff. McDonald Creek would not be diverted during the project.

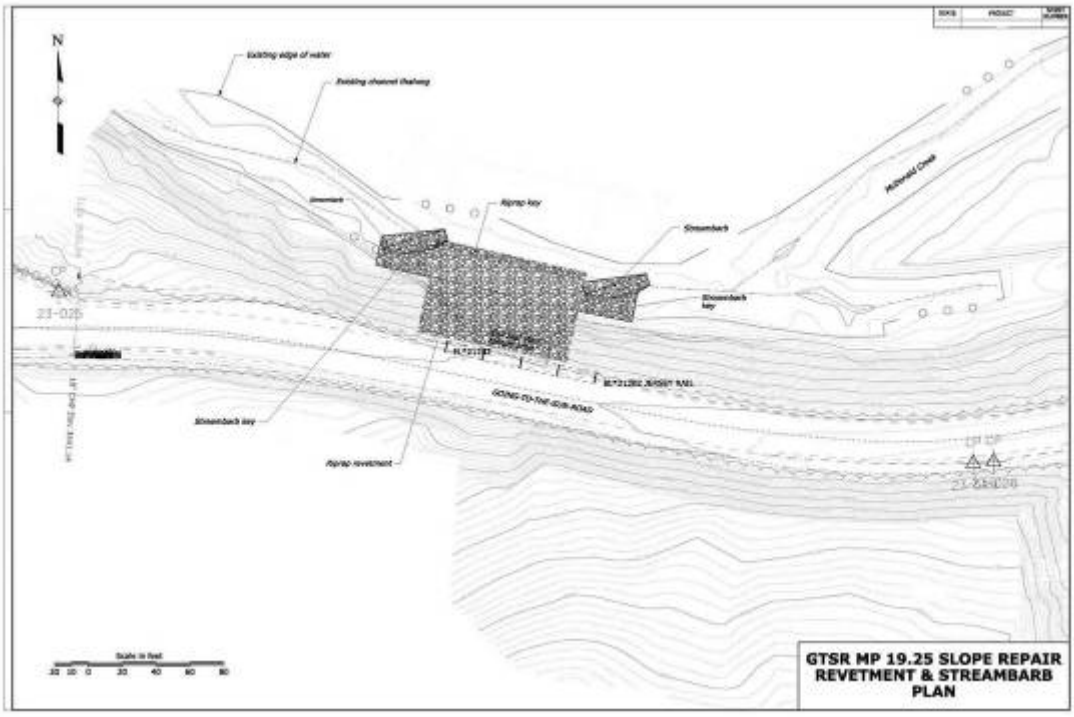

Figure 3. General design layout of alternative using revetment and stream barbs

SITE-SPECIFIC FLOOD RISK

The November 2006 flood exceeded the 100-year flood levels, and the park must take into consideration all reasonable scenarios as weather patterns might become more sporadic and severe. The front edge of the point bar directly across and immediately downstream of the projects site would likely retreat a few feet to maintain an effective channel width. The potential for bank erosion would be immediately reduced upon project completion as stream flow energy is dissipated and the flow is redirected across the stream. Natural adjustments to accommodate flow on the opposite side of the creek are expected to occur and would help maintain natural floodplain processes, and beneficial, resulting from maintaining the floodplain process northwest of the creek.

MITIGATION

Actions proposed in the floodplain would not affect the flood storage capacity of the floodplain. The natural floodplain value would not be reduced but slight alterations would be expected. Alterations would not influence the overall dynamics of the floodplain. The project design would further minimize potential hazards to human life and property destruction.

- Development within the floodplain would not result in an increase of the base flood level more than 0.5 feet.
- Work would be completed during the fall at low water times such that any impact to the floodplain would be remediated by spring floods.

SUMMARY

The preferred alternative was designed to avoid and minimize impacts to the floodplain along McDonald Creek while stabilizing the bank in order to protect the historic Going-to-the-Sun Road.

There would be no loss of floodplain area or impacts to floodplain dynamics upon implementation of the proposed action. Therefore the NPS finds this proposed action is consistent with the policies and procedures of NPS Director's Order #77-2: Procedural Manual 77-2: Floodplain Management which provides NPS policies and procedures for complying with Executive Order 11988.

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