National Park Service
U.S. Department of the Interior

Glacier National Park
Waterton – Glacier International Peace Park
Montana

Large-Scale Removal of Lake Trout in Quartz Lake Environmental Assessment

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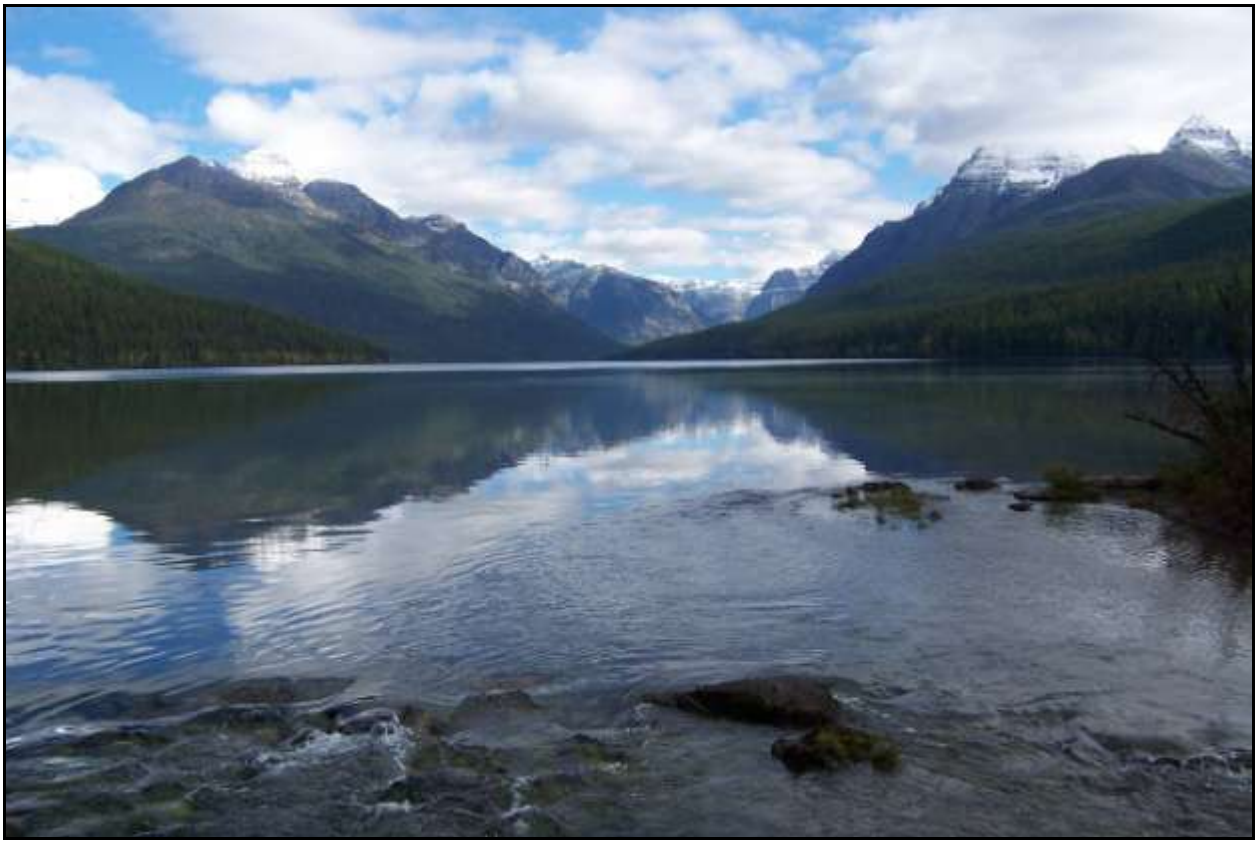

Environmental Assessment

Large-Scale Removal of Lake Trout in Quartz Lake
Glacier National Park • Montana

Summary

Since Glacier National Park was designated a National Park in 1910, native fish populations have been negatively impacted by non-native fish species. Many of the early impacts were the result of stocking non-native fish. Non-native fish such as Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) and rainbow trout (*O. mykiss*) were introduced into lakes and streams with native fish species such as westslope cutthroat trout (*O. c. lewisi*)). Native fish hybridized with non-native fish species, and in many cases, the native species were lost from portions of their range within the park as a result of both hybridization and competition with nonnative fish. In more recent years native fish in the park have been significantly impacted by the invasion of non-native lake trout (*Salvelinus namaycush*) that have expanded within the Flathead River and lake system. Lake trout were originally introduced into Flathead Lake in 1905 (Deleray et al. 1999) and have migrated upstream into the lakes of Glacier National Park. Reproducing populations of lake trout subsequently became established in the majority of the accessible large lakes on the west side of the park. Research and monitoring have shown that the invasion of non-native lake trout into the lakes and streams west of the Continental Divide are having a major adverse impact on populations of federally-threatened bull trout (S. confluentus) (Fredenberg 2002) are likely adversely impacting the native westslope cutthroat trout, a Species of Concern in Montana.

Until recently, Quartz Lake, located within the park in the North Fork of the Flathead River drainage, was the largest natural lake containing bull trout within the Columbia River basin with an intact native fish species assemblage not compromised by non-native species. In 2004 the park, with the assistance of the U.S. Fish and Wildlife Service, began construction of a fish barrier on Quartz Creek between Middle and Lower Quartz lakes to prevent the migration of non-native fish species into the Quartz Lake drainage. However, before it was completed, lake trout were discovered in Quartz Lake and the barrier project was halted. This project proposes to make improvements to the existing fish passage barrier structure to prevent/impede colonization of the lake by other non-native fish species (i.e. rainbow and brook trout), and reduce or eliminate continued movement of lake trout into Quartz Lake from Lower Quartz Lake, and the North Fork of the Flathead River. However, the primary focus of the project is to evaluate lake trout status and spawning habitat use in the system in order to evaluate, develop, and implement effective lake trout suppression actions.

This environmental assessment (EA) evaluates two alternatives. Under the no action alternative the park would not implement any suppression actions to control lake trout in Quartz Lake and risk extirpation of bull and westslope cutthroat trout from the lake system. The preferred alternative intends to reduce or eliminate competitive/predation interactions between lake trout and bull trout. The demographics of the lake trout population and the location of their spawning areas would be determined by acoustic telemetry and netting. The information obtained from netting would then be used to target and remove individual lake trout from the Quartz Lake system. The project would evaluate lake trout abundance and spawning habitat use

in the system to implement suppression actions, and develop experimental suppression techniques. Additionally it would improve the fish passage barrier constructed in 2004 at the outlet of Middle Quartz Lake to reduce non-native fish movement into the system.

Resource specialists evaluated the following impact topics: fisheries; recommended wilderness; terrestrial wildlife; threatened, endangered, and species of concern; water resources; natural sound; and visitor use and experience.

This environmental assessment (EA) has been prepared in compliance with the National Environmental Policy Act (NEPA) to provide the decision-making framework. It 1) analyzes a reasonable range of alternatives to meet the purpose and need of the proposal, 2) evaluates potential issues and impacts to resources and values, and 3) identifies mitigation measures to lessen the degree or extent of these impacts.

