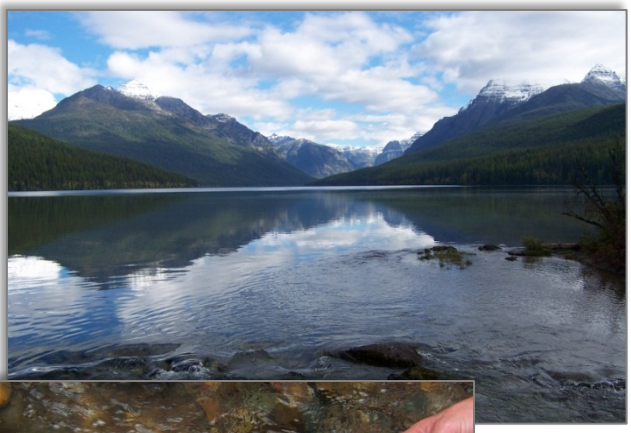
National Park Service
U.S. Department of the Interior

GLACIER NATIONAL PARK
Montana
Waterton-Glacier International Peace Park

# Continued Lake Trout Suppression on Quartz Lake & Lake Trout Removal and Bull Trout Conservation in the Logging Lake Drainage Environmental Assessment

**December, 2013**



*Quartz Lake, NPS photo.*

*Bull trout, NPS photo.*

*Logging Lake, NPS photo.*

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# Environmental Assessment
# Continued Lake Trout Suppression on Quartz Lake & Lake Trout Removal and Bull Trout Conservation in the Logging Lake Drainage

**Summary**— Glacier National Park is proposing to continue lake trout suppression on Quartz Lake and begin lake trout removal and bull trout conservation on Logging Lake to protect bull trout and other native fish. Bull trout are listed as a threatened species under the Endangered Species Act. Glacier National Park has a critical role in the regional recovery and long-term conservation of bull trout because the park contains intact ecological systems with historic bull trout habitat, and because approximately one-third of the nation's bull trout populations inhabiting natural, undammed lake systems are found in the park. The park's bull trout populations are increasingly at risk due to invasive non-native lake trout. On the west side of the park, lake trout have invaded nine of twelve lakes to which they have access and are known to have severe negative effects on the survival of native fish populations. Two of the park's premier bull trout supporting lakes, Quartz Lake and Logging Lake, are at risk of losing their historically robust bull trout populations to non-native invasive lake trout. Climate change could compound these challenges, as changes in stream flow combined with warmer water temperatures will likely stress bull trout and other native fish and favor invasive non-native species. In 2009, Glacier National Park and the U.S. Geological Survey (USGS) began an experimental project on Quartz Lake to reduce or eliminate lake trout. Results from this work have been promising. Because of its once vigorous bull trout population, Logging Lake follows Quartz Lake as a high priority for bull trout conservation, and experimental lake trout suppression at both lakes could do much to protect the park's bull trout populations for the long-term, as well as contribute to the species' regional recovery.

This environmental assessment (EA) evaluates four alternatives: a no action alternative and three action alternatives. The no action alternative describes the current conditions if the park does not continue lake trout suppression on Quartz Lake or begin lake trout removal and bull trout conservation on Logging Lake. The action alternatives include continued lake trout suppression at Quartz Lake and lake trout removal and bull trout conservation on Logging Lake.

This EA has been prepared in compliance with the National Environmental Policy Act (NEPA) to provide the decision-making framework that 1) analyzes a reasonable range of alternatives to meet the objectives of the proposal, 2) evaluates potential issues and impacts to Glacier National Park's resources, and 3) identifies mitigation measures to lessen the degree or extent of these impacts. Resource topics analyzed include fisheries, bull trout, and westslope cutthroat trout; wildlife, bald eagles, common loons, and grizzly bears; recommended wilderness; natural soundscapes; and visitor use and experience. All other resource topics were dismissed because the project would result in negligible or minor effects to those resources or because the resource is not found in the analysis area, the issue is not applicable to the proposal, or the resource would not be affected by the project. No major effects are anticipated as a result of this project. Public scoping was conducted in accordance with the National Environmental Policy Act (NEPA), and the majority of the comments received were in support of the proposed project.

**How to Comment**— If you wish to comment on the EA, you may post comments online at **http://parkplanning.nps.gov/LoggingQuartz** or mail or hand deliver comments to: Superintendent, Glacier National Park, Attention: *Logging/Quartz EA,* PO Box 128, West Glacier, Montana 59936. This EA will be on public review for 30 days. Before including your address, phone number, email 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. Although you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. Comments will not be accepted by fax, email, or in any other way than those specified above. Bulk comments in any format (hard copy or electronic) submitted on behalf of others will not be accepted.

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# Purpose and Need

***The purpose of Glacier National Park 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 Glacier National Park 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.

## Introduction

Glacier National Park is an approximately one million acre park in the Northern Rockies of northwestern Montana, along the United States-Canadian border. The park straddles the rugged mountains of the Continental Divide, and is at the center of the Crown of the Continent Ecosystem. The Crown of the Continent ecosystem encompasses approximately 28,000 square miles (72,000 square kilometers) of mountainous terrain between the southern regions of British Columbia and Alberta in Canada and the Blackfoot River south of Montana's Scapegoat Wilderness. Together with Canada's Waterton Lakes National Park, Glacier National Park forms the Waterton-Glacier International Peace Park, the world's first international peace park. The parks are listed together as a World Heritage Site and separately as International Biosphere Reserves. Outstanding natural and cultural resources are found in both parks. Glacier National Park's 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.

Glacier National Park is renowned for its intact ecological systems, which provide valuable opportunities for recreation, education, and scientific study and are of paramount importance in the overall conservation and protection of the park's resources. Protecting native fish resources is integral to the park's conservation and management programs (NPS 2006). Glacier National Park contains approximately one-third of the bull trout populations inhabiting natural (un-dammed) lakes in the United States (Fredenberg et al. 2007). The park is therefore is a key player and has a high level of responsibility in the recovery and long-term conservation of bull trout, not only within Glacier National Park, but on a regional scale. Bull trout are listed as a threatened species under the U.S. Endangered Species Act (ESA), and the park's bull trout populations are increasingly at risk due to invasive non-native lake trout. On the west side of the park, lake trout have invaded nine of twelve lakes to which they have access and are known to have severe negative effects on native fish populations. Two of the park's premier bull trout supporting lakes, Quartz Lake and Logging Lake, located in the North Fork District (Figure 1), are at risk of losing their historically robust bull trout populations to non-native invasive lake trout. Climate change will compound this challenge, as changes in stream flow combined with warmer

water temperatures will likely stress bull trout and other native fish and favor invasive non-native species.

Results from the recent experimental effort to remove lake trout from Quartz Lake and suppress the population have been promising. Therefore, the park is proposing to continue lake trout suppression in Quartz Lake and begin lake trout removal in Logging Lake. This EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, regulations of the Council on Environmental Quality (CEQ) (40 CFR § 1508.9), and the National Park Service Director's Order (DO)-12 (*Conservation Planning, Environmental Impact Analysis, and Decision-Making*).

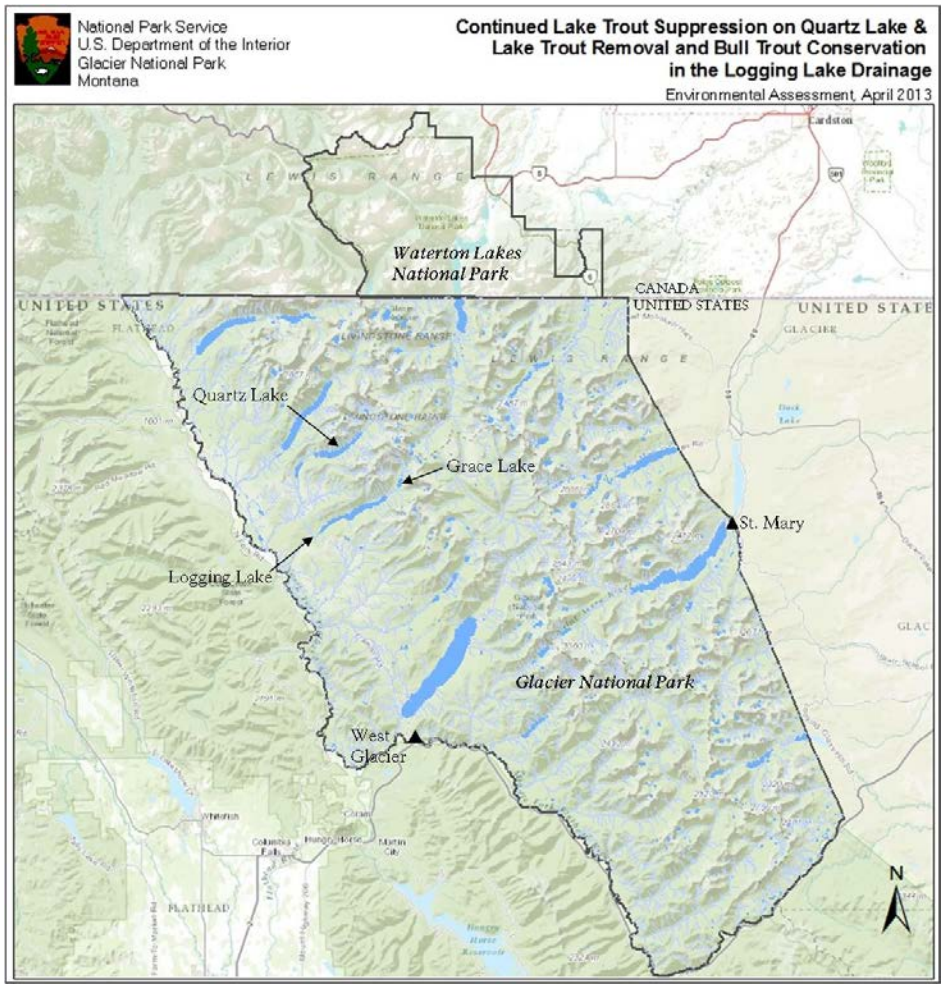


**Figure 1:** Logging and Quartz Lakes, Glacier National Park.

## Background

Non-native lake trout presumably entered Glacier National Park waters west of the Continental Divide via the Flathead River system along the park's western and southern boundaries. No stocking records exist for planting of lake trout into the park's western waters, but lake trout were introduced into Flathead Lake in the early 1900's. Of the seventeen lakes on the west side of the park that support bull trout, twelve are accessible to lake trout and nine have been invaded. Two more are at-risk of invasion because there are no physical barriers to preclude lake trout invasion, and a third has been invaded by brook trout.

Lake trout pose serious threats to bull trout (federally listed as threatened) and westslope cutthroat trout (a state-listed species of concern), and are known to cause major adverse impacts to native fish populations, as has been documented within the park in Lake McDonald and Kintla, Bowman, and Logging Lakes (Downs et al. 2011) and in numerous lakes outside the park where lake trout have been introduced (Martinez et al. 2009). Lake trout generally replace bull trout as the dominant aquatic predator in waters where they are introduced; competition and predation are the most likely mechanisms. Because they live longer and spawn in lakes where they likely benefit from expansive juvenile rearing habitat, lake trout also have a reproductive

advantage over bull trout and westslope cutthroat trout, which spawn in streams and tributaries where spawning and rearing habitat is generally more limited and is vulnerable to events such as flooding, fire, and drought. Additionally, lake trout have the potential to impact terrestrial species such as bald eagles and common loons, which depend on shallower water-dwelling native fish for food.

Bull trout and introduced lake trout are generally viewed as incompatible where they occur together, with lake trout typically displacing bull trout and harming existing fisheries (Donald and Alger 1993, Fredenberg 2002, Martinez et al. 2009). Fredenberg (2002) concludes that in lakes of the Rocky Mountains, conversion of unique bull trout ecosystems to lake trout dominated systems appears to be a common result once lake trout are established. Further, he contends that this transition may be rapid (20-30 years) even when habitat conditions remain relatively unaltered from the natural state. In Glacier National Park, data from lakes that have been monitored over time show that lake trout are increasing in abundance and bull trout are in decline, and lake trout have largely replaced bull trout as the top level aquatic predator (Downs et al. 2011). In some park lakes, bull trout populations appear to be at imminent risk of functional extinction, meaning their populations would no longer be self-sustaining and would not play a significant role in the ecosystem.

As the apex aquatic predator in the park, bull trout join other top, iconic predators such as the grizzly bear in representing the pristine, natural character of the park's backcountry and recommended wilderness. Bull trout are part of a historic fishery that is fundamental to Glacier National Park's biodiversity and the park's designation as a biosphere reserve and World Heritage Site, and have long been an integral component of the park's culture and visitor use. In the Action Plan for Conservation of Bull Trout in Glacier National Park, developed by the USFWS and Montana State University to conserve the long-term abundance, distribution and genetic diversity of bull trout in the park, Fredenberg et al. (2007) concluded that "protection from near-term decline in the face of lake trout invasion is critically important to the conservation of bull trout in the park". From a regional perspective, Glacier National Park has a critical role in the conservation of adfluvial (lake-dwelling) migratory bull trout because of the high proportion of natural lake core areas found in the park. The colonization of several of the park's lakes by lake trout and the subsequent decline of bull trout in the park therefore make protecting remaining bull trout populations a high priority.

Glacier National Park is also at high risk of critical habitat alteration from climate change induced glacier and snow loss. Changes in stream flow, warmer water, and the increasing frequency and intensity of disturbances such as rain-on-snow events in the fall and winter, altered precipitation patterns, and wildfire are the most significant factors associated with climate warming likely to impact native trout populations in the western United States (Williams et al. 2009). Such alterations to the park's ecological systems will compound existing stressors (e.g., invasive species) on already depressed bull trout populations. Bull trout require among the lowest water temperatures for optimal growth of any North American trout or salmon species (Selong et al. 2001), and many of the park's bull trout populations inhabit drainages where melting snowfields and glaciers support late season stream flow and cold water temperatures. Climate change impacts are difficult to predict. But changes in habitat conditions such as alterations of water temperature and flow patterns, including mid-winter flooding of spawning areas, are expected and would likely adversely impact bull trout populations and ultimately favor non-native species such as lake trout and brook trout. With its high elevation watersheds, the park will provide important refugia for bull trout and other native fish from the stressors of climate change. Ensuring the availability of habitat that is free of lake trout and other aquatic

invasive species (AIS) will be essential in maintaining this safeguard. The park is currently engaged in rigorous efforts to prevent AIS from invading park waters. (The zebra mussel, for example, would further reduce the availability of food in the park's already low-productivity waters.)

In 2005, non-native invasive lake trout were detected in Quartz Lake. At the time, Quartz Lake supported the most viable and uncompromised bull trout population among the park's larger lakes. A study from the U.S. Fish and Wildlife Service (USFWS) entitled "Glacier National Park, Flathead Drainage Lake Survey, and Fish Passage Evaluation" concluded the following: "Clearly, the Quartz Lake chain is one of the remaining strongholds for bull trout in the Flathead drainage on the west side of Glacier National Park. It should be protected from lake trout or other non-native species introductions at all costs" (USFWS 2001). Further, the aforementioned Action Plan for Conservation of Bull Trout in Glacier National Park concluded that the upper Quartz Lake system is the highest priority for conservation and preservation of bull trout among the 17 lakes examined (Fredenberg et al. 2007).

In 2009, Glacier National Park and the U.S. Geological Survey (USGS) began an experimental project on Quartz Lake to reduce or eliminate lake trout. Under the project, individual lake trout were caught, radio-tagged, and tracked to spawning areas. Gill nets were then deployed over the spawning areas to capture and remove spawning lake trout. Results from the project have been promising, with identification of lake trout spawning areas and annual removal of spawning adults. Overall, 91 percent of radio-tagged adult lake trout were removed from Quartz Lake during gill netting operations in 2009, and 44 percent were removed in 2010 (Muhlfeld and Fredenberg 2009 and D'Angelo et al. 2011). All 11 radio-tagged lake trout tagged in 2011 and 2012 were caught and removed by the end of 2012 (V. D'Angelo, personal communication). This data suggests that the project has already successfully removed a high percentage of spawning adults and thereby reduced the size of the adult lake trout population in Quartz Lake. Initially proposed to take place through 2012, netting operations were resumed in the spring and fall of 2013. It is becoming increasingly more difficult to catch adult-sized lake trout either with gill nets or with hook and line in Quartz Lake (Figure 2). This proposal seeks to continue lake trout suppression at Quartz Lake for the longer term, which is necessary to further reduce the lake trout population and keep it at a low level. At this juncture, it is especially important to remove juvenile lake trout, which appear to be considerably more abundant than adult lake trout and have not yet grown large enough to be caught by the adult sampling gear, before they reach reproductive age.

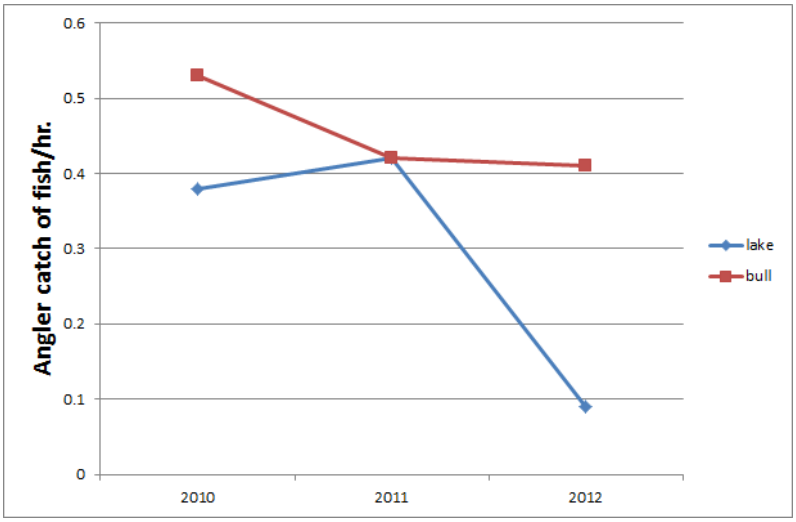


**Figure 2:** Annual spring catch rates for experienced anglers enlisted to catch adult lake trout for radio-tagging in Quartz Lake.

Logging Lake follows Quartz Lake as a high priority for bull trout conservation, as also identified in the Action Plan for Conservation of Bull Trout in Glacier National Park

(Fredenberg et al. 2007). Once considered one of the most productive bull trout fisheries in the park, Logging Lake is now at imminent risk of losing bull trout as a functional part of the aquatic ecosystem due to invasive non-native lake trout. In 2000, the park began standardized, periodic (every five years) gill netting on Logging Lake. Based on netting and redd count data, there are very few bull trout remaining in Logging Lake (Downs et al. 2011). Without action to reduce the lake trout population and conserve the remaining bull trout, the Logging Lake bull trout population faces functional extinction in the near term. Therefore, in addition to continued lake trout suppression at Quartz Lake, the park is also proposing to remove lake trout from Logging Lake using methods developed on Quartz Lake. Additionally, the park would undertake a number of bull trout conservation measures to protect Logging Lake's few remaining bull trout and boost the population during and/or after lake trout suppression.

Other state and federal projects designed to reduce the abundance of lake trout and maintain native fish populations are also underway (e.g. NPS efforts on Yellowstone Lake, Montana Fish, Wildlife and Parks efforts on Swan Lake, and Idaho Department of Fish and Game efforts on Lake Pend Oreille and Upper Priest Lake). Researchers and managers implementing these projects, as well as those implementing the Quartz Lake project, routinely share information to improve effectiveness of lake trout suppression. Protecting bull trout and other native fish populations in Glacier National Park is therefore consistent with other efforts by state and federal agencies outside the park, and is essential for the long-term persistence and protection of functional native fish populations in the Flathead watershed and throughout the western United States.

## Purpose and Need

The purpose of this project is to protect bull trout populations in the Logging and Quartz drainages from the severely detrimental, long-term effects of invasive non-native lake trout. The project would meet the following objectives:

- Continue to recover and protect the park's imperiled bull trout populations from invasive non-native lake trout, and thereby assist with bull trout conservation efforts on a regional scale.
- Increase the resiliency of the park's bull trout populations in the face of the potential added stressors associated with climate change.
- Continue the development of lake trout suppression techniques that could be used in other locations within and outside the park.
- Maintain a stable native fish complex to support fish-dependent predators such as common loons and bald eagles.
- Conserve and maintain the natural condition of the park's recommended wilderness by protecting native fish populations and the ecological integrity of the backcountry lakes they inhabit.

## Relationship to Other Plans and Policies

Current plans and policies that pertain to this proposal include the 2006 NPS *Management Policies*, Glacier National Park's *Resources Management Plan* (NPS 1993), the park's *General Management Plan* (GMP) (NPS 1999), the park's *Bear Management Plan* (NPS 2010a), the *Large-Scale Removal of Lake Trout in Quartz Lake Environmental Assessment* (NPS 2009), and the *Quartz Creek Fish Barrier Modification and Improvement Environmental Assessment* (NPS

2012a). Following is more information on how this proposal meets the goals and objectives of these plans and policies:

- The proposal is consistent with the NPS Organic Act of 1916, which established the National Park Service and the agency's purpose to "conserve the scenery and the natural and historic objects and the wild life therein" and to "leave them unimpaired" for future generations; and the enabling legislation for Glacier National Park, through which the park was established in part to "provide for the preservation of the park in a state of nature so far as is consistent with the purposes of this act, and for the care and protection of the fish and game within the boundaries thereof."
- The proposal is consistent with the goals and objectives of the 2006 *NPS Management Policies* which hold the NPS responsible for maintaining all animals native to the natural ecosystems of parks, including fish, and for the reestablishment of "natural functions and processes", including the control of exotic species. Section 4.4.2.3 of the Management Policies direct the NPS to meet its responsibilities under the Endangered Species Act, and includes the control of "detrimental non-native species".
- In keeping with Glacier National Park's 1993 *Resources Management Plan*, which gives the management and research of bull trout high priority, the project would protect two out of twelve remaining at-risk bull trout populations on the west side of the park.
- The proposal would restore and protect the integrity of bull trout and other native fish populations within the Quartz and Logging drainages and would therefore be in accordance with the park's 1999 *General Management Plan*, which states that "management of natural resources in the backcountry zone would focus on protection and (when necessary) restoration of resources and natural processes".
- The implementation plan for the proposed project contains mitigation measures to minimize temporary impacts to bears, including strict storage requirements for food and other attractants, and would not permanently affect bears or bear habitat. The project is therefore consistent with the objectives of the park's 2010 *Bear Management Plan*, which provides guidelines for the management of bears in the park.
- The project would sustain the objectives of the 2009 *Large-Scale Removal of Lake Trout in Quartz Lake Environmental Assessment,* which was designed to protect native fish and control non-native invasive fish species for the long term.
- The proposed action is consistent with the 2012 *Quartz Creek Fish Barrier Modification and Improvement Environmental Assessment* in that both projects call for the protection of native fish populations and the control non-native invasive fish.

## Identification of Impact Topics

The NPS takes a "hard look" at all potential impacts by considering the direct, indirect, and cumulative effects of the proposed action on the environment, along with connected and cumulative actions. In the environmental consequences section of this EA, impacts are described in terms of context and duration. The context or extent of the impact is described as localized or widespread. The duration of impacts is described as short-term or long-term. The intensity and type of impact is described as negligible, minor, moderate or major, and as beneficial or adverse. The NPS equates "major" effects as "significant" effects. The identification of "major" effects would trigger the need for an environmental impact statement

(EIS). Where the intensity of an impact could be described quantitatively, numerical data is presented; however, most impact analyses are qualitative and use best professional judgment in making the assessment.

The NPS defines "measurable" impacts as moderate or greater effects. It equates "no measurable effects" as minor or less effects. "No measurable effect" is used by the NPS in determining if a categorical exclusion applies or if impact topics may be dismissed from further evaluation in an EA or EIS. The use of "no measurable effects" in this EA pertains to whether the NPS dismisses an impact topic from further detailed evaluation in the EA. The reason the NPS uses "no measurable effects" to determine whether impact topics are dismissed from further evaluation is to concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail in accordance with CEQ regulations at 1500.1(b).

## Impact Topics Retained for Further Analysis

Impact topics for this project were identified on the basis of federal laws, regulations, and orders; 2006 NPS *Management Policies*; and NPS knowledge of resources at Glacier National Park. Impact topics that are carried forward for further analysis in this EA include:

- **Fisheries, bull trout (threatened species under ESA), and westslope cutthroat trout**
- **Wildlife, common loons, and bald eagles**
- **Grizzly bears (threatened species under ESA)**
- **Recommended wilderness**
- **Natural soundscapes**
- **Visitor use and experience**

## Impact Topics Dismissed from Further Analysis

This section provides a limited evaluation and explanation as to why the following impact topics are not evaluated in more detail. Impact topics are dismissed from further evaluation if:

- they do not exist in the analysis area, or
- they would not be affected by the proposal or the likelihood of impacts are not reasonably expected, or
- through the application of mitigation measures, there would be minor or less effects (i.e. no measurable effects) from the proposal, and there is little controversy on the subject or reasons to otherwise include the topic.

Due to there being no effect or no measurable effects, there would either be no contribution towards cumulative effects or the contribution would be low. For each issue or topic presented below, if the resource is found in the analysis area or the issue is applicable to the proposal, then a limited analysis of direct and indirect, and cumulative effects is presented.

**Federally Listed Threatened, Endangered, Proposed, and Candidate Species that have been dismissed from further analysis**

The NPS analyzes impacts to federally listed species in accordance with NEPA and the Endangered Species Act (ESA). Section 7 of the Endangered Species Act requires all federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of listed species or critical habitats. In addition, the 2006 *Management Policies* and Director's Order-77 *Natural Resources Management Guidelines* require the NPS to examine the

impacts of projects on federal candidate species as well as state listed threatened, endangered, candidate, rare, declining, and sensitive species (NPS 2006).

The USFWS confirmed that the park currently has authorization under Section 10 of the ESA to undertake gill netting operations in bull trout waters. Bull trout translocation and stocking in Logging and Grace Lakes would occur under an amendment to the existing Section 10 permit, and captive propagation of bull trout would be covered under a separate Section 10 permit. (See also Compliance Requirements and Consultation and Coordination, Agency Consultation, at the end of this document.)

The following species (Table 1) would not be affected by the project and are therefore dismissed from further analysis.

**Table 1:** Federally listed species for Glacier National Park that have been dismissed from further analysis.

| Species | Status |
|---|---|
| Canada lynx (*Lynx canadensis*) | Threatened |
| Spalding's catchfly (*Silence spaldingii*) | Threatened |
| Water howellia (*Howellia aquatilis*) | Threatened |
| Wolverine (*Gulo gulo*) | Proposed |

**Canada Lynx** (*Lynx canadensis*). Federally listed as Threatened. Canada lynx habitat is generally described as climax boreal forest with a dense undercover of thickets and windfalls (Ruediger et al. 2000). Preliminary lynx habitat modeling for the park defines moist conifer forests at elevations above 4,000 feet as most likely to support lynx. While these model criteria are general in nature and little is known about lynx habitat use in the park, the model indicates the presence of lynx habitat in the Quartz and Logging drainages. Lynx tracks have also been documented over the years near both Quartz and Logging Lakes (NPS files). The proposed project, however, would not affect lynx habitat and would occur outside the lynx denning period. Lynx would not be impacted by the project, and the species is therefore dismissed from analysis.

**Water Howellia** (*Howellia aquatilis*) **and Spalding's Catchfly**(*Silene spaldingii*)**.** Federally listed as Threatened. While present in Flathead County, there are no known locations of the threatened water howellia or the threatened Spalding's catchfly within Glacier National Park. Habitat for water howellia, a wetland-dependent species, may be present in the park, but habitat for Spalding's catchfly has not been identified. There are no recorded observations of water howellia or Spalding's catchfly in the vicinity of Logging Lake or Quartz Lake, nor is suitable habitat that could potentially support the species known to be present. If the species is present, neither would be affected by the proposed activity, which would primarily occur on open water, away from wetland areas. If locations of listed plant species become known within the vicinity of the project area, the plants would be avoided. Consequently, there would be no impacts to Spalding's catchfly or water howellia from the proposed project.

**Wolverine (*Gulo Gulo*).** Proposed for Listing. On February 4, 2013, the USFWS published a proposal in the Federal Register to list the wolverine as a threatened species (Federal Register 2013). The USFWS has determined that habitat loss from decreased snow pack in the late spring as a result of higher temperatures and climate change is likely to significantly, adversely affect wolverine populations within the contiguous United States. Continued habitat loss could threaten wolverines in the contiguous United States with extinction (Federal Register 2013).

Park files contain several records of wolverine sightings and tracks in the North Fork District, including two sightings and one track observation in the Logging drainage, and one sighting and two track observations in the Quartz drainage. Additionally, park biologists collected wolverine hair samples from hair-snares at the head of Quartz Lake in 2011 and at Grace Lake in the Logging drainage in 2011 and 2012. Wolverines travelling through the Logging and Quartz drainages are likely in search of ungulate carrion, especially during winter and early spring. But neither area provides primary foraging or denning habitat, and wolverine use is likely occasional and sporadic. Wolverines are highly mobile and wide ranging and would not be affected by the proposed work at Quartz or Logging Lake; wolverines are therefore dismissed from further analysis.

**Meltwater Stonefly** *(Lednia tumana)*. Candidate Species. Neither Logging Lake nor Quartz Lake is located near or within meltwater stonefly habitat. Therefore, the meltwater stonefly would not be impacted by the project and is not analyzed.

**Whitebark Pine** (*Pinus albicaulis*). Candidate Species. Whitebark pine generally occurs near treeline in subalpine zones between 5000 and 7000 feet in elevation. At 4416 and 3810 feet respectively, the elevations at Quartz and Loggings Lakes are too low for whitebark pine, and the species does not occur within or near the project areas. There would be no impacts to whitebark pine, and the species is not analyzed.

**State-listed Species of Concern that have been dismissed from further analysis**

A number of state-listed bird species of concern and potential species of concern have been documented near Quartz and Logging Lakes. Species included in data reports from the Montana Natural Heritage Program include the great gray owl, pileated woodpecker, boreal chickadee, brown creeper, and Pacific wren for Quartz Lake; and the great gray owl, Pacific wren, and Le Conte's sparrow for Logging Lake (MNHP 2012). None of these species would be affected by the project because the majority of the proposed activity would take place on open lake water and would not occur in their immediate habitat.

In addition to being federally listed as threatened, grizzly bears and Canada lynx are state-listed species of concern; impacts to grizzly bears are addressed in this EA under *Affected Environment and Environmental Consequences, Threatened and Endangered Species and Species of Concern*, and impacts to Canada lynx have been dismissed from further analysis in the previous discussion. As for other state-listed mammalian species of concern, fishers have not been recently detected in the park and may not be present. If fishers do frequent areas near Quartz and Logging Lakes, they are not likely to be affected by the project, which would occur outside the denning period and would not affect fisher

habitat. Townsend's big-eared bats and hoary bats could be found in the habitat type surrounding both Quartz and Logging Lakes, but would not be affected by the project since most of the activity would occur on the lake and not within bat habitat. Bats are highly mobile except when roosting, and would not likely be much affected if temporarily displaced. There is one verified record of a northern bog lemming from the park, collected in the Camas drainage in 1949 (Wright 1950), and two unverified, more recent reports from east of the Continental Divide. If bog lemmings do occur in the vicinity of Quartz and Logging Lakes, the proposed project does not involve any activities that would impact them or their habitat. Therefore, other than grizzly bears, mammalian species of concern would not be impacted and are not further analyzed.

There are no known records of the northern leopard frog in Glacier National Park. Boreal toads have been observed in the vicinity of Quartz, Logging, and Grace Lakes, but larvae indicative of reproduction have not been reported in these lakes. Despite its status as a state listed species of concern, the boreal toad is the most widespread amphibian in the park (Galloway 2013, C. Downs, NPS, personal communication). Transient use of the project area by amphibians is likely, especially along the lake shores. Introduced fish can have adverse impacts on amphibian populations. The addition of bull trout to Grace Lake would not be expected to have a meaningful impact on amphibian use of Grace Lake because introduced fish (Yellowstone cutthroat trout) have been present in the lake for over 80 years. Impacts on amphibians or their habitat would be no more than negligible to minor. Amphibian species of concern are therefore dismissed from further analysis.

While distribution and abundance of invertebrate species of concern within the park are not well known, the nature of the proposed activity is not such that it would affect invertebrate species in any measurable way. Impacts would be negligible or less, and invertebrate species of concern are not further analyzed.

**Vegetation and Plant Species of Concern**

Vegetation, including plant species of concern, would not be disturbed during the proposed project; impacts to vegetation resources are therefore not analyzed.

**Soils**

There would be no disturbance to soils during the proposed activities, and impacts to soils are therefore dismisses from analysis.

**Water Resources**

National Park Service policies require protection of water quality consistent 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". To enact this goal, the U.S. Army Corps of Engineers 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 U.S. Environmental Protection Agency also has responsibility for oversight and review of permits and actions, which affect waters of the United States. If the preferred alternative is implemented, all necessary federal, state and local permits would be obtained to ensure compliance with the Clean Water Act.