The No Action Alternative would have major, short term and long term adverse site specific impact on the fisheries, aquatic life, bull trout and other fish species of concern due to the eventual loss of the native fish populations. There would be moderate, adverse local and regional and long term impacts on recommended wilderness due to the loss of historic fishing opportunities. Impacts on wildlife would be minor to moderate long term, adverse and site specific due to the loss of a food source for terrestrial and avian predators. Impacts to the gray wolf and grizzly bear would be negligible and under Section 7 "no effect." Impacts to the Common loon and the bald eagle would be minor to moderate, long term adverse and regional because of the loss of a food source. There would be no effect on natural sounds and impacts on visitors and visitor experience would be negligible to moderate, long term and adverse due to the loss of fishing opportunities in a backcountry lake.

The Preferred Alternative would have moderate, localized, short term, adverse impacts on fisheries, aquatics and threatened species and species of concern because of by catch potential, but moderate, long term, beneficial regional impacts by maintaining a native fishery. Impacts on recommended wilderness would be minor to moderate, short term and long term adverse and beneficial, localized and regional from the use of a motorized boat in the recommended wilderness. However the benefits of maintaining the native fishery would persist for the long term and maintain wilderness values. Impacts on wildlife species would be negligible to minor, localized, short and long term and adverse during the operation and use of a boat during a time when visitation is usually low. Impacts would be beneficial localized and long term by maintaining a native fishery. Impacts to gray wolves and grizzly bears would be negligible to minor, adverse and long term because project activity would take place during a time when these species are preparing for the winter. Impacts to common loons and bald eagles would be negligible to minor, adverse and beneficial, regional and short and long term because their food source (shallow dwelling fish) would be maintained. Natural sound would experience minor to moderate short and long term adverse localized impact around the lake from the operation. Impacts to visitor use and experience would be minor to moderate, short term localized and adverse during the netting operation. However upon completion impacts would be beneficial and long term from preserving the native fishery.

Public Comment

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

TABLE OF CONTENTS

Figures and Tables

PURPOSE AND NEED

Introduction

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

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

The purpose of 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 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, American Indians, early explorers, railroad development, and modern use and visitation) 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.

After 14,000 years of dominance, Glacier National Park's greatest native aquatic predator is at high risk of extirpation in the majority of lakes along the western slopes of the Continental Divide within GNP. The decline of bull trout in GNP is directly attributed to the invasion and establishment of nonnative lake trout, which consistently displace bull trout in systems where they have been introduced (Donald and Alger 1993, Fredenberg 2002). Glacier's ecologically unique bull trout populations will continue to decline and the remaining vulnerable populations will likely eventually be extirpated if no action is taken.

Background

Glacier National Park (GNP) is a cherished natural and cultural legacy to the American people as well as to people from around the world. The park provides rare glimpses of the natural world and contains superb examples of pristine natural resources and significant cultural resources. Rated the most threatened national park and natural area in the 1980 State of the Parks Report to Congress, GNP strives to protect its native wildlife and provide critical habitat, including pristine waterways for native fishes. In a twenty-year follow-up assessment, Sax and Keiter (2006) found the major threats identified in the 1980 study were lessened, especially on the adjoining National Forests and on private lands on the east side, as the thinking and local management of the park and adjacent lands has begun to encompass a regional scale of ecosystem integrity to protect wildlife and habitat.

The native fish assemblage west of the Continental Divide in GNP has become severely compromised, primarily due to invasion and establishment of nonnative fish populations (Marnell 1988, Fredenberg 2002). Quartz Lake was considered to be among the best natural bull trout (classified as threatened under the Endangered Species Act (ESA) in June 1998) lakes remaining in their range prior to the 2005 discovery of invasive lake trout. Even with the detection of lake trout, Quartz Lake currently supports 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. We do not have abundance data for lake trout in Quartz Lake, and only a few have been captured to date using gill nets and fishing gear. 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 suggests an increasing population. Other native salmonids present on the west side of the park are westslope cutthroat trout, a Montana state species of special concern, mountain whitefish (*Prosopium williamsoni*), and pygmy whitefish (*P. coulteri*).

In 2007 an analysis was completed by the USFWS and USGS as a cooperative fisheries research project to formulate an action plan to conserve bull trout in Glacier National Park. The *Action Plan to Conserve Bull Trout in Glacier National Park* (Fredenberg et al. 2007) examined bull trout resources on the west side of the park. The authors evaluated the status, threats, and security of each of the known bull trout populations (there are currently 17 lakes on the west side supporting bull trout), and placed each lake into a management priority matrix. Quartz Lake was one of only two lake trout compromised lakes that were assigned a "high" management priority, meaning the highest importance should be placed on maintaining and protecting this population.

Purpose and Need

Glacier National Park needs to implement an aggressive plan to protect a remaining intact bull trout population from what appears to be a recent invasion of lake trout in the upper Quartz Lake system (Middle Quartz, Quartz and Cerulean lakes). The 1916 Organic Act that established the National Park Service, the park's enabling legislation, the 1978 Redwood Act, and current NPS Management Policies (NPS 2006) all in one form or another direct the National Park Service to conserve and manage native populations of plants and animals within the parks in an unimpaired state for the enjoyment of future generations. The presence of invasive lake trout in waters on the west side of GNP clearly threatens the parks ability to accomplish this objective. The specific purpose of this project would be to reduce or eliminate negative inter-specific interactions between lake trout and bull trout (and other native fish species), which generally lead to bull trout population loss over time. Successful implementation would also help in

preventing the spread of lake trout into Cerulean Lake, located upstream. Lake trout have not been detected in Cerulean to date, but access from Quartz Lake appears possible.

GNP possesses some of the best physical habitat remaining for bull trout and other native fish species remaining in the Intermountain West. Based on the condition of the physical habitat and its management as wilderness, native fish populations should be relatively secure in GNP. This is not necessarily the case. Invading non-native fish (e.g. lake trout and rainbow trout) threaten native populations of bull and westslope cutthroat trout to the point where populations are being lost, or genetically altered through hybridization. Of the 17 known bull trout lakes within the park west of the Continental Divide, only five lakes appear to be secure from non-native fish invasion due to their isolation above natural waterfalls. It is reasonably foreseeable that given enough time (i.e. several decades or less), the other 12 lakes not secure from invasion by non-native fish (10 of these 12 have already been invaded by lake trout) could see their bull trout populations severely compromised or lost altogether and replaced by lake trout. This is already evident in the majority of the lakes where long term fish population data exists. Fredenberg (2002) documented the replacement of bull trout by lake trout in four of the five Glacier National Park lakes where long term fish population data exist over the remarkably short period of about 30 years. The fifth lake in the study was Quartz Lake, 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. Currently, security from invasion in the form of physical barriers is the only strategy that provides a reasonable degree of protection for native fish on the west side of the park.

Quartz Lake was the largest lake on the west side of the park not compromised by lake trout, until their discovery in 2005. The remaining seven lakes that are not known to have been compromised by lake trout on the west side of the park are all relatively small (all less than 470 acres with five of the seven being less than 60 acres), and are more vulnerable to future disturbance/impacts than would larger lake populations. Quartz Lake currently supports strong native westslope cutthroat and bull trout populations. Loss of these native fish populations would be a severe blow to Glacier's native fish resources. This project is needed to attempt to eradicate lake trout from Quartz Lake, or manage them through regular or periodic netting removal efforts to levels sufficiently low to prevent native fish declines.

Successful suppression or long term removal of lake trout may require annual or semi-annual netting efforts to keep the lake trout population suppressed to the point where the bull trout population is able to survive.

The Montana Bull Trout Scientific Group (1995) suggested five situations where removal and suppression of non-native species should be a priority:

1) Where a recent invasion of a non-native species has occurred.
2) Where action is necessary to protect core areas supporting the strongest remaining bull trout populations.
3) Where a bull trout population is in immediate danger of extinction.
4) Where preservation of native species is a priority.
5) Where innovative experimental projects will further the knowledge of how this tool might be most effective.

Consideration of each of the five situations outlined above as they pertain specifically to Quartz Lake, lends clear support to the actions proposed by GNP under Alternative B, the preferred alternative.

The project is needed to meet the following objectives:

- Preserve the native fish assemblage in Quartz Lake (including bull and westslope cutthroat trout)
- Determine the population dynamics and status of lake trout in Quartz Lake
- Identify spawning locations of lake trout
- Determine the most efficient technique(s) to lethally remove lake trout
- Prevent the spread of an invasive species (lake trout)

Relationship to Other Plans and Policies

The proposed action is consistent with the objectives of Glacier National Park's *General Management Plan* (NPS 1999). The project is proposed within the backcountry zone of the North Fork geographic area. According to the *General Management Plan* (GMP) the backcountry zone "would be managed to maintain natural processes". The proposed action would promote the maintenance of native fish populations within the drainage and, consequently, is in conformance with the *GMP* for Glacier National Park. National Park Service 2006 *Management Policies* (4.4.4 Management of Exotic Species) require national parks to prevent the displacement of native species by exotic [non-native] species. Under Executive Order 13112 a federal agency is "not authorized to fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions." The Executive Order also requires federal agencies to develop management plans to identify invasive species and develop a plan that would prevent the introduction and reduce the risk of spread of identified species. Lake trout are an aquatic invasive species that threaten native fish populations within Glacier National Park.

Appropriate Use

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

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

- consistency with applicable laws, executive orders, regulations, and policies;
- consistency with existing plans for public use and resource management;
- actual and potential effects on park resources and values;

- total costs to the service; and
- whether the public interest will be served.

Park managers must continually monitor all park uses to prevent unanticipated and unacceptable impacts. If unanticipated and unacceptable impacts emerge, the park manager must engage in a thoughtful, deliberate process to further manage or constrain the use, or discontinue it. More information on the definition of unacceptable impacts as cited in §1.4.7.1 of *Management Policies* (NPS 2006) can be found in the Environmental Consequences chapter.

The park reviewed alternatives to preserve native species by preventing the spread of an invasive species while not creating unacceptable impacts to natural and historic resources and park values. In addition, the park performed a Minimum Requirements/Minimum Tool Analysis and preliminarily concluded a single motorized boat was the minimum "tool" needed to safely and effectively accomplish the project objectives. (Appendix A). The proposed action is consistent with the park's general management plan and other related park plans. With this in mind, the NPS finds that an aggressive plan to protect bull trout by use of a motorized boat on a lake within recommended wilderness is an appropriate use at Glacier National Park.

Public Scoping

Scoping is a process to identify the resources that may be affected by a project proposal, and to explore possible alternative ways of achieving the proposal while minimizing adverse impacts. Glacier National Park conducted both internal scoping with appropriate NPS staff and external scoping with the public and interested/affected groups and agencies.

Public scoping was conducted from March 4, 2009 until April 6, 2009. Brochures were sent to the park's mailing list for EAs, and various federal, state, and local agencies, including the USFWS and the Blackfeet and Confederated Salish and Kootenai Indian Tribes. A press release was issued on March 6, 2009 announcing scoping.

In accordance with 36 CFR800.8, Glacier National Park also notified the Montanan State Historic Preservation Office (SHPO), the Confederated Salish and Kootenai Tribes and the Blackfeet Business Council of the project. The Blackfeet Tribal Historic Preservation Office responded applauding the park for this project proposal. They also reminded the park that they should be immediately contacted in the event of discovery of any traditional cultural properties, sites or artifacts.

Twenty five letters were received during the scoping period for this EA. Of these, 7 were from organizations and special interest groups and 18 were from individuals. All of the comments supported the proposal to remove lake trout from Quartz Lake and about ½ of them urged the park to take an aggressive approach. Most of the comments supported the use of a motor boat to conduct the operation, despite the impacts on wilderness and visitor experience. However a number of commenters raised concerns about the method and urged the park to carefully consider the impacts versus the anticipated results of this effort. More specific comments and concerns are described below.

Questions were raised by a few commenters about the status of the existing fish barrier on Quartz Creek. This is addressed under the Preferred Alternative.

Questions were raised about the long term strategy and how success would be evaluated, how a boat would be transported to the lake and how many helicopter trips would be required. Concerns were raised about the length of the netting operation each season and a few others raised concerns about whether the project would last longer than 4 years and what were the plans for long term monitoring. A few commenters asked how the fish would be disposed of. A question was raised whether 4 years was necessary to determine the status and effective control techniques. A suggestion was made that a monitoring program should be implemented to mitigate potential fuel spills, whether the boat would be left on the lake when not in use and how the park would keep it secure. These concerns and questions are addressed under the Purpose and Need section and under the description of the Preferred Alternative.

Specific questions and comments were raised about potential impacts including concerns about impacts to wildlife and nesting and rearing birds such as common loons, other waterfowl and eagles. A concern was raised about the operation attracting wildlife as well as the anticipated level of mortality for bull trout. A couple of commenters suggested using the checklist developed by the Montana Bull Trout Scientific Group. This has been referred to in the Purpose and Need section. One commenter stated that they did not want to see helicopters used to transport equipment. A number of commenters expressed concern about effects to wilderness and questioned what the chances were for success, and if successful what was the likelihood of lake trout becoming reestablished. Concerns were raised about fuel spills in the recommended wilderness. These comments are addressed in the Environmental Consequences section of the EA and under the description of the Preferred Alternative.

Suggestions were made for mitigation which included providing signing on all the trails leading to the lake advising everyone of the study underway. Suggestions were also made that the park seek funding from the Stimulus Bill. One individual was cautiously supportive but suggested that there be no area closures, no additional restrictions on fishing or camping in undesignated locations such as at the head of Cerulean. He stated that researcher needs should not result in exclusion of the public. There should be no restrictions on angling and no reduction in the number of camp sites at Quartz. Fires should be permitted again at the Campground. One commenter noted that bull trout should be preserved not just because it is endangered but because it provides an historic angling opportunity. These are all addressed under the Preferred Alternative and in the mitigation section, except for the comment about permitting fires. Fires are currently not permitted at Quartz Lake, but are permitted at Lower Quartz. The availability of dead and downed wood is evaluated annually and the use of campfires can change. At this time, due to lack of dead and downed wood, no campfires will be permitted at Quartz Lake.