Under the proposed project, the use of 4-stroke gasoline powered motorboats is anticipated on both Quartz and Logging Lakes. The seasonality and short duration annually of the work would not likely affect water quality. Due to differences in technology, carbureted 2-stoke motors produce substantially more pollution than the more recently developed 4-stroke or direct fuel-injected 2-stroke marine motors (California Air Resources Board 2001). Four-stroke motors appear to be less polluting in terms of releasing hydrocarbons into the air than the direct fuel-injected 2-stroke engines, but the direct fuel-injected 2-stroke engines appear to have slightly better fuel economy (California Air Resources Board 2001). With respect to water pollution, although an order of magnitude cleaner than earlier carbureted 2-stroke engines, direct fuel-injection 2-stroke motors emit more fuel constituents directly into the water than do 4-stroke motors (California Air Resources Board 2001).

The park anticipates using approximately 200 gallons of fuel each year on the two lakes combined. The boats would likely be used for approximately five to seven days per week for approximately sixteen weeks per year at each lake. Using engine efficiencies (99%) for 4-stroke outboard motors from the Tahoe Regional Planning Agency Environmental Assessment (1999), a total of approximately two gallons of un-burnt fuel in the form of engine emissions could be released into the environment each year. For comparison to other marine outboard technology currently in use, the Tahoe Regional Planning Agency Environmental Assessment utilized an emissions factor ten times higher for carbureted 2-stroke technology than 4-stroke technology in its evaluation of the pollution potential of outboards on Lake Tahoe, and subsequently banned the use of the carbureted 2-stroke outboard engines on the lake. Therefore, the proposed activities could result in negligible to minor, short-term and site-specific impacts to water resources at Quartz and Logging Lakes from immeasurable quantities of pollutants released from the outboard motors.

Glacier National Park does not have a restriction on the use of carbureted 2-stroke boat motors in park waters where motors are permitted, and although survey data are not available, they almost certainly are in use where motors are allowed on the west side of the park (i.e. Bowman and McDonald Lakes). Cumulative impacts would involve the combined releases of pollutants from boat motors on Bowman and McDonald Lakes and subsequent transport to downstream areas both within and outside of the park. Any pollutants from Bowman Lake boating would ultimately combine with releases of pollutants from the Quartz and Logging Lake projects in the North Fork Flathead River. Lake McDonald is the largest lake in the park and flows into the Middle Fork of the Flathead River via McDonald Creek. The North and the Middle Forks of the Flathead River form the mainstem Flathead River near Blankenship, Montana. The small amount of pollutants released on Quartz and Logging Lakes from two motorized boats used for approximately sixteen weeks per year would not have any measurable cumulative impact on North Fork of the Flathead River or ultimately mainstem Flathead River water quality.

There is a chance that some chemical contamination of the lakes from gasoline or motor oil could occur in the event of mechanical failure or spill during operation of the boats. The risk of mechanical failure or spill would be low based

on past experience, but is not discountable. To mitigate this risk, the crews would inspect the engines, fuel lines, and fittings prior to commencement of activities each day. Appropriate absorbent supplies would be on site to address a spill both on shore and on the water. Bulk fuel would be stored within in larger spill/bear proof containers. Within these containers, fuel would be stored in 5 to 6-gallon gas cans.

Therefore, adverse impacts to water resources from the proposed action would be negligible to minor, short-term, and site-specific, and the topic is dismissed from further analysis.

**Wild and Scenic Rivers**

Quartz and Logging Creeks are tributaries of the North Fork of the Flathead River, which is designated as a Wild and Scenic River. Quartz and Logging Lakes are over twelve and four stream miles from the North Fork, respectively, well outside the Wild and Scenic River Corridor. The corridor would not be affected by human activity associated with the project, and the very small amount of pollutants released from two 4-stroke outboard motors used for approximately five days per week for approximately ten weeks per year would not have any measurable impact on the North Fork of the Flathead River. There would be no short or long-term effects to the North Fork and no change in water quality, riparian areas, floodplain conditions, or any of the outstanding, remarkable, values which led to its designation as a Wild and Scenic River. Therefore, Wild and Scenic Rivers are dismissed as an impact topic.

**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 2006 NPS *Management Policies* and *Director's Order 77-2 Floodplain Management* provide 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. The project would not alter the function of the floodplains within the project area, therefore this topic was eliminated from further study and a Statement of Findings was not prepared.

**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 United States Army Corps of Engineers 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 *Wetland 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.

The NPS classifies wetlands in accordance with the USFWS "Classification of Wetlands and Deepwater Habitats of the United States", Report FWS/OBS-79/31 (NPS 2012b). Lakeshores are considered wetlands under this classification system. The proposed project would occur on the open water of Quartz and Logging Lakes and would not affect lakeshores or wetlands. There would therefore be no impacts to wetlands, and the topic has been dismissed from further analysis. A Statement of Findings has not been prepared.

**Air Quality**

The Clean Air Act of 1963 (42 U.S.C. 7401 *et seq*.) was established to promote the public health and welfare by protecting and enhancing the nation's air quality. The act establishes specific programs that provide special protection for air resources and air quality related values associate with NPS units. Section 118 of the Clean Air Act requires a park unit to meet all federal, state, and local air pollution standards. Glacier National Park 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. Use of two motorized boats for approximately five days per week for approximately ten weeks per year would add a negligible amount of pollution to the air in the vicinity of Quartz and Logging Lakes. Air quality would not be measurably affected by the proposed activities, and the topic is not analyzed further.

**Climate**

The Intergovernmental Panel on Climate Change (IPCC) predicts "impacts of climate change will vary regionally but, aggregated and discounted to the present, they are very likely to impose net annual costs which will increase over time as global temperatures increase" (IPCC 2007). The proposed project would not have a detectable impact on the global climate since it would not change visitor use patterns and is not likely to cause measurable increases or reductions in greenhouse emissions. In general, burning a gallon of gas produces 19.564 pounds of carbon dioxide. Estimated emissions from the motorboats would equate to approximately 3,912 pounds of carbon dioxide per year per boat. Vegetation in temperate forests, such as those in Glacier National Park, sequester on average 25 tons of carbon per acre (Gorte 2009). Glacier National Park is a landscape of approximately 1,000,000 acres, much of which is vegetated by coniferous forest. New vegetation growth in the immediate project area (e.g. local fire regeneration) would easily offset any additional carbon produced. Therefore climate change has been dismissed from further analysis.

**Night Skies**

In accordance with 2006 *Management Policies*, the NPS strives to preserve natural night skies and will "minimize light that emanates from park facilities, and also seek the cooperation of park visitors, neighbors, and local government agencies to prevent or minimize the intrusion of artificial light into the night scene of the ecosystems of parks". Glacier National Park considers the impacts

to night skies in all projects. For this project, small work lights would periodically be used to illuminate work areas during nighttime operations, but the lights would not be bright enough to intrude upon night skies or interfere with night sky visibility. There would therefore be no impact to night skies, and the topic is dismissed from additional analysis.

**Visual Resources**

Visual resources at Logging and Quartz Lakes are characterized by natural, scenic vistas of pristine glacial lakes surrounded by densely forested mountains and the rugged, towering peaks of the Continental Divide. Human-made features are limited to hiking trails, primitive backcountry campsites, and rustic backcountry patrol cabins. A motorboat on the lake with crews conducting gill netting operations would be visible and would detract from an otherwise mostly natural setting. But the boats would only be temporarily visible to visitors within the immediate area of the boat's location. Changes to the viewshed would therefore only be slightly detectable and would not change the character of visual resources. Adverse impacts to visual resources would only be minor, short-term, and site-specific, and the topic has therefore been dismissed.

**Cultural Resources**

**Historic Structures**

Within the Area of Potential Effect of the preferred alternative are four historic buildings. The Quartz Lake Patrol Cabin (24FH0399), the Lower Logging Lake Snowshoe Cabin and Boathouse (24FH0894) and the Upper Logging Lake Snowshoe Cabin (24FH0822) are listed in the National Register of Historic Places. The preferred alternative would involve the use of motorboats on Quartz and Logging Lakes. The boats would be stored near the Quartz Lake and Logging Lake cabins. The effect on the buildings would be visual, but not out of character with buildings located on a lakeshore. For Section 106 purposes, the park has reached a finding of "no adverse effect". Since there would only be negligible impacts to historic structures, the topic has been dismissed from further analysis.

**Cultural Landscapes**

There are no cultural landscapes in the project area; cultural landscapes are therefore dismissed from further analysis.

**Archeological Resources**

The first archeological survey of the Quartz Lake Valley was conducted in 1992 after the Red Bench Fire (Conner 1996). Near the area of Quartz Lake, one light lithic scatter was recorded. The site was determined not to meet the criteria for listing in the National Register of Historic Places (SHPO, consensus determination of eligibility, 2002). The area was again surveyed in 1995 with no new sites identified (Reeves and Shortt 1996).

The first archeological survey of the Logging Lake Valley was conducted by Fredlund and Fredlund in 1970. Dr. Brian O.K. Reeves and Mack Shortt conducted a reconnaissance survey of the trail, including the cabin areas, extending to Grace Lake. Light lithic scatters were recorded, but were determined to be less intensive than more northerly areas (Reeves and Shortt 1996).

Based upon these surveys, the probability of impacting archeological sites is unlikely. Since impacts to archeological resources would be minor or less, the topic of archeological resources has been dismissed from further analysis.

**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. Director's Order-28 and Executive Order 13007 *Indian Sacred Sites,* charge the NPS with the preservation and protection of ethnographic resources. An ethnographic study of Glacier National Park was completed in 2001 (Reeves and Peacock 2001). Park staff discussed the project with the Confederated Salish and Kootenai Tribes (CSKT) Preservation Department staff in March 2013. No ethnographic resources have been identified by the CSKT or the Blackfeet Tribal Business Council in the Quartz or Logging Lake areas and the Tribal Historic Preservation Officers raised no concerns during scoping for this project. Glacier National Park 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 National Park Service policy. Since no ethnographic resources have been identified, 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 these alternatives, and the topic is dismissed.

**Socioeconomics**
There would be no change to socioeconomic resources under either alternative. Visitor numbers would not change, and park concession operations and local businesses would not be impacted. The topic is therefore dismissed.

**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.

**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), and this topic is dismissed.

**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 call for risk recognition and early prevention for a safe work and recreational environment, and the NPS is committed to eliminating and reducing health and safety risks when they are identified. There would be no impacts to human health and safety from any of the four alternatives, and the topic is dismissed from further analysis.

**Park Operations**

The backcountry patrol cabins at Quartz and Logging Lakes would be used by fishery crews working on the lake trout suppression and bull trout conservation projects. Overnight stays at the cabins would be coordinated with the North Fork District Ranger and the park's trail crew supervisors so as not to disrupt backcountry ranger patrols and trail maintenance. The project would therefore not affect park operations, and this topic is dismissed from further analysis.

# Alternatives

A Glacier National Park interdisciplinary team, in consultation with staff from the U.S. Fish and Wildlife Service, U.S. Geological Survey, and Montana Fish, Wildlife, and Parks, and using input from the public, identified four alternatives which have been carried forward for further evaluation. Alternatives to conduct lake trout removal at other park lakes, remove lake trout using non-motorized equipment, and suppress lake trout using introduced predator/prey fish species were considered but dismissed and are discussed under *Alternatives Considered but Eliminated from Detailed Study*.

# Alternatives Carried Forward

## Alternative A: No Action Alternative

The no action alternative describes the conditions that would continue to exist if lake trout suppression does not continue at Quartz Lake and if lake trout removal and bull trout conservation efforts do not occur at Logging Lake. The no action alternative provides a baseline for evaluating the changes and related environmental impacts that would occur under the action alternatives.

Under the no action alternative, the NPS would not continue lake trout suppression at Quartz Lake, nor would the park conduct lake trout removal and bull trout conservation in the Logging Lake drainage. In Quartz Lake, the lake trout population would expand to the point where it reaches equilibrium with the environment. Lake trout would likely replace bull trout as the upper Quartz system's top level aquatic predator over the next 25 years, as has been observed in other park lake systems. Eventually, Quartz Lake bull trout would likely become functionally extinct. In Logging Lake, the lake trout population would increase in size until it reaches carrying capacity, likely within a decade, and would push the lake's few remaining bull trout closer to functional extinction if they are not already there. Bull trout would not be conserved in either Quartz or Logging Lake under this alternative.

## Alternative B: Continue Lake Trout Suppression at Quartz Lake

Under Alternative B, the park would continue lake trout suppression on Quartz Lake. Lake trout capture and removal techniques would continue to be refined, and the results would be transferrable to other park waters and other systems across the western U.S. Netting (e.g. gill netting and trap netting) and angling would continue to remain the primary removal method, but other experimental lake trout suppression techniques may also be employed as they are developed. Removal efforts would continue each year for seven to ten years, with ongoing project assessments. The program would be re-evaluated at the end of ten years and additional environmental review and compliance would occur should the project be proposed for continuation.

A motorized boat would continue to be used to deploy and retrieve nets, as well as to tag and track radio-tagged fish. The boat would be no longer than 25' in length and the motor is anticipated to be 90 horsepower or less. Smaller horsepower "twin" motors may be employed to improve safety. While operating, the boat is expected to generate noise ranging from 60-90 dB. A portable generator may be used to power a gill net "lifter" to retrieve nets. The gill net lifter aids in removing the net from the water more rapidly, reducing stress on captured fish, and also reduces the risk of injury to the crew. The generator would operate intermittently, during net retrieval efforts, which are relatively short in duration (typically approximately 15 to 30 minutes).

If a replacement boat is needed in the future, it would be hauled in by helicopter. Crews would likely maintain the boat and motor at the lake, but the motor may need to be flown out periodically (possibly one flight anticipated each year or every few years) for dealer maintenance. Standard park-specific NPS administrative helicopter flight policies and procedures would be followed for all flights. Flight times are not anticipated to exceed approximately 30 minutes one way between West Glacier and the staging area (likely in the Polebridge vicinity), and approximately 30 minutes round trip between the staging area and Quartz Lake. (The use of helicopters and other motorized equipment is also addressed in the Minimum Requirements Decision Guide, Appendix A.)

Netting operations would occur in both spring (May-June) and fall (September-October) and target both adult and juvenile lake trout. Equipment and supplies would be packed in on livestock whenever possible. Fisheries staff would use the patrol cabin at the foot of the lake as the base of operations. Netting activities could occur at any time of the day or night. Staff would generally be onsite for five to seven days per week during suppression periods. The crew would implement measures to prevent other aquatic invasive species (AIS) from entering park waters, and fuel and oil would be stored in spill and bear proof containers near the cabin.

As has been occurring since 2009, fisheries staff would continue to capture, radio-tag, and track lake trout as the fish move around the lake and begin to stage at spawning areas during September and October. This information would be used to target spawning concentrations of adult lake trout for removal. The gill nets would be set using a motorized boat and deployed on suspected lake trout spawning locations, and field crews would use the nets to remove as many lake trout as possible. Gill nets would also be used to locate and target juvenile/sub-adult lake trout rearing areas during both spring and fall. Net sets would generally be deployed for short durations, typically less than six hours, and would not be set overnight (barring unforeseen circumstances, such as stuck nets that require more time to pull, or severe weather that would prohibit crews from being on the water, for example). Gill nets are commonly used for large-scale fishing operations because of their ability to capture large numbers of fish with great efficiency. Mesh size, twine diameter and color, net length, and net depth are all factors in determining netting effectiveness. In general, nets would typically be set at depths greater than 60 feet. Mesh sizes for gill nets would be based on information gained from the ongoing Quartz project and other similar studies (e.g. lake trout removal effort on Swan Lake, Montana), and sized to maximize the capture of lake trout while minimizing the capture and mortality of non-target fish species. Removal efforts would occur each year or at a lower frequency should modeling or other data indicate that a reduced effort would be effective in keeping lake trout at sufficiently low abundance.

When not in use, the boat would be stored on shore near the patrol cabin and boat house where it would be out of sight from the trail or campground, possibly on a temporary, low-profile, removable roller-style ramp (logs and a winch system, for example, may be feasible, but an aluminum or metal ramp may be necessary). Such a ramp may also serve as a beaching site while the project is in operation in order to avoid damage to the boat or

**Figure 3:** Boat currently in use for Quartz Lake netting operations. NPS photo.

lakeshore. During prolonged non-use periods (such as wintertime), the boat would be covered with a boat cover, camouflage netting, and/or other appropriate but visually unobtrusive material to protect it from the snow load.

Success of the project would be measured as to whether the objectives outlined in the Purpose and Need section of this document are achieved. Fish population monitoring in the Quartz drainage would likely continue over time using established netting programs which would survey the lake every five years. Nets would be set at established locations and fish species relative abundance would be compared over time to identify trends in fish populations.

In addition, annual redd surveys of bull trout spawning areas would provide a regular measure of adult bull trout abundance that could be used to evaluate trends in population strength over time. Novel genetic techniques using bull trout fin tissue may be applied to estimate and monitor adult bull trout population size.

It is not anticipated that lake trout would be removed completely from the Quartz system. However, the species' population would likely be suppressed enough to allow bull trout and other native fish populations in Quartz Lake to continue to thrive and would reduce the likelihood of upstream expansion of lake trout into Cerulean Lake.

During the project, signs would be placed at trailheads leading to Quartz Lake informing hikers of the project and associated activity. Backcountry campsites and fishing would remain available to park visitors. Backcountry permits issued for the area would include information about the project.

## Alternative C: Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage

Under Alternative C, lake trout suppression would begin on Logging Lake; efforts would be similar to those that have been underway on Quartz Lake. Radio-telemetry coupled with experimental netting (e.g. gill netting, trap netting) and angling would be the primary lake trout removal methods, but other experimental suppression techniques may also be employed as they are developed. Removal efforts would be conducted annually. A motorized boat would be flown by helicopter to Logging Lake and used to conduct netting and telemetry operations. Crews would likely maintain the boat and motor at the lake, but the motor may need to be flown out periodically for dealer maintenance.

The boat would be no longer than 25' and the motor is anticipated to be 90 horsepower or less. Smaller horsepower "twin" motors may be employed to improve safety. While operating, the boat is expected to generate noise ranging from 60-90 dB. A portable generator may be used to power a gill net "lifter" to retrieve nets. The gill net lifter aids in removing the net from the water more rapidly, reducing stress on captured fish, and also reduces the risk of injury to the crew. The generator would be operated intermittently, during net retrieval efforts, which are relatively short in duration (typically approximately 15 to 30 minutes). Similar to the Quartz Lake project, netting operations would occur in both spring (May-June) and fall (September-October) and target both adult and juvenile lake trout. Equipment and supplies would be packed in on livestock whenever possible. Fisheries staff would use the patrol cabin at the foot of Logging Lake as the primary base of operations. Similar to efforts at Quartz Lake, netting activities could occur at any time of the day or night. Staff would generally be on-site for five to seven days per week during suppression periods.

When not in use, the boat would be stored on shore near the patrol cabin where it would be out

of sight from the trail and campground, possibly on a temporary, low profile, removable roller-style ramp (logs and a winch system, for example, may be feasible, but an aluminum or metal ramp may be necessary). The ramp may also serve as a regular beaching site while the project is in operation in order to avoid damage to the boat or lakeshore. During prolonged non-use periods (such as wintertime), the boat would be covered with a boat cover, camouflage netting, and/or other appropriate, visually unobtrusive material to protect it from the snow load.

**Figure 4:** Waterfall barrier on Logging Creek between Logging and Grace Lakes. NPS photo.

As with Alternative B, fuel and oil would be stored in spill and bear proof containers near the cabin. The crew would implement measures to prevent other aquatic invasive species (AIS) from entering park waters. Signs would be placed at the Logging Lake trailhead informing hikers of the project, backcountry permits issued for the area would include similar information, and backcountry campsites and fishing at Logging Lake would remain available to park visitors.

Because of the more advanced status of the lake trout invasion, this alternative would also include measures to conserve and rejuvenate bull trout in the Logging Lake drainage. Logging Lake is separated from Grace Lake (located upstream) by an impassable waterfall. The waterfall is approximately 0.7 miles upstream of Logging Lake (Figures 4 and 5). The only fish species in Grace Lake are introduced Yellowstone/westslope cutthroat trout hybrids. As many as possible of the few remaining juvenile bull trout in the Logging Lake system would be captured in their natal habitat (where they were hatched) in Logging Creek (Logging Lake inlet stream) and transported upstream to Grace Lake on foot or by pack stock. Relocating young bull trout to Grace Lake would preserve the maximum amount of native

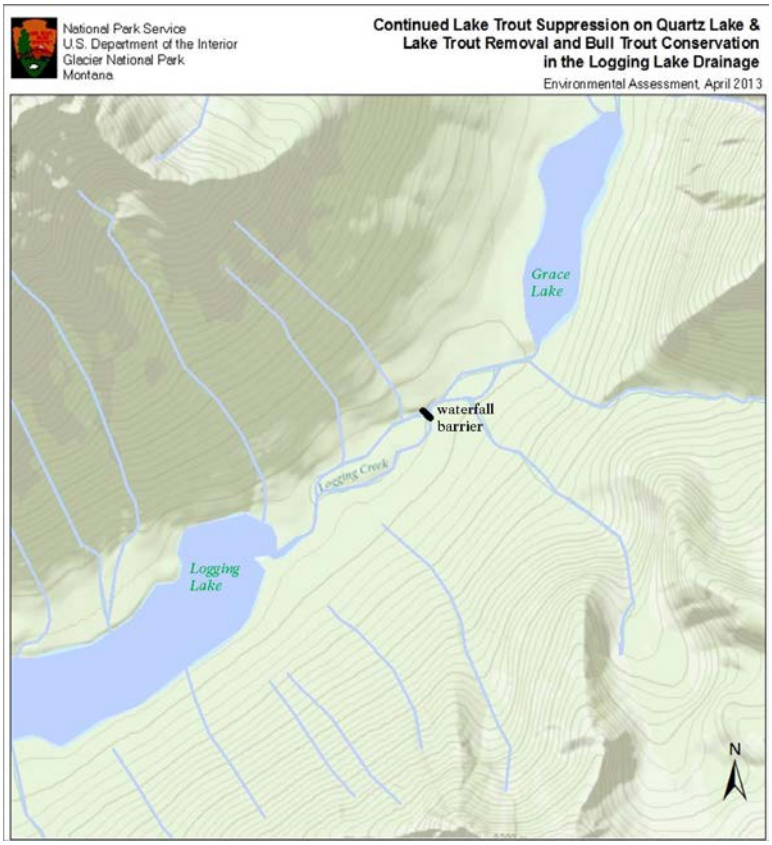


**Figure 5:** Approximate location of waterfall barrier between Logging and Grace Lakes.

genetic diversity in the drainage and reduce the likelihood of juvenile bull trout being unintentionally killed in subsequent lake trout gill net removal efforts, or being predated upon by lake trout. Physical habitat in Grace Lake appears suitable for establishment of bull trout (Galloway 2013). The Yellowstone cutthroat hybrids would serve as a food source for the bull trout transplants, and they would likely establish a reproducing population physically isolated from invasive lake trout. Isolated bull trout populations exist in nearby drainages (e.g. Upper Kintla Lake). Isolating a bull trout population in the Logging drainage would help secure the unique genetic lineage of the Logging Lake bull trout stock, which is currently at risk of being lost due to the likelihood of near-term functional extirpation.

The Logging Creek bull trout spawning area would also be surveyed for the presence of spawning adults. Redd counts over the past five years have ranged from zero to five redds and averaged 2.4. This suggests an average adult spawning population of fewer than ten adult bull trout. To further conserve bull trout in the Logging system, as many as possible of the remaining adults in Logging Creek would be captured and spawned. The fertilized eggs would be transported to Creston National Fish Hatchery (or other appropriate conservation rearing facility) where they would be reared by the USFWS under a captive propagation plan. After hatching in the conservation rearing facility, the juvenile bull trout would be stocked into Grace and Logging Lakes. Along with the juveniles translocated from Logging Creek, the facility-reared fish would help establish a self-sustaining bull trout population safe from lake trout.

Bull trout eggs and juveniles may be transported by foot or pack stock. However, if it is determined that the risk of losing the eggs or harming the young fish is too high due to water temperature increases, oxygen loss, or carbon dioxide buildup, the eggs and juveniles may need to be transported by helicopter. We anticipate that up to four helicopter flights per year (approximately) for the first few years of the project could be necessary, including flights for boat delivery and maintenance as well as bull trout translocation. Fewer flights would likely be necessary during later stages of the project, when the translocation component phases out. If a helicopter is required, a previously scheduled administrative flight would be used whenever possible. Standard park-specific NPS administrative helicopter flight policies and procedures would be followed during all flights. Flight times would not be expected to exceed approximately 30 minutes one way between West Glacier and the staging area (anticipated to be in the Polebridge vicinity), and approximately 30 minutes round trip between the staging area and Logging Lake. (The use of helicopters and other motorized equipment is also addressed in the Minimum Requirements Decision Guide, Appendix A.)

Fish translocation would likely occur over an approximately five year period. Translocation/bull trout stocking would be adaptive and experimental in nature and could occur at any time of year, when the lakes are ice-free. We would be attempting to maximize survival of translocated/stocked fish, and survival may be influenced by factors that vary by season, including lake productivity, prey availability, and water temperature. Translocation and stocking would likely be discreet events, occurring for only a few days each year the project is underway.

At the same time, aggressive lake trout removal efforts would be occurring on Logging Lake in order to rapidly reduce the lake trout population. The intent of the bull trout conservation measures just described would be to move as many bull trout as possible from Logging Creek/Lake into Grace Lake (and/or eggs into the conservation rearing facility) so the last few bull trout wouldn't be exposed to potential netting by-catch mortality during lake trout removal efforts in Logging Lake. Removing individual bull trout from the hazards of netting operations on the lake would enable more aggressive netting, whereby more nets and longer net sets could be employed to more efficiently remove lake trout. Net sets would generally be deployed for

short durations, typically less than six hours (barring unforeseen circumstances, such as stuck nets that require more time to pull, or severe weather that would prohibit crews from being on the water, for example). In general, nets would typically be set at depths greater than 60 feet. Netting methods would be modified should by-catch of other non-target species become unacceptably high. The overall objective would be to rapidly reduce the lake trout population and then re-introduce juvenile bull trout from the conservation rearing facility back to Logging Lake in large numbers and bring the species composition back to one dominated by bull trout. Suppression netting would then continue in order to keep the lake trout population at a sufficiently low abundance and allow bull trout and other native fish species to function with minimal adverse impacts from lake trout.

Lake trout suppression and bull trout conservation at Logging Lake is experimental in nature and could be underway for approximately seven to ten years, as this would be the required time frame to determine whether suppression, translocation, and hatchery rearing efforts are succeeding. Should results indicate that efforts are successfully recovering bull trout, lake trout suppression actions at some level may need to continue into the foreseeable future. If lake trout suppression efforts and/or bull trout conservation were to continue beyond ten years, it would require additional environmental analysis and review.

If enough bull trout (eggs or juveniles) cannot be secured from Logging Lake to start a Logging Lake-specific conservation population in Grace Lake or to support bull trout supplementation in Logging Lake following lake trout suppression, a "nearest neighbor" approach may be implemented in the future. The "nearest neighbor" approach could involve supplementing native bull trout stock from Logging Lake with eggs or juveniles from other nearby populations that have undergone similar evolutionary/natural selection/environmental pressures, or which have the closest genetic profile to the natal stock and would therefore be more likely to survive and persist. Although the intent of this project is to specifically conserve Logging Lake bull trout (and their unique evolutionary and genetic legacy), supplementing with other locally adapted stocks could be necessary due to the small number of bull trout that appear to persist in Logging Lake. It may also have some advantages as it would preserve and secure additional Glacier National Park-specific bull trout life history and genetic diversity.

Monitoring would occur regularly and would include periodic assessment of lake trout population size and/or catch rates in Logging Lake. The age composition of the lake trout population would be monitored over time and age-structured population models would be used to evaluate long-term suppression and removal options. Adult bull trout abundance in Logging Lake would be monitored annually using bull trout redd counts. In addition, periodic standardized gill netting begun in 2000 would likely continue on Logging Lake to provide information on relative abundance of lake and bull trout as well as other native species. Relative abundance could then be compared to pre-suppression levels. Genetic techniques would also be periodically employed to estimate the number of reproducing adult bull trout in Logging Lake. Juvenile bull trout abundance would be routinely assessed in spawning and rearing areas using electrofishing and/or snorkeling. Similar techniques, along with novel genetic approaches, would be used to evaluate the success of bull trout translocation efforts into Grace Lake. (See also *Affected Environment and Environmental Consequences, Fisheries, Bull Trout and Westslope Cutthroat Trout* for analysis of effects to Grace Lake from bull trout translocation.)

Should lake trout suppression and bull trout conservation measures appear promising after several years of implementation (e.g. as measured by increasing relative abundance of bull trout and declining catch of lake trout, as well as increasing bull trout redd counts), the NPS would consider construction of a fish passage barrier downstream of Logging Lake to prevent

additional lake trout (and other non-native species) from entering Logging Lake. Construction of a fish passage barrier would require additional environmental analysis and review.

## Alternative D: Both Alternatives B and C - Preferred

Under Alternative D, both Alternatives B and C would be implemented. Using methods developed on Quartz Lake since 2009, lake trout suppression would continue on Quartz Lake and lake trout removal and bull trout conservation would be conducted in the Logging Lake drainage. Methods, operations, and anticipated outcomes would be as previously described for Alternatives B and C. Both projects could occur simultaneously during approximately the same time of year, depending on area-specific needs and logistics. We anticipate that up to five helicopter flights per year (approximately), including flights for bull trout translocation in the Logging drainage as well as boat delivery and maintenance at both Logging and Quartz Lakes, could be required for the first several years of the project. The number of annual flights would be expected to decline over time as the translocation phase is completed. The intent of using helicopters during bull trout translocation would be to reduce the risk of losing eggs or harming young fish.

Lake trout removal would continue on Quartz Lake for seven to ten years as described in this EA. Lake trout suppression and bull trout conservation at Logging Lake is experimental in nature, also requiring a seven to ten year time frame to determine if suppression, translocation, and hatchery rearing efforts are succeeding. The project would occur in cooperation with the USFWS. Future lake trout suppression and bull trout conservation beyond the seven to ten year time frame addressed in this EA may continue at both Quartz and Logging Lakes, especially if results indicate that efforts are successfully recovering bull trout. The nature of future lake trout suppression and/or bull trout conservation efforts is unknown at this time, and any future action at either Quartz or Logging Lake beyond ten years would require additional environmental analysis and review.

## Mitigation Measures

The following mitigation measures would minimize the degree and/or severity of adverse effects and would be implemented during the project:

*Fisheries*

- Handling stress and injury to unavoidably captured native fish would be minimized. Any bull or westslope cutthroat trout captured alive in nets would be carefully revived and released, as possible.
- Nets would be checked at least once every 24 hours to minimize mortality to non-target fish species.
- Information gained from other lake trout removal projects would be used to minimize catch and mortality of non-target species.

*Wildlife, Threatened and Endangered Species, Species of Concern, and Special Status Species*

- Project personnel would be trained on appropriate behavior in the presence of bears and other wildlife and would adhere to park regulations concerning proper storage of food, garbage, and other attractants.
- All lethally taken lake trout or other fish mortalities would be disposed of by sinking in deep water to avoid creating an attractant to wildlife.
- Pit toilets would be utilized by staff to eliminate human waste as a wildlife attractant.
- The motorboat would be inspected for fuel and oil leaks prior to use each day and spill

prevention materials would be kept on site for cleanup of spilled fuel or oil (such fluid spills are potential unnatural attractants to wildlife species).

- The boat motor would be selected, in part, to minimize noise.
- Timing and location of administrative helicopter flights would consider impacts on wildlife species, including nesting bald eagles and common loons.
- Montana's Common Loon Conservation Plan (Hammond 2009) recommends avoiding human activity within ¼ mile of nesting loons. If loons are nesting during project implementation, every effort would be made to observe this buffer.
    - Active nests would be identified as early in the spring as possible.
    - Project personnel would be educated in identifying loon nesting habitat and nesting disturbance behavior. Any suspected nesting behavior would be reported to park wildlife staff for verification. The area would be avoided to the greatest extent possible until the potential nest site could be evaluated.
    - In areas where the ¼ mile active nest site buffer cannot be observed (due to narrow areas of the lake, for example), activities would occur in a manner that is as least disturbing to loons as possible. These may include travel at "flat wake" speed, maintaining the maximum distance possible while traveling through the area, or no netting within the ¼ mile buffer.
    - If trap nets are used and deployed in shallow waters, they would be modified to provide a means of wildlife exclusion and/or escape.
- If bald eagles are nesting during project implementation, project personnel would avoid whenever possible approaching within 1/4 mile of an active nest when no visual buffer is present and within 1/8 mile when a visual buffer is present (per recommendation from the Montana Bald Eagle Management Guidelines, Montana Bald Eagle Working Group, 2010).

*Water Resources*

- A spill plan would be developed and followed in case of a fuel leak either on the ground or in the lake. Work crews would inspect the boat engines, fuel lines, and fittings prior to commencement of activities each day. Appropriate absorbent supplies would be on site to address a spill both on shore and on the water. Bulk fuel would be stored within in larger spill/bear proof containers. Within these containers, fuel would likely be stored in 5 to 6-gallon gas cans.
- Crews would implement best practices to prevent entry of aquatic invasive species into park waters.

*Natural Sound*

- Flat-wake speed would be used within 300 yards of the patrol cabins and campgrounds.

*Visitor Use and Experience*

- Signs informing visitors of the motorized activity on the lakes and providing information about the suppression efforts would be posted at the trailheads to Quartz and Logging Lakes as well as the backcountry permit office.

## Alternatives Considered but Eliminated from Detailed Study

**Conduct lake trout removal and suppression at lakes with better access, such as Kintla Lake, Lake McDonald, or Bowman Lake, or where motorized boat use is permitted.**
Spawning and rearing habitat for bull trout in Kintla Lake and Lake McDonald is limited, and genetic data (Meeuwig 2008) suggest that these lakes' bull trout populations may be supported by emigration of bull trout from Flathead Lake (i.e. may not be completely self-sustaining populations). It is uncertain how much benefit to bull trout could be anticipated from a lake trout suppression project at Kintla Lake or Lake McDonald. Bowman Lake was considered for this project as it too offers the potential to reduce lake trout and benefit bull trout. However, anecdotal information indicates that Logging Lake was a stronger bull trout fishery prior to lake trout establishment and offers the better opportunity to recover a bull trout population. Morton (1968) quoted Garlick (1950): "Logging and Quartz provide excellent fishing while McDonald, Bowman, and Kintla are only fair to poor". Quartz and Logging Lakes have therefore been selected for the proposed action because they offer the best opportunity for success. As a result, this alternative has been dismissed from further consideration.

**Conduct lake trout removal with non-motorized equipment.**
During analysis of the minimum tool required to implement the project within recommended wilderness (see Minimum Requirements Decision Guide, Appendix A), the park considered whether lake trout could be removed using non-motorized watercraft and equipment. This approach would involve setting and pulling gill nets by hand from a rowboat or canoe. This alternative was dismissed because the work would not be possible with non-motorized equipment, the level of mortality to non-target fish species (including the ESA listed bull trout) would increase, and there would be a high risk to crew safety. With regard to safety, lake temperatures are very cold and lake trout removal operations often occur in inclement weather and at night, when temperatures can be freezing. There would be a high potential for capsizing if nets were set and retrieved from a rowboat or canoe. Hypothermia would be likely should a crew member enter the water, and there would be little or no opportunity for timely rescue. Lifting thousands of meters of wet, heavy gill nets each week from the water by hand requires bending at the waist over the side of a boat for long periods of time. This would not only increase the chances of falling out of the boat, but would create a high risk of back injury.

The project could also not be completed using only non-motorized equipment. Quartz and Logging Lakes are large and have the potential to be windy with large waves. Long travel times to net sites using a large rowboat would limit the amount of net that could be set each day, such that not enough lake trout would be removed fast enough to reduce the population. Crews also could not physically set and pull enough net by hand from a rowboat to effectively reduce the number of lake trout. Mortality would be higher for non-target fish because they would be in the nets longer due to the additional time required to pull the nets by hand. Also, if a net became lodged on debris on the bottom of the lake as is fairly common, it would have to be abandoned since retrieving and pulling such nets free requires a motor with sufficient thrust. This alternative has therefore been dismissed.

**Conduct netting and telemetry operations using a motorized inflatable boat.**
This was considered but dismissed for functionality and safety reasons. Netting gear and sharp tools could easily wear through and/or puncture a soft-sided boat. An inflatable boat would also not provide the necessary stability while setting and retrieving nets, and would probably not support the net puller and net-clearing table. An inflatable boat may also create more wave activity and could end up burning more gas. Pulling nets over the wide, tubed siding of an inflatable boat would be extremely difficult and would put the crew at higher risk of back injury

or falling out of the boat. For these reasons, using an inflatable boat for the project has been dismissed.

**Introduce one or more fish species (such as cisco and burbot) that prey on the early life forms of lake trout and are a preferred prey for adult lake trout.**
Well-intended introductions of non-native fish species are the root cause of many of the problems native fish face across western North America, including Glacier National Park. Introducing new species to Quartz and Logging Lake as a biological control comes with the potential for significant negative unintended consequences, including competition with native fish (i.e. mountain whitefish, sculpin, redside shiner, westslope cutthroat trout). Quartz and Logging Lakes are not closed systems and any fish species introduced into the lakes could migrate downstream and colonize other waters in the Flathead Basin. Additionally, introducing a forage fish such as cisco would support lake trout, thereby potentially increasing the size of lake trout populations as well as the potential for lake trout to invade other park waters. Supporting the non-native lake trout population would contradict the park's commitment to preventing the establishment of the species to the maximum extent possible. This approach is therefore not under consideration, and this alternative has been dismissed. The methods proposed under the preferred alternative are expected to substantially reduce lake trout recruitment in both Quartz and Logging Lakes. This likelihood is reinforced by promising results from suppression efforts underway since 2009 at Quartz Lake, where a high percentage of spawning adult lake trout have already been removed.

## Alternatives, Suggestions, and Concerns from Public Scoping

Eleven comment letters were received during scoping. Nine letters were supportive of the proposal and two were opposed. Suggestions and concerns from public scoping are addressed below.

**Comment:** *Will not trying to maintain low populations of lake trout require an unending netting program that could take place for many years?* **Response:** Yes. The prospect of lake trout suppression at Logging Lake is a long-term process. For this reason, we are proposing netting commitments for seven to ten years in both lakes with periodic re-assessment. Future action at either Quartz or Logging Lake beyond ten years would require additional environmental analysis and review.

**Comment:** *Will the same type of motor boats and helicopters be needed to supply the netting operation as they have in the current Quartz operation?* **Response**: Yes. This is addressed under *Alternatives Carried Forward*.

**Comment:** *To maintain low populations of lake trout in Logging Lake, will you have to put in a fish barrier as was placed in Quartz?* **Response:** Possibly. This is addressed under *Alternatives Carried Forward, Alternative C*, and under *Cumulative Impact Scenario, Future Actions*. Construction of a fish passage barrier in Logging Creek would require additional environmental analysis and review.

**Comment:** *Lake trout have had a detrimental impact on the cutthroat trout population in Kintla Lake over the past 20 years; consider exploring methods to remove lake trout and strengthen the cutthroat trout population in Kintla Lake also*. **Response**: Given limited resources, the park has at this time prioritized maintaining a strong native fish community in Quartz Lake and attempting to recover bull trout (and conserve westslope cutthroat) in Logging Lake.

**Comment:** *Concurrent with lake trout removal by seine in both lakes, consider annually introducing one or more fish species (such as cisco and burbot) that prey on the early life forms of*

*lake trout and are a preferred prey for adult lake trout, one that would spawn in the lake and which lake trout would pursue in deep water in the summer; consider acquiring brood stock from Bear Lake in Utah. To finally escape the need for seining and trapping, one must find a way to reduce the recruitment of lake trout by lowering the rate and number reaching spawning age. If Mysis shrimp are present, the introduction of rainbow smelt is about your only option to reduce their numbers. When the number of fish entering a spawning stream used by bull trout has increased for several years, the trout removal by seine should be terminated. This will allow a test of an aquatic method for lake trout control.* **Response**: This comment has been addressed under *Alternatives Considered but Eliminated from Detailed Study*.

**Comment:** *Use of helicopters and motorized boats conflicts with issues listed in the scoping brochure such as natural soundscapes, backcountry visitor experiences, and possible disruption of other wildlife. These disruptive activities could be very long term if conducted on several other North Fork lakes. There is no way that all lake trout will be removed, and very unfortunately we may just have to live with that fact.* **Response**: Impacts to natural soundscapes, visitor experience, and wildlife are discussed under *Affected Environment and Environmental Consequences*. While it is recognized that lake trout would not likely be completely eradicated from North Fork waters, results from suppression efforts at Quartz Lake since 2009 and Lake Pend Oreille in Idaho indicate the strong likelihood of reducing lake trout populations to the point where native bull trout populations would be able to continue to thrive for the long-term. Recovery of bull trout in Logging Lake would be much more challenging, but is viewed as feasible with sufficient effort aimed at reducing lake trout. The Action Plan for Conservation of Bull Trout in Glacier National Park (Fredenberg et al. 2007) ranked such an effort as a "high priority" when compared to other park lakes. The park's efforts to suppress lake trout and conserve bull trout are also very much in keeping with conservation mandates that govern the management of the park's natural resources. The conservation of native fish and wildlife is part of Glacier National Park's enabling legislation, and the NPS Organic Act charges the NPS with preserving natural resources "unimpaired for future generations". In addition, all federal agencies have the obligation to assist in recovery of ESA listed species.

**Comment:** *Any actions taken need to maintain or enhance the wilderness character of the area rather than detract from it. Included in this is the potential for increased usage by park personnel to the detriment of the backcountry visitor's experience and loss of the natural soundscape to helicopter or mechanized tool or transportation use.* **Response**: This issue is addressed under *Mitigation Measures* and in the *Affected Environment and Environmental Consequences* section of this EA, under *Recommended Wilderness* and *Natural Soundscapes*.

**Comment:** *The park needs to take all available steps and precautions to minimize the impact that increased human travel and usage of Logging and Quartz Lakes will have on wildlife populations, ensure that implementation of the project does not lead to increased human/wildlife conflicts or wildlife disruption, and minimize by-catch of non-targeted fish species.* **Response**: These issues are addressed in the *Mitigation Measures* and *Affected Environment and Environmental Consequences* section of this EA, under *Fisheries/Aquatic Threatened Species and Species of Concern*, *Wildlife*, and *Threatened and Endangered Species and Species of Concern*.

**Comment:** *The park should attempt to engage in management activities during low visitor use periods, such as before/after visitor use increases during the summer, to ensure that visitors are able to experience the solitude of Glacier's backcountry to its fullest.* **Response**: This is discussed under the *Preferred Alternative* and *Mitigation Measures*, and in the *Affected Environment and Environmental Consequences* section, under *Visitor Use and Experience*, *Recommended Wilderness*, and *Natural Soundscapes*.

## Alternative Summaries

Table 2 summarizes the major components of Alternatives A, B, C, and D and compares the ability of each alternative to meet the project objectives (as identified in the *Purpose and Need*). As shown, Alternative D maximally achieves all the project objectives while Alternatives B and C achieve each objective only within their respective areas, and Alternative A (no action) achieves none.

**Table 2:** Summary of alternatives and how each alternative meets the project objectives.

| Alternative Elements | Alternative A: No Action | Alternative B: Continue Lake Trout Suppression at Quartz Lake | Alternative C: Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage | Alternative D: Both B and C (Preferred) |
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| **Threatened bull trout** | Threatened bull trout would become functionally extinct in the Quartz and Logging drainages due to invasive non-native lake trout. | Bull trout in Quartz Lake would be protected by the removal of invasive non-native lake trout. The Quartz Lake bull trout population would continue to remain viable for the long-term. | Bull trout in Logging Lake would be protected by the removal of invasive non-native lake trout and by conservation measures such as translocating individuals within the Logging drainage and/or releasing conservation facility-reared bull trout back into Logging Lake to boost the population. The Logging Lake bull trout population would be given the opportunity to become self-sustaining for the long-term. | Bull trout in both Quartz and Logging Lakes would be protected from the long-term adverse effects of invasive non-native lake trout. Quartz Lake bull trout would remain as a viable population, and Logging Lake could very likely become self-sustaining for the long-term. Bull trout would be protected within two aquatic systems instead of one, thereby benefiting bull trout over a greater area. |
| **Other native fish species** | Native fish, including westslope cutthroat trout, would continue to be adversely affected by invasive non-native lake trout in both the Quartz and Logging drainages. | Native fish, including westslope cutthroat trout, in Quartz Lake would be protected from invasive non-native lake trout. | Native fish, including westslope cutthroat trout, in Logging Lake would be protected from invasive non-native lake trout. | Native fish, including westslope cutthroat trout, in both Quartz and Logging Lakes would be protected from invasive non-native lake trout. |
| **Invasive non-native lake trout** | Invasive non-native lake trout populations would persist in both Quartz and Logging Lakes and replace bull trout as the top level aquatic predator in both systems. | Invasive non-native lake trout populations would continue to be suppressed and eliminated if possible in Quartz Lake. | Invasive non-native lake trout populations would be suppressed and eliminated if possible in Logging Lake. | Invasive non-native lake trout populations would be suppressed and eliminated if possible in Quartz and Logging Lakes. |

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| **The number of bull trout supporting aquatic systems that would be affected.** | The Quartz and Logging drainages, two high priority bull-trout supporting aquatic systems, would both be adversely impacted by invasive non-native lake trout populations. | One important bull trout supporting aquatic system, the upper Quartz drainage, would be beneficially affected by the continued suppression of invasive non-native lake trout. | One important bull trout supporting aquatic system, the Logging drainage, would be beneficially affected by the removal of invasive non-native lake trout. | Two high priority bull trout supporting aquatic systems, both the Quartz and Logging drainages, would benefit from the removal of invasive non-native lake trout. |
| **Project Objectives** | **Meets Project Objectives?** | **Meets Project Objectives?** | **Meets Project Objectives?** | **Meets Project Objectives?** |
| **Continue to recover and protect the park's imperiled bull trout populations from invasive non-native lake trout, and thereby assist with bull trout conservation efforts on a regional scale.** | No. Two of the park's historically robust but currently imperiled bull trout populations would become functionally extinct due to invasive non-native lake trout. | Yes. Bull trout in Quartz Lake would be protected from invasive non-native lake trout and would persist as a self-sustaining population. | Yes. Severely at risk bull trout in Logging Lake would be protected from invasive non-native lake trout and would have the opportunity to rebound toward a self-sustaining population. | Yes. Bull trout populations in two aquatic systems, Quartz and Logging Lakes, would be protected from invasive non-native lake trout. Bull trout would be conserved on a wider scale. |
| **Increase the resiliency of the park's bull trout populations in the face of the potential added stressors associated with climate change.** | No. Secure, ecologically intact habitat would not be available to bull trout populations subject to increasing climate change stressors. | Yes. The ecological integrity of Quartz Lake would be preserved, providing refugia for a bull trout population that may become stressed by climate change. | Yes. The ecological integrity of Logging Lake would be preserved, providing refugia for a bull trout population that may become potentially stressed by climate change. | Yes. The ecological integrity of both Quartz and Logging Lake would be preserved, providing refugia for bull trout populations that are potentially stressed by climate change. |
| **Continue the development of lake trout suppression techniques that could be used in other locations within and outside the park.** | No. Continued development of lake trout suppression techniques would not occur, which would inhibit park managers' ability to apply the best, most up to date science to suppression efforts elsewhere. | Yes. Lake trout suppression techniques would continue to be developed at Quartz Lake and could be used in other locations. | Yes. Lake trout suppression techniques would be developed at Logging Lake and could be used in other locations. | Yes. Lake trout suppression techniques would continue to be developed at both Quartz and Logging Lakes. Conducting lake trout removal within two aquatic systems would enhance park managers' understanding about the effectiveness of current suppression techniques across multiple systems, thus facilitating decisions regarding their use in other locations. |

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| **Maintain a stable native fish complex to support fish-dependent predators, such as common loons and bald eagles.** | No. A reduction in available native fish numbers and corresponding increases in lake trout could be detrimental for predators that rely on native fish in the upper levels of the water column and cannot access deeper dwelling lake trout. | Yes. An intact native fishery would be maintained on Quartz Lake and would continue to support fish-dependent predators, including common loons and bald eagles, which are especially dependent on shallow water-dwelling native fish for food. | Yes. An intact native fishery would be maintained on Logging Lake and would continue to support fish-dependent predators, including common loons and bald eagles, which are especially dependent on shallow water-dwelling native fish for food. | Yes. Intact native fisheries would be maintained on both Quartz and Logging Lakes and would continue to support fish-dependent predators, including common loons and bald eagles, which are especially dependent on shallow water-dwelling native fish for food. |
| **Conserve and maintain the natural condition of the park's recommended wilderness by protecting native fish populations and the ecological integrity of the backcountry lakes they inhabit.** | No. Native fish populations and the ecological integrity of Quartz and Logging Lakes would not be protected, and this would diminish the natural condition of recommended wilderness within both the Quartz and Logging drainage. | Yes. By protecting the ecological integrity of Quartz Lake, the natural condition of recommended wilderness in the Quartz drainage would be conserved and maintained. | Yes. By protecting the ecological integrity of Logging Lake, the natural condition of recommended wilderness in the Logging drainage would be conserved and maintained. | Yes. By protecting the ecological integrity of both Quartz and Logging Lakes, the natural condition of recommended wilderness in the both drainages would be conserved and maintained. |

Table 3 summarizes the anticipated environmental impacts for Alternatives A, B, C, and D. Only those impact topics that have been carried forward for further analysis are included. The Affected Environment/Environmental Consequences section provides a more detailed explanation.

**Table 3:** Environmental impact summary by alternative.

| Impact Topic | Alternative A: No Action | Alternative B: Continue Lake Trout Suppression at Quartz Lake | Alternative C: Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage | Alternative D: Both B and C (Preferred) |
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| **Fisheries, bull trout (threatened species), and westslope cutthroat trout (state-listed species of concern)** | Major, short and long-term, site specific, local and regional adverse impacts would be expected due to the eventual loss of native fish populations. Cumulatively, no action would undermine past and ongoing efforts designed to benefit native fisheries; cumulative impacts would be major, short and long-term, regional and adverse. | Moderate, long-term, site-specific to regional beneficial impacts would be expected for the native fish assemblage, including bull trout and westslope cutthroat trout, because the successful large-scale removal of lake trout would decrease competition and predation by lake trout.<br><br>Short-term, site-specific, adverse impacts that are minor to moderate for bull trout and minor for westslope cutthroat trout and other native fish would occur due to incidental netting mortality.<br><br>Cumulatively, beneficial impacts from this alternative combined with other actions would be moderate and long term due to continued protection of native fish, and adverse impacts would be minor to moderate and short-term from bull trout mortality. | Moderate, long-term, site-specific to regional beneficial impacts would be expected for the native fish assemblage, including bull trout and westslope cutthroat trout, because the successful large-scale removal of lake trout would decrease competition and predation by lake trout.<br><br>Short-term, site-specific, adverse impacts that are minor to moderate for bull trout and minor for westslope cutthroat trout and other native fish would occur due to incidental netting mortality and the removal of juvenile bull trout/eggs from Logging Lake.<br><br>Cumulatively, there would be moderate, long-term, beneficial impacts from the protection of native fish, and minor to moderate, adverse, short-term impacts from incidental bull trout mortality and the removal of juvenile bull trout/eggs from Logging Lake. | Moderate, long-term, site-specific to regional beneficial impacts would be expected for the native fish assemblages, including bull trout and westslope cutthroat trout, in two lakes because the successful large-scale removal of lake trout would decrease competition and predation by lake trout.<br><br>Short-term, site-specific, adverse impacts that are minor to moderate for bull trout and minor for westslope cutthroat trout and other native fish would occur due to incidental netting mortality and the removal of juvenile bull trout/eggs from Logging Lake.<br><br>Cumulatively, there would be moderate, long-term beneficial impacts to fisheries from to combined efforts to protect native fish populations, and minor to moderate, short-term adverse impacts from |

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| | | | | incidental bull trout mortality and the removal of juvenile bull trout/eggs from Logging Lake. |
| **Wildlife** | Minor to moderate, long term, site-specific to local and possibly regional adverse impacts would occur due to eventual loss of available fish biomass for fish-dependent terrestrial and avian predators.<br><br>Cumulatively, there would be minor to moderate, long-term, and site-specific to regional adverse impacts because the efficacy of other actions designed to protect native fish populations would be undermined. | Negligible to minor, long-term, site-specific to local and possibly regional beneficial impacts would occur from the preservation of an intact native fishery and shallow water-dwelling fish that are more accessible to fish-dependent predators.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to disturbances from motorboat use, infrequent helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. | Negligible to minor, long-term, site-specific to local and possibly regional beneficial impacts would occur from the preservation of an intact native fishery and shallow water-dwelling fish that are more accessible to fish-dependent predators.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to disturbances from motorboat use, helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. | Negligible to minor, long-term, site-specific to local and possibly regional beneficial impacts would occur from the preservation of two intact native fisheries and shallow water-dwelling fish that are more accessible to fish-dependent predators at both Quartz and Logging Lakes.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to disturbances from motorboat use, helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. |
| **Bald Eagle (special status species)** | Minor to moderate, long-term, local and possibly regional adverse impacts | Minor, long-term, site-specific to local and possibly regional beneficial impacts would occur | Minor, long-term, site-specific to local and possibly regional beneficial impacts would occur | Minor, long-term, site-specific to local and possibly regional beneficial |

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| | would occur from a decrease in the availability of shallow water-dwelling, native fish for food.<br><br>Cumulatively, there would be minor to moderate, long-term, and site-specific to regional adverse impacts because the efficacy of other actions designed to protect native fish populations would be undermined. | from the preservation of an intact native fishery and shallow water-dwelling fish that are more accessible to bald eagles.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to disturbances from motorboat use, infrequent helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. | from the preservation of an intact native fishery and shallow water-dwelling fish that are more accessible to bald eagles.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to disturbances from motorboat use, helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. | impacts would occur from the preservation of two intact native fisheries and shallow water-dwelling fish that are more accessible to bald eagles foraging at both Quartz and Logging Lakes.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to disturbances from motorboat use, helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. |
| **Common Loon (state-listed species of concern)** | Minor, long-term, local and possibly regional adverse impacts would occur from a decrease in the availability of shallow water-dwelling, native fish for food.<br><br>Cumulatively, there would be minor to moderate, long-term and site-specific to regional adverse impacts because the efficacy of other actions designed to protect native fish | Negligible to minor, long-term, site-specific to local and possibly regional beneficial impacts would occur from the preservation of an intact native fishery and shallow water-dwelling fish that are more accessible to common loons.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to | Negligible to minor, long-term, site-specific to local and possibly regional beneficial impacts would occur from the preservation of an intact native fishery and shallow water-dwelling fish that are more accessible to common loons.<br><br>Negligible to minor, short-term, site-specific to local and possibly regional adverse impacts would occur due to | Negligible to minor, long-term, site-specific to local and possibly regional beneficial impacts would occur from the preservation of two intact native fisheries and shallow water-dwelling fish that are more accessible to common loons on both Quartz and Logging Lakes.<br><br>Negligible to minor, short- |

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| | populations would be undermined. | disturbances from motorboat use, infrequent helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, and site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. | disturbances from motorboat use, helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, and site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. | term, site-specific to local and possibly regional adverse impacts would occur due to disturbances from motorboat use, helicopter flights, and the presence of project personnel at a time when human activity is typically low.<br><br>Cumulatively, there would be negligible to minor, short and long-term, and site-specific to regional beneficial and adverse impacts from other actions that protect native fish as well as disturbances from past, ongoing, and future human activity. |
| **Grizzly Bear (threatened species)** | No impacts.<br><br>Under Section 7, the determination for grizzly bears would be "no effect". | Negligible to minor, short and long-term, and site-specific to local adverse impacts would occur due to disturbances from human activity, including motorboat use and infrequent helicopter flights.<br><br>Cumulatively, there would be negligible to minor, short and long-term, and site-specific to local adverse impacts from intermittent, low intensity increases in human activities.<br><br>Under Section 7, the determination for grizzly bears would be "may affect, not likely to adversely affect". | Negligible to minor, short and long-term, and site-specific to local adverse impacts would occur due to disturbances from human activity, including motorboat use and helicopter flights.<br><br>Cumulatively, there would be negligible to minor, short and long-term, and site-specific to local adverse impacts from intermittent, low intensity increases in human activities.<br><br>Under Section 7, the determination for grizzly bears would be "may affect, not likely to adversely affect". | Negligible to minor, short and long-term, and site-specific to local adverse impacts would occur due to disturbances from human activity, including motorboat use and helicopter flights at both Quartz and Logging Lakes.<br><br>Cumulatively, impacts would be negligible to minor, short and long-term, site-specific to local, and adverse from intermittent, low intensity increases in human activities.<br><br>Under Section 7, the determination for grizzly bears would be "may affect, |

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| | | | | not likely to adversely affect". |
| **Recommended Wilderness** | Moderate, site-specific and local, long-term adverse impacts would occur from the permanent degradation of the natural condition, unique ecological value, and unique scientific value of recommended wilderness in the upper Quartz and Logging drainages.<br><br>Cumulatively, there would be negligible to moderate, short and long-term, site-specific and local adverse impacts from past, ongoing, and future disturbances combined with the degradation of native fisheries and the diminished efficacy of other projects designed to protect native fish populations. | Moderate, long-term, and site-specific to regional beneficial impacts would occur from the preservation of a native fishery and protection of the natural condition and unique ecological, scientific, and educational value of recommended wilderness at Quartz Lake.<br><br>Minor to moderate, short and long-term, site-specific and local adverse impacts would occur from the continued use of a motorboat on the lake, motorized noise disturbances during netting, and possible roundtrip helicopter flights.<br><br>Cumulatively, there would be minor to moderate, short and long-term, site-specific and local adverse impacts from increased disturbances; there would also be moderate, long-term, and local beneficial impacts from further protection of native fisheries. | Moderate, long-term, and site-specific to regional beneficial impacts would occur from the preservation of a native fishery and protection of the natural condition and unique ecological, scientific, and educational value of recommended wilderness at Logging Lake.<br><br>Minor to moderate, short and long-term, site-specific and local adverse impacts would occur from the use of a motorboat on the lake, motorized noise disturbances during netting, and roundtrip helicopter flights.<br><br>Cumulatively, there would be minor to moderate, short and long-term, site-specific and local adverse impacts from increased disturbances; there would also be moderate, long-term, and local beneficial impacts from further protection of native fisheries. | Moderate, long-term, and site-specific to regional beneficial impacts would occur from the preservation of two native fisheries and protection of the natural condition and unique ecological, scientific, and educational value of recommended wilderness at both Quartz and Logging Lakes.<br><br>Moderate, short and long-term, site-specific and local adverse impacts would occur from the use of motorboats, motorized noise during netting, and roundtrip helicopter flights at two backcountry lakes.<br><br>Cumulatively, there would be minor to moderate, short and long-term, site-specific and local adverse impacts from increased disturbances; there would also be moderate, long-term, and local beneficial impacts from further protection of native fisheries. |
| **Natural Soundscapes** | No impacts. | Minor to moderate, short-term, site-specific and local adverse impacts would occur due to intermittent, temporary noise from a motorboat, portable generator, and possible helicopter flights. | Minor to moderate, short-term, site-specific and local adverse impacts would occur due to intermittent, temporary noise from a motorboat, portable generator, and helicopter flights. | Moderate, short-term, site-specific and local adverse impacts would occur due to intermittent, temporary noise from a motorboat, portable generator, and helicopter flights at both |

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| | | Cumulatively, there would be minor to moderate, site-specific to local, short and long-term adverse impacts from an increased number of noise intrusions. | Cumulatively, there would be minor to moderate, site-specific to local, short and long-term adverse impacts from an increased number of noise intrusions. | Quartz and Logging Lakes.<br>Cumulatively, there would be minor to moderate, site-specific to local, short and long-term adverse impacts from an increased number of noise intrusions. |
| **Visitor Use and Experience** | Negligible to moderate, long-term, and site-specific adverse impacts would occur due to degraded recreational fishing opportunities and compromised opportunities to visit two ecologically intact backcountry areas.<br>Cumulatively, there would be negligible to moderate, short and long-term, and site-specific to local beneficial and adverse impacts from diminished angling opportunities combined with administrative activities that primarily benefit visitors but may also disrupt the backcountry experience. | Moderate, long-term, and site-specific beneficial impacts would occur from the preservation of angling opportunities as well as opportunities for non-anglers to visit an ecologically intact backcountry location.<br>Minor to moderate, short-term, and site-specific adverse impacts would occur because project noise and activity would be disruptive to visitors seeking a primitive wilderness experience.<br>Cumulatively, there would be negligible to moderate, short and long-term, and site-specific beneficial and adverse impacts from additional disturbances as well as protected recreational opportunities. | Moderate, long-term, and site-specific beneficial impacts would occur from the preservation of angling opportunities as well as opportunities for non-anglers to visit an ecologically intact backcountry location.<br>Minor to moderate, short-term, and site-specific adverse impacts would occur because project noise and activity would be disruptive to visitors seeking a primitive wilderness experience.<br>Cumulatively, there would be negligible to moderate, short and long-term, and site-specific beneficial and adverse impacts from additional disturbances as well as protected recreational opportunities. | Moderate, long-term, site-specific and local beneficial impacts would occur from the preservation of angling opportunities at two lakes, as well as opportunities for non-anglers to visit two ecologically intact backcountry locations.<br>Minor to moderate, short-term, site-specific and local adverse impacts would occur because project noise and activity would be disruptive to visitors seeking a primitive wilderness experience at two backcountry lakes.<br>Cumulatively, there would be negligible to moderate, short and long-term, and site-specific to local beneficial and adverse impacts from additional disturbances as well as protected recreational opportunities. |

## Environmentally Preferable Alternative

According to the CEQ regulations implementing NEPA (43 CFR 46.30), the environmentally preferable alternative is the alternative "that causes the least damage to the biological and physical environment and best protects, preserves, and enhances historical, cultural, and natural resources. The environmentally preferable alternative is identified upon consideration and weighing by the Responsible Official of long-term environmental impacts against short-term impacts in evaluating what is the best protection of these resources. In some situations, such as when different alternatives impact different resources to different degrees, there may be more than one environmentally preferable alternative."

Alternative B (continue lake trout suppression at Quartz Lake), Alternative C (remove lake trout and conserve bull trout in the Logging Lake drainage) and Alternative D (continue lake trout suppression on Quartz Lake and remove lake trout and conserve bull trout in the Logging Lake drainage) are all environmentally preferable for several reasons: 1) Native fish populations in either or both the Quartz and Logging drainages would be protected for the long-term; 2) Quartz Lake, one of the last remaining strongholds in the Flathead Basin for the threatened bull trout, and/or Logging Lake, once one of the most productive bull trout fisheries in the park, would be protected for the long term; 3) a top aquatic predator, the bull trout, would continue to play a significant role in the predator-prey dynamics of either or both Quartz and Logging Lakes; 4) one or two important potential refugia for native fish from the combined stressors of climate change and invasive non-native species would be protected; 5) the long-term persistence of native fish species would help reflect the overall ecological integrity of either or both the Quartz and Logging drainages, recommended wilderness, the park, and the Flathead watershed; 6)valuable opportunities for scientific research of one or two ecologically sound aquatic systems would be maintained; 7) outdoor educational opportunities inherent within one or two unique and increasingly rare aquatic ecosystems would endure for future generations; 8) backcountry angling opportunities would remain undiminished by significant changes to fish species composition and abundance; and 9) the park would be in keeping with other efforts by state and federal agencies to protect functional native fish populations throughout the western United States.

Of the three action alternatives, Alternative D would protect threatened bull trout and other native fish on the widest scale. Alternatives B and C would also provide long-term protection for bull trout and native fish within their respective areas. But their implementation would protect only one aquatic ecosystem, whereas Alternative D would extend protection to two systems and thus be of greater overall benefit to bull trout and native fish throughout the region.

By contrast, Alternative A (no action) is not the environmentally preferable alternative because, although there would be no activities that would disturb elements of the biological and physical environment, 1) the integrity and persistence of native fish populations in the Quartz and Logging systems would be permanently compromised by non-native invasive lake trout; 2) the potential effects to native fisheries would be adverse, major and long-term; 3) bull trout, a threatened species and top aquatic predator, would be significantly, adversely affected and at risk of functional extinction in Quartz and Logging Lakes; 4) two important refugia for native fish from the combined stressors of climate change and invasive non-native species would be at risk; 5) the overall ecological integrity of the Quartz and Logging drainages, recommended wilderness, the park as a whole, and the Flathead watershed would be diminished; 6) the park would not be in keeping with numerous state and federal efforts to protect functional native fish populations throughout the western United States; 7) scientific research, outdoor education, and angling opportunities within the Quartz and Logging drainages would be permanently

compromised.

## Preferred Alternative

No new information came forward from public scoping or consultation with other agencies to necessitate the development of any new alternatives, other than those described and evaluated in this document. Alternative D best meets the project objectives because it would be of the greatest overall benefit to bull trout and native fish throughout the region. Alternative D is therefore considered the NPS preferred alternative.

# Affected Environment and Environmental Consequences

This chapter describes the affected environment (existing setting or baseline conditions) and analyzes the potential environmental consequences (impacts or effects) that would occur as a result of implementing the proposed project. Direct, indirect, and cumulative effects are analyzed for each resource topic carried forward. Potential impacts are described in terms of type, context, duration, and intensity. General definitions are defined as follows, while more specific impact thresholds are given for each resource in Table 4 and at the beginning of each resource section.