A few suggestions were received describing other alternatives and methods to consider. One commenter suggested that inflatable zodiac boats be considered. A few commenters raised questions about type of motor and size in a wilderness setting and potential impacts and suggested that sailboats and electric motors should be evaluated. One commenter asked that one alternative employ adaptive management techniques and attempt this study on a more accessible lake first. They suggested Kintla, McDonald and Bowman lakes. They also said if Quartz drainage remains the preferred, the agency needed to make enough of an investment in time and money to eradicate lake trout. Poison was suggested by a couple of commenters. All of these suggestions were considered but dismissed from further analysis.

The Blackfeet Tribes Tribal Historic Preservation Office wrote that they supported the removal of lake trout using a motorized boat.

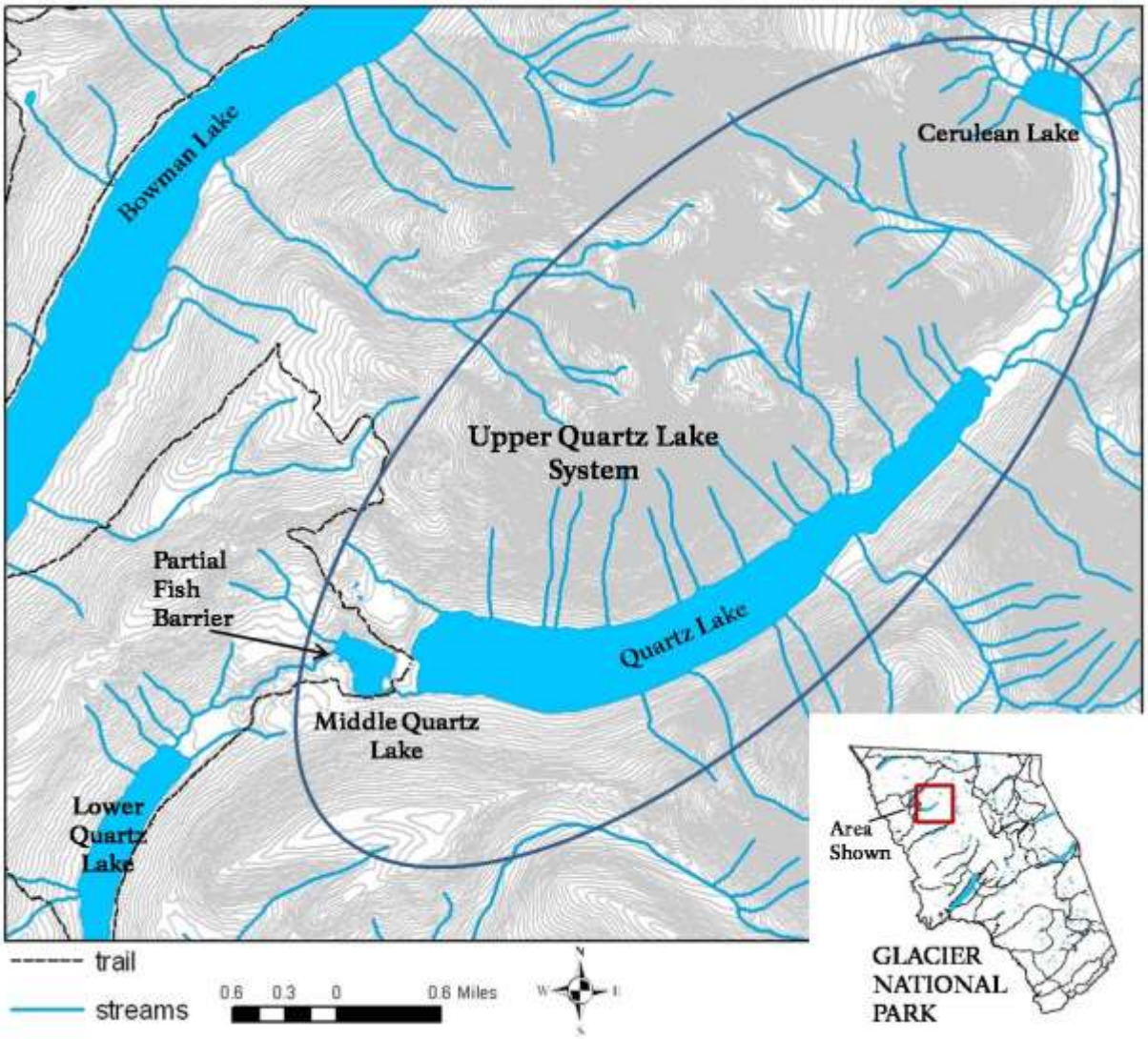

Figure 1. Location of proposed activities.

Impact Topics Retained for Further Analysis

Impact topics for this project have been identified on the basis of federal laws, regulations, and orders; 2006 *Management Policies*; and National Park Service knowledge of resources at Glacier National Park. Impact topics that are carried forward for further analysis in this environmental assessment are listed below along with the reasons why the impact topic is further analyzed.

Fisheries

In accordance with the 2006 *Management Policies,* the park is responsible for the reestablishment of natural functions and processes resulting from human disturbances; which includes removal of an introduced exotic species (NPS 2006). Native fish communities, including bull and westslope cutthroat trout populations in Quartz Lake, are being compromised by the expansion of lake trout within the Flathead Lake/River Basin. Quartz Lake has the most viable and least impacted bull trout population remaining (among the larger lakes) in GNP (Fredenberg et al. 2007). In order to maintain native fish populations, lake trout would need to be eradicated or successfully suppressed; therefore fisheries has been retained for further analysis.

Recommended Wilderness

The 1964 Wilderness Act (16 USC 1131 *et seq.*) provides for protection of wilderness for future generations. Most of the backcountry zone of GNP is recommended wilderness; it is managed as designated wilderness in accordance with NPS policy (NPS 1999). Management of natural resources in the backcountry zone focuses on protection and restoration of resources and natural processes (NPS 2006). Ordinarily, recommended wilderness would be exempt from motorized activity but the park also has commitment to protecting the threatened (federally listed) bull trout, therefore temporary use of motorized activity is being proposed. Because the project would involve activities within recommended wilderness, including two helicopter flights to bring in the boat and motor and motorboat use and storage, impacts on wilderness are analyzed.

Wildlife

According to the 2006 *Management Policies*, the NPS strives to maintain all components and processes of naturally evolving park unit ecosystems, including the natural abundance, diversity, and ecological integrity of animals (NPS 2006). A search of the park's wildlife sighting database reveals records in the Quartz Creek drainage for a large variety of wildlife species including: waterbirds (e.g., western grebe, cinnamon teal, American wigeon, wood duck, American avocet, common loon), raptors (e.g., red-tailed hawk, great horned owl, barred owl), non-migratory residents (hairy woodpecker, three-toed woodpecker, common raven, boreal chickadee), migrant songbirds (e.g., western wood peewee, Swainson's thrush, Townsend's warbler, western tanager), and several mammals (e.g., mountain lion, badger, river otter, black and grizzly bear, beaver, moose, elk). Activities proposed would temporarily increase human presence and noise in the Quartz Lake area; therefore affects on terrestrial wildlife are analyzed.