- **Type** describes the classification of the impact as either beneficial or adverse, direct or indirect:
    - *Beneficial:* A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
    - *Adverse:* A change that moves the resource away from a desired condition or detracts from its appearance or condition.
    - *Direct:* An effect that is caused by an action and occurs in the same time and place.
    - *Indirect:* An effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.
- **Spatial Context** describes the area or location in which the impact would occur. Effects may be 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** describes the length of time an effect would occur, either short-term or long-term. The definitions for these periods depend upon the impact topic and are described in Table 4.
- **Intensity** describes the degree, level, or strength of an impact. For this analysis, intensity has been categorized into negligible, minor, moderate, and major. Because definitions of intensity vary by resource topic, intensity definitions are provided separately for each impact topic analyzed in this EA and are also provided in Table 4.

## Cumulative Impact Scenario

The CEQ regulations which implement NEPA 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 preferred alternative with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at Glacier National Park and, if applicable, the surrounding region. The geographic scope for this analysis includes actions

primarily within the park's North Fork District, while the temporal scope includes projects within a range of approximately ten to fifteen years. Given this, the following projects were identified for the purpose of conducting the cumulative effects analysis, listed from past to future:

**Past Actions**

- *Experimental lake trout suppression at Quartz Lake.* In 2009, the NPS and USGS began a collaborative and experimental project to remove and control lake trout at Quartz Lake. The project was intended to develop methods and approaches to remove or suppress lake trout. Radio-tagged lake trout were monitored to identify spawning locations. Spawning concentrations of adult lake trout and juveniles from rearing areas were removed using gill nets. Netting efforts occurred in the spring and fall for greatest efficiency in catching and removing lake trout while minimizing by-catch of non-target fish species. A motorboat equipped with an outboard motor was used to conduct the netting operation. Project staff members were housed at the Quartz Lake patrol cabin near Quartz Lake during netting operations. Peak netting activities occurred during early morning hours and at dusk/night to take advantage of fish behavior. Fuel and other supplies were packed in by livestock and stored onsite. A report from the USGS detailing alternatives for managing the lake trout population in Quartz Lake is anticipated in 2014; results to date have been positive.

- *Wildlife research and monitoring activity*. A wolverine DNA study involved the installation and monitoring of hair snagging stations at the foot of Logging Lake in the winters of 2010, 2011 and 2012, and at the foot of Grace Lake and the head of Quartz Lake in the winters of 2011 and 2012. Historically, fixed-wing bald eagle nest monitoring has occurred annually in the North Fork, including the Quartz and Logging drainages, with one flight early each spring to determine bald eagle nesting activity. Bald eagle nests as well as loon nesting activity at both Quartz and Logging Lakes have also been monitored from the ground and via non-motorized watercraft.

- *Quartz Creek fish barrier*. In 2012, Glacier National Park improved and completed the construction of a fish passage barrier on Quartz Creek between Middle and Lower Quartz Lakes to protect the upper Quartz drainage and the bull trout population in Quartz Lake from invasive non-native lake trout.

- *Changes to park fishing regulations.* Park fishing regulations were changed in 2008 to allow unlimited harvest of lake trout by anglers.

- *Road maintenance and repair along the Inside North Fork Road.* Seasonal maintenance along the Inside North Fork Road between Fish Creek and Kintla Lake has included clearing downed timber and obstructive vegetation, replacing log railings on bridges, replacing signage, clearing debris from culverts, and installing new culverts or replacing existing culverts where needed. Most of the new culverts have been installed between Fish Creek and Dutch Creek. Annually, gravel has been hauled in and added to problem areas followed by grading. Riprap material was installed on both sides of the road approximately 1.0 mile (1.6 kilometers) north of the Anaconda Creek Bridge in response to a high water event in 2006 that washed out part of the road. A secondary channel of Anaconda Creek continues to flood and wash out sections of the road each spring, and road maintenance has occurred annually until more permanent solutions can be implemented. Riprap and culverts have also been used to make interim repairs to a portion of the Inside North Fork Road at Logging Creek, where annual high water

during spring has washed out a portion of the road and inundated the nearby campground and ranger station.

**On-going Actions**

- *Wildlife research and monitoring activity*. Bald eagle nests and loon nesting activity at both Quartz and Logging Lakes are monitored from the ground during the nesting season by park staff; non-motorized watercraft may be used during loon and bald eagle nest monitoring.

- *Actions the state is taking on the North Fork and other waters.* Montana Fish, Wildlife, and Parks is conducting rainbow trout and rainbow-westslope cutthroat trout hybrid suppression actions on the mainstem of the North Fork Flathead River and a number of its tributaries. These activities are conducted each spring using electrofishing from boats or by crews with backpack electrofishing equipment.

- *Boat inspections to protect park waters from aquatic invasive species (AIS).* Motorboats and sailboats are thoroughly inspected for AIS (quagga and zebra mussels and other aquatic invasives) prior to entering park waters. Hand-propelled watercraft users must provide self-certification that their boats are free of AIS. Boats that fail inspection are not permitted in park waters. If AIS infestations are found, a boat may be quarantined until fully decontaminated.

- *Road maintenance and repair along the Inside North Fork Road.* Previously described seasonal and routine maintenance activities along the Inside North Fork Road are ongoing (see Past Actions, above).

- *Trail clearing and maintenance.* Trails in the project vicinities include the Quartz Lake Trail traversing Cerulean Ridge between the foot of Bowman Lake and the foot of Quartz Lake, the Quartz Creek Trail between Quartz Lake and the Inside North Fork Road, the West Lakes Trail over Quartz Ridge between Lower Quartz Lake and Bowman Lake, and the Logging Lake Trail between the Inside North Fork Road and Grace Lake. These trails are cleared annually, usually in June, and clearing generally requires two days. Trail maintenance is performed as needed and is generally underway for approximately two weeks every summer. In the Quartz Lake area, maintenance is primarily focused on an ongoing project to construct multiple turnpikes across a wet area near Middle Quartz, where a raised boardwalk once existed. Turnpike construction has been ongoing for about ten years and is expected to continue for another five years. Turnpike construction is also ongoing along the Logging Lake Trail due to wet conditions. Intermittent maintenance of the campgrounds at Quartz Lake, Lower Quartz Lake, Logging Lake, and Grace Lake generally occurs on a five year, cyclic basis. Emergency repair and maintenance projects occur as the need arises.

- *Administrative helicopter flights to Granite Park.* Untreated human waste is removed annually from the biological mediation system unit (toilet) that services the Granite Park Chalet. Waste removal occurs in mid to late September and, depending on the amount of waste, requires approximately six round trip flights over a period of a few hours in a single day.

- *Commercial scenic helicopter air tours*. A number of commercial operators currently provide scenic air tours over the park. Such commercial flights over the park occur multiple times each day during peak summer months. The NPS does not have jurisdiction over the airspace in the park, or over commercial air tour businesses that are

located outside the park but provide tours within the park. The Federal Aviation Administration (FAA) recommends that commercial air tour operators fly at least 2000 feet above ground level (AGL) over parks and wilderness areas.

**Future Actions**

- *Akokala Creek Fish Passage Barrier*. The park is considering proposing construction of a fish passage barrier on Akokala Creek to protect bull and westslope cutthroat trout. Construction techniques would likely be similar to those used to construct the Quartz Creek fish passage barrier.
- *Logging Creek Fish Passage Barrier*. The park will consider proposing a fish passage barrier on Logging Creek, downstream of Logging Lake, should lake trout suppression results appear promising. Construction techniques would likely be similar to those used to construct the Quartz Creek fish passage barrier.
- *Wildlife research and monitoring activity*. Bald eagle and loon nest monitoring at Quartz and Logging Lakes will likely continue. Nests are monitored from the ground during the nesting season by backcountry rangers and park biologists; non-motorized watercraft may be used.
- *Road maintenance and repair along the Inside North Fork Road*. Previously described seasonal and routine road maintenance is anticipated to continue (see Past Actions). During spring runoff, both Anaconda Creek and Logging Creek have repeatedly flooded the Inside North Fork Road and washed away substantial portions of the road. The park is exploring a number of short and long-term options to address the situation.
- *Additional administrative helicopter flights west of the Continental Divide*. Helicopters are used administratively as necessary, and only after rigorous review, to deliver equipment and supplies necessary for backcountry projects and periodic maintenance and rehabilitation of backcountry structures, trails, lookouts, and campsites each year. Flights are not permitted if materials can be transported to the work sites by other methods. Additional helicopter flights west of the Continental Divide are anticipated to deliver supplies and materials to project sites in the backcountry, and to remove waste from Sperry and Granite Park Chalets. The park closely manages the use of administrative flights and has determined that approximately fifty flights per year will not result in measurable effects to park resources (NPS 2003). Glacier National Park conducts an aviation meeting each year with park staff to review and approve or deny flight requests for park projects. Information from this meeting is used to combine flights to reduce the total number of administrative flights. If more than approximately 50 flights are required in a given year, an environmental assessment or impact statement would be prepared.
- *Emergency response helicopter flights*. Helicopter flights in the backcountry could be required for emergencies.

**Table 4:** Definitions for intensity levels and duration.

| Impact Topic | Negligible | Minor | Moderate | Major | Duration |
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| **Fisheries and Aquatic Threatened Species and Species of Concern (including bull trout and westslope cutthroat trout for the current proposal)** | Impacts would be barely perceptible and impact a few individuals of a sensitive species or other native species, or their habitat. | Impacts would affect a relatively small proportion of the population of a sensitive species or other native species, or have very localized impacts upon their habitat. The change would require considerable scientific effort to measure and have minor consequences to the species or habitat function. | Impacts would cause measurable effects on: (1) a moderate number of individuals within the population of a sensitive native species, (2) the existing dynamics between multiple species (e.g., predator-prey), or (3) a moderately sized habitat area or important habitat attributes. A sensitive species or other native species population or their habitat might deviate from existing levels/conditions, but would remain viable indefinitely. | Impacts would have substantial and possibly permanent consequences for a sensitive native species population, the dynamics between multiple native species, or almost all available critical or unique habitats. A sensitive species or other native species population or its habitat would be permanently altered such that their continued survival would be threatened. | Short-term: After implementation, would be expected to recover in 1-5 years.<br><br>Long-term: Effects would be expected to persist beyond 5 years. |
| **Wildlife, Species of Concern, Special Status Species (including bald eagles and common loons for the current proposal)** | 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 wildlife species' populations. | Effects on wildlife species would be detectable, although the effects would be localized and would be small and of little consequence to the species' population. | Effects on wildlife species would be readily detectable and widespread, with consequences at the population level. | Effects on wildlife 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.<br><br>Long-term: After implementation, would take more than 1 year to recover or effects would be permanent. |

| Impact Topic | Negligible | Minor | Moderate | Major | Duration |
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| **Terrestrial Threatened and Endangered Species (including grizzly bears for the current proposal)** | 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. | An individual(s) of a listed species or its critical habitat would be affected, but the change would be small. | 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. | An individual or population of a listed species, or its critical habitat, would be noticeably affected and there could be a vital consequence to the population or habitat. | Short-term: After implementation, would recover in less than 1 year.<br>Long-term: After implementation, would take more than 1 year to recover or effects would be permanent. |
| **Recommended Wilderness** | The effect on recommended wilderness would not be detectable. | The effect would be detectable, but would not appreciably affect the defining attributes of wilderness as described by the Wilderness Act. | The effect would be readily apparent and/or would appreciably affect the defining attributes of wilderness as described by the Wilderness Act. | The effects would be highly apparent and would significantly affect the defining attributes of wilderness as described by the Wilderness Act. | Short-term: Occurs for one year or less.<br>Long-term: Occurs for more than one year or is permanent. |
| **Natural Soundscapes** | Noise from the action would be below the level of detection and would not result in any perceptible consequences. | Noise from the action would be localized and rarely audible, and/or would occur for less than 1 month. | Noise from the action would be localized to widespread and periodically audible, and/or would occur for 1 to 3 months. | Noise from the action would be widespread, regularly audible, and/or would occur for more than 3 months. | Short-term: Would occur only during project implementation.<br>Long-term: Would be permanent or occur beyond project implementation. |

| Impact Topic | Negligible | Minor | Moderate | Major | Duration |
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| **Visitor Use and Experience** | Visitors would not be affected or changes in visitor use and/or 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 use and/or 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. | Changes in visitor use and/or experience would be readily apparent. The visitor would be aware of the effects associated with the alternative. | Changes in visitor use and/or experience would be readily apparent and have important consequences. The visitor would be aware of the effects associated with the alternative. | Short-term: Occurs only during project implementation.<br>Long-term: Occurs after project implementation or is permanent. |

# Fisheries, Bull Trout, and Westslope Cutthroat Trout
## Affected Environment

The proposed project would occur in both the Quartz and Logging lake drainages, which flow into the North Fork of the Flathead River in the headwaters of the Columbia River Basin. The proposed project would affect the entire upper Quartz Lake system, which includes Middle Quartz, Quartz, and Cerulean Lakes. Middle Quartz Lake is 49 acres, has a maximum depth of 41 feet, and is connected to Quartz Lake by 0.25 miles of low-gradient stream channel. The combined surface area of Quartz Lake and Cerulean Lake is 920 acres (Quartz 870 acres; Cerulean 50 acres). Quartz Lake has a maximum depth of 273 feet.

Native fish species in the Quartz drainage are bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), mountain whitefish *(Prosopium williamsoni)*, longnose sucker *(Catostomus catostomus)*, largescale sucker *(Catostomus macrocheilus)*, sculpin *(Cottus sp.)*, and redside shiner *(Richardsonius balteatus)*. The only known non-native fish species known to be present in the Quartz drainage is lake trout, which were first discovered in Lower Quartz Lake in 2003 and Quartz Lake in 2005.

Bull trout are present and lake trout have not yet been detected in Cerulean Lake. There are no fish barriers between Quartz Lake and Cerulean Lake. The outflow from Cerulean Lake feeds Quartz Lake, and water from Quartz Lake flows into Middle Quartz Lake, which is assumed to also have lake trout. Further downstream is Lower Quartz Lake, with a well-documented lake trout presence. In 2004, the park initiated construction of a barrier below Middle Quartz Lake to limit the number of lake trout moving into the upper Quartz system; the barrier was completed in 2012, with repairs occurring in 2013.

Logging Lake is located in the North Fork Flathead River drainage at an elevation of 3,810 feet. The lake is 1,114 acres in size and has a maximum depth of 198 feet. Logging Lake supports bull trout, westslope cutthroat trout, mountain whitefish, longnose sucker, largescale sucker, sculpin, northern pikeminnow (*Ptychocheilus oregonensis*) and redside shiner. There is approximately 0.7 miles of accessible stream habitat in Logging Creek, upstream of Logging Lake. A more than 20-foot tall waterfall precludes further upstream movement of native fish.

Grace Lake, located in the Logging Creek drainage, is located upstream of the waterfall. Grace Lake sits at an elevation of 4,396 feet, and has a surface area of 82 acres and a maximum depth of 49 feet. Logging Creek upstream of the waterfall and Grace Lake are believed to have been historically fishless (Marnell et al. 1987). In 1925, 101,000 cutthroat trout eggs (dominated by Yellowstone cutthroat genetics) were stocked into Grace Lake, and a self-sustaining population became established. This is the only record of stocking in Grace Lake. By the early 1930's, cutthroat fishing in Grace Lake was reported to be excellent. A photograph from park files from 1930 shows two men with a stringer of ten cutthroat trout from Grace Lake with a note on the back from one of the individuals saying that some of the fish were "so full of freshwater shrimp they were coming out of their mouths". Recent sampling in Grace Lake and Logging Creek upstream of the waterfall using both gill nets and electrofishing captured only hybrids of Yellowstone cutthroat trout (YCT) and westslope cutthroat trout (WCT) (Galloway 2013). The genetic makeup of these fish is estimated to be approximately 30% WCT and 70% YCT (C. Muhlfeld, USGS, personal communication). Plankton sampling in Grace Lake captured one family of amphopods (*Gammaridae*), one family of cladocerans (*Daphniidae*), and one family of copepods (*Cyclopidae*). Stream sampling of macroinvertebrates in Logging Creek upstream of the waterfall collected insects comprising twelve families from six orders (*Diptera, Ephemeroptera, Megaloptera, Odonata, Plecoptera, Trichoptera*) as well as two families of

annelids (*Hirudinea, Oligochaeta*). No ESA listed or candidate invertebrate species were found (Galloway 2013). Amphibian surveys have also been conducted at Grace Lake, and both boreal toads (*Bufo boreas*) and long-toed salamander larvae (*Ambystoma macrodactylum*) were present in low abundance at the time of sampling (Galloway 2013).

Logging Creek upstream of the waterfall has approximately 5,600 feet of spawning and rearing habitat, of which approximately 1,000 feet is characterized as suitable bull trout spawning habitat (Galloway 2013). Maximum summer surface water temperature in Grace Lake was measured at $16^0$C, but generally Grace Lake water temperatures remain below $15^0$C year-around. Weak thermal stratification is also evident, with cooler water in deeper areas of the lake (Galloway 2013). Stream temperatures both upstream and downstream of Grace Lake are suitable for bull trout, and mean daily water temperatures remain below $15^0$C year-around (Galloway 2013). Galloway (2013) concluded that the physical habitat was likely suitable for establishing a bull trout population and the probability of success for such an effort would be high.

**Bull Trout, Federally Listed Threatened Species**

Bull trout have declined across their range in recent decades, resulting in a threatened listing for the species under the Endangered Species Act in 1998. The bull trout's decline has been attributed to habitat degradation and fragmentation, introductions of non-native species, and angling pressure (Al-Chokhachy et al. 2010). Among the approximately 100 lakes in the contiguous United States with bull trout populations, only about 50 are in naturally functioning (i.e. undammed) ecosystems, including the upper Flathead River system. Glacier National Park is an essential part of the remaining population stronghold for bull trout in the Flathead, and has approximately one-third of the natural lakes that still support the adfluvial (migrating between lakes and rivers or streams) life history of bull trout (Fredenberg et al. 2007).

Lake trout consistently displace bull trout in systems where they have been introduced (Donald and Alger 1993, Fredenberg 2002, Martinez et al. 2009). Of 17 bull trout populations located west of the Continental Divide in the park, only five are protected from lake trout invasion, due to impassable waterfalls. Lake trout have compromised nine of the twelve accessible bull trout lakes on the west side of the park and are driving bull trout towards functional extinction in systems where monitoring data exist (Downs et al. 2011). The lone exception is Quartz Lake, where lake trout suppression activities were initiated in 2009.

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). In the lakes of Glacier National Park, bull trout exhibit adfluvial and lacustrine-adfluvial life history strategies. These bull trout grow to maturity in the lakes, and then spawn in tributaries (adfluvial) or lake outlets (lacustrine-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; Downs and Jakubowski 2006). Resident and migratory forms may be found together, and either form can produce resident or migratory offspring. Spawning typically occurs in tributary streams 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 one and five, 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 1995). 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 $14^0$C) 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 are part of a historic fishery that is a fundamental to the biodiversity of the park. Protecting native fish resources is a high priority for the park's conservation and management programs (National Park Service 2006). Fredenberg et al. (2007) published an action plan to conserve the long-term abundance, distribution and genetic diversity of bull trout in Glacier and concluded specifically for Quartz Lake "protection from near-term decline in the face of lake trout invasion is critically important to the conservation of bull trout in the park." Further, the authors concluded that the upper Quartz Lake system is the highest priority for conservation and preservation of bull trout among 17 lakes they examined.

Quartz Lake was considered to be among the best natural bull trout lakes in the Columbia River Basin, until the 2005 discovery of invasive non-native lake trout. Prior, Quartz Lake contained an intact native fish assemblage. Even with the detection of lake trout, Quartz Lake currently hosts the most viable and un-impacted bull trout population remaining among the larger lakes in the park. For the near term it continues to provide a model of a fully functioning native aquatic ecosystem. It is expected that if lake trout successfully reproduce and expand in Quartz Lake, then the entire Quartz Lake chain would likely be severely and perhaps permanently compromised for native fish.

A total count of bull trout redds (spawning nests) was conducted in the upper Quartz Lake system (including spawning bull trout from both Quartz and Cerulean Lakes) in 2008 (L. Tennant, Montana State University, personal communication) and a total of 81 redds were counted. Fifty-two redds were counted in Quartz Creek, while 28 were counted in Rainbow Creek. However, it is unknown which redds were created by Quartz Lake spawners versus Cerulean Lake spawners, but recent genetic evidence suggests Middle Quartz, Quartz, and Cerulean Lakes are comprised of one breeding population (Meeuwig et al. 2007). Other studies have estimated the number of adult bull trout in a stream for each redd counted to be between 1.5 and 3.2 adults per redd, with an average of 2.2 adults bull trout per redd range-wide (Bonar et al. 1997). Downs et al. (2006) estimated 3.2 adult bull trout per redd in the Lake Pend Oreille system in Idaho, as did Fraley and Shepard (1989) for Flathead River drainage tributaries. Using the 3.2:1 spawner:redd ratio, bull trout redd counts in Quartz and Logging Creeks suggest average spawning runs of about 100 and less than 10 spawning adults, respectively. This is occurring despite Logging Lake having a 28% larger surface area than Quartz Lake.

**Westslope Cutthroat Trout, State-listed Species of Concern**

State listed species of concern 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. Westslope cutthroat trout are listed as a Montana "Species of Concern." Westslope cutthroat trout in the Flathead drainage can be adfluvial, fluvial, or resident. Adfluvial fish occupy lakes (e.g. Quartz Lake) and spawn in tributaries (e.g. Quartz Creek). Fluvial fish reside in rivers or large streams and utilize tributaries for spawning and rearing. Resident fish spend their entire lives in a relatively small section of stream. All three life history forms potentially occur in the Quartz Lake 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. Westslope cutthroat trout 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 and Flathead river systems, occurring as peak flows subside, on the descending limb of the hydrograph (Schmetterling 2001, Muhlfeld et al. 2009). They typically spawn at age four or five, from March to July at water temperatures near ten degrees Celsius (Shepard et al. 1984). Resident fish complete their life history in tributaries and seldom exceed 300 millimeters in length. Resident westslope cutthroat males begin to 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 millimeters, mean depths ranging from 17 to 20 centimeters, and mean velocities ranging from 0.3 to 0.4 meters per second (Shepard et al. 1984). Westslope cutthroat trout 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 (Shepard et al. 2002). Rainbow trout (*O. mykiss*) also likely compete with westslope cutthroat trout for food and space, but also pose a threat from hybridization (Hitt et al. 2003). Both Lower Quartz and Quartz Lakes as well as Grace Lake were stocked with cutthroat trout between 1925 and 1944. These were presumably Yellowstone cutthroat trout, however there is no evidence those fish persisted in the Quartz drainage. A single westslope x rainbow hybrid was recently detected in Cerulean Lake, but there is no evidence of brook trout in either of the systems.

Recent sampling in Grace Lake and Logging Creek upstream of the waterfall using both gill nets and electrofishing captured only Yellowstone cutthroat trout/ westslope cutthroat trout hybrids (YCT x WCT) (Galloway 2013). The genetic makeup of these fish is estimated to be approximately 30% WCT and 70% YCT. Downstream genetic sampling of cutthroat trout from Logging Lake in 2005 did not show any influence of YCT (C. Muhlfeld, USGS, personal communication) despite their presence upstream in Grace Lake since the 1920's.

## Intensity Level Definitions

*Negligible:* Impacts would be barely perceptible and impact a few individuals of a sensitive species or other native species, or their habitat.

*Minor:* Impacts would affect a relatively small proportion of the population of a sensitive species or other native species, or have very localized impacts upon their habitat. The change would require considerable scientific effort to measure and have minor consequences to the species or habitat function.

*Moderate:* Impacts would cause measurable effects on: (1) a moderate number of individuals within the population of a sensitive native species, (2) the existing dynamics between multiple species (e.g., predator-prey), or (3) a moderately sized habitat area or important habitat attributes. A sensitive species or other native species population or their habitat might deviate from existing levels/conditions, but would remain viable indefinitely.

*Major:* Impacts would have substantial and possibly permanent consequences for a sensitive native species population, the dynamics between multiple native species, or almost all available critical or unique habitats. A sensitive species or other native species population or its habitat would be permanently altered such that their continued survival would be threatened.

*Short-term:* After implementation, would be expected to recover in 1-5 years.

*Long-term:* Effects would be expected to persist beyond 5 years.

## Impacts of Alternative A – No Action

Under the no action alternative, the NPS would not continue lake trout suppression at Quartz Lake, nor would the park conduct lake trout removal and bull trout conservation on Logging Lake. This alternative would by default rely on existing recreational fishing activity to suppress lake trout at Quartz and Logging Lakes. The park's fishing regulations were changed in 2008 and now allow anglers to keep all lake trout they catch from park waters west of the Continental Divide, regardless of size or number. This regulation change resulted in fishing regulations that were more consistent with NPS policies regarding conservation of native fish. The change is largely expected to benefit native fish resources in the park through angler education, and by providing a clear and consistent message to the public that lake trout are not desired in park waters west of the Continental Divide due to their negative impacts on native fish communities.

However, for much of the fishing season in Glacier National Park, lake trout inhabit deep water which is not readily accessed by anglers fishing from the lake shore. From 1984 through 1986, anglers reported fishing an average of 61 hours per year on Quartz Lake (Haines 1987). This represents the minimum average angling pressure on Quartz Lake for that time period. Creel census data collected from 1984 through 1986 (Haines 1987) reported that anglers turned in an average of 9.3 creel cards per year from Quartz Lake and estimated that a park-wide average of 264 hours were fished for each creel card returned. Using these values, an estimated average of 2,455 angler hours were expended annually on Quartz Lake during the report period. This estimate is consistent with more recent mail-in creel survey data reported by Montana Fish, Wildlife, and Parks (MFISH database), who estimated that 109 and 403 angler days were expended on Quartz Lake in 2003 and 2005, respectively.

Lake trout were first verified in Logging Lake in 1984 (Fredenberg 2002). The average lake trout catch rate for Logging Lake from 1984 through 1986 was 0.047 lake trout per hour. Using the

Logging Lake lake trout catch rate and the average annual fishing effort estimate for Quartz Lake from 1984-1986, we can estimate that anglers may catch approximately 100 lake trout per year in Quartz Lake as the population grows and expands. This would also represent the maximum amount of harvest anglers would be expected to exert on the population, if they kept every fish they caught. It is far more likely that in such a remote area as Quartz Lake, anglers would only keep a small fraction of their catch.

From 1984-1986 (Haines 1987), anglers turned in an average of 12.3 creel cards per year from Logging Lake. Using the same expansion factor of 264 hours of effort for each card returned (Haines 1987), we can estimate that an average of 3,247 angler hours of effort were expended annually during this time-period with an estimated catch rate of 0.047 lake trout per hr. In 2001 and 2007, Montana Fish, Wildlife, and Parks estimated anglers fished 47 and 56 days on Logging Lake, respectively (MFISH database). We would expect a higher catch rate on Logging Lake due to the expanding lake trout population (Downs et al. 2011), but the extremely low amount of angling pressure and the difficulty in catching lake trout from shore suggest there would be no effect on lake trout population growth from current levels of recreational angling. It should be noted that anglers did not keep any of the lake trout they caught in Logging Lake in 1986.

Angling alone has not been successful at suppressing lake trout populations in other regional waters such as Yellowstone Lake, Flathead Lake, Lake Pend Oreille, Priest Lake, and Upper Priest Lake despite substantial fishing effort with excellent boat access. Creel survey estimates indicate Flathead Lake supports an annual angling effort ranging from 41,000 to 103,000 angler days per year (Deleray et al. 1999). Angling pressure alone would not be sufficient to control or suppress lake trout on Quartz Lake nor to reduce the lake trout population at Logging Lake. At Quartz Lake, lake trout population growth would likely accelerate if left unchecked under this alternative, and lake trout would eventually overwhelm the native fish community. The now reduced lake trout population in Quartz Lake would be allowed to expand to the point where it reaches equilibrium with the environment, and lake trout would likely replace bull trout as the upper Quartz system's top level aquatic predator over the next 25 years, as has been observed in other park lake systems. Eventually, Quartz Lake bull trout would likely become functionally extinct. In Logging Lake, the lake trout population would be allowed to increase in size until it reaches carrying capacity, likely within a decade, and would push the lake's few remaining bull trout closer to functional extinction if they are not already there. Bull trout would therefore not recover in either Quartz or Logging Lake under this alternative.

**Bull Trout**

Under the no action alternative, Glacier's ecologically unique bull trout populations would continue to decline at a park-wide scale, and both the Quartz Lake and Logging Lake populations of bull trout would, quite likely, eventually be extirpated. This conclusion is supported by an ever increasing body of information documenting the replacement of bull trout by introduced lake trout at a range-wide scale (Donald and Alger 1993, Martinez et al. 2009) and at a local park scale (Downs et al. 2011). Fredenberg (2002) documented the replacement of bull trout by lake trout in four of five Glacier National Park lakes studied over the remarkably short period of about 30 years (including Logging Lake). Quartz Lake was fifth in the study, and given enough time and a lack of aggressive lake trout control action, it is highly likely that lake trout would eventually replace bull trout there as well. Of the seventeen lakes known to support bull trout on the west side of the park, twelve are accessible to lake trout. Nine of these lakes have been invaded by lake trout, two more are at-risk of invasion because there are no physical barriers to preclude lake trout invasion, and a third has been invaded by brook trout and could eventually be invaded by lake trout.

Bull trout have consistently been displaced in systems where lake trout have been introduced (Donald and Alger 1993; Fredenberg 2002). Bull trout and lake trout have similar morphologies, diets, and growth rates (Donald and Alger 1993). In Bow and Hector Lakes, lake trout were introduced in 1964 and by 1992 bull trout were absent in both lakes (Donald and Alger 1993). Following this same pattern, lake trout have become established and have displaced native bull trout in several lakes in Glacier National Park, forcing these populations near the point of extirpation (Fredenberg 2002). Meeuwig (2008) used stable isotope analysis to evaluate the potential for competition for food resources in Glacier National Park and documented bull and lake trout occupying dominant trophic levels relative to other fish species, with lake trout feeding slightly higher on the food-chain.

Glacier has documented that the single greatest threat to the persistence of bull trout on the west side of the park is the invasion and establishment of non-native lake trout. In 1969 and 1977, fisheries surveys were conducted in five large lakes (Logging, Bowman, Harrison, Kintla, and Quartz) to assess the status of fish populations. In 2000, these lakes were resurveyed using similar methods. The 2000 results indicated a broad decline in bull trout in four of the five lakes and a corresponding increase in non-native lake trout (Fredenberg 2002). However, the catch data for bull trout in Quartz Lake remained similar. Presumably this is because lake trout were absent until recently (Fredenberg 2002).

Similar to the catch data, bull trout spawning data (e.g. redd counts) exists for some of the large and historically productive (from a bull trout perspective) lakes on the west side of the park. Data collected from 2002 to 2008 suggests precariously low numbers of adult bull trout remain in Logging Lake (Downs et al. 2011). Redd counts can be used to estimate the number of adult bull trout that spawned in a stream, and using established redd spawner relationships (Bonar et al. 1997, Fraley and Shepard 1989, Downs and Jakubowski 2006), the data suggests that the Logging Lake population has less than ten spawning adults remaining. In contrast, redd counts in Quartz Lake have remained stable and relatively strong during this same time period (Downs and Stafford 2009). When gill net and redd count trend data are viewed together, they indicate that native bull trout populations have drastically declined in the park. Bull trout are therefore at imminent risk of functional extinction or extirpation in several lakes due to competitive/predation interactions with introduced lake trout.

Quartz Lake was considered to be among the most important remaining natural bull trout lakes before the 2005 discovery of invasive lake trout. Prior to that time, Quartz Lake contained an intact native fish assemblage and was one of the "Crown Jewels" of the Crown of the Continent ecosystem. Even with the detection of lake trout, Quartz Lake currently supports the most viable and unimpacted bull trout population remaining among the larger lakes in the park. For the near term, it continues to provide a model of a fully functioning native aquatic ecosystem. Although we do not have a reliable population estimate for lake trout in Quartz Lake, 91 percent (10 of 11) of radio-tagged adult lake trout were removed from Quartz Lake during gill netting operations in 2009, and 44 percent (4 of 9) were removed in 2010 (Muhlfeld and Fredenberg 2009 and D'Angelo et al. 2011). Eight of nine lake trout radio-tagged in 2011 and 2012 were caught and removed by the end of 2012 (V. D'Angelo, personal communication). All four lake trout radio-tagged in 2013 were recaptured and removed by the end of 2013. This data suggests that the project has already successfully removed a high percentage of spawning adults and thereby reduced the size of the adult lake trout population in Quartz Lake.

Although we believe lake trout are a relatively new arrival to Quartz Lake, the ability of anglers to catch lake trout in recent years in Quartz Lake suggested an increasing population at the time the experimental suppression program was initiated. Under the "no action" alternative and the

cessation of netting efforts on Quartz Lake, it is likely that the current low numbers of lake trout would grow unchecked, eventually overwhelm the system, and replace bull trout within 30 years as they have done in other park lakes (Fredenberg 2002). This scenario has already played out in Logging Lake where lake trout dominate the system. No action would likely result in significant decline or loss of the Quartz Lake and Logging Lake bull trout populations to the point of functional extinction. Loss of both the Quartz Lake and Logging Lake bull trout populations would reduce the overall viability of bull trout as a species on the west side of the park. Therefore the no action alternative would have major, long-term adverse impacts on bull trout.