Threatened and Endangered Species and Species of Concern

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

Federally Listed Species

Grizzly Bear (*Ursus arctos horribilis*) – Federally Threatened. Glacier National Park was placed into grizzly bear management "situations" in accordance with the *Grizzly Bear Recovery Plan* (USFWS 1993). Over 1 million acres of the park (recommended wilderness) are established as Management Situation 1, in which management decisions would favor the needs of the grizzly bear when grizzly habitat and other land-use values compete, and grizzly-human conflicts would be resolved in favor of grizzlies, unless a bear is determined to be a nuisance. The remainder of the park, which is developed front-country, is established as Management Situation 3, in which grizzly habitat maintenance and improvement are not the highest management considerations, grizzly bear presence would be actively discouraged, and any grizzly involved in a grizzly-human conflict would be controlled. The proposed project would increase human activity during den construction period for grizzly bears and possibly emergence. Therefore impacts on grizzly bears are analyzed.

Gray Wolf (*Canis lupus*.) Gray wolves, a federally listed endangered species (as of July 28, 2008; status pending litigation), inhabit the area around Quartz Lake. Prey species are abundant and the quality of habitat is suitable in the Quartz Lake drainage. Wolves tend to avoid humans and areas of high use (Mech 1989). The actions proposed in this environmental assessment might temporarily impact the gray wolf behavior in this area of the park; therefore impacts to gray wolves are analyzed.

Bull Trout (*Salvelinus confluentus*). Bull trout is listed as a threatened species under the Endangered Species Act and is also a "Species of Special Concern" in Montana. Quartz Lake currently has the most viable and least impacted bull trout population remaining among the larger lakes in the park. Bull trout survival is threatened by increases in the lake trout population in Quartz Lake. Therefore impacts to bull trout are analyzed.

Species of Concern

Westslope cutthroat trout are present in Quartz Lake. The removal and eradication of lake trout proposed in this project would also beneficially impact the westslope cutthroat trout population. Therefore, impacts to westslope cutthroat trout are analyzed.

Bald Eagles. The bald eagle (*Haliaeetus leucocephalus*) nests along the shores of Quartz Lake and nearby Bowman Lake. The proposed project would not take place during any critical periods (nest building, egg laying/incubation, hatching/rearing young, fledging young) but the project could discourage eagles from returning to the nest sites due to elevated human activity, thus potential impacts on bald eagles are analyzed.

Common loons (*Gavia immer*) occur from spring through fall, but rarely during winter, on large and small lakes throughout the park. A high proportion of Montanan's nesting pairs are found in the park, making it especially important to the viability of the state's loon population. The highest productivity occurs among breeding pairs in the North Fork of the Flathead River Valley. Parkwide productivity appears to have declined since the 1980s (NPS files). Historic information on common loon distribution and productivity is limited. Common loons have been observed at Quartz Lake. Actions propose might conflict with critical migration or egg laying periods; therefore common loons would be included in the analysis of for species of concern

Natural Soundscapes

In accordance with 2006 *Management Policies* (NPS 2006) and Director's Order 47 *Sound Preservation and Noise Management*, an important component of the National Park Service's mission is the preservation of natural soundscapes associated with national park units. Natural soundscapes exist in the absence of human-caused sound. The natural ambient soundscape is the aggregate of all the natural sounds that occur in park units, together with the physical capacity for transmitting natural sounds. The frequencies, magnitudes, and durations of human-caused sound considered acceptable varies among National Park Service units as well as potentially throughout each park unit, being generally greater in developed areas and less in undeveloped areas.

Actions proposed would introduce noise created by human presence and use of a motorized boat on a lake where normally motors are not permitted. The effect on natural soundscapes is expected to continue for four years and would last a good portion of the day during netting; therefore impacts to natural soundscapes are analyzed.

Visitor Use and Experience

Visitors seeking the natural quiet of the wilderness and removal from human-caused disturbance would be impacted by the presence of field crews and a motorized boat during implementation of the proposed project. The use of the motorized boat would not occur every day, all day long throughout the season; however, if a visitor chose to recreate during the proposed netting operation, impacts would be readily apparent and visitors would be aware of the changes during the use of the motorized boat. Therefore, impacts to visitor use and experience are analyzed.

Impact Topics Eliminated from Detailed Study

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

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

Soils

The NPS preserves the soil resources of parks and protects those resources by preventing unnatural erosion, physical removal, or contamination (NPS 2006). Soil disturbance would not occur during implementation of all alternatives; therefore, impacts to soil resources are not analyzed in this EA.

Vegetation

The NPS strives to maintain all components and processes of naturally evolving park unit ecosystems, including the natural abundance, diversity, and ecological integrity of plants (NPS 2006). Vegetation disturbance would not occur; therefore, impacts to vegetation resources are not analyzed in this EA.

Aquatic Species (non-fish)

The NPS strives to maintain all components and processes of naturally evolving park unit ecosystems, including the natural abundance, diversity, and ecological integrity of aquatic species (NPS 2006). Knowledge of other aquatic species in the park is limited, including the Quartz Lake area; however, actions propose are not expected to change the habitat to any level that would impact aquatic species beyond negligible.

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.

Authors of a comprehensive water monitoring program conducted in Glacier National Park noted that "the lakes selected for study clearly reflect the pristine attributes that stimulated the creation of Glacier National Park and its designation as a Biosphere Reserve" (Ellis et al. 1992).

The proposed project would include the use of a 4 stroke gasoline powered motorboat on Quartz Lake. Use of this size motor boat would not affect water quality. Due to differences in technology, carbureted 2-stoke motors produce significantly 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 two-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 to the water than do 4-stroke motors (California Air Resources Board 2001). Therefore we selected a 4-stroke outboard motor for this study.

Quartz Lake covers approximately 869 acres and has a maximum depth of 273 feet. The lake basin contains a large volume of water sufficient to dilute these emissions to levels that would not measurably adversely impact aquatic resources. In addition, spring flow rates through Quartz Lake, estimated as the bankfull stream discharge out of Middle Quartz Lake, is 700 cubic-feet-per-second (River Design Group 2009). Flow rates are considerably lower in the summer and fall, but the spring exchange rate demonstrates that sufficient water exchange occurs to remove pollutants released from the boat motor into the water over time. Under the preferred alternative, negligible to minor, short term, site specific adverse, impacts could occur to water quality.

The park anticipates using approximately 100 gallons of fuel each year in the study. The boat would be used for approximately four days per week and a total of 10 weeks/year at Quartz Lake. By using the engine efficiencies (99%) used in the Tahoe Regional Planning Agency Environmental Assessment (1998) for 4 stroke outboard motors, up to an estimated one gallon of un-burnt fuel in the form of engine emissions could be released into the environment over approximately 40 days of work on the lake each year. For comparison to other marine outboard technology currently in use the Tahoe Regional Planning Agency Environmental Assessment (1998) utilized an emissions factor 10 times higher for carbureted two-stroke technology than four-stroke technology in its evaluation of the pollution potential of outboards on Lake Tahoe, and subsequently banned the use of the carbureted two-stroke outboard engines on the lake.