**Westslope Cutthroat Trout**
Westslope cutthroat trout populations would also likely be substantially compromised by the expansion of lake trout in the Quartz Lake and Logging Lake systems. Westslope cutthroat trout feed primarily on aquatic and terrestrial invertebrates in the upper level of the water column, and lake-dwelling cutthroat would be particularly vulnerable to predation by lake trout in spring and fall when lake trout use similar, shallower habitats (Dux 2005). Other native fish (e.g. mountain whitefish) may offer a prey buffer between lake trout and westslope cutthroat trout, but it is likely that population growth and the longevity of lake trout would eventually be sufficient to cause substantial disruption and harm to the entire native fish community, including westslope cutthroat trout. Dramatic reductions in Yellowstone cutthroat trout abundance in Yellowstone Lake, for example, have been attributed to the expansion of illegally introduced lake trout (Koel et al. 2012).

Lake trout differ considerably in their biology from bull and westslope cutthroat trout in that they spawn in the lake, and would presumably benefit from expansive high-quality rearing habitat for young lake trout that is typically available in park lakes. Bull and westslope cutthroat trout spawn and rear in streams, and their populations are likely limited by the amount of accessible high-quality stream rearing habitat, particularly during winter months. Natural waterfalls limit the amount of this habitat in some areas, and in others, appropriate stream habitat is not present. These stream spawning and rearing species are also at risk from natural events such as fire, flood, and drought, which are far less likely to substantially impact a lake trout population than a stream spawning/rearing bull or westslope cutthroat trout population. Lake trout also have the potential to live considerably longer than bull or westslope cutthroat trout (Schram and Fabrizio 1998, Downs et al. 1998, Downs et al. 2006), and by living longer, they gain a competitive reproductive advantage. Under no action, migratory westslope cutthroat trout would likely be reduced to the point where they no longer play a meaningful role in the lake ecosystem. Westslope cutthroat trout would likely continue to persist in the drainage in a resident tributary form, but migratory lake-dwelling westslope cutthroat trout would likely suffer dramatic reductions in abundance in both lakes. Therefore, the no action alternative would have major, long-term adverse impacts on westslope cutthroat trout.

**Cumulative Impacts of Alternative A**
Cumulative impacts under this alternative would be minimal. Lake trout suppression has been ongoing in Quartz Lake since 2009 and construction of a fish passage barrier near the outlet of Middle Quartz Lake was completed in 2012. Removal of cobble and small boulders from the stream channel during construction of the barrier likely impacted individual aquatic macroinvertebrates, but would not have had a population-level impact. Removal of the large rocks from the streambed also may have impacted the carrying capacity for overwintering juvenile salmonids in the immediate project reach. Juvenile bull trout use unembedded cobble-sized substrate for overwinter habitat (Bonneau and Scarnecchia 1998, Thurow 1997). However, the small reach of stream impacted (approximately 75 meters upstream of the barrier) likely had

minimal impacts on overall system stream rearing capacity. The no action alternative would not increase any adverse impacts to native fisheries that may have occurred from the barrier or previous suppression actions.

In response to expanding lake trout numbers and populations, fishing regulations were changed in 2008 to allow unlimited harvest of lake trout by anglers. Angler misidentification of bull trout and other trout species has been documented in angler surveys. If angling pressure increases dramatically on Quartz Lake and Logging Lake, misidentification of lake and bull trout could result in illegal harvest of bull trout. However, due to the remote nature of these systems, we do not expect the regulation change to result in a substantial increase in unintentional harvest of bull trout. No action would not increase any adverse impacts that might occur from unintentional harvest.

Cumulatively, this alternative would not advance past, ongoing, and future efforts to conserve native fish populations in the North Fork Flathead River drainage. Actions including the Quartz Creek fish passage barrier, four years of lake trout suppression at Quartz Lake, and rigorous efforts to prevent other aquatic invasive species from entering park waters were/are undertaken to protect bull trout and other native species and are benefitting native fisheries, and lake trout suppression efforts on Quartz Lake during the last four years have yielded promising results. The no action alternative would likely undermine those efforts, compromising their potential benefits. Eventually, taking no action to continue lake trout suppression on Quartz Lake would eliminate the progress that has been made during the previous four years of lake trout suppression.

**Conclusion**
This alternative would result in the demise of bull trout as a functional part of the aquatic ecosystem in two lakes that are essential to the overall persistence of native bull trout on the west side of the park. Under the no action alternative, impacts would be major, adverse, short and long-term to the native fishery in Quartz Lake and Logging Lake, including bull and westslope cutthroat trout. These impacts would be site specific, local and regional for both species. Cumulatively, this alternative could undermine past and ongoing actions designed to benefit native fisheries, including previous lake trout suppression efforts over the past four years; impacts would be major, short and long-term, regional and adverse.

## Impacts of Alternative B – Continue Lake Trout Suppression on Quartz Lake

Lake trout suppression gill netting has been ongoing on Quartz Lake since 2009. Suppression activities are refined with each year of netting in order to reduce by-catch of non-target fish species and maximize the efficiency at which lake trout are removed. Suppression activities are also informed and adjusted annually through knowledge gained from suppression actions on other waters, such as those currently underway on Swan Lake in Montana and Lake Pend Oreille in Idaho. For example, net mesh size and netting depth are particularly important in reducing by-catch and targeting lake trout. Actions proposed under this alternative would involve continued lake trout suppression, largely employing angling, radio-telemetry and established netting techniques to remove lake trout from Quartz Lake.

When compared to overnight gill net sets used on Quartz Lake in periodic monitoring efforts, the shorter-duration netting actions proposed in this alternative would result in fewer non-target fish caught and would have lower mortality rates. Buchanan et al. (2002) demonstrated an inverse relationship between gill net soak time and fish survival – that is, the longer the nets are

in the water, the higher the fish mortality rate. Set times would be anticipated to be shorter than our standard overnight monitoring net sets. In addition, we would continually refine our netting approach to minimize by-catch of other species. This has proven to be effective on Quartz Lake in reducing by-catch.

From 2009-2013, a total of 4,579 lake trout were removed from Quartz Lake (Muhlfeld and Fredenberg 2010, D'Angelo et al. 2011, V. Dangelo, USGS, personal communication). Over the past five years of suppression implementation, the mortality ratio of lake trout:bull trout in the net catch has consistently improved from 17:1 to 84:1 from 2009-2013 (Muhlfeld and Fredenberg 2010, D'Angelo et al. 2011, V. D'Angelo, USGS, personal communication). Adjustments were made to avoid using certain net mesh sizes that resulted in higher mortality to bull trout and deeper depths were targeted where few non-target fish exist. Changes in the mortality ratios indicate that we are improving our ability to specifically target lake trout and reduce by-catch mortality of bull trout. The mortality rate for bull trout captured in the suppression gill nets has ranged from 17%-35% from 2009-2013 (Muhlfeld and Fredenberg 2010, D'Angelo et al. 2011, V. D'Angelo, USGS, personal communication). Improvements in netting techniques and the use of a live-well style fish recovery box has helped keep mortality rates relatively low. Other lake trout removal programs using similar methods have estimated mortality rates of captured bull trout from as low as 20% on Lake Pend Oreille (A. Dux, Idaho Department of Fish and Game, personal communication) to as high as 40% on Swan Lake (W. Fredenberg, USFWS, personal communication).

Using a spawner:redd ratio of 3.2:1 (Fraley and Shepard 1989, Downs et al. 2006) and an annual average of 32 redds since the project began in 2009 (Downs and Woody 2013), we can estimate a current adult bull trout population (2009-2013) of approximately 100 adults. The by-catch mortality rate for adults in the past several years has averaged about eight individuals, or less than 10% of the adult abundance estimate. D'Angelo et al. (2012) estimated a population of 478 bull trout greater than 400 millimeters in length in Quartz Lake. Using this population estimate and the average annual number of eight adult mortalities in 2011-2013, the estimated bull trout mortality rate drops to about 2% of the "adult" fish population. Fredenberg and Rumsey (2007) evaluated potential bull trout mortality from lake trout-related gill netting efforts on Swan Lake and concluded that the lethal removal (a combination of legal recreational fishing harvest and netting) of approximately 7-9% of the adult bull trout population in the Swan Lake project would not pose an unacceptable risk to the population. Glacier National Park used a slightly different approach to estimating the adult population size from bull trout redd counts in the Quartz Lake system than was used on Swan Lake and arrived at a more conservative (worse case) estimate of impact on the adult population in Quartz Lake. When this is considered in comparison, our estimated mortality rate is similar to the assessment for Swan Lake and would not be anticipated to pose an unacceptable risk to the bull trout population in Quartz Lake.

Over the past five years, due to improvements in netting techniques, we have increased our ability to target and remove both juvenile and adult lake trout. However, bycatch of juvenile mountain whitefish increased in 2013 as we deployed the finer mesh nets for juvenile lake trout. We captured a total of 561 mountain whitefish, of which 155 were mortalities in 2013. We do not expect this level of mortality to impact the mountain whitefish population in Quartz Lake. Due to the relatively low by-catch and mortality rates of other non-target fish species, we do not anticipate any population level impacts or risks to these species from the continued netting operation. Frequent net checks and regular communication with the USFWS regarding acceptable limits of bull trout mortality would also minimize the risk of having a long-term

population level impact on bull trout. Releasing native fish incidentally caught in the removal nets alive would remain a very high priority.

In 2013 we began using finer net material on the juvenile gill nets, which dramatically increased the catch of juvenile lake trout. Juvenile lake trout catch increased from 480 in 2012 to over 2,000 in 2013. The need to minimize the capture of bull trout as well as impacts on the visiting public from motorized boat use limits our ability to more aggressively target sub-adult lake trout or increase netting efforts for juvenile lake trout. However, we have continued to improve capture rates during juvenile removal periods by employing more effective nets at more effective locations. These efforts would continue to be refined and continue to improve in the future. We anticipate the number of juvenile lake trout removed will increase as we become even more effective over time. Similarly, removal of adult bull trout peaked in 2009 at 140 fish, and has declined to a fairly constant catch over the past few years of about 50 adults. Based on netting recapture and removal of previously radio-tagged adult bull trout (81%), we are also likely removing a high proportion of the un-tagged lake trout spawning population annually. Based on angling catch rates from spring sampling, it is becoming increasingly more difficult to catch adult lake trout in Quartz Lake (W. Fredenberg, USFWS, personal communication). It is clear that we are impacting the adult lake trout population. Additional years of suppression are needed to remove lake trout showing up on the spawning grounds annually as adults that were either in the system before we started netting or have escaped juvenile netting efforts. Removal of additional juveniles coupled with continued removal of adults during spawning should lead to a continued reduction in the overall number of lake trout in the population. Coupled with the recently completed fish passage barrier on Quartz Creek, native fish would continue to benefit from the reduction of lake trout in Quartz Lake.

**Cumulative Impacts of Alternative B**
This alternative would complement the long-term benefits to native fisheries that are anticipated from the recent completion of a fish passage barrier on Quartz Creek, which will prevent non-native fish species, including lake trout, from entering the upper Quartz system. Together with the barrier, previous lake trout suppression efforts on Quartz Lake, and ongoing efforts to keep the park's waters free of other aquatic invasive species, a continued lake trout suppression program in Quartz Lake would greatly improve the chances of long-term, sustainable native fish populations, including bull trout, in the upper Quartz system. In addition, the park is considering construction of a similar fish passage barrier on Akokala Creek, which in combination with ongoing efforts on Quartz Lake would have larger overall benefits to native fish.

Park fishing regulations were changed in 2008 to allow unlimited harvest of lake trout by anglers, and angler misidentification of bull trout and other trout species has been documented in angler surveys (e.g. Schill 1999). If angling pressure increased dramatically on Quartz Lake, misidentification of lake vs. bull trout could result in unintentional harvest of bull trout. This angling mortality would be additive to any netting mortality that would occur under this alternative. However, due to the remote nature of Quartz Lake, we do not expect the regulation change to result in substantially increased unintentional harvest of bull trout in the system.

There would be short-term, minor to moderate, adverse cumulative impacts to native fish from continued suppression actions combined with previous suppression actions on Quartz Lake due to by-catch mortality. In addition, Glacier National Park would likely continue to implement a periodic monitoring program on lakes on the west side of the park, potentially including Quartz Lake. This netting provides information on changes in fish species composition over time, and is intended to inform fishery management of waters where it is implemented. The next gill net

monitoring sampling for Quartz Lake is scheduled to occur in 2015. But additional gill netting combined with this alternative would result in additional mortality to bull trout; sampling through periodic gill netting may be suspended during implementation of this alternative.

**Conclusion**
Under this alternative, there would be minor to moderate short and long-term, site-specific, negative impacts to the Quartz Lake bull trout and only minor impacts to the westslope cutthroat trout population and other native fish, through incidental netting mortality. If the project is successful, however, bull trout and native fish populations would be protected from the severely detrimental effects of lake trout and other non-native invasive fish, and there would be moderate long-term benefits for bull trout and other native fish observed at multiple scales (i.e. site-specific, local, widespread, and regional). Cumulatively, beneficial impacts from this alternative combined with past, present and future actions would be moderate and long term due to continued protection of native fish populations, and adverse impacts would be minor to moderate and short-term from bull trout mortality.

## Impacts of Alternative C – Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage

Initial lake trout removal efforts on Logging Lake are anticipated to be more aggressive than those on Quartz Lake. Nets would be used to capture lake trout at spawning locations and juveniles would be targeted in rearing areas. The intent would be to rapidly reduce the lake trout population and then re-introduce juvenile bull trout in large numbers to turn the species composition back to one dominated by bull trout. More targeted suppression netting would then be used to keep the lake trout population at a sufficiently low abundance to allow bull trout and other native fish species to function with minimal adverse impacts from lake trout. We would initially attempt to move as many bull trout as possible from Logging Creek and/or Lake into Grace Lake (and/or eggs into the conservation rearing facility) so the last few bull trout remaining won't be exposed to potential netting by-catch mortality during lake trout removal efforts. This would also allow us to be more aggressive in netting by using more nets and longer net sets to more efficiently remove lake trout. Netting methods would be modified should by-catch of other non-target species become unacceptably high.

When compared to overnight gill net sets currently used on Logging Lake in periodic monitoring efforts, the actions proposed in this alternative would result in fewer non-target fish caught and would have lower mortality rates. In 2010, ten overnight gill net sets on Logging Lake caught a total of 459 fish. Forty-two lake trout and no bull trout were captured. The remainder of the catch was comprised of mountain whitefish (215), northern pikeminnow (97), longnose sucker (66), coarsescale sucker (35), and westslope cutthroat trout (4). These net sets are intended to sample all fish species in Logging Lake in a standardized fashion and sample both shallow and deep habitats. By-catch of native fish would be anticipated to be much lower (particularly for westslope cutthroat trout, mountain whitefish, and northern pikeminnow) when targeting lake trout, since native fish tend to inhabit the upper level of the water column and the nets would be set at greater depths due to the lake trout's affinity for deep-water habitats.

Set times would also be anticipated to be lower than our standard monitoring net sets. Buchanan et al. (2002) demonstrated an inverse relationship between gill net soak time and fish survival – that is, the longer the nets are in the water, the higher the fish mortality rate. In

addition, we would continually refine our netting techniques to minimize by-catch of other species. This has proven to be an effective approach on Quartz Lake to reduce by-catch.

The impacts analysis for continued lake trout suppression at Quartz Lake (Alternative B, previous section) discusses the mortality ratios of lake trout:bull trout in the net catch and methods to minimize by-catch mortality while improving our ability to target lake trout. We would be employing similar techniques and equipment in the Logging Lake suppression effort, and these catch numbers, ratios and mortality rates represent approximations of what we may anticipate at Logging Lake. As with Quartz Lake, we would seek to minimize catch and mortality of non-target fish species by adjusting net set locations and net set duration as the project progresses. We do not anticipate any long-term population level impacts to non-target species (except for bull trout, see next paragraph for discussion) from this project.

Logging Lake is a system in which lake trout are very abundant and bull trout are increasingly rare. We expect to catch few bull trout as by-catch, but because there are so few bull trout remaining, by-catch mortality would be a greater concern. We would mitigate this impact by moving juvenile bull trout from Logging Lake and/or Creek upstream over the barrier falls and into Grace Lake to reduce their risk of being captured and killed in the lake trout removal nets at Logging Lake. In addition, we would capture remaining adult bull trout in Logging Creek upstream of the lake inlet, spawn them on-site, and take the fertilized eggs to a conservation rearing facility to improve survival. We anticipate that the eggs would be incubated and the juveniles reared and released into Grace and Logging Lakes, but eggs may also be directly transplanted into the Grace Lake system. This would ensure protection of the genetic legacy of bull trout in Logging Lake in the event some of the few remaining bull trout in the lake are captured and killed in the suppression nets. Removal of juvenile bull trout from the stream coupled with the removal of eggs from the system would have negative consequences for the bull trout population in Logging Lake in the short-term, but the bull trout population already appears to be nearing functional extinction without action.

No fish have been stocked into Logging Lake since 1944 and the only stocking of Grace Lake was of cutthroat eggs in 1925. Cutthroat trout are therefore the only species that has been stocked in the Logging/Grace system. Fish translocation from one water body to another may lead to the transfer of pathogens that can cause disease in some fish species. The risk of transferring pathogens from Logging Lake to Grace Lake under this alternative would be low, however. In 2000, fish health testing was completed on a variety of fish species from six lakes in the park, including Logging Lake (Peters 2002). One-hundred eighty-three fish from Logging Lake, including bull trout (4), westslope cutthroat (20), lake trout (12), longnose sucker (22), mountain whitefish (87) and northern pikeminnow (38) were tested for various fish pathogens. No pathogens were detected in bull trout from Logging Lake. One westslope cutthroat trout tested positive for the bacteria that causes furunculosis, although no signs of disease were observed. Similarly, the bacteria (and/or the antigen) responsible for bacterial kidney disease (BKD) was found in westslope cutthroat trout, lake trout, longnose sucker, and mountain whitefish from Logging Lake. This bacteria has a worldwide distribution and was also found in all six of the park lakes in the study, including both Quartz and Harrison Lakes, also located in the park's backcountry. No external or internal signs of BKD were observed in any fish and the antigen level in Logging Lake was characterized as "low". No viral pathogens were detected in the park. All fish tested negative for whirling disease. We have no reason to believe fish health status has changed in Logging Lake since this testing.

BKD can be transmitted from parent to offspring at the egg stage, and ovarian fluid from bull trout parents would be tested for the presence of the BKD bacteria during the egg take.

Although bull trout are susceptible to BKD, they appear relatively resistant to the disease (Jones et al. 2007). Jones et al. (2007) further concluded that infection of bull trout with BKD likely poses a low risk to successful restoration of threatened populations. Moving eggs to a conservation hatchery has much lower risk than moving live fish to a hatchery because other diseases of concern aren't transferred from parents to eggs, and eggs can be disinfected of some disease-causing bacteria.

Moving live fish has higher risk because the individuals can't be tested for the presence of disease (disease testing requires lethal sampling of the fish). To assess risk, we rely on disease testing of other fish species or individuals in the population. Although sample size is low (4 fish), bull trout from Logging Lake tested negative for all pathogens (Peters 2002). Disease tests of the closest relative, lake trout (n=12), indicate some were exposed to the bacteria that causes BKD at some point, but did not show any signs of the disease itself. The risk of moving the bacteria that causes BKD upstream into Grace Lake (it is potentially already present) by moving wild juvenile bull trout appears fairly low given the evidently low prevalence of the disease in Logging Lake. Moreover, we would be capturing the translocated fish in the stream (upstream of the lake) before they move to Logging Lake to rear to adulthood. Therefore, they would likely not be exposed to the waters of Logging Lake; the only water they would have likely been exposed to would be from upstream of the lake, flowing down from Grace Lake itself. Translocated fish would also be at low risk of disease from any pathogens already present in Grace Lake, as this project would involve only within stream transfer of live fish, and the source fish (downstream of the falls) are already living in the water coming from the potential upstream recipient water and have been exposed to any pathogens present in upstream areas.

Bull trout are already at precariously low numbers in Logging Lake. The intent of this project would be to preserve and rescue as much of the Logging Lake bull trout population's unique genetic and evolutionary legacy within the drainage as possible. Taking eggs from what few parents remain and can be captured would allow us to conserve some of that remaining genetic diversity, but it is being lost with each generation that passes due to the low breeding population size. By also moving remaining wild juvenile bull trout that were produced in earlier years upstream, we would be able to capture and preserve as much genetic diversity as possible in the system. These genetic/population size tradeoffs have been weighed against the potential risk of disease transfer upstream within the drainage. We would employ standard USFWS policies and procedures regarding captive propagation of ESA listed species and would work with both the USFWS and MFWP to ensure any necessary fish transfer permits are received.

Grace Lake, the proposed translocation site, currently supports a population of introduced Yellowstone cutthroat trout (YCT) x westslope cutthroat trout (WCT) hybrids. Grace Lake is believed to have been historically fishless as it is located upstream of a substantial waterfall (Marnell et al. 1987). The only record of fish stocking was of 101,000 cutthroat eggs in 1925. Recent studies (Galloway 2013) evaluated habitat suitability for bull trout and documented baseline biological conditions. Galloway (2013) concluded there was sufficient suitable habitat for bull trout in Grace Lake and that the probability of success of translocation was high.

Non-native Yellowstone cutthroat trout and native bull trout have co-existed for decades in the neighboring Trout and Arrow Lakes system in the park. Also of note is that there are two lakes in the park where bull trout are the only fish species known to be present: Cracker Lake in the Many Glacier Valley and Upper Kintla Lake located several drainages to the North of the Logging Lake drainage. In these systems, bull trout must rely on invertebrates and cannibalism to survive. Galloway (2013) documented the presence of boreal toads in the vicinity of Grace Lake, but lakeshore surveys of Grace Lake failed to document any tadpoles or other evidence of

reproduction in Grace Lake. A single long-toed salamander (*Ambystoma macrodactylum)* larvae was detected in Grace Lake during surveys in 2010 (Galloway 2013). Grace Lake does not appear to support reproduction of boreal toads and appears to have at least some limited use by long-toed salamanders. However, any impacts to the invertebrate and/or amphibian communities from fish stocking in 1925 have likely played out over the past 80-90 years in the presence of the YCT x WCT hybrids, and may partially explain current amphibian use patterns in the lake. The addition of bull trout to the Grace Lake fish community would not likely result in much additional alteration of the lake's invertebrate or amphibian communities. Because bull trout spawn in the fall and cutthroat in the spring, there would be no risk of spawning habitat use overlap at critical time periods. Non-native YCT x WCT hybrids would serve as the primary food source for bull trout.

**Cumulative Impacts of Alternative C**
In 2008, park fishing regulations were changed to allow unlimited harvest of lake trout, and angler misidentification of lake trout and bull trout has been documented in other systems (e.g. Lake Pend Oreille, Idaho). If angling pressure increases dramatically on Logging Lake, misidentification of lake and bull trout could result in unintentional harvest of bull trout. This angling mortality would be additive to any netting mortality that would occur under Alternative C, and would incrementally increase adverse impacts to bull trout. However, due to the remote nature of Logging Lake, we do not expect the 2008 regulation change to result in much increase in unintentional harvest of bull trout in the system.

There would be short-term, local, minor to moderate, adverse cumulative impacts to native fish from the actions proposed under Alternative C combined with past and future suppression actions on Quartz Lake due to by-catch mortality. Glacier National Park would also likely continue to implement a periodic monitoring program on lakes on the west side of the park, potentially including Logging Lake. This netting provides information on changes in fish species composition over time, and is intended to inform fishery management of waters where it is implemented. The next gill net monitoring sampling for Logging Lake is scheduled to occur in 2015. However, additional gill net sampling combined with this alternative could result in additional mortality to bull trout; sampling through periodic gill netting may be suspended during implementation of this alternative.

In addition, the park recently completed a fish passage barrier on Quartz Creek, has been suppressing lake trout on Quartz Lake for the past four years, is undertaking rigorous efforts to keep park waters free of other aquatic invasive species, and is proposing to construct a fish passage barrier on Akokala Creek. These actions are largely intended to prevent or reduce impacts of lake trout and other non-native fish on the native fish communities. Alternative C, combined with these actions would help protect and restore native fish populations on the west side of Glacier National Park.

**Conclusion**
Under this alternative, there would be minor to moderate short and long-term, site-specific adverse impacts to the Logging Lake bull trout population and minor impacts to the westslope cutthroat trout population and other native fish due to incidental netting mortality and the removal of juvenile bull trout/eggs from Logging Lake. However, if the project is successful, the Logging Lake bull trout population could eventually recover, and bull trout and native fish populations would be protected from the severely detrimental effects of lake trout and other invasive non-native fish. Impacts would be moderate, long-term, and beneficial for bull trout and other native fish at multiple scales (i.e. site-specific, local, widespread and regional). There is the potential for minor to moderate short and long-term negative impacts to the Yellowstone

cutthroat trout population in Grace Lake due to predation by bull trout. But this would also have minor benefits to downstream westslope cutthroat trout by reducing the risk of hybridization with introduced Yellowstone cutthroat trout. Cumulatively, there would be moderate, long-term, beneficial impacts to fisheries from this alternative combined with past, present and future actions due to the protection of native fish populations from non-native invasive species. Cumulative adverse impacts would be minor to moderate and short-term from incidental bull trout mortality.

## Impacts of Alternative D – Both Alternatives B and C Preferred

Under Alternative D, the park would implement both Alternatives B and C simultaneously. Lake trout suppression would continue on Quartz Lake, experimental lake trout suppression would be initiated on Logging Lake, and bull trout would be translocated into Grace Lake. The impact analyses for each of these Alternatives are well described in the previous sections. Adverse impacts due to by-catch mortality would occur on both Quartz and Logging Lakes, but combining the two alternatives would extend benefits to native fish populations over a wider area than if Alternative B or C were implemented singly. Native fish would be protected for the long-term from the highly detrimental effects of non-native lake trout in two lakes instead of one. Combined, Alternatives B and C would protect bull trout and other native fish at a larger scale, increasing the overall viability of bull trout as a species in the park.

Alternative D would also increase the resiliency of bull trout and other native fish populations in the face of climate change by reducing other stressors, such as invasive species, on a broad scale. As air and water temperatures rise, species of fish, wildlife, and plants will experience changes to their habitat conditions that may limit their abundance, distribution, and phenology. Mean annual air temperature in Glacier National Park has increased 1.6°C during the past century, three times the global mean increase (Fagre 2005). Glacier National Park is part of the Northern Rockies Ecosystem, the Crown of the Continent Ecosystem, and the Northern Continental Divide Ecosystem, which have been identified as important to the survival of native fish, wildlife, and plants. These large sections of land, preserved as wilderness areas or national parks, are connected with important biological corridors that allow wildlife to move relatively unimpeded by human development. This is important, especially when considering climate change. As habitat conditions change, fish and wildlife species will need the ability to disperse to new locations that might be more suitable. Increasing water temperatures may create thermal barriers to native fish movement in lower valley stream reaches or may make it easier for non-native fish species to colonize and compete in warmer park waters. Warmer winter temperatures will likely increase the frequency of mid-winter rain-on-snow flood events, which would negatively impact bull trout spawning and rearing success.

Bull trout may eventually be extirpated from some areas of their native range simply due to global climate change and subsequent water temperatures increases, which may reduce the suitability of some spawning and rearing habitats (Rieman et al. 2007). As water temperatures warm, habitat suitability may increase for other invasive non-native fish species like rainbow and brook trout. However, in the near term, higher elevation lakes such as Quartz, Logging, and Grace Lakes are likely continue to provide high quality bull trout habitat from a water temperature perspective, due to their elevation and headwater locations. Changing volume and timing of runoff may be a more immediate issue for native fish in headwater areas. All of the park's glaciers are predicted to disappear over the next 20 years (Hall and Fagre 2003). As glaciers continue to shrink within Glacier National Park, critical late season sources of cold

water will also be lost from some systems. These sources of water are likely important in maintaining late season stream flows in some bull trout spawning and rearing habitats. This may be particularly true during dry years. Bull trout are likely to be increasingly pressed between invasive non-native species such as lake trout and climate change impacts on critical evolutionary linkages between stream flow quality, timing, and quantity as glaciers are lost. Alternative D would reduce the population size of lake trout and reduce competition and predation in two lakes, which would reduce the number of stressors on native bull trout populations and is one strategy to mitigate the adverse impacts of global climate change on bull trout.

**Cumulative Impacts of Alternative D**

Cumulative impacts from Alternative D combined with past, ongoing, and future actions, including fish passage barriers on Quartz and Akokala Creeks, changes to the park's fishing regulations, lake trout removal efforts on Quartz Lake for the past four years, and efforts to keep park waters free of other aquatic invasive species, would be similar to those described for Alternatives B and C. This alternative would result in some bull trout mortality due to translocation on Logging Lake and by-catch during netting on both Quartz and Logging Lakes, which would be additive to incidental netting by-catch that has already occurred on Quartz Lake during the last four years of lake trout suppression efforts. Bull trout mortality under Alternative D would be only incrementally additive to any unintentional bull trout harvest as a result of aforementioned changes to park fishing regulations. Biologically meaningful additive increases in mortality would only occur however, if angling at both Quartz and Logging Lakes were to increase dramatically, which we do not anticipate. We do not expect mortality to increase to a level that would affect the sustainability of bull trout populations in either lake.

Glacier National Park may continue to implement a periodic monitoring program on lakes on the west side of the park, including Logging and Quartz Lake, with gill nets. Additional gill netting combined with Alternative D would result in additional mortality to bull trout. Therefore, sampling through periodic gill netting could potentially be suspended during implementation of the preferred alternative.

The cumulative beneficial impacts of Alternative D combined with other projects that seek to protect native fish populations would be realized on a broader scale than if Alternative B and C were implemented singly. Benefits to bull trout and other native fish species would increase the overall resiliency of native fish populations on the west side of the park, improving the chances of long-term population viability in the face of climate change.

**Conclusion**

Under the preferred alternative, there would be minor to moderate short and long-term, site-specific to local, adverse impacts to the Quartz and Logging Lake bull trout populations from netting and translocation. There would also be minor short and long-term adverse impacts to other native fish due to by-catch mortality. However, if the project is successful, bull trout and native fish would be protected from the detrimental effects of invasive non-native species at a larger spatial scale, and the increased resiliency of native fish populations would improve long-term population sustainability in the face of climate change. Impacts would therefore be moderate, long-term, and beneficial for bull trout and other native fish at multiple scales (i.e. site-specific, local, widespread and regional). The project would protect more populations than either Alternatives B or C alone. Cumulatively, there would be moderate, long-term, beneficial impacts to fisheries from this alternative combined with past, present and future actions due to the large-scale protection of native fish populations from non-native invasive species and

improved population resiliency in the face of climate change. Cumulative adverse impacts would be minor to moderate and short-term from incidental bull trout mortality.

Under Section 10 of the ESA, the park has authorization from the USFWS to conduct gill netting operations in bull trout waters. Bull trout translocation and stocking in Logging and Grace Lakes would occur under an amendment to the park's existing Section 10 permit, and captive propagation of bull trout would be covered under a separate Section 10 permit.

# Wildlife, Bald Eagles, and Common Loons

## Affected Environment

Over 300 species of terrestrial wildlife occupy Glacier National Park either seasonally or year-round. Quartz and Logging Lakes are in two remote, backcountry areas of the park that provide foraging, nesting, and denning habitat as well as travel corridors for many species. The remoteness of these areas makes them especially valuable for wildlife security, since human activity and associated disturbances are few and infrequent, especially in wintertime and during spring and fall. Lakes and lake shores, streams and riparian areas, meadows, old-growth forests, burns, avalanche chutes, shrub lands, snags, and cliffed areas all contribute to a diversity of habitat types that are utilized by a number of species. Mammalian species documented in the Quartz and/or Logging drainages include moose, elk, mule and white-tail deer, black and grizzly bear, wolves, mountain lion, lynx, bobcat, red fox, fisher, wolverine, marten, river otter, mink, short-tailed weasel, beaver, bat species, and numerous small mammals, among others (GNP files). Avian species that have been documented in the Quartz and/or Logging drainages include bald eagle, golden eagle, osprey, northern goshawk, sharp-shinned hawk, great gray owl, barred owl, northern pygmy owl, northern saw-whet owl, great blue heron, belted kingfisher, tundra swan, trumpeter swan, western grebe, eared grebe, Barrow's goldeneye, common loons, pileated woodpecker, black-backed woodpecker, three-toed woodpecker, Lewis' woodpecker, spruce grouse, ruffed grouse, common nighthawk, Clark's nutcracker, hermit thrush, northern water thrush, olive sided flycatcher, brown creeper, chestnut-backed chickadee, boreal chickadee, and others (GNP files).

**Bald Eagles, Special Status Species**

It is NPS policy (NPS Management Policies 2006) to "inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible". Special Status Species are not federally listed under the ESA or listed by the state as a Species of Concern, but are otherwise legally protected (Montana Field Guide 2013a). Bald Eagles (*Haliaeetus leucocephalus*) are a Special Status Species, protected by the Bald and Golden Eagle Protection Act of 1940 and the Migratory Bird Treaty Act. Under the state's standardized ranking system, bald eagles are described as globally "common, widespread, and abundant", and statewide as "apparently secure" though possibly "quite rare in parts of its range, and/or suspected to be declining" (Montana Field Guide 2013b). While not listed as a Species of Concern by the state of Montana, bald eagles are listed as "Sensitive" by the United States Forest Service, Northern Region 1 (USDA 2013).

Bald eagles use portions of Glacier National Park on a year-round basis as nesting and wintering residents (Yates 1989 and GNP files) and as seasonal migrants (McClelland et al. 1994, Yates et al. 2001, and GNP files). Glacier National Park is within an important bald eagle migration corridor (McClelland et al. 1994). Productivity of the park's nesting bald eagle population has historically been considered low and is lower than the statewide average (K. Dubois, personal communication). This is likely due to the park's relatively high elevation and harsh climate.

Eagles in the park tend to nest later in the year and produce smaller broods than eagles elsewhere in the state, and lower productivity is typical for higher elevation bald eagle populations, as has been observed in southwest Montana (K. Dubois, personal communication). There are over 600 nesting pairs of bald eagles in the state, and the population is continuing to increase every year (K. Dubois, personal communication). In Glacier National Park, there are currently 15 known bald eagle breeding areas, including seven in the North Fork District (GNP files). The park's population appears to be increasing and may be benefitting from population gains elsewhere in the state; there may also be additional nesting pairs in the park that haven't been discovered (K. Dubois, personal communication).

There is one known bald eagle nesting territory at Quartz Lake. Two nest sites have been documented, including one that was last successful in 2003 (the last year a chick was observed at the lake) but has not been active since 2005, and another that has been active but unsuccessful every year since its discovery in 2009. At Logging Lake, one nest has been active each year since 2009, with two chicks fledged in 2009 and one chick fledged each year from 2010-2013. The status of a second nest on Logging Lake is largely unknown, primarily due to a lack of monitoring resources; the nest has not been active since 2007, when nesting was initiated but not successful.

Bald eagle nesting habitat characteristics include old-growth forest types near water, where eagles are afforded some seclusion from human activity. Nest sites are located near lake inlets, where foraging for fish is productive. Vegetative screening provides much of the necessary seclusion for eagles near nest, roost, forage, and feeding areas (Caton et al. 1992). The breeding period includes courtship from late February to mid-April; egg laying and incubation from late March to late May; nestling from mid-May to early August; and fledging from early August to late September. Nestlings usually fledge at 10 to 12 weeks of age (by mid-Aug.); young eagles migrate from breeding areas between mid-September and early October (McClelland et al. 1996).

Nest areas are critical, and bald eagles are especially sensitive to human disturbance during the breeding period (Hamann et al. 1999). Human activity may cause abandonment of the breeding area, affect successful completion of the nesting cycle, and reduce productivity. Effects of disturbance on breeding birds during incubation include short-term nest abandonment or nest desertion resulting in exposure of the eggs to detrimental temperature extremes and predators (Hamann et al. 1999). Disturbance during rearing can result in trampling of young, young jumping or falling from nests before they can fly, and/or separation of young from parents. Chronic disturbance can cause nest abandonment. The potential for nest failure and nestling death due to human disturbance is reduced but not eliminated after nestlings reach an age of about 4 weeks (usually early to late June in Glacier National Park), and the fledging period is the least sensitive period. Outside of the breeding season, disturbance by humans may cause birds to change their feeding habits, thereby reducing normal food intake (Hamann et al. 1999).

**Common Loons, State-Listed Species of Concern**

State listed Species of Concern are species that are native to Montana and are "at risk" due to declining population trends, limited distribution, habitat threats, and/or other causes (Montana Field Guide 2013a). Common loons (*Gavia immer*) are protected under the Migratory Bird Treaty Act and are a state listed Species of Concern. Under the state's standardized ranking system, common loons are described in global terms as "common, widespread, and abundant", but with a breeding population that is "potentially at risk" in the state (Montana Field Guide 2013c). Common loons are also listed as "Sensitive" by the United States Forest Service, Northern Region 1 (USDA 2013). Montana's common loon population is at the southern extent

of the species' range in western North America (Hammond 2009). The population appears to be relatively stable, and may be increasing slightly (Paugh 2006, C. Hammond, personal communication). The state supports an average of 200 loons each year, and has the largest breeding population in the western continental United States (Hammond 2009; C. Hammond personal communication).

Common loons occur from spring through fall on large and small lakes throughout Glacier National Park. Based on the average number of territorial pairs in the park from 2006-2012 (16) and the average number of territorial pairs for the state (62), roughly 26 percent of Montana's territorial pairs inhabit the park (C. Hammond, personal communication; GNP files). Park records contain numerous loon sightings on Quartz, Middle Quartz, Lower Quartz, and Logging Lakes (GNP files). Breeding loons have been well documented on Lower and Middle Quartz Lakes, with nesting and chick rearing activity observed at one or both lakes every year since 2007. Loons are frequently observed on Quartz Lake, sometimes in large congregations. Quartz Lake may also be an important foraging lake for loons nesting at Middle Quartz and Lower Quartz Lakes. Loon nesting was recently documented for the first time at Quartz Lake by the lake trout suppression crew, and a chick was documented to be present (J. Belt, personal communication; Table 5). This suggests that the ongoing lake trout suppression program at Quartz Lake can be implemented in a manner which does not impact loon reproduction and may serve as a valuable monitoring opportunity for loons at both lakes.

Logging Lake supports multiple territorial pairs of loons, and is the only lake among 45 regularly monitored lakes in the park that is known to do so. A territorial pair consists of two birds inhabiting and defending a territory together during the breeding season, and pairs may defend a territory for a long time before becoming a breeding pair (C. Hammond, personal communication). Multiple territorial pairs on a single lake could indicate the presence of high quality loon habitat or may also indicate all other nearby loon territories are occupied and the shared lake may be acting as a "sink", attracting loons produced on other lakes (Paugh 2006) with a resulting drop in nest success due to competition. Such multiple territorial pair lakes have been shown to have lower reproductive success (Paugh 2006). Over the past six years, only five chicks have been documented on Logging Lake, with none observed from 2010 to 2012, and one chick documented in 2013 (Table 5, Glacier National Park, unpublished data). Loon nests are often difficult to detect, and the level of monitoring necessary to confirm nesting has not always been possible. As a result, it is not always known whether territorial pairs observed early in the season ever breed, nest, or produce chicks. Survey numbers should therefore be viewed as minimums. Few loon chicks have been observed in recent years, but it is possible that future chick production may be influenced by annual variation in factors that may affect nesting success, such as weather, predation, competition with other pairs, and human disturbance.

**Table 5:** Number of common loon pairs, breeding pairs, and chicks observed on Logging and Quartz Lakes, 2007 to 2013.

| | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lake | Qrtz. | Log. | Qrtz. | Log. | Qrtz. | Log. | Qrtz. | Log. | Qrtz. | Log. | Qrtz. | Log. | Qrtz. | Log. |
| **No. Pairs** | 1 | 3 | 0 | 3 | 1 | 3 | 0 | 2 | 2 | 1* | 0 | 2 | 0 | 1 |
| **No. Breeding Pairs** | 0 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1** | 0*** | 1 |
| **No. Chicks** | 0 | 3 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

* Insufficient survey coverage for the year.
** Nest failed.
***No pairs observed; only a single adult observed with the chick.

Common loon breeding and nesting was first documented on Grace Lake, upstream of Logging Lake, in 2009. A resident pair has been observed every year since, and two chicks were produced each year from 2009 to 2011. A pair was using the lake in 2012 and 2013, but no chicks were observed.

Male and female loons have the same plumage, but the males are slightly larger. Loons spend most of their time in or around water because their legs are set back on the body making it difficult for them to walk. Common loons usually feed on fish they dive for, small amphibians or invertebrates. Loons are selective about nesting habitat, which requires accompanying nursery areas for chicks. Nests are usually within three feet of the water's edge (Hammond 2009) and can be located on islands or grassy shores. Nests are typically located in secure areas, such as bays and the lee side of islands or peninsulas that are sheltered from wind, waves, and boat wakes; nesting loons also tend to avoid human development (Hammond 2009).

Loons generally begin laying their eggs in early spring (mid to late April), and the nesting and chick rearing period may extend until early July. Loons only raise a single brood per year, with no more than two chicks per brood. Chicks require approximately 12 weeks to fledge from a lake (Hammond 2009), and are most susceptible to mortality within the first week of hatching (Paugh 2006). Both parents raise the young and defend nesting territories, and loons are very territorial and sensitive during nesting (Hammond 2009). If initial nesting attempts fail due to disturbance or other causes, loons may often reinitiate nesting. During nesting and chick rearing, loons may travel to other nearby lakes to forage.

Loons depart nesting territories sometime in the fall, likely in early to mid-September. Juveniles require three years to mature, usually spend their first three years on the coast before returning to their natal areas, and have an average first time breeding age of about seven years (Hammond 2009). Juvenile loon mortality can be high during migration or during the first three years on the coast. An average of 41 chicks fledge from Montana lakes each year, but fewer than ten (approximately) are expected to reach adulthood and return to the state to breed (Hammond 2009; C. Hammond personal communication). When disturbed, loons may accidentally knock eggs off nests or flush from their nest and lose eggs to predators or excessive heat or cold. Human caused disturbance can cause nest failure, and prolonged nest failures could affect loon populations for the long term (Hammond 2009). Conservation of occupied territories is also important because loons do not readily recolonize vacant territories (C. Hammond et al. 2012).

# Intensity Level Definitions

*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 wildlife species' populations.

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

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

*Major:* Effects on wildlife 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.

# Impacts of Alternative A – No Action

The no action alternative would adversely affect wildlife species that are directly or indirectly dependent upon the available biomass of native fish in Quartz and Logging Lakes. Avian predators such as osprey, bald eagles, and loons would be especially affected if lake trout numbers increase and native fish populations are reduced. Native fish tend to forage nearer the water surface than lake trout, and are therefore more accessible to avian predators. Conversely, lake trout inhabit deeper waters and are therefore less accessible. A reduction in native fish communities could also have adverse effects on mammalian predators such as mink and river otters. A lower native fish-based prey biomass could cause some fish dependent predators to switch to other prey species. Changes in the fish community as a result of this alternative could also cause changes in richness and abundance of insects and other invertebrate species, which could manifest as unpredicted changes in populations of amphibians and insectivorous birds, and even disease prevalence.

**Bald Eagles**

The no action alternative would facilitate the deterioration of native fish assemblages in Quartz and Logging Lakes, thereby diminishing foraging opportunities and further reducing the productivity of nesting bald eagles at both lakes. Foraging opportunities would also decrease as bull and cutthroat trout are replaced by lake trout, which occur in deeper waters than native fish and are therefore less accessible to foraging eagles. Migrating bald eagles or eagles nesting along the North Fork of the Flathead River that forage at Quartz and Logging Lakes could also be affected, extending the adverse impacts of no action throughout the North Fork District and possibly beyond.

**Common Loons**

Common Loons dive from the surface of shallow lakes and feed mostly on small fish. Lake trout spawn in cold and deep waters, which generally are not complimentary to common loon feeding preferences. The loss of native fish communities under no action would decrease the availability of fish inhabiting the upper level of the water column and compromise a substantial component of the common loon's diet. Quartz Lake likely provides valuable foraging habitat for loons that breed and nest on adjacent lakes, and may also be a foraging lake for migrating loons; nesting was also recently documented on the lake, with one chick observed (J. Belt, personal communication). Logging Lake is also an important foraging lake and has been used by breeding

loons. Therefore, the impacts of no action at either lake could adversely affect loons throughout the North Fork District.

**Cumulative Impacts of Alternative A**
The park has undertaken or is proposing several other actions designed to protect native fish populations, including lake trout suppression on Quartz Lake for the last four years, a fish passage barrier installed on Quartz Creek in 2012, and a proposed fish passage barrier on Akokala Creek. These actions would help preserve the available biomass of native fish for fish-dependent predators. No action, however, would likely undermine or possibly eliminate the efficacy of these actions. Cumulative impacts to terrestrial wildlife, bald eagles, and common loons would therefore be adverse due to the eventual loss of available fish biomass and native, shallow water-dwelling fish in Quartz and Logging Lakes.

**Conclusion**
No action would lead to a reduction in available native fish biomass for fish-dependent terrestrial and avian predators. Reductions in native fish numbers and corresponding increases in lake trout could be especially detrimental for avian predators that rely on native fish in the upper levels of the water column and cannot access deeper dwelling lake trout. Under no action, impacts to wildlife that are directly or indirectly dependent on the native fish community for prey would be adverse, minor to moderate, long term, site-specific to local, and possibly regional if migrating individuals are affected.

Common loons and bald eagles rely on shallow water-dwelling fish for food. Because lake trout are deep water fish, food would be depleted for loons and bald eagles if no action is taken to suppress lake trout and protect native fish communities at Quartz and Logging Lakes. Adverse impacts to common loons would be minor; adverse impacts to bald eagles would be minor to moderate because eagles are unable to forage as deeply as loons and are likely more dependent on surface oriented species such as cutthroat trout. The negative impacts would be long-term for both species, local, and possibly regional because they could affect migrating individuals or loons and eagles nesting at nearby locations. Cumulatively, no action would undermine other actions designed to protect native fish populations, and result in minor to moderate adverse, long-term, and site-specific to regional impacts to terrestrial wildlife, common loons, and bald eagles.

## Impacts of Alternative B – Continue Lake Trout Suppression on Quartz Lake

Maintaining an intact native fishery on Quartz Lake would benefit wildlife species that directly or indirectly depend on the lake's fish biomass, or which rely on accessible and/or shallow water-dwelling native fish for food. Native fish, which tend to forage nearer the water surface than deeper dwelling lake trout, would remain accessible to avian predators such as osprey, bald eagles, and loons. There could be some negligible to minor displacement of wildlife due to an extended presence of project personnel at a time when visitation is otherwise low, and from motorboat noise during netting operations. The motorboat would generally operate between idle and cruising speeds, and the noise would be temporary and intermittent (see analysis of impacts to natural soundscapes, below). Some species may be slightly more vulnerable to disturbance during springtime netting operations (May-June), but netting in the fall (September-October) would occur during a less sensitive time of year, when nesting and reproductive periods would have concluded and most migrant bird species would have departed. Round trip helicopter flights to Quartz Lake could occur, but they would be infrequent (possibly one flight

anticipated each year or every few years), and any disturbances to wildlife from helicopter noise would be very temporary. Because the project would be limited to the lake, it would occur over a relatively small area and impacts would be localized. While some individual animals could be affected, the project would not adversely affect terrestrial wildlife species at the population level, and there would be no measurable adverse alterations to habitat. Adverse impacts to wildlife would therefore be negligible to minor.

**Bald Eagles**
Alternative B would protect native fish, which tend to occur nearer the water surface than lake trout. Bald eagles do not forage deeply and are likely to be especially dependent on species that inhabit the upper level of the water column, such as westslope cutthroat trout. This alternative would maintain the availability of prey for bald eagles and benefit eagles that are nesting at Quartz Lake as well as pairs that are nesting elsewhere and foraging at the lake. Activities would take place during the spring incubation and nestling periods and the fall migration period, and have the potential to disturb nesting and foraging bald eagles. Mitigation measures would direct project activities away from sensitive areas, however, and reduce the possibility of disturbance. Beneficial and adverse impacts to bald eagles could occur on a regional level if migrating individuals that forage at Quartz Lake are affected.

After a period of inactivity since 2005, nesting activity has been documented at Quartz Lake every year since 2009, and incubation was observed in 2011 and 2012. None of the nesting attempts between 2009 and 2012 have been successful. Given the distance project personal maintain from active nests, it is not likely that human activity associated with lake trout suppression led to these nest failures. Also, nesting has not been successful at Quartz Lake since 2003, and observations of nesting initiation and incubation since 2009 (when lake trout suppression was underway) suggest that suppression activities have not deterred nesting attempts. Numerous observations by the netting crew have not demonstrated any alarm response by eagles due to the presence of the boat, and eagles have been observed periodically scavenging dead fish from behind the netting boat (V. D'Angelo, USGS, personal communication). Project personnel avoid approaching within one-quarter mile of an active nest, and there are a number of other, more likely factors that could have caused nest failure, including late, wet springs with unusually cold temperatures in 2011 and 2012. Three other bald eagle nests in the park were also unsuccessful in 2011 and 2012, including two with strong histories of success. It is also possible that the pair observed at Quartz Lake since 2009 is new to the lake, and possibly young and inexperienced. Young, inexperienced eagles may require several attempts before nesting is successful, as observed at the Fish Creek bald eagle nest on Lake McDonald. The Fish Creek pair initiated nesting in 2007, was unsuccessful that year and in 2008, but fledged one and two chicks in 2009 and 2010, respectively. The Fish Creek nest was unsuccessful in 2011 and inactive in 2012, possibly due to the cold, late springs previously mentioned. Motorboat use is permitted on Lake McDonald, and the Fish Creek nest is not far from Apgar, Fish Creek Campground, and associated human activity and watercrafts. A distance buffer was in place around the nest, similar to the mitigation that would occur under Alternative B. With disturbance mitigation in place (including restrictions on the timing of any round trip helicopter flights), it is not anticipated that adverse impacts to bald eagles nesting and/or foraging on Quartz Lake would exceed a minor level.

**Common Loons**
Because Alternative B would maintain the availability of native fish, which inhabit shallower waters and the upper levels of the water column, it would benefit common loons on Quartz Lake. Motorboat use and human activity associated with the project could disturb foraging and

nesting loons. Beneficial and adverse impacts to loons could extend regionally if migrating individuals using the lake for forage are affected. Regional effects would likely be slight and difficult to detect, however. Recent documentation of loon reproduction on Quartz Lake suggests lake trout suppression projects can be implemented without impacting loon nesting success. Should nesting continue to occur on Quartz Lake in the proposed timeframe for the project, fisheries staff would be trained to identify loon nesting behavior and would avoid setting nets or working in close proximity (within 1/4 mile, as feasible) of any known or suspected nesting areas. They would also provide valuable observations on nesting success. Flat wake travel would occur around any known or suspected loon nesting areas, and operations would be conducted with the utmost care and consideration for nesting or brood rearing loons. These mitigations would reduce the likelihood of disturbance, and adverse impacts from human activity on the lake would be negligible to minor.

There is a very remote chance that a loon could become caught in a net under this alternative. Loons can dive to depths of 200 feet or more in pursuit of their prey, and may be attracted to fish trapped within the nets (C. Hammond, personal communication, Evers 2004). Loon by-catch in gill and trap nets has been documented for commercial ocean fishing operations and in the lake whitefish fisheries of the upper Great Lakes (Forsell 1999, Evers 2004, Johnson et al. 2004, Zydelis et al. 2009, and Warden 2010). It is very unlikely, however, that loons would be pursuing forage in park waters at depths where they may encounter a gill net. Also, the level of fishing operations under Alternative B, when compared to the Great Lakes and ocean netting operations, would be at a much smaller scale. Despite widespread and long-term use of gill nets for fish sampling across loon habitat in this region, we know of only three loons that have been captured in a gill net, including a loon caught in a shallow gill net set in Lake Pend Oreille, Idaho; one caught on Lake Alva in Montana; and one caught on Lake Roosevelt in eastern Washington (C. Hammond, personal communication). Gill netting on Quartz Lake using similar methods and timeframes described for this alternative has occurred annually since 2009 without the capture of a single bird of any type. Most of the other large lakes supporting loons in the park have been gill netted multiple times over the past 13 years and no loons (or other diving birds) have been captured. Other nearby waters supporting seasonal aggregations of loons, such as Hungry Horse Reservoir and Flathead Lake, are gill netted regularly by state and tribal entities without incident. In addition, MFWP and the USFWS have been conducting lake trout suppression netting using similar methods to those proposed in Quartz and Logging Lakes on Swan Lake for the past several years, and have not captured any loons.

Two factors that appear important in the risk of diving birds being caught in gillnets are set depth and net "soak" time (the time the net is fishing in the water). Zydels et al. (2009) reviewed 30 studies relating to bird by-catch in coastal gill net fisheries in the Baltic and North Sea regions and concluded net set depth was very important in bird by-catch vulnerability because the majority of diving birds prefer shallow water. The majority of the bird by-catch in the studies the authors reviewed occurred at depths of less than 60 feet. Due to the depth of net sets anticipated for this project (generally greater than 60 feet), it is highly unlikely that loons would be captured. While loons are capable of deep dives, they are more likely to forage in the upper level of the water column. Visibility is reduced in deeper water, limiting the ability of loons to see and catch prey and making foraging at depth very inefficient. There is also abundant prey at shallower water levels in Quartz Lake, including cutthroat trout, suckers, and mountain whitefish.

Longer "soak" times typical of ocean fishing operations may also attract loons to nets because the higher numbers of captured fish in the nets become more visible to loons. Studies in ocean environments suggest shorter "soak" times reduce the likelihood of loon capture in gill nets.

Julian and Beeson (1998) demonstrated a doubling of the odds of entanglement of birds when net soak times extend beyond one day. In order to minimize mortality of bull trout and other native fish in gill nets, net set (soak) times under this alternative would typically be short in duration (4-6 hours). Trap nets would be checked at least every 24 hours. This would further reduce the already very low probability of unintentional loon mortality in the nets.

**Cumulative Impacts of Alternative B**
Alternative B would be an integral part of a concerted effort on the west side of the park to protect native fish populations. Lake trout suppression on Quartz Lake for the last four years, a fish passage barrier constructed on Quartz Creek in 2012, and a proposed fish passage barrier on Akokala Creek are past, ongoing, and foreseeable actions that are part of this effort. Through these projects combined, the long-term protection of the native fish population in Quartz Lake would benefit terrestrial wildlife, including bald eagles and common loons, that directly or indirectly rely on native fish for food. Cumulative disturbances from human activity and other past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would also occur, but they would be non-detrimental to species' populations. Cumulative impacts would therefore be negligible to minor, beneficial and adverse, short and long-term, and site specific to regional.

**Conclusion**
Alternative B would maintain an intact native fishery on Quartz Lake and would benefit wildlife species that directly or indirectly depend on the lake's native fish biomass, or which rely on accessible and/or shallow water-dwelling native fish for food. Beneficial impacts would be long-term and negligible to minor for wildlife and common loons, and minor for bald eagles. Disturbances due to motorboat use, the extended presence of personnel during typically low visitor use periods, and infrequent round trip helicopter flights would have negligible to minor, short-term adverse impacts to wildlife, bald eagles and common loons, especially during spring. Mitigation measures would minimize disturbance in the vicinity of bald eagle and common loon nest sites. There is an extremely remote chance that a common loon could be caught in a gill or trap net, but this would be highly unlikely due to the length of time the nets would soak, the depth at which the nets would be set, and loons' shallow water foraging preferences. Beneficial and adverse impacts would generally be site-specific to local, but could extend regionally. Cumulatively, Alternative B combined with other actions designed to protect native fish would have negligible to minor, beneficial and adverse, short and long-term, and site specific to regional impacts wildlife, bald eagles, and common loons.

## Impacts of Alternative C – Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage

By maintaining and restoring an intact native fishery on Logging Lake, Alternative C would benefit wildlife that directly or indirectly depend on the lake's native fish populations, or which rely on accessible and/or shallow water-dwelling native fish for food. Native fish, which tend to forage nearer the water surface than deeper dwelling lake trout, would remain accessible to avian predators such as osprey, bald eagles, and loons. As with Alternative B, wildlife could be disturbed by human activity at a time when visitation is typically low and from motorboat noise. Boat noise would temporary and intermittent, however, and the motorboat would generally operate between idle and cruising speeds (see analysis of impacts to natural soundscapes, below). Some species may be somewhat more vulnerable to disturbance during springtime

netting operations (May-June), but netting in the fall (September-October) would occur during a less sensitive time, when nesting and natal periods would be over and most migrant bird species would have left the area. There would be at least one round trip helicopter flight to deliver the boat, and possibly additional flights for boat and/or motor maintenance and bull trout translocation (up to four flights per year, approximately, anticipated for the first few years, with fewer anticipated during the later stages of the project). Helicopter flights would likely cause temporary disturbances to wildlife along the flight path. Impacts would be fairly localized, since activity under Alternative C would be limited primarily to Logging Lake, with some non-motorized activity at Grace Lake. The project would not adversely affect terrestrial wildlife at the population level, and there would be no measurable adverse alterations to habitat. Adverse impacts to wildlife would therefore be negligible to minor.

**Bald Eagles**
Alternative C would protect native fish, which tend to occur nearer the water surface than lake trout. Bald eagles do not forage deeply and are likely to be especially dependent on species that inhabit the upper level of the water column, such as westslope cutthroat trout. Alternative C would maintain the availability of prey for bald eagles, benefitting eagles that are nesting and/or foraging at Logging Lake. Project activities would take place during the spring incubation and nestling periods and the fall migration period, and would have the potential to disturb nesting and foraging bald eagles. With disturbance mitigation in place, however (including consideration of the timing and location of any round trip helicopter flights), adverse impacts to bald eagles nesting on Logging Lake would not likely exceed a minor level. Beneficial and adverse impacts could be regional if migrating individuals that forage at Quartz Lake are affected.

**Common Loons**
Alternative C would maintain the availability shallow water-dwelling fish and native fish that live nearer the water surface than lake trout, and would therefore benefit common loons on Logging Lake. Motorboat use and human activity associated with the project could disturb nesting and foraging loons. Disturbance at nest and nursery sites could cause brood failure through egg or nest abandonment. Logging Lake loons were not successful in incubating and/or fledging chicks from 2010 to 2012, and the reasons remain unclear. Competition/conflict between breeding pairs or nest predation may have affected success during those years. Staff implementing the proposed lake trout project would aid in the loon monitoring effort by helping to identify loon nesting sites and documenting any observed chick presence while conducting lake trout removal efforts. Fisheries staff would also be trained to identify loon nesting behavior and would avoid setting nets or working in close proximity (within 1/4 mile, if feasible) of any known or suspected loon nesting areas. Flat wake travel would occur around any known or suspected loon nesting areas, and operations would be conducted with the utmost care and consideration for nesting or brood rearing loons. Recent documentation of loon reproduction success on Quartz Lake suggests lake trout suppression can be implemented without impacting loon nesting success. Mitigation measures would greatly reduce the likelihood of disturbances that could cause nest failure, and adverse impacts would not be expected to exceed a minor level. Beneficial and adverse impacts to loons could occur regionally if migrating individuals using the lake to forage are affected. Regional effects would likely be slight and difficult to detect, however.

As with Alternative B, there is a very remote chance that a loon could be caught in a net under Alternative C. The low probability of this occurring is discussed above, under *Impacts of Alternative B, Common Loons*.

**Cumulative Impacts of Alternative C**
Alternative C would be an important part of a concerted effort on the west side of the park to protect native fish populations. Lake trout suppression on Quartz Lake for the last four years, a fish passage barrier constructed on Quartz Creek in 2012, and a proposed fish passage barrier on Akokala Creek are past, ongoing, and foreseeable actions that are part of this effort. Through these projects combined, the long-term protection of the native fish population in Logging Lake would benefit terrestrial wildlife, including bald eagles and common loons, that directly or indirectly rely on native fish for food. Cumulative disturbances from human activity and other past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would also occur, but they would be non-detrimental to species' populations. Cumulative impacts would therefore be negligible to minor, beneficial and adverse, short and long-term, and site specific to regional.

**Conclusion**
Because Alternative C would maintain an intact native fishery on Logging Lake, it would benefit wildlife species that directly or indirectly depend on the lake's fish biomass, or which rely on accessible and/or shallow water-dwelling native fish for food. Beneficial impacts would be long-term and negligible to minor for wildlife and common loons, and minor for bald eagles. Disturbances from motorboat use, the extended presence of personnel during typically low visitor use periods, and round trip helicopter flights would have negligible to minor, short-term adverse impacts to wildlife, bald eagles and common loons, especially during springtime. Mitigation measures would minimize disturbance in the vicinity of bald eagle and common loon nest sites. There is an extremely remote chance that a common loon could be caught in a gill or trap net, but this would be highly unlikely due to the length of time the nets would soak, the depth at which the nets would be set, and because loons prefer to forage in shallow water. Beneficial and adverse impacts would generally be site-specific to local, but could be regional. Cumulatively, Alternative C combined with other actions designed to protect native fish would have negligible to minor, beneficial and adverse, short and long-term, and site specific to regional impacts to wildlife, bald eagles, and common loons.

## Impacts of Alternative D – Both Alternatives B and C Preferred

Under Alternative D, impacts to terrestrial wildlife would be similar to those already described for Alternatives B and C, but would occur at two lakes instead of one. Alternative D would maintain and/or restore intact native fisheries on both Quartz and Logging Lakes, benefitting wildlife species that directly or indirectly depend on a native fish biomass within both lakes. Species that rely on accessible and/or shallow water-dwelling native fish for food would especially benefit from the preferred alternative. Native fish, which tend to forage nearer the water surface than deeper dwelling lake trout, would remain accessible to avian predators such as osprey, bald eagles, and loons at both lakes. Human activity at Quartz, Logging, and Grace Lakes in the spring and fall, when backcountry visitation is usually low, could displace wildlife, as could motorboat noise on Quartz and Logging Lakes during netting operations. The motorboats would generally operate between idle and cruising speeds, and the noise would be temporary and intermittent (see analysis of natural soundscapes, below). Some wildlife species may be slightly more vulnerable to disturbance during springtime netting operations (May-June), but work in the fall (September-October) would occur during a less sensitive time of year,

when nesting and natal periods would have concluded and most migrant bird species would have departed. Round trip helicopter flights to Quartz Lake and Logging Lake (up to four per year, approximately, anticipated to Logging Lake for the first few years, with fewer anticipated during the later stages of the project; possibly one flight anticipated each year or every few years to Quartz Lake) would likely temporarily disturb wildlife. Adverse impacts would occur over a greater spatial area under this alternative, since project activities would be underway on three backcountry lakes. But while some individual animals could be affected, adverse effects at the population level would be unlikely, and there would be no measurable adverse alterations to habitat. Adverse impacts to wildlife would therefore be negligible to minor and site-specific to local.

**Bald Eagles**
Alternative D would protect native fish, which tend to occur nearer the water surface than lake trout, at both Quartz and Logging Lakes. Bald eagles do not forage deeply and are likely to be especially dependent on species that inhabit the upper level of the water column, such as westslope cutthroat trout. This alternative would maintain the availability of prey for bald eagles at two important backcountry lakes and two nesting territories. Benefits would likely also extend to bald eagle pairs that nest elsewhere in the North Fork area but forage at Quartz and/or Logging Lake. Adverse impacts would be similar to those already described for Alternatives B and C, but with the potential to affect nesting and/or foraging bald eagles at both lakes. Implementation of Alternative D would take place during the spring incubation and nestling periods, when bald eagles are most sensitive, as well as the fall migration period. However, as with previous alternatives, mitigation measures under the preferred alternative (including consideration of the timing and locations of any round trip helicopter flights) would direct project activities away from sensitive areas and minimize the potential for disturbance; adverse impacts to bald eagles on either lake would therefore not likely exceed a minor level. Beneficial and adverse impacts to bald eagles could occur regionally if migrating individuals foraging at Quartz and/or Logging Lake are affected.

**Common Loons**
Alternative D would maintain the availability of native and shallow water-dwelling fish species at both Quartz and Logging Lake, and would therefore benefit common loons at both lakes. In addition to recently documented nesting activity, Quartz Lake appears to be an important foraging lake for loons nesting at Middle and Lower Quartz Lake. The preferred alternative's benefits to loons would therefore extend to multiple nesting territories. There could also be adverse impacts to loons at both lakes, especially during springtime netting operations. Motorboat use and human activity could disturb nesting and foraging loons, and disturbance at nest and nursery sites could cause brood failure through egg or nest abandonment. Fisheries staff would aid in the loon nest monitoring effort by helping to identify loon nesting sites and documenting any observed chick presence while conducting lake trout removal efforts. Project personnel would also avoid setting nets or working in close proximity (within 1/4 mile) of any known or suspected loon nesting areas. Flat wake travel would occur around any known or suspected loon nesting areas, and operations would be conducted with the utmost care and consideration for nesting or brood rearing loons. Recent documentation of successful loon reproduction on Quartz Lake suggests lake trout suppression projects can be implemented without impacting loon nesting success. Mitigation measures implemented under the preferred alternative would reduce the risk of human-caused nest failure, and adverse impacts to loons would likely not exceed minor. Beneficial and adverse impacts to loons could occur regionally if migrating individuals foraging on the lake are affected. Regional effects would likely be slight and difficult to detect, however.