GNP does not have a restriction on the use of carbureted 2-stroke boat motors in park waters, and although survey data are not available, they almost certainly are in use where boats with motors are allowed on the west side of GNP (i.e. Bowman and McDonald lakes). Cumulative impacts evaluation would involve the combined releases of pollutants from boat motors in use on Bowman and McDonald lakes and subsequent transport to downstream areas both within and outside of the park. Bowman Lake, located immediately north of Quartz Lake, is a remote lake but is accessible to smaller motor boats with trailers via a gravel road. Any pollutants from Bowman Lake boating would ultimately combine with releases of pollutants from the Quartz Lake project, in 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 pollutants released on Quartz Lake from our single 50 hp 4-stroke outboard motor used only seasonally, would be so small as to not have any measurable cumulative impact on North Fork Flathead River or ultimately mainstem Flathead River water quality.

There is a chance that some chemical contamination of the lake from gasoline or motor oil could occur in the event of mechanical failure or spill during operation of the boat (see Appendix A). The risk of mechanical failure or spill would be low based on past experience, but is not discountable. To mitigate this risk, the crew would inspect the engine, 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 impacts to water resources would be no more than minor, and the topic was dismissed from further analysis.

Cultural Resources

Historic Structures

The project is located in an undeveloped area of the park. The National Register of Historic Places listed Quartz Lake Patrol Cabin which is located on the south shore of Quartz lake. The preferred alternative would involve the use of a motorboat on the lake. The boat would be stored near the cabin. It is anticipated that a boat house could be required to protect the boat over the winter. If required, a site for the boat house would be selected that would have the least visual effect on the cabin as possible. (Some of the park's patrol cabins have associated historic boathouses, i.e. Lower Logging Lake and Kintla.) If it cannot be sited so it is not visible, the boathouse would be designed to be compatible with the architectural characteristics of the cabin using the Secretary of the Interior's Standards for the Treatment of Historic Properties,

and thus have a minor, adverse, localized, and long term impact on cultural resources. For compliance with Section 106, the park would consult with the Montana State Historic Preservation Officer with the anticipation of reaching a finding of "no adverse effect." Since impacts to historic structures are minor or less, the topic of historic structures has been dismissed from further analysis.

Air Quality/Climate Change

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

Scientific research is continually supporting the conclusion that increases in global temperatures are being accelerated by human-caused greenhouse gas emissions; this is generally referred to as global climate change. Global climate change will impact several factions of human health and the environment. Impacts of rising average temperatures are already visible in such changes as shrinking glaciers, unpredictable weather patterns, thawing of permafrost, and longer growing seasons. Temperatures are predicted to continue to rise as humans continue to emit gases such as carbon dioxide, methane, nitrous oxide, and other greenhouse gases into the atmosphere.

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 IPCC estimates that for increases in global mean temperature of less than 1-3°C (1.8-5.4°F) above 1990 levels, some places and sectors will see beneficial impacts while others will experience harmful ones. Some low-latitude and polar regions are expected to experience net costs even for small increases in temperature. For increases in temperature greater than 2-3°C (3.6-5.4°F), the IPCC says it is very likely that all regions will experience either declines in net benefits or increases in net costs. "Taken as a whole," the IPCC concludes, "the range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time."

Global air and water temperatures continue to rise increasing the risk and severity of wildfire; changing the timing and water content of snowpack; increasing the chance of flooding from rain-on-snow events; and promoting glacial recession; all of which contribute to creating habitat conditions that are more favorable to invasive species. The effects of climate change on bull trout are being explored by scientist from multiple agencies. Since adequate supply of very cold and clean water is critical for to maintain high quality bull trout and westslope cutthroat trout habitat, they would continue to be threatened by the effects of a warming climate aside from impacts associated with the no action alternative. 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 significantly impact a lake trout population than a stream spawning/rearing bull or westslope cutthroat trout population.

As 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 temperature in GNP has increased 1.6°C during the past century, three times the global mean

increase (Fagre 2005). A key component for survival, of any species, is the amount of suitable habitat available has to be compatible with the population size. Glacier National Park is part of the Northern Rockies Ecosystem, the Crown of the Continent Ecosystem, and the Northern Continental Divide Ecosystem. These ecosystems have been identified as important to the survival of fish, wildlife, and plants and guarded to control land fragmentation, loss of habitat, and the introduction of exotic species. 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 stream/valley reach's, or may make it easier for non-native fish species to colonize and compete in warmer park waters.

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). However, in the near term, higher elevation lakes such as Quartz Lake are likely continue to provide high quality bull trout habitat relative to water temperature, 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. As glaciers shrink within GNP, 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 bull trout spawning and rearing habitats. 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 and quantity, and glacier and snowmelt. This project intends to reduce the population size lake trout in order to reduce competition and predation. This is one strategy to mitigate the adverse impacts of global climate change on bull trout by reducing the number of stressors on these populations.

The preferred alternative would not have a detectable impact on global climate change. In general, burning a gallon of gas produces 19.564 pounds of carbon dioxide. Estimated emissions from the boat would equate to 1,956 pounds of carbon dioxide per year. Therefore climate change has been dismissed from further analysis.

Threatened and Endangered Species and Species of Concern: Canada Lynx, wolverine, fisher, Spalding's catchfly, water howellia, Ruffed grouse, calliope hummingbird, olive-sided flycatcher and pileated woodpecker:
The NPS protects and attempts to recover all native species that are listed under the Endangered Species Act of 1973. Both the Management Policies (2006) and Director's Order 77 (Natural Resources Management Guidelines) require the NPS to examine and minimize the impacts of projects on federal candidate species as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species.

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

Wildlife Species of Concern. These alternatives are not expected to have any impact on the following sensitive species as they have not been documented in the project area or no impacts on these species are anticipated. Both Ruffed grouse (*Bonasa umbellus*) and spruce grouse

(*Falcipennis canadensis*) are not well documented in the project area, though they might occur there in low numbers, and are not likely to be affected by the project because the majority of activity would take place out on the lake and not in their immediate habitat. The calliope hummingbird (*Stellula calliope*) might occur during the summer nesting season in riparian areas near the project, but would be far enough from the project area that there would be no impact on the species. Olive-sided flycatchers (*Contopus cooperi*) has been heard and seen along the Quartz Lake trail, north of Middle Quartz Lake but the proposed project is not expected to interfere with their feeding habits, distribution or migration. Pileated woodpeckers (*Picoides articus*) are fairly common resident of late-seral stages of montane, lower montane, and riparian woodland community groups. Pileated woodpeckers depend on large snags for nesting and roosting. Nesting has been documented in the park but population status and trend are unknown (GNP files). They would not be affected by the project because the majority of activity would take place out on the lake and not in their immediate habitat.

Canada Lynx (*Lynx canadensis*). The Canada lynx is a federally listed threatened species. A preliminary map of lynx habitat in the park defined moist conifer forest above 4,000 feet elevation as the most likely areas supporting lynx (Quartz Lake is at 4,416 feet). Canada lynx habitat is generally described as climax boreal forest with a dense undercover of thickets and windfalls (Ruediger et al. 2000). Lynx often prefer advanced successional stages of forests and dense conifer stands for denning and foraging respectively. Large amounts of woody debris and minimal human disturbance are important to denning sites (Brittell et al. 1989). Though little is known about lynx habitat use in the park and these criteria are general in nature, preliminary mapping of lynx habitat in the park includes the Quartz Lake drainage. Den locations are not known in the park and proposed activities would not coincide with the Canada lynx denning period; therefore Canada lynx are dismissed from further analysis.