As described for Alternatives B and C, there is a very remote chance that a loon could become caught in a net under this alternative. The low probability of this occurring is discussed under *Impacts of Alternative B, Common Loons*.

**Cumulative Impacts of Alternative D**
Alternative D would be a vital component of Glacier National Park's concerted effort to protect native fish populations on the west side of the park. Lake trout suppression on Quartz Lake for the last four years, a fish passage barrier constructed on Quartz Creek in 2012, and a proposed fish passage barrier on Akokala Creek are past, ongoing, and foreseeable actions that are part of this effort. Through these projects combined, the long-term protection of native fish populations in both Quartz Lake and Logging Lake would benefit terrestrial wildlife, including bald eagles and common loons, that directly or indirectly rely on native fish for food. Cumulative disturbances from human activity and other past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would also occur on both lakes, but they would be non-detrimental to species' populations. Cumulative impacts would therefore be negligible to minor, beneficial and adverse, short and long-term, and site specific to regional.

**Conclusion**
Alternative D would maintain intact native fisheries on both Quartz and Logging Lake. The project would benefit wildlife species that directly or indirectly depend on native fish biomass or which rely on accessible and/or shallow water-dwelling native fish for food, and these benefits would extend to two important backcountry lakes. Beneficial impacts would be long-term and negligible to minor for wildlife and common loons, and minor for bald eagles. Disturbances due to motorboat use, the extended presence of personnel during typically low visitor use periods, and round trip helicopter flights would have negligible to minor, short-term adverse impacts to wildlife, bald eagles and common loons, especially during spring. Mitigation measures would minimize disturbance in the vicinity of bald eagle and common loon nest sites. There is an extremely remote chance that a common loon could be caught in a gill or trap net, but this would be highly unlikely due to the depth at which the nets would be set and because loons typically prefer to forage in shallow water. Beneficial and adverse impacts would generally be site-specific to local, but could be regional. Cumulatively, Alternative D combined with other actions designed to protect native fish would have negligible to minor, beneficial and adverse, short and long-term, and site specific to regional impacts to wildlife, bald eagles, and common loons.

## Grizzly Bears, Federally Listed Threatened Species

### Affected Environment

Grizzly bear habitat is found throughout Glacier National Park and ranges from the lowest valley bottoms to the summits of the highest peaks. Grizzly bears have home ranges of 130 to 1,300 square kilometers, require large areas of undeveloped habitat (including a mixture of forests, moist meadows, grasslands, and riparian habitats), and a substantial amount of solitude from human interactions (USFWS 1993). 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. Bears often congregate in areas of high huckleberry productivity during late summer and fall. 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. In addition to diverse foraging habitat, grizzly bears require natural habitat that provides connectivity, or travel corridors, between foraging sites. The breeding season for grizzly bears occurs from May 1 until July 1.

Glacier National Park is part of the Northern Continental Divide Ecosystem (NCDE) grizzly bear recovery area. The park was placed into grizzly bear management "situations" in accordance with the Grizzly Bear Recovery Plan (USFWS 1993) and Interagency Grizzly Bear Committee (IGBC) guidelines. Over 1 million acres of the park (proposed 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 location is within Management Situation 1. The *Grizzly Bear Recovery Plan* (USFWS 1993) and the *Glacier National Park Bear Management Plan* and *Bear Management Guidelines* (NPS 2010a and 2010b) serve as guidelines for management of grizzly bears in Glacier National Park. Field work conducted during 1998-2000 identified 246 grizzly bears in Glacier National Park; however, many of these bears were also found in the areas surrounding the park (Kendall and Waits 2002). Kendall et al. (2009) recently estimated that there were 765 grizzly bears in the NCDE system during 2004. Based on data from an ongoing interagency grizzly bear population trend monitoring project, the grizzly bear population in the NCDE was found to be increasing at 3% per year between 2004 and 2009 (Mace et al. 2012).

The greatest number of grizzly bear observations reported by visitors and park employees are from the months of May through August, with considerably fewer records from March, April, September, October, and November. The number of records is likely correlated with visitor use numbers, and is not necessarily an indicator of relative grizzly bear presence and habitat use. Some bears have habituated to the high level of human activity during these months, and continue to use open habitats along roads and within sight of visitor facilities, roads, and park administrative offices when people are present. Some bears that are more sensitive to human disturbance probably avoid these areas entirely or concentrate their activity at night or in remote areas relatively free from human influence.

The park's bear sighting database contains 14 and 15 grizzly bear sightings since 2007 for the Quartz and Logging drainages, respectively. Fifteen of those sightings occurred on or along trails, one was in the Lower Quartz Lake campground, one was along the Logging Lake lakeshore near the outlet, and the remaining sightings were from the Inside North Fork Road. As stated above, these observations are not necessarily indicative of grizzly bear habitat use. Habitat modeling indicates medium to high value grizzly bear springtime foraging habitat on north aspect slopes above Quartz and Logging Lakes, especially in avalanche chutes; habitat values around the lakeshores are at a moderate level. During late summer and autumn (after mid-July), grizzly bear habitat values within most of the drainage are low. Neither lake is located in an area of prime grizzly bear habitat, and grizzlies likely use the project areas primarily as travel corridors.

## Intensity Level Definitions

*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.

*Minor*: An individual(s) of a listed species or its critical habitat would be affected, but the change would be small.

*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.

*Major*: An individual or population of a listed species, or its critical habitat, would be noticeably affected and there could be a vital consequence to the population or habitat.

*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.

The impact intensity levels for federally listed species are classified using the following terminology, as defined under Section7 of the Endangered Species Act:

*No Effect*: There would be no effects, either positive or negative, to a listed species or its critical habitat. No incidental take of a listed species would be anticipated. Consultation with the USFWS is not required.

*May Affect / Not Likely to Adversely Affect*: Effects on listed species or its critical habitat would be insignificant or discountable (i.e. cannot be meaningfully measured, detected, or evaluated, or are extremely unlikely to occur). No incidental take of a listed species would be anticipated. Requires informal consultation with the USFWS and written concurrence.

*Beneficial:* All effects to a listed species or its critical habitat are entirely beneficial or positive without any adverse effects to the species or habitat. No incidental take of a listed species would be anticipated. Requires informal consultation with the USFWS and written concurrence.

*May Affect, Likely to Adversely Affect:* At least one adverse effect may occur to a listed species or its critical habitat and the effect is not insignificant, discountable, or beneficial. Incidental take may or may not be anticipated. Requires formal consultation with the USFWS.

## Impacts of Alternative A – No Action

Alternative A would have no impacts on grizzly bears since there would be no action and no change to existing conditions.

**Cumulative Impacts of Alternative A**

There would be no cumulative impacts to grizzly bears under Alternative A, because no action would be taken.

**Conclusion**
There would be no action under Alternative A, and therefore no impacts to grizzly bears. The Section 7 determination would be "no effect".

# Impacts of Alternative B – Continue Lake Trout Suppression at Quartz Lake

Activities under Alternative B would occur primarily on the open water of a lake, be intermittent (occurring only during spring and fall) and of low overall intensity, and would therefore have little effect on grizzly bears. While most bears would likely be using upper elevations during project implementation periods, motorboat noise and the extended presence of project personnel during spring and fall when human activity is typically low could displace individual bears from the project area. Infrequent round trip helicopter flights (possibly one flight anticipated each year or every few years) to Quartz Lake under this alternative could also temporarily displace individual bears. Also, fuel and fish nets would present a potential attractant for bears that, while manageable, could influence grizzly bear movements and potentially increase the risk of encounter or conflict. Mitigation measures ensuring the proper storage of wildlife attractants would be required, however, and impacts to grizzly bears under this alternative would be negligible to minor, adverse, long-term, and site-specific to local.

**Cumulative Impacts of Alternative B**
Alternative B combined with lake trout suppression on Quartz Lake for the last four years, a fish passage barrier on Quartz Creek, a proposed fish passage barrier on Akokala Creek, and other past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would increase the overall potential for disturbance or displacement of individual bears. This increase would be intermittent (only occurring during spring and fall) and of low intensity. Cumulative impacts to grizzly bears would be negligible to minor, adverse, short and long-term, and site specific to local.

**Conclusion**
Alternative B would have the potential to displace individual grizzly bears from the Quartz Lake vicinity in the spring and fall, and could slightly increase the potential for bear-human encounters and conflict. Impacts to bears are expected to be low, however, due to the intermittent, low intensity nature of the activity overall, and because most bears would likely be using upper elevations when project activities are underway. The risk of bear-human conflict would be minimized by strict measures to secure food and other bear attractants. Impacts to grizzly bears would therefore be negligible to minor, adverse, short and long-term, and site-specific to local. Cumulatively, impacts to grizzly bears would be negligible to minor, adverse, short and long-term, and site specific to local from intermittent, low intensity increases in human activities that could displace individual grizzly bears.

Under Section 7, adverse effects to grizzly bears from possible displacement would be difficult to detect or measure and there would be no effects to grizzly bear habitat if Alternative B was implemented. Mitigation measures preventing bears from obtaining food rewards and minimizing the chances of bear human conflict would further reduce the risk of adverse effects and make the prospect of incidental take as defined by the USFWS extremely unlikely. The Section 7 determination for effects to grizzly bears would therefore be "may affect, not likely to adversely affect".

# Impacts of Alternative C – Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage

The impacts to grizzly bears under this alternative would, in general, be similar to those described for Alternative B. Logging Lake is an especially heavily forested area, is not prime grizzly bear habitat, and lake trout suppression efforts on the lake would not likely affect grizzly bears in any measurable way. The work would be of low intensity and intermittent, occurring only during spring and fall. Motorboat noise, round trip helicopter flights (up to four per year, approximately, anticipated for the first few years, with fewer anticipated during the later stages of the project), and the extended presence of project personnel at a time when visitor use is typically low could displace individual bears from the project area. The potential for bear encounters would increase with the bull trout conservation component of this alternative, which would entail more human activity off the water as crews translocate juvenile bull trout from Logging Lake to Grace Lake. As with Alternative B, fuel and fish nets used at Logging Lake would be potential attractants for bears. The potential for displacement and bear-human conflict would increase if work crews occupy the patrol cabin at the more remote, upper end of the lake. A higher level of grizzly bear use is apparent at the upper end of the lake, as evidenced by tracks and rub trees. But the upper cabin would not be routinely occupied, and mitigation measures requiring the proper storage of wildlife attractants would be in place. Impacts to grizzly bears under this alternative would be negligible to minor, adverse, long-term, and site-specific to local.

**Cumulative Impacts of Alternative C**

Alternative C combined with lake trout suppression on Quartz Lake for the last four years, a fish passage barrier on Quartz Creek, a proposed fish passage barrier on Akokala Creek, and other past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would increase the overall potential for disturbance or displacement of individual bears. This increase would be intermittent (only occurring during spring and fall) and of low intensity. Cumulative impacts to grizzly bears would be negligible to minor, adverse, short and long-term, and site specific to local.

**Conclusion**

Alternative C would have the potential to displace individual grizzly bears from the vicinity of Logging Lake in the spring and fall, and could increase the potential for bear-human encounters and conflict. Due to the intermittent, low intensity nature of the activity overall, impacts to grizzly bears are expected to be low. The bull trout translocation component of this alternative would increase the potential for encounters with bears. But the risk of bear-human conflict would be minimized by strict requirements to secure food and other bear attractants. Impacts to grizzly bears would therefore be negligible to minor, adverse, short and long-term, and site-specific to local. Cumulatively, impacts to grizzly bears would be negligible to minor, adverse, short and long-term, and site specific to local from intermittent, low intensity increases in human activities that could displace individual grizzly bears.

Under Section 7, adverse effects to grizzly bears from possible displacement would be difficult to detect or measure, and there would be no effects to grizzly bear habitat under Alternative C. Mitigation measures preventing bears from obtaining food rewards and minimizing the chances of bear-human conflict would further reduce the risk of adverse effects and make the prospect

of incidental take as defined by the USFWS extremely unlikely. The Section 7 determination for effects to grizzly bears would therefore be "may affect, not likely to adversely affect".

## Impacts of Alternative D – Both Alternatives B and C Preferred

Impacts to grizzly bears under the preferred alternative would be generally similar to those described for Alternatives B and C, but would occur at both Quartz and Logging Lakes. The proposed activities would be intermittent (occurring only during spring and fall) and of low intensity. Because they would occur primarily on the open waters of Quartz and Logging Lakes, they would have little effect on grizzly bears. Motorboat noise, round trip helicopter flights (up to four per year, approximately, anticipated to Logging Lake for the first few years, with fewer anticipated during the later stages of the project; possibly one flight anticipated each year or every few years to Quartz Lake), and the extended presence of project personnel at a time when visitor use is typically low could displace some individual bears from the project areas. The potential for bear encounters would increase with bull trout conservation efforts at Logging Lake, because there would be more human activity off the water as crews translocate juvenile bull trout from Logging Lake to Grace Lake. Fuel and fish nets used at Quartz and Logging Lake would be potential bear attractants. The potential for displacement and bear-human conflict would increase if work crews occupy the patrol cabin at the more remote, upper end of Logging Lake. But the patrol cabin would not be routinely occupied, and mitigation measures requiring the proper storage of attractants would be in place. Impacts to grizzly bears under this alternative would therefore be negligible to minor, adverse, long-term, and site-specific to local.

**Cumulative Impacts of Alternative D**

Alternative D combined with lake trout suppression on Quartz Lake for the last four years, a fish passage barrier on Quartz Creek, a proposed fish passage barrier on Akokala Creek, and other past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would increase the overall potential for disturbance or displacement of individual bears. This increase would be intermittent (only occurring during spring and fall) and of low intensity. Cumulative impacts to grizzly bears would be negligible to minor, adverse, short and long-term, and site specific to local.

**Conclusion**

Alternative D would have the potential to displace individual grizzly bears from the vicinities of Quartz and Logging Lakes in the spring and fall, and could increase the potential for bear-human encounters and conflict. Because of the intermittent, low intensity nature of the proposed activities overall, impacts to grizzly bears are anticipated to be low. Bull trout translocation between Logging and Grace Lake would increase the potential for bear encounters. But the risk of bear-human conflict would be minimized by strict requirements to secure food and other bear attractants. Impacts to grizzly bears would therefore be negligible to minor, adverse, short and long-term, and site-specific to local. Cumulatively, impacts to grizzly bears would be negligible to minor, adverse, short and long-term, and site specific to local from intermittent, low intensity increases in human activities that could displace individual grizzly bears.

Under Section 7, adverse effects to grizzly bears from possible displacement would be difficult to detect or measure and there would be no effects to grizzly bear habitat under the proposed

action. Mitigation measures preventing bears from obtaining food rewards and minimizing the chances of bear-human conflict would further reduce the risk of adverse effects and make the prospect of incidental take as defined by the USFWS extremely unlikely. The Section 7 determination for effects to grizzly bears would therefore be "may affect, not likely to adversely affect".

# Recommended Wilderness

## Affected Environment

In 1964, Congress passed the Wilderness Act to "assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition" [Section 2(a)]. The National Wilderness Preservation System was thus established, preserving millions of acres of undeveloped wild country across a diversity of landscapes in the nation's wildlife refuges, forests, and national parks.

The defining attributes of wilderness as described by the Wilderness Act [Section 2(c)] include: "untrammeled"; "undeveloped Federal land retaining its primeval character and influence"; "without permanent improvements or human habitation"; "protected and managed so as to preserve its natural conditions"; "generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable"; "has outstanding opportunities for solitude or a primitive and unconfined type of recreation"; "has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition"; and "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value".

In 1974, Glacier National Park completed a study and environmental impact statement to comply with the Wilderness Act. That document resulted in the recommendation by the Secretary of the Interior that over 90% of the park be designated as wilderness. Amendments to the wilderness recommendation in 1984 and 1994 increased the amount of proposed wilderness in the park to 95%. Glacier National Park manages recommended wilderness as designated wilderness in accordance with NPS management policies (2006). Wilderness management guidelines promote natural processes and allow humans only as temporary visitors.

Recommended wilderness in Glacier National Park begins 100 feet from the centerline of paved and unpaved roads, and 300 feet from developed areas (DO #41 and NPS 2004). The park's recommended wilderness remains "untrammeled" and relatively unmanipulated, with landscapes that have retained their intrinsically wild character and persist in their essentially natural condition. The park's recommended wilderness provides outstanding opportunities for solitude and primitive recreation, such as hiking, backcountry camping, canoeing/kayaking, and mountaineering. Much of the park's wilderness resource is characterized by features and attributes of unique value, including scenic landscapes, cultural resources that reflect the park's history, educational settings for students of all ages, and areas that provide valuable opportunities for scientific research. Human developments consist of trails and associated constructions such as bridges and turnpikes, backcountry campsites, and historic lookouts and cabins. There are no permanently occupied structures, most of the park's recommended wilderness is trail-less, and motorized use and access is prohibited except in the case of emergency or administrative purposes necessary for the management of wilderness.

Administrative activity is generally limited to trail and campsite maintenance, preservation of historic structures, invasive species control, and fish and wildlife management and research.

Recommended wilderness surrounding Quartz and Logging Lakes is largely untrammeled, characterized by rugged, remote, and wild country, spectacular scenery, and a diverse assemblage of native plants and animals. The areas are essentially natural, and development is limited to hiking trails, backcountry campgrounds, and backcountry patrol cabins. Many visitors to Quartz and Logging Lake come to experience a sense of solitude and enjoy numerous recreational opportunities, including hiking, backcountry camping, and fishing. The wilderness resource in the Quartz and Logging drainages also offers unique opportunities for outdoor education, and the upper drainages provide especially valuable opportunities for scientific research on intact terrestrial and aquatic ecological systems, including those which support bull trout and other native fish species.

Maintained trails in the vicinity of Quartz Lake include the Quartz Creek Trail from the Inside North Fork Road to the foot of Quartz Lake, the Quartz Lake Trail over Cerulean Ridge between the foot of Quartz Lake and Bowman Lake, and the West Lakes Trail which traverses Quartz Ridge between Lower Quartz Lake and Bowman Lake. The park maintains a single trail in the Logging drainage, between the Inside North Fork Road and the foot of Grace Lake. Backcountry cabins are maintained at the foot of Quartz Lake, the foot of Logging Lake, and the head of Logging Lake.

## Intensity Level Definitions

*Negligible:* The effect on recommended wilderness would not be detectable.

*Minor:* The effect would be detectable, but would not appreciably affect the defining attributes of wilderness as described by the Wilderness Act.

*Moderate:* The effect would be readily apparent and/or would appreciably affect the defining attributes of wilderness as described by the Wilderness Act.

*Major:* The effects would be highly apparent and would significantly affect the defining attributes of wilderness as described by the Wilderness Act.

*Short-term:* Occurs for one year or less.

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

## Impacts of Alternative A – No Action

The no action alternative would increase the potential for native fish populations to be compromised or permanently lost due to the expansion of non-native fish populations, which would adversely affect certain wilderness defining attributes of the Quartz and Logging drainages. The natural, historic condition of the native fish communities and the ecological integrity of both the Quartz and Logging drainages would become permanently altered as non-native fish species predominate over native fish. Such a profound alteration of these backcountry fisheries would degrade the unique ecological value of the Quartz and Logging drainages, where the threatened bull trout still resides at the top of the food chain. The unique scientific value of the Quartz and Logging drainages would also be diminished, as opportunities to study and monitor areas of ecologically intact bull trout habitat would be lost. Recreational opportunities would be impacted, as changes to fish species composition and distribution would alter the dynamics of lake and stream fishing within both drainages. Over much of the fishing season, lake trout inhabit deep water, which is not readily accessible by anglers on the lake

shore. Anglers would likely experience more difficulty in catching fish, and the quality of the recreational experience would diminish. Adverse impacts to the wilderness resource would extend throughout the upper Quartz and upper Logging drainages, and would be long-term if not permanent.

**Cumulative Impacts of Alternative A**
Past, current and future actions such as trail maintenance activities involving mechanized equipment, research efforts, and backcountry helicopter or fixed-wing flights have had and continue to have some temporary adverse effects on wilderness defining attributes. These actions combined with the long-term degradation of the natural condition (specifically, the eventual degradation of native fisheries) within the upper Quartz and Logging drainages under no action would incrementally increase the overall level of adverse impacts to the wilderness resource. No action would undermine the overall benefit of previous efforts to suppress lake trout at Quartz Lake, and would also diminish the efficacy of other projects intended to reduce access for non-native fish species elsewhere in the North Fork (such as Akokala Cr.), thereby degrading the natural condition of recommended wilderness on a wider scale.

**Conclusion**
Taking no action would result in the permanent degradation of the natural condition, unique ecological value, and unique scientific value of recommended wilderness in the upper Quartz and Logging drainages. Impacts to recommended wilderness would be adverse, moderate, site-specific and local, and long-term. Cumulatively, no action combined with short-term disturbances from past, ongoing, and reasonably foreseeable actions would incrementally increase adverse effects to the overall quality of recommended wilderness, and would diminish the overall benefit of efforts to protect the native fish community elsewhere in the North Fork district. Cumulative impacts would be adverse, negligible to moderate, short and long-term, site-specific and local.

## Impacts of Alternative B – Continue Lake Trout Suppression on Quartz Lake

Alternative B would contribute to the conservation of regional and parkwide bull trout populations, and would protect the overall native fish community in Quartz Lake. The natural condition and unique ecological, scientific, and educational value of the wilderness resource within the Quartz drainage would be safeguarded for the long term, and recreational fishing opportunities would remain unaltered.

The use of a motorized boat and portable generator during netting operations would intermittently disturb the untrammeled (unmanipulated) quality of recommended wilderness within and near Quartz Lake. Impacts would be long term, since the project would be underway for more than one year (likely seven to ten years). Opportunities for solitude would be adversely affected for visitors to Quartz Lake during the spring (May-June) and fall (September-October), when netting operations would be underway. The boat would interfere with the scenic viewshed and undeveloped character, especially when it is visible on the open water, and the presence of a field crew might infringe upon a sense of solitude. Any helicopter flights would be infrequent, possibly with one round-trip flight anticipated each year or every few years depending on boat motor maintenance needs. Helicopter flights would cause transitory noise along the flight path that would temporarily interfere with the wilderness character of the Quartz drainage.

**Cumulative Impacts of Alternative B**

The continued use of motorized equipment during netting operations would prolong ongoing minor to moderate adverse impacts to recommended wilderness during spring and fall. These ongoing impacts have been occurring since lake trout suppression began on Quartz Lake in 2009. Effects from netting operations would also increase the level of disturbance from other past, ongoing, and future actions (such as construction of a fish passage barrier on Quartz Creek, trail maintenance activities involving mechanized equipment, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide). Not all of these activities would be occurring at the same time as netting operations, however, and adverse cumulative impacts would be most apparent when netting operations in May-June and September-October occur simultaneously with other actions. Roundtrip helicopter flights for this project would be included in the park's annual restricted administrative flight quota of approximately 50 administrative flights. Flights for the project may therefore increase the number of flights in the Quartz drainage, but would not increase the park's overall number of administrative flights. Alternative B would also have beneficial cumulative impacts to the long-term natural character and ecological and scientific value of the wilderness resource when combined with other efforts to suppress lake trout and inhibit non-native fish from accessing park waterways.

**Conclusion**

By continuing to suppress invasive non-native lake trout and protect bull trout and other native fish in Quartz Lake, Alternative B would appreciably benefit the natural condition and unique ecological, scientific, and educational value of recommended wilderness, resulting in long-term, moderate, beneficial, and site-specific to regional impacts. The continued use and presence of a motor boat on the lake for the next seven to ten years, motorized noise disturbances during netting, and possible roundtrip helicopter flights would have impacts to wilderness qualities (untrammeled, undeveloped, and opportunities for solitude) that are adverse, site-specific and local, short and long-term, and minor to moderate. Cumulatively, disturbances from Alternative B would intermittently increase disturbances from past, ongoing, and reasonably foreseeable actions and have minor to moderate, adverse, short and long-term, site-specific and local impacts on recommended wilderness. But the project would further the benefit of other efforts to protect native fisheries, resulting in beneficial cumulative impacts to recommended wilderness that are moderate, long-term, and local.

## Impacts of Alternative C – Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage

Under Alternative C, the native fish community at Logging Lake would be protected for the long term, which would contribute to the conservation of regional and parkwide bull trout populations. Lake trout suppression and conservation measures to protect native fish and boost the bull trout population would benefit the natural condition and unique ecological, scientific and educational value of recommended wilderness. Similar to the benefits of Alternative B in the Quartz drainage, Alternative C would safeguard these attributes of wilderness character for the long term within the Logging drainage, and recreational fishing opportunities would remain unaltered.

As with lake trout suppression efforts on Quartz Lake, use of a motorized boat and portable generator during annual netting operations on Logging Lake would intermittently disturb the untrammeled (unmanipulated) quality of recommended wilderness. Translocating bull trout would also interfere with the area's untrammeled character. Opportunities for solitude would be

adversely affected for visitors who visit Logging Lake when netting or translocation operations are underway. The presence of a boat, especially when on the open water, would interfere with the scenic viewshed and undeveloped character, and field crew activity might also infringe upon a sense of solitude. The project would be underway for more than one year (seven to ten years), and adverse impacts would therefore be long-term. Compared with Alternative B, the higher number of helicopter flights required for this alternative (up to four per year, approximately, anticipated for the first few years, with fewer anticipated during the later stages of the project) would cause a higher level of disturbance to recommended wilderness. Noise along the flight paths would be transitory and adverse impacts would be temporary, but interferences with the wilderness character of the Logging drainage would be more frequent.

**Cumulative Impacts of Alternative C**
Disturbances during netting and bull trout translocation combined with past, ongoing, and future actions (such as trail maintenance activities involving mechanized equipment, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would increase the level of disturbance to recommended wilderness character in the Logging drainage. Ongoing and future actions may not occur at the same time as netting operations. Adverse cumulative impacts would therefore be most apparent when netting operations and other actions occur simultaneously in May-June and September-October. Roundtrip helicopter flights would be included in the park's annual restricted administrative flight quota of approximately 50 administrative flights. Flights for the project may therefore increase the number of flights in the Logging drainage, but would not increase the park's overall number of administrative flights. Combined with other efforts in the North Fork district to suppress lake trout and inhibit non-native fish from accessing park waterways, this alternative would also benefit the long-term natural character and unique ecological scientific value of the wilderness resource in the park.

**Conclusion**
Alternative C would suppress invasive non-native lake trout and protect bull trout and other native fish in Logging Lake, thereby appreciably benefitting the natural condition and unique ecological, scientific, and educational value of recommended wilderness. Beneficial impacts would be long-term, moderate, and site-specific to regional. The presence and use of a motor boat on Logging Lake for the next seven to ten years, motorized noise during netting, bull trout translocation activity, and roundtrip helicopter flights would have impacts to wilderness qualities (untrammeled, undeveloped, and opportunities for solitude) that are adverse, site-specific and local, short and long-term, and minor to moderate. Cumulatively, disturbances from Alternative C would intermittently increase disturbances from past, ongoing, and reasonably foreseeable actions and have minor to moderate, adverse, short and long-term, site-specific and local impacts on recommended wilderness. But the project would also further the benefit of other efforts to protect native fisheries, resulting in beneficial cumulative impacts to recommended wilderness in the Logging Lake drainage that are moderate, long-term, and local.

## Impacts of Alternative D – Both Alternatives B and C Preferred

Alternative D would preserve two bull trout populations and protect native fish communities in two of the park's backcountry drainages, which would further contribute to the conservation of regional and parkwide bull trout populations. Extending the benefits of lake trout suppression and bull trout conservation across two drainages would benefit the park's recommended wilderness on a wider scale. This alternative would preserve the natural condition, recreational

opportunities, and unique ecological, scientific, and educational value of recommended wilderness within both the Logging and Quartz drainages.

Adverse impacts to recommended wilderness would also occur on a larger scale. Motorized boat use and a portable generator at both Quartz and Logging Lakes would extend intermittent disturbances to the untrammeled quality of recommended wilderness to two backcountry locations. Activities necessary to translocate bull trout in the Logging drainage would contribute to these impacts. Impacts would be long-term, as the projects would be underway for more than one year (seven to ten years) at both lakes. During the spring and fall, when netting operations are underway, backcountry visitors would experience diminished opportunities for solitude in two locales, and motorboat use would adversely impact the scenic viewshed and undeveloped character at two backcountry lakes. Compared with Alternatives B and C, this alternative would require the most helicopter flights (up to four per year, approximately, anticipated to Logging Lake for the first few years, with fewer anticipated during the later stages of the project; possibly one flight anticipated each year or every few years to Quartz Lake). Helicopter noise would be transitory along the flight paths, but the higher number of flights would have more negative impacts to the North Fork District's wilderness character, and over a greater area.

**Cumulative Impacts of Alternative D**
Cumulative beneficial and adverse impacts to recommended wilderness under Alternative D would be as described for Alternatives B and C, only they would occur at two backcountry locations instead of one. Netting and bull trout translocation combined with past, ongoing, and future actions (such as construction of a fish passage barrier on Quartz Creek, trail maintenance activities involving mechanized equipment, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide) would intermittently increase disturbances to recommended wilderness character at both Logging and Quartz Lakes. Adverse cumulative impacts would be most apparent if netting operations and other actions occur simultaneously during May-June and September-October. Roundtrip helicopter flights would be included in the park's annual restricted administrative flight quota of approximately 50 administrative flights. Flights for the project may therefore increase the number of flights in the Quartz and Logging drainages, but would not increase the park's overall number of administrative flights. This alternative combined with other efforts in the North Fork to suppress lake trout and inhibit non-native fish access would also benefit the long-term natural character and unique ecological and scientific value of the wilderness resource, and these benefits would occur on a wider scale.

**Conclusion**
By suppressing lake trout and protecting bull trout and native fish populations in two drainages, Alternative D would appreciably benefit the natural condition, recreational fishing opportunities, and unique ecological, scientific, and educational value of the park's recommended wilderness on a wider scale. Beneficial impacts would be long-term, moderate, and site-specific to regional. Motorboats on Logging and Quartz Lakes for the next several years, motorized noise during netting, bull trout translocation, and roundtrip helicopter flights would have impacts to wilderness qualities (untrammeled, undeveloped, and opportunities for solitude) that are adverse, site-specific and local, short and long-term, and moderate. Cumulatively, disturbances from Alternative D would intermittently increase those from past, ongoing, and reasonably foreseeable actions and have minor to moderate, adverse, short and long-term, site-specific and local impacts on recommended wilderness. But the project would also further the benefits of other efforts to protect native fish populations, resulting in beneficial

cumulative impacts to recommended wilderness in the Logging and Quartz drainages that are moderate, long-term, and local.

The Minimum Requirement Decision Guide (MRDG) used for the minimum requirement-minimum tool analysis for this alternative is included in Appendix A.

# Natural Soundscapes

## Affected Environment

An important part of the NPS mission is to preserve the natural soundscapes of national parks. Natural soundscapes are the sounds of nature, a diminishing resource in an ever modernizing world. Natural sounds have intrinsic value as part of the unique environment of Glacier National Park, and they predominate throughout most of the park. Glacier's natural soundscape includes the pervading quiet and stillness, low decibel background sounds, birdsong and animal calls, the buzz of insects, and the sound of wind, rain, and water, among many others. Natural soundscapes vary across the park, depending on elevation, proximity to water, vegetative cover, topography, time of year, and other influences.

In general, soundscapes in the park are managed according to the management objectives for the park's four different management zones (backcountry, rustic, day use, and visitor service). Existing ambient sound levels differ within each of these zones, and therefore soundscape management objectives for each zone are also different. Soundscapes for the park's backcountry and rustic zones differ markedly from the soundscapes within visitor service zones. Day use zones often overlap between rustic or backcountry zones, and soundscapes in these areas may be characteristic of both the backcountry and more developed areas.

According to the park's *General Management Plan* (NPS 1999), management in backcountry areas (which includes recommended wilderness) is focused on protection and, when necessary, restoration of resources and natural processes. Backcountry zones, where natural sounds predominate, are therefore managed for natural quiet. The rustic zone is managed to provide a staging area for use of the adjacent backcountry zone; facilities and campgrounds are primitive, and natural sounds also predominate. In contrast, visitor service and day use zones allow for heavier use and more congested conditions, and some level of human caused, artificial noise is expected. Soundscapes in day use zones are managed for a range of conditions that include some noise as well as natural quiet, depending on their location in the park, while visitor service zones are managed for higher levels of human caused noise.

Noise intrusions can mask biologically important sounds, degrade habitat, and cause behavioral and physiological changes in wildlife, and can interfere with visitors' experience of quietude or other qualities of the natural soundscape. The effects of noise typically diminish as the distance from the source of the noise increases. However, depending on sound frequencies and environmental factors, noise intrusions can contribute to overall background noise over very large distances, even if they are not distinctly audible.