Wolverines (*Gulo gulo*) are wide-ranging carnivores that inhabit primarily alpine areas. Although they may travel through the project areas, they are not primary or denning habitats and they probably make only temporary or sporadic use of the area, more likely during winter months. Therefore wolverines are dismissed from further analysis.

Fishers (*Martes pennanti*) are residents of coniferous forests and riparian areas. Breeding in the park is probable, but the population status and trend are unknown. Fishers were probably eliminated from Montana, as there were no trapping records for the state from 1920-1960. In 1950-60, fishers were transplanted from British Columbia to Montana, but population numbers remain low (USFS 1994). Fishers inhabit moist coniferous forests and prefer mature stands with abundant small mammal prey. They generally frequent drainage bottoms, lower slopes, and riparian areas (USFS 1994). Fishers have been documented on both sides of the Continental Divide in the park, including the St. Mary, McDonald, Two Medicine and Many Glacier drainages (NPS files). Fishers are likely to inhabit the forests surrounding Quartz Lake but are unlikely to be impacted by project activities. Therefore fishers are dismissed from further analysis.

Wild and Scenic Rivers

The project would occur on upper Quartz Lake system which eventually flows into the North Fork of the Flathead River, which is designated as a Wild and Scenic River. The North Fork is over 12 stream miles from the project site and would not be affected by any activities at the project site. There would be no short or long-term effects on the North Fork and no change in water quality, riparian areas, floodplain conditions, or any other outstanding, remarkable, or

other significant feature which led to the Wild and Scenic Rivers Act designation. Therefore, Wild and Scenic Rivers was dismissed as an impact topic.

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 (DO) 77-1 Wetlands Protection* strive to prevent the loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In accordance with DO 77-1, the potential adverse impacts of proposed actions must be addressed in a separate Statement of Findings document. There are no known wetlands within the project area that would be affected, therefore impacts to wetlands were not given further detailed analysis and a Statement of Findings was not prepared.

Floodplains

Executive Order 11988 Floodplain Management requires all federal agencies to avoid construction within the 100-year floodplain unless no other practicable alternative exists. The NPS is guided by the *2006 Management Policies* and *Director's Order 77-2 Floodplain Management*, which provides guidance on how to implement *Executive Order 11988*. The service will strive to preserve floodplain values and minimize hazardous floodplain conditions. According to *Director's Order 77-2*, the impacts of proposed actions within the 100-year floodplain must be addressed in a separate Statement of Findings document. The project would not alter the function of the floodplains associated within the project area, therefore this topic was eliminated from further study and a Statement of Findings was not prepared.

Socioeconomic Resources

Socioeconomic resources would not be changed by the preferred alternative therefore; socioeconomic resources would not be affected and are dismissed from further analysis.

Archeological Resources

The first archeological survey of the Quartz Lake Valley was conducted in 1992 after the Red Bench Fire (Connor 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 1997). Based upon these surveys, the probability of impacting archeological sites is unlikely. If the implementation of the preferred alternative results in construction of a boat house, the area would be surveyed by an archeologist prior to ground disturbing activities. If the survey identifies unevaluated archeological artifacts with the Area of Potential Effect, they would be evaluated in consultation with the State and Tribal Historic Preservation Officers in accordance with Section 106. Since impacts to archeological resources are 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). No ethnographic resources have been identified by the Confederated Salish and Kootenai Tribes or the Blackfeet Tribal Business Council in the Quartz Lake area and the Tribal Historic Preservation Officers raised no concerns during scoping for this project. The Confederated Salish and Kootenai Tribal Historic Preservation Department did request that the Tribal Division of Fish and Wildlife be added to the mailing list since the project is within the aboriginal territories of the Salish, Pend d'Oreille, and Kootenai tribes. 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 therefore have been 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. Prime and unique farmlands are not located within GNP (NPS 1999).

Environmental Justice

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

ALTERNATIVES CONSIDERED

During March 2009, an interdisciplinary team of GNP and USGS employees considered the issues and developed project alternatives based on knowledge of the issues and the park resources as well as issues and concerns raised by the public during scoping. Three possible action alternatives were initially identified, however after further analysis only one action alternative and a no action alternative were retained for further analysis. The other alternatives were dismissed from further analysis. A summary table comparing alternative components is presented at the end of this section (see table 1).

Alternative A – No Action Alternative

Under the no action alternative, the NPS would maintain its current management of the Quartz Lake drainage. The fish barrier on Quartz Creek would not be improved to prevent future lake trout or other non-native species migration into the lake. Construction of a fish barrier was initiated in 2004, but never completed because lake trout were subsequently found upstream of the barrier.

Recreational fishing would continue to be the only mechanism used to control the lake trout population in the system. The park's fishing regulations were changed in 2008, allowing 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. This regulation change is largely expected to benefit native fish resources in the park through angler education, 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.

Alternative B – Preferred Alternative

Under Alternative B, netting (gill netting and possibly other experimental netting techniques) and hook-and-line sampling would be used to capture and remove lake trout in Quartz Lake largely from late August through November each year (2009 through 2012). Netting may also occur earlier in the year (May- early July) depending on effectiveness, the amount of acceptable by-catch mortality of non-target fish species, and lake stratification.

U.S. Geological Survey (USGS) and NPS fisheries staff would capture, radio-tagged, and intensively track lake trout as they move around the lake and begin to stage at spawning areas during September and October. Spawning locations and spawning timing would be estimated using the results of the telemetry data. Individual fish locations would be documented using GPS technology. This information would be used to evaluate lake trout suppression options and to target spawning concentrations of adult lake trout for removal using nets. Nets would be deployed on suspected lake trout spawning locations. Experimental "low profile" gill nets would also be used to locate and target juvenile lake trout rearing area. Field crews would use the nets to remove as many lake trout as possible from Quartz Lake. The existing fish passage barrier would be improved to prevent/impede future migration of lake trout and other non-native fish into the Quartz Lake system. In order to implement a barrier design with the best chance of preventing/impeding fish passage, barrier material (e.g. rock, etc.) would be flown to the site. Approximately 10-15 helicopter trips with a long line would be required. The use of off-site material was not analyzed in the 2004 Quartz Creek Fish Barrier EA (NPS 2004).

An adaptive management approach would be employed to tailor netting times to seasons of greatest efficiency for catching and removing lake trout, while minimizing by-catch of non-target native fish species. Personnel involved with the project would continually evaluate locations, timing, and duration of net sets to maximize effectiveness of the netting for capturing lake trout. Similarly, park staff would confer with other ongoing lake trout suppression projects in the greater area to ensure gill nets are set at depths that make them most efficient in capturing lake trout while minimizing capture of non-target fish species. Any tagged lake trout captured alive in the gill nets would be released alive to identify additional spawning locations and improve spawning timing estimates. Biological samples/information would be collected from any captured lake trout including genetics, maturity status, and age and growth structures.

Lake trout have been documented to spawn from mid-October into early-November in the McDonald Lake system (Dux 2005), and it is anticipated a similar pattern exists for the Quartz Lake system. Timing and location of spawning areas is critical to minimizing non-target by-catch during the netting portion of this alternative. Ideally, 30 lake trout would be tagged with individually coded transmitters that would be surgically implanted (Winter 1996). The locations of each tagged fish would be identified through telemetry data and recorded with a global positioning system (GPS). Water depth would be recorded from an on-board depth finder. Tracking would continue through the potential spawning season until mid-November, or as weather permits. Nets would be set to confirm the presence of mature fish as well as used for removal, in areas where spawning aggregates are located. Any lake trout captured that are not used for radio-tagging and tracking would be lethally removed. Fish bladders would be cut to allow the carcasses to sink and deposit in deeper areas of the lake to avoid removing nutrients from an already low-productivity lake system, and also to avoid attracting wildlife.

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, line strength, net length, and net depth are all factors in determining netting effectiveness. Mesh sizes for gill nets would be based on information gained from 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. Other entrapment methods may also be utilized depending on the success of the gill nets and the amount of by-catch.

We would employ the general knowledge and experience gained through lake trout removal netting operations currently underway on Yellowstone, Swan, Priest and Upper Priest lakes, as well as on Lake Pend Oreille. Each of these projects is attempting to reduce the abundance of lake trout to maintain native fish populations, as we propose to attempt on Quartz Lake.

The gill netting portion of this alternative would take place largely during the fall (10-12 weeks during late August through November), when lake trout are congregating for spawning and are more vulnerable to suppression netting (Dux 2005). Gill nets would be deployed on identified spawning and rearing locations to lethally remove large numbers of lake trout. Some netting may also occur in spring and early summer, before the lake stratifies because this has been identified as a time when lake trout are located at shallower depths and may be more vulnerable to suppression netting (Dux 2005).

An approximately 18-foot long motorboat equipped with a 50 horsepower 4-stroke outboard motor with a small (approximately five to six-gallon) external fuel tank would be flown into the site by helicopter and used to conduct the netting operation. Two flights would be required. This size boat is the minimum size that could safely carry the gear and work crew and also serve as a work platform on the lake.

The boat would be securely stored year-round in a structure or otherwise protected from the weather at Quartz Lake. If a structure is required, it would be designed so as not to be visible from the cabin or it would blend in with the cabin so it is compatible. Research staff and other project staff would stay at the Quartz Lake patrol cabin located on Quartz Lake during September through early-November for approximately five days per week while implementing the project. Peak netting activities would take place during early morning hours and at dusk/night to take advantage of fish behavior. Fuel and other supplies would be packed in by stock and stored on-site. Fuel and oil would be stored in spill and bear proof containers near the cabin.

Improvements to the fish barrier would involve expanding the existing gabion barrier with additional rock-filled gabions and installing a cantilevered fish screen/grate or similar structure to prevent/inhibit upstream fish movement. Existing gabions showing signs of deformation could be repaired or replaced at the same time. Based on preliminary assessments, approximately 8-12 additional gabions may be needed to increase the barrier height and uniformity (River Design Group 2009). A rock foundation would be installed downstream of the barrier to minimize jumping pool depths during all flow levels. Rock, for the foundation and gabions, would need to be supplied and flown in from outside the park. Other ways to improve the existing fish barrier include adding log-crib structures and retrofitting the existing barrier with culverts to prevent fish passage during all flow levels.

Success of the project would be measured as to whether the objectives outlined earlier are achieved. Fish populations in Quartz Lake drainage would continue to be monitored over time using established netting programs which would survey Quartz 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 population numbers that could be used to evaluate trends in population strength over time. It is not anticipated that Lake trout would be removed completely from the system, but that their populations would be suppressed enough to allow the bull trout population to thrive. Lake trout would be able to enter the system during extreme high flows, when the barrier would not be effective.

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 in this area. Backcountry permits issued for this area would include information about the project.

Figure 1. Similar type boat for netting operations

Mitigation Measures

The following mitigation measures were developed to minimize the degree and/or severity of adverse effects and would be employed as needed:

Fisheries

- Minimize handling stress and injury to native fish unavoidably captured. Quickly remove and release any captured bull or westslope cutthroat trout that appear alive and healthy.
- Check nets frequently to minimize mortality to non-target fish species.
- Use information gained from other lake trout removal projects to minimize catch and mortality of non-target species.
- Carefully revive, as possible, any injured bull or westslope cutthroat trout captured in nets.
- Incidental taking of the federally threatened bull trout would be documented. Maintain close communication with USFWS regarding acceptable levels of bull trout mortality.
- If bull trout mortality becomes excessive, gill netting would cease.

Wildlife, Threatened, Endangered and Species of Concern

- 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.
- Helicopter use would be timed to minimize impacts on wildlife species.
- 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.
- Measures would be implemented to reduce potential for bear-human conflicts. Personnel would be required to adhere to park regulations concerning food storage and refuse management.
- Regulations would be enforced that prohibit feeding of wildlife and require proper food and garbage storage.
- Pit toilets would be utilized to eliminate human waste as a wildlife attractant.

Water Resources

- A spill plan would be developed and followed in case of a fuel leak either on the ground or in the lake.

Natural Sound

- The motorboat would only be used during netting and hook-and-line operations.
- No-wake speed would be used within 300 yards of the patrol cabin and campground.

Visitor Use and Experience

- Signs would be posted at the trailheads to Quartz Lake and the backcountry permit office informing visitors of the motorized activity on the lake and information about the eradication effort.

Alternatives Considered but Dismissed

An alternative was considered to use a non-motorized or electric powered watercraft to evaluate lake trout population status and remove lake trout from Quartz Lake. This alternative was dismissed due to a lack of sampling efficiency, lack of sampling flexibility, the potential for significantly increased bull trout mortality, and employee safety. Using a non-motorized watercraft would limit the time of day, number of days, and weather conditions that crews could safely conduct the project. Rowing, sailing or using a electric motor on a 18 foot boat under inclement weather conditions would be neither efficient nor safe. Crews would be working until late in the fall and weather conditions could be adverse and change rapidly. It would be necessary for crews to quickly remove nets from the water should serious storms be approaching, or check them under adverse weather conditions. Even on clear days, winds often pick up in the afternoon making non-motorized travel inefficient and even hazardous due to wind and wave action. Using a non-motorized boat to set nets in various locations around the lake and then check them every couple of hours to reduce mortality to bull trout would also be inefficient and unsafe. In addition, they would be required to travel the entire lake regularly to track tagged fish. Rowing/sailing a large boat to conduct telemetry and travel between nets distributed around a lake the size of Quartz Lake at a speed necessary to tend the nets every couple of hours would not be feasible nor effective.

Electric motors are generally intended for use at very slow speeds with very low horsepower. The technology relies on providing power to a small motor (e.g. up to 4 or 5 hp) from a battery bank consisting of multiple heavy, lead-acid batteries. Such motors would not allow travel around the lake at speeds necessary for efficient fish tracking or operation of nets, or the ability to get off the lake rapidly should inclement weather or an emergency occur. In addition, batteries would require daily recharging in a remote wilderness setting with unreliable solar charging capacity (i.e. lots of cloudy days in the fall). Batteries have a finite life, and would require periodic replacement and safe disposal. In addition, water and air temperatures would be dangerously cold, and relying on a hand-propelled or electric watercraft to travel around the lake to conduct telemetry as well as set and pull nets