Short segments of lower Quartz Creek and lower Logging Creek are within the rustic zone where they are crossed by the Inside North Fork Road. Otherwise, the Logging and Quartz drainages are entirely within the park's backcountry management zone, in the conifer forest acoustic zone, which has natural ambient sound levels ranging between 19.4 and 30.5 dBA (U.S. DOT 2009). Natural ambient sound levels in the Quartz and Logging drainages are likely at the low end of this range, at approximately 20 dBA, and existing ambient sound levels are likely between 20 and 25 dBA, as suggested by specific sound level data obtained at similar

measurement sites within the conifer forest acoustic zone (U.S. DOT 2009). Ambient sound levels are likely to be slightly higher in areas where natural stream sounds predominate. The natural soundscape in the upper Quartz and Logging drainages is characterized almost exclusively by natural sounds, interrupted only now and then by hiking parties or park administrative activities such as trail and backcountry campground maintenance. Scenic helicopter air tours can be a more regular source of disruption during the summer months. Since 2009, lake trout gill netting operations on Quartz Lake involving the use of a motorboat equipped with an outboard motor have produced some low-level artificial noise that is audible in the vicinity of the lake during the spring and fall.

## Intensity Level Definitions

*Negligible:* Noise from the action would be below the level of detection and would not result in any perceptible consequences.

*Minor:* Noise from the action would be localized and rarely audible, and/or would occur for less than 1 month.

*Moderate:* Noise from the action would be localized to widespread and periodically audible, and/or would occur for 1 to 3 months.

*Major:* Noise from the action would be widespread, regularly audible, and/or would occur for more than 3 months.

*Short-term:* Would only occur during project implementation.

*Long-term:* Would be permanent or occur beyond project implementation.

## Impacts of Alternative A – No Action

There would be no action under this alternative, and therefore no new impacts to natural soundscapes.

**Cumulative Impacts of Alternative A**

Because no action would be taken, there would be no additional impacts to natural sounds from past, ongoing, or future actions.

**Conclusion**

No action would be taken under Alternative A, and there would be no impacts to natural soundscapes.

## Impacts of Alternative B – Continue Lake Trout Suppression on Quartz Lake

Alternative B would cause temporary, discontinuous noise during the use of a motorboat, a portable generator, and possible helicopter use. The motorboat would likely produce noise ranging between 60 and 90 dBA, but the engine would be operating at its lower speeds most of the time. The generator, which would only be used for short periods during net retrieval, would be expected to produce noise at approximately 60 dBA. Motorboat and generator noise would occur intermittently, day or night, during two separate two-month long periods (May-June and September-October) each year for seven to ten years. The noise would be highly audible, given Quartz Lake's remote backcountry setting, the area's high level of quietude, and because lake water would transmit the sound. However, the audibility of the noise would be dampened and minimized by topography, weather conditions, and fairly dense forest and understory

vegetation. Adverse effects to soundscapes would therefore diminish as distance from the source increases. Noise would occur over a greater area if helicopter flights are necessary (possibly one flight anticipated each year or every few years), but the disturbance would be temporary and transitory along the flight path. Effects to natural soundscapes would be negligible when the helicopter is flying at high elevations, but helicopter noise would be more audible and disruptive as the helicopter travels at lower elevations between the staging area and the work site. Project noise could temporarily displace animals, cause brief behavioral and physiological changes, and mask biologically important sounds (sounds that would alert animals to threats or foraging opportunities, for example). It could also disrupt opportunities for visitors to experience the quietude of the backcountry.

The presence of field crews at a time of year when human activity in the backcountry is usually low (or non-existent) would likely create additional, periodic, low level noise. None of the noise from the project would be continuous, however. Frequent and/or extended periods of quiet would occur such that the area would likely be quiet more often than not. Noise effects would also be temporary, ceasing altogether at the end of each two-month work session and following project implementation. Adverse impacts to natural soundscapes would not exceed a moderate level due to primarily localized, discontinuous audibility and because project noise would not occur over periods that are longer than two months at a given time.

**Cumulative Impacts of Alternative B**
Minor to moderate adverse noise impacts that have been occurring intermittently since lake trout suppression began on Quartz Lake in 2009 would continue under Alternative B due to the use of a motorboat and generator during netting operations, and possible helicopter flights. When combined with other past, ongoing, and future actions (such as construction of a fish passage barrier on Quartz Creek in 2012, trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide), the project would create additional, intermittent increases in the amount of noise at Quartz Lake (and possibly beyond in the event of helicopter activity). Ongoing and future actions would not necessarily occur at the same time as netting operations, however, and adverse cumulative impacts would be most apparent in May-June and September-October if netting operations occur simultaneously with other actions. Any roundtrip helicopter flights for the project would be included in the park's annual restricted administrative flight quota of approximately 50 administrative flights.

**Conclusion**
Noise from a motorboat, portable generator, and possible helicopter flights would have discontinuous, temporary adverse effects on the natural soundscape, primarily localized to the project area. Motorized noise would be highly audible because of the quiet, remote location and because lake water would transmit the sound. But topography, weather, and vegetation would minimize the audibility of the noise and effects to the soundscape would diminish at increasing distances from the source. Helicopter noise, if it occurs, would be infrequent, transitory, and very temporary. Noise from the project would not be continuous and would not occur over periods that are longer than two months at a given time. Impacts to natural soundscapes would therefore be adverse, minor to moderate, short-term, site-specific, and local in the event of helicopter activity. Cumulatively, this alternative would intermittently increase the number of noise intrusions occurring from past, ongoing, and future actions and would have minor to moderate, adverse, site-specific to local, and short and long-term impacts on natural soundscapes.

# Impacts of Alternative C – Remove Lake Trout and Conserve Bull Trout in the Logging Lake Drainage

As with Alternative B, Alternative C would produce temporary, discontinuous noise disturbances due to the use of a motorboat, a portable generator, and up to four helicopter flights per year (approximately) anticipated in the first few years, with fewer flights anticipated during the project's later stages. The motorboat would likely produce noise ranging between 60 and 90 dBA, but the engine would be operating at its lower speeds most of the time. The generator would only be used for short periods during net retrieval and would likely produce noise at approximately 60 dBA. Motorboat and generator noise would occur intermittently, day or night, during two separate two-month long periods (May-June and September-October) each year for seven to ten years. The noise would be highly audible, given Logging Lake's remote backcountry setting, the area's high level of quietude, and because lake water would transmit the sound. The audibility of the noise would be dampened, however, and minimized by topography, weather conditions, and fairly dense forest and understory vegetation. Adverse effects to soundscapes would therefore diminish as distance from the source increases. Noise from helicopter flights would affect a greater area and, compared with Alternative B, the higher number of helicopter flights would result in a more noise disturbances. Noise along the flight paths would be transitory and adverse impacts would be temporary, but impacts to soundscapes would be more frequent. When the helicopter is flying at high elevations, effects to natural soundscapes would be at a negligible level. Helicopter noise would be more audible and disruptive as the aircraft travels at lower elevations between the staging area and the work site. Project noise could temporarily mask important sounds for wildlife and displace animals, and could cause brief behavioral and physiological changes. It could also disrupt opportunities for visitors to experience the natural quietude of the area.

The work would occur at a time of year when human activity in the backcountry is usually low (or non-existent), and the presence of field crews would likely create additional, periodic, low level noise. But none of the noise from the project would be continuous, since frequent and/or extended periods of quiet would occur, and the area would likely be quiet more often than not. Noise effects would be temporary, ceasing altogether at the end of each two-month work session and following project implementation. Adverse impacts to natural soundscapes would not exceed a moderate level due to primarily localized, intermittent audibility and because project noise would not occur over periods that are longer than two months at a given time.

**Cumulative Impacts of Alternative C**

Alternative C would create intermittent noise that would be additive to that produced by past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance and repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide). These activities would not necessarily occur at the same time as netting operations, however. Adverse cumulative impacts to soundscapes would be most apparent in May-June and September-October if netting operations occur simultaneously with other actions. Any roundtrip helicopter flights occurring under Alternative C would be included in the park's annual restricted administrative flight quota of approximately 50 administrative flights.

**Conclusion**

Noise from a motorboat, portable generator, and helicopter flights would have discontinuous, temporary, primarily localized adverse effects on the natural soundscape. Motorized noise would be highly audible due to the quiet, remote location and because lake water would

transmit the sound. But topography, weather, and vegetation would minimize the audibility of the noise and effects to the soundscape would diminish at increasing distances from the source. Helicopter noise would increase under this alternative, but would be transitory and temporary. Noise from the project would not be continuous and would not occur over periods that are longer than two months at a given time. Impacts to natural soundscapes would therefore be adverse, minor to moderate, short-term, site-specific and local. Cumulatively, this alternative would intermittently increase the number of noise intrusions occurring from past, ongoing, and future actions and would have minor to moderate, adverse, site-specific to local, and short and long-term impacts on natural soundscapes.

## Impacts of Alternative D – Both Alternatives B and C Preferred

Impacts to natural soundscapes under Alternative D would generally be as described for Alternatives B and C, but would occur at two locations. There would be temporary, discontinuous noise disturbances during the use of a motorboat and portable generator at both Quartz and Logging Lakes. The greater number of helicopter flights under this alternative (up to four per year (approximately) anticipated to Logging Lake for the first few years, with fewer anticipated during the later stages of the project; possibly one flight anticipated each year or every few years to Quartz Lake) would increase the level of impacts on soundscapes. Helicopter noise would be transitory along the flight paths, but adverse effects would occur over a greater area. The motorboats would likely produce noise ranging between 60 and 90 dBA, but the engines would be operating at lower speeds most of the time. The generators, which would only be used for short periods during net retrieval, would be expected to produce noise at approximately 60 dBA. Motorboat and generator noise would occur intermittently, day or night, during two separate two-month long periods (May-June and September-October) each year for seven to ten years. The noise at both Quartz and Logging Lakes would be highly audible, given the remote backcountry settings, high levels of ambient quietude, and because lake water would transmit the sound. The audibility of the noise would be dampened, however, and minimized at both lakes by topography, weather conditions, and fairly dense forest and understory vegetation. Adverse effects to soundscapes would therefore diminish as distance from the source increases. During helicopter flights, effects to natural soundscapes would be negligible when the helicopter is flying at high elevations. But helicopter noise would be more audible and disruptive during lower elevation flights between the staging areas and the work sites. Project noise could temporarily displace animals, mask important sounds, and cause brief behavioral and physiological changes. The noise could also temporarily disrupt the natural, backcountry quietude for visitors at both Quartz and Logging Lakes.

Work would occur at a time of year when human activity at Quartz and Logging Lake is usually low (or non-existent), and the presence of field crews would likely create additional, periodic, low level noise. But none of the project noise would be continuous. Frequent and/or extended periods of quiet would occur such that both areas would likely be quiet more often than not. Noise effects would be temporary, ceasing altogether at both lakes at the end of each two-month work session and following project implementation. While adverse impacts to natural soundscapes would affect two backcountry lakes under this alternative, they would not exceed a moderate level due to the intermittent, discontinuous audibility of the noise and because noise production would not occur over periods that are longer than two months at a given time. The impacts would also be primarily localized to Quartz and Logging Lakes.

**Cumulative Impacts of Alternative D**

The use of motorboats, portable generators, and helicopters at both Quartz and Logging Lakes under Alternative D would contribute additional, intermittent noise impacts to those that have already been occurring since lake trout suppression began on Quartz Lake in 2009. Noise from this alternative would also contribute to noise generated by other past, ongoing, and future actions, such as construction of a fish passage barrier on Quartz Creek in 2012, trail maintenance, road and/or bridge maintenance or repairs, administrative flights and possible emergency flights to backcountry sites near the project area, as well as commercial scenic flights on the west side of the divide. Ongoing and future actions may not be underway at the same time as netting operations on Quartz and Logging Lakes, however, and adverse cumulative impacts would be most apparent in May-June and September-October if netting operations and other actions occur simultaneously. Helicopter flights for the project would be included in the park's annual restricted administrative flight quota of approximately 50 administrative flights.

**Conclusion**

Noise from motorboats, portable generators, and helicopter flights would cause discontinuous, temporary intrusions to natural soundscapes at both Quartz and Logging Lakes. Effects would be primarily localized to the lakes, except during helicopter activity when they would temporarily be more widespread. Motorized noise would be highly audible due to the quiet, remote environments at each lake, and because lake water would transmit the sound. But topography, weather, and vegetation would minimize the audibility of project noise and effects to natural soundscapes would diminish at increasing distances from the source. Helicopter noise would increase under this alternative, but it would be temporary and transitory along the flight paths. Noise from the project would not occur over periods that are longer than two months at a given time, but impacts would affect a greater area. Impacts to natural soundscapes would therefore be adverse, moderate, short-term, site-specific and local. Cumulatively, this alternative would intermittently increase the number of noise intrusions from past, ongoing, and future actions and would have minor to moderate, adverse, site-specific to local, and short and long-term impacts on natural soundscapes.

# Visitor Use and Experience

## Affected Environment

Since Glacier National Park was established in 1910, visitors have created and maintained a strong heritage of backcountry recreation throughout the park, including hiking, mountaineering, camping, horseback riding, fishing, and canoeing, to name a few. Today, visitors from around the world come to the park to enjoy world class backcountry recreational opportunities and a primitive wilderness experience. There are over 60 backcountry campgrounds in Glacier National Park. In 2013, there were over 33,000 overnight stays in the backcountry parkwide, an approximately nine percent increase from the previous year (data excludes December; GNP files). In general, most backcountry use in the park (approximately 75%) occurs during July and August; approximately 22% of the park's backcountry use occurs in June and September.

The North Fork District receives high levels of year-round backcountry use, and the Quartz and Logging drainages are popular areas for both day hikers and overnight backcountry campers. Visitors access Quartz Lake via the Quartz Creek Trail from the Inside North Fork road to the foot of Quartz Lake, the Quartz Lake Trail over Cerulean Ridge between the foot of Quartz Lake and Bowman Lake, or the West Lakes Trail over Quartz Ridge between Lower Quartz and Bowman Lake. The Logging Creek Trail provides access from the Inside North Fork Road to

Logging Lake and Grace Lake. Visitors venture to the Quartz and Logging areas to fish, camp, view wildlife, and explore diverse natural surroundings, among other activities. Remote, pristine, and spectacularly scenic, Quartz, Logging, and Grace Lakes provide visitors with unique and increasingly rare opportunities to experience wild and undeveloped landscapes, signifying the value and importance of the park's backcountry.

There are three backcountry campsites in the proposed project areas, including one at the foot of Quartz Lake, at the foot of Logging Lake, and along the north shore of Logging Lake (Adair campground). In 2013, there were 365, 322, and 157 overnight stays at the Quartz Lake, foot of Logging Lake, and Adair backcountry campgrounds, respectively. The work periods for the proposed project would be during May-June and September October. There were 163 overnight stays at the three project area campsites combined during May-June, and 63 overnight stays during September-October. Visitation was highest during July and August, with 618 overnight stays at project area campsites combined.

## Intensity Level Definitions

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

*Minor:* *Changes in visitor use and/or 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.*

*Moderate:* *Changes in visitor use and/or experience would be readily apparent. The visitor would be aware of the effects associated with the alternative.*

*Major:* *Changes in visitor use and/or experience would be readily apparent and have important consequences. The visitor would be aware of the effects associated with the alternative.*

*Short-term:* *Occurs only during project implementation.*

*Long-term:* *Occurs after project implementation or is permanent.*

## Impacts of Alternative A – No Action

Taking no action to further suppress lake trout in Quartz Lake and begin lake trout suppression in Logging Lake would eventually lead to permanently compromised angling opportunities in both lakes. Lake trout prey on westslope cutthroat trout, one of the primary species caught by anglers in the Quartz and Logging drainages. Lake trout also live longer and are capable of quickly outnumbering westslope cutthroat trout, thereby achieving a competitive reproductive advantage. Under no action, lake trout populations would increase in both lakes, and westslope trout would become highly susceptible to predation.

In the analysis of impacts to native fisheries under this alternative, the park has determined that adverse impacts to westslope cutthroat trout would be major (see *Affected Environment and Environmental Consequences, Fisheries, Bull Trout, and Westslope Cutthroat Trout*). If westslope cutthroat trout populations in Quartz and/or Logging Lake are diminished or eventually lost, lake trout would make a poor substitute in terms of angling opportunities. Lake trout inhabit deeper waters that are hard to reach by conventional shore-based fishing methods. This is especially true during high use summer months when lake trout use deeper habitats. The damage to two native westslope cutthroat trout fisheries would therefore have readily apparent

impacts on angling visitors. Angling opportunities elsewhere in the Quartz and Logging drainages, including Middle and Lower Quartz, Cerulean, and Grace Lakes, may also be affected by changes in the native fish assemblage. While non-angling visitors would not be directly affected and may not be able to detect these impacts, the irretrievable harm to native fisheries at both lakes would diminish opportunities for future generations to visit an ecologically intact backcountry area. Wildlife viewing opportunities would also be diminished if fewer fish dependent species such as bald eagles, osprey, and common loons use the lake due to reduced numbers of native, shallow water-dwelling fish species.

**Cumulative Impacts of Alternative A**
A number of past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance or repairs, and possible emergency flights to backcountry sites near the project areas) benefit the park's backcountry visitors. Some of these activities (and others, such as administrative flights and commercial scenic flights on the west side of the divide) also have the potential to disturb visitors seeking solitude in a backcountry setting. Diminished angling opportunities from Alternative A would add to the number of adverse impacts to the visitor experience.

**Conclusion**
Under Alternative A, angling opportunities at Quartz and Logging Lake (and possibly within the upper reaches of the Quartz and Logging drainages) would be permanently compromised by increasing lake trout populations and consequentially diminished westslope cutthroat trout populations. The effects to anglers would be readily apparent and permanent. Non-angling visitors would also be impacted, because the opportunity for future generations to visit and view wildlife within two ecologically intact backcountry areas would be forever compromised. Impacts to visitor use and experience would therefore be negligible to moderate, adverse, site-specific, and long-term. Cumulative impacts would be negligible to moderate, short and long-term, beneficial and adverse, and site-specific to local from no action combined with a number of past, ongoing, and future actions that primarily benefit visitors but can also be disruptive to the visitor backcountry experience.

## Impacts of Alternative B – Continue Lake Trout Suppression on Quartz Lake

Under Alternative B, opportunities to catch native fish would be protected in Lower Quartz, Middle Quartz, Quartz, and Cerulean Lakes, thus benefitting long-term recreational fishing opportunities for anglers. By preserving opportunities to visit an ecologically intact backcountry setting, this alternative would also be of long-term benefit to future generations of non-angling visitors. Wildlife viewing opportunities would also be maintained because predators such as bald eagles, osprey, and common loons, which depend on shallow water-dwelling, native fish for food, would continue to forage at Quartz Lake. The use of a motorized boat and generator, helicopter flights, and the presence of a field crew would be temporarily disruptive for visitors who wish to experience solitude and the quiet character of the backcountry. The project would occur during May-June and September October. During these time periods, impacts to visitor use and experience would likely be most evident in June and September, and less apparent in May and October, when fewer people are likely to visit the park's backcountry. The project would not be underway during July and August, when visitation to Quartz Lake is likely to be highest. The trailhead and backcountry permit office would be posted with notices informing visitors of the project, and some visitors may choose to avoid Quartz Lake during lake trout suppression activity.

**Cumulative Impacts of Alternative B**
Several past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance or repairs, and possible emergency flights to backcountry sites near the project areas) benefit visitor use and experience in the park's backcountry. Some of these activities (and others, such as administrative flights and commercial scenic flights on the west side of the divide) may also disturb visitors seeking solitude and a primitive wilderness experience. Under Alternative B, lake trout suppression would protect opportunities to catch native fish and visit an ecologically intact backcountry setting, and would incrementally increase the overall level of past, ongoing, and future benefits to visitors (especially anglers). But noise and human activity from this alternative that occurs at the same time as other actions would add to the amount of disturbance to visitors seeking a quiet, backcountry experience.

**Conclusion**
Lake trout suppression and the preservation of the native fishery at Quartz Lake would benefit anglers as well as non-angling visitors seeking opportunities to visit and/or view wildlife in an ecologically intact backcountry area. Disturbances from a motorboat, generator, helicopter flights and the presence of a field crew would have temporary, adverse impacts on visitors seeking solitude and a primitive wilderness experience. Adverse impacts to visitor use and experience would likely be most apparent in June and September, but there would be no adverse impacts during July and August, when people are most likely to visit the backcountry. Beneficial impacts to visitor use and experience would be moderate, long-term and site-specific; adverse impacts would be minor to moderate, short-term and site-specific. Cumulatively, Alternative B would incrementally increase both beneficial and adverse impacts from other projects, resulting in impacts that are negligible to moderate, beneficial and adverse, short and long-term, and site-specific.

## Impacts of Alternative C – Remove Lake Trout and Conserve Bull Trout Conservation in the Logging Lake Drainage

Alternative C would protect and restore native fish in Logging Lake and establish a conservation population of bull trout in Grace Lake. These actions would benefit recreational fishing opportunities for anglers over the long-term. Opportunities to visit an ecologically intact backcountry setting would also be protected, which would benefit future generations of non-angling visitors. This alternative would also protect wildlife viewing opportunities because predators such as bald eagles, osprey, and common loons, which depend on shallow water-dwelling, native fish for food, would continue to forage at Logging Lake. A motorized boat and generator, helicopter flights, and the presence of a field crew for an extended period of time would temporarily disturb visitors seeking solitude and the quiet character of the backcountry at Logging Lake. Work would be underway in May-June and September October. During these work periods, impacts to visitor use and experience would likely be most evident in June and September, and less so in May and October, when fewer people are likely to visit backcountry areas. The project would not be underway at Logging Lake during July and August, when backcountry visitation is likely to be highest. The trailhead and backcountry permit office would be posted with notices informing visitors of the project, and some visitors may decide not to visit Logging Lake when lake trout suppression activity is underway.

**Cumulative Impacts of Alternative C**
Backcountry visitor use and experience benefit from a number of past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance or repairs, and possible emergency flights to backcountry sites near the project areas). But some of these activities (and

others, such as administrative flights and commercial scenic flights on the west side of the divide) may also disturb visitors seeking solitude and a primitive wilderness experience. Lake trout suppression under Alternative C would protect opportunities to catch native fish and visit an ecologically intact backcountry setting, and would incrementally increase the benefits from past, ongoing, and future actions (especially for anglers). But noise and human activity from this alternative combined with that from other actions occurring at the same time would increase the level of disturbance to visitors seeking solitude in the backcountry.

**Conclusion**
Lake trout suppression and the preservation of the native fishery at Logging Lake would have long-term benefits for anglers as well as non-angling visitors seeking opportunities to visit and/or view wildlife in an ecologically intact backcountry area. Disturbances from a motorboat, generator, helicopter flights and the presence of a field crew would have temporary, adverse impacts on visitors seeking solitude and a primitive wilderness experience. Adverse impacts to visitor use and experience would be most likely in June and September; there would be no adverse impacts during July and August, when visitation to Logging Lake is likely to be high. Beneficial impacts to visitor use and experience would be moderate, long-term and site-specific; adverse impacts would be minor to moderate, short-term and site-specific. Cumulatively, Alternative C would incrementally increase both beneficial and adverse impacts from other projects, resulting in impacts that are negligible to moderate, beneficial and adverse, short and long-term, and site-specific.

## Impacts of Alternative D – Both Alternatives B and C Preferred

The preferred alternative would protect native fish communities at both Logging and Quartz Lakes, thereby extending long-term benefits to recreational fishing opportunities over a greater area. Additionally, Alternative D would preserve long-term opportunities for non-angling visitors to experience two ecologically intact backcountry settings. Wildlife viewing opportunities would also be maintained at two backcountry lakes since predators such as bald eagles, osprey, and common loons would continue to forage at both Quartz and Logging Lakes. Disturbances would also occur over a greater area, however, including those from motorboats and generators, helicopter flights, and the extended presence of field crews. Such activity would be temporarily disruptive for visitors seeking solitude and a primitive backcountry experience at both Logging and Quartz Lakes. The project would be underway at both lakes during May-June and September October. During these time periods, impacts to visitor use and experience would likely be most evident in June and September, and less apparent in May and October, when fewer people are likely to visit the park's backcountry. Work would not be underway during July and August, when visitation to Quartz and Logging Lakes is likely to be highest. Notices informing visitors of the project would be posted at the backcountry permit office as well as trailheads to Logging and Quartz Lakes, and some visitors may choose to avoid one or both areas during lake trout suppression periods.

**Cumulative Impacts of Alternative D**
Several past, ongoing, and future actions (such as trail maintenance, road and/or bridge maintenance or repairs, and possible emergency flights to backcountry sites near the project areas) benefit visitor use and experience in the park's backcountry. Some of these activities (and others, such as administrative flights and commercial scenic flights on the west side of the divide) may also disturb visitors seeking solitude and a primitive wilderness experience. Under Alternative D, lake trout suppression at both Quartz and Logging Lakes would protect

opportunities to catch native fish and visit two ecologically intact backcountry settings, and would incrementally increase the overall level of past, ongoing, and future benefits to visitors (especially anglers). But if the project occurs at the same time as other actions, noise and human activity from this alternative would increase the level of disturbance for visitors seeking a quiet, backcountry experience.

**Conclusion**

Lake trout suppression and the preservation of native fisheries at Quartz and Logging Lakes would benefit anglers as well as non-angling visitors seeking opportunities to visit and/or view wildlife in two ecologically intact backcountry areas. Disturbances from motorboats, generators, helicopter flights and the presence of field crews would have temporary, adverse impacts on visitors seeking solitude and a primitive wilderness experience; two backcountry areas would be impacted under this alternative. Adverse effects to visitor use and experience would likely be most apparent in June and September. There would be no adverse impacts during July and August, when people are most likely to visit backcountry areas such as Quartz and Logging Lakes. Beneficial impacts to visitor use and experience would be moderate, long-term, site-specific and local; adverse impacts would be minor to moderate, short-term, site-specific and local. Cumulatively, Alternative D would incrementally increase both beneficial and adverse impacts from other projects, resulting in impacts that are negligible to moderate, beneficial and adverse, short and long-term, and site-specific to local.

# 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 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.)** – The Endangered Species Act (ESA) was enacted to protect imperiled species and their habitat. Section 7 of the ESA is designed to ensure that any action authorized, funded, or carried out by a federal agency does 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 informal consultation with the USFWS is required. Section 10 of the ESA regulates activities that affect endangered and threatened species; under Section 10, the USFWS may authorize certain activities, including scientific research, enhancement of propagation or survival, and taking that is incidental to an otherwise lawful activity, when the purpose of those activities is consistent with the species' conservation (USFWS 2013).

The USFWS confirmed that the park currently has authorization under Section 10 of the ESA to undertake gill netting operations in bull trout waters. Bull trout translocation and stocking in Logging and Grace Lakes would occur under an amendment to the existing Section 10 permit. Incidental take of bull trout would be covered under the Section 10 permit. Captive propagation of bull trout at Creston National Fish Hatchery is a related action that would be covered under a separate Section 10 permit. As required, the park would document incidental taking of bull trout and maintain close communication with USFWS regarding acceptable levels of bull trout mortality.

Compliance with Section 7 of the ESA is being completed under the Section 10 permitting process. Per discussions with the USFWS, the analysis in the EA of other listed species meets the requirements of a biological assessment under the Section 10 process, and will be reviewed by the USFWS. The NPS has determined that the proposed action would have **"no effect" to Canada lynx, wolverine, water howellia,** or **Spalding's catchfly,** and has reached a determination of **"may affect, not likely to adversely affect" for grizzly bears.**

**Wilderness Act** – the Wilderness Act of 1964 (16 USC 1131 et seq.) established a wilderness preservation system. Public law 88-577 established a national wilderness preservation system and describes wilderness with the following language:

> A wilderness…is…an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean… an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which: 1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's

work substantially unnoticeable; 2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; 3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and 4) may also contain ecological, geological, or other features of scientific, educational, scenic or historical value.

The Minimum Requirement Decision Guide (MRDG) prepared for this project is included in Appendix A.

**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 in the National Register of Historic Places (NHRP) prior to initiating such actions. During scoping, Glacier National Park notified the Montana State Historic Preservation Office (SHPO), the Confederated Salish and Kootenai Tribes, and the Blackfeet Tribal Business Council of the project in keeping with 36 CFR800. The proposed project would have only negligible visual impacts on historic structures in the Areas of Potential Effect. There are no cultural landscapes in the project area. The Areas of Potential Effect have been surveyed for archeological resources and none were identified, and neither the Blackfeet Tribe nor the Confederated Salish and Kootenai Tribes raised concerns about the proposed action. The NPS will request concurrence with a finding of a "no adverse effect" in the EA transmittal letter to the Montana SHPO.

All necessary permits required by state and federal law would be obtained.

# Consultation and Coordination

## Internal and External Scoping

Scoping is an early and open process to determine the environmental issues, resources affected, and alternatives to be considered in an EA. Glacier National Park conducted both internal scoping with park staff and external scoping with the public and interested and affected groups and agencies. The scoping process helped identify potential issues, alternatives, the possible effects of cumulative actions, and what resources would be affected. Public scoping began on August 8, 2012 and the comment period closed on September 10, 2012. A press release was distributed to several media outlets and a scoping brochure was mailed to individuals and organizations on the park's EA mailing list, including members of Congress and various federal, state, and local agencies. An email announcement was sent to a number of interested parties, with a link to the brochure on the NPS Planning, Environment, and Public Comment (PEPC) website. Eleven comment letters were received during scoping. Nine letters were from private individuals and two were from private organizations. Nine letters were supportive of the proposal and two were opposed. Specific comments are described under Alternatives, Suggestions, and Concerns from Public Scoping and are addressed as appropriate throughout the document.

## Agency Consultation

Glacier National Park initiated informal consultation with the USFWS on August 8, 2012. The USFWS confirmed that the park currently has authorization under Section 10 of the ESA to undertake gill netting operations in bull trout waters. Bull trout translocation and stocking in Logging and Grace Lakes would occur under an amendment to the existing Section 10 permit, and captive propagation of bull trout would be covered under a separate Section 10 permit. Compliance with Section 7 of the ESA is being completed under the Section 10 permitting process. Per discussions with the USFWS, the analysis in the EA of other listed species meets the requirements of a biological assessment under the Section 10 process, and will be reviewed by the USFWS. The NPS has determined that the proposed action would have **"no effect" to Canada lynx, wolverine, water howellia,** or **Spalding's catchfly,** and has reached a determination of **"may affect, not likely to adversely affect" for grizzly bears.**

On August 8, 2012, Glacier National Park notified the Montana State Historic Preservation Office (SHPO) in keeping with 36 CFR800. For Section 106 purposes, the park has reached a finding of "no adverse effect" and will request concurrence in the EA transmittal letter to the SHPO.

## Native American Consultation

Glacier National Park also notified the Confederated Salish and Kootenai Tribes and the Blackfeet Tribal Business Council on August 8, 2012, in accordance with 36 CFR800. Neither the Blackfeet Tribe nor the Confederated Salish and Kootenai Tribes raised concerns about the proposed action during scoping for this project.

## Environmental Assessment Review and Recipients

This EA is subject to a 30-day public comment period. The public was notified of the EA availability through news releases to a number of state and local media outlets and a letter and/or document to various agencies, tribes, groups businesses and individuals who have asked to receive notification or are otherwise required to get notification. The EA will be available for

review on the park's planning website at http://parkplanning.nps.gov/LoggingQuartz. Copies of the EA will be provided to other interested individuals upon request.

During the 30-day public review period, the public is encouraged to submit their written comments to the NPS, as described in the instructions at the beginning of this document. Following the close of the comment period, all public comments will be reviewed and analyzed prior to the release of a decision document. The NPS will issue responses to substantive comments received during the public comment period.

## List of Preparers

*Mark Biel, Natural Resources Program Manager*—wildlife, common loons, and bald eagles; document review
*Chris Downs, Fisheries Biologist*—co-team captain; purpose and need/introduction/background; alternatives and project description; fisheries, bull trout, and westslope cutthroat trout; water resources; agency consultation; document review
*Lon Johnson, Cultural Resource Specialist*—cultural resources, SHPO consultation
*Kyle Johnson, Wilderness Manager*—recommended wilderness and visitor use and experience
*Mary Riddle, Chief of Planning and Environmental Compliance*—NEPA compliance, technical adequacy and document review, guidance with agency consultation
*Amy Secrest, Environmental Protection Assistant*—co-team captain; purpose and need/introduction/background; wildlife, common loons, and bald eagles; recommended wilderness; natural soundscapes; visitor use and experience; agency consultation; technical writing/editing and document compilation/formatting; coordination of EA schedule and review
*John Waller, Wildlife Biologist*—grizzly bears

## Consultation and Review

*Lisa Bate, Lead Wildlife Sciences Technician, Glacier National Park*
*Jami Belt, Citizen Science Coordinator, Glacier National Park*
*Kristi DuBois, Wildlife Biologist, Montana Fish, Wildlife and Parks*
*Wade Fredenberg, Bull Trout Recovery Coordinator, U.S. Fish and Wildlife Service*
*Chris Hammond, Wildlife Biologist, Montana Fish, Wildlife and Parks*
*Clint Muhlfeld, Aquatic Ecologist, U.S. Geological Survey*
*Lee Nelson, Native Fish Coordinator, Montana Fish, Wildlife and Parks*
*Phil Wilson, Chief, Division of Science and Resources Management, Glacier National Park*

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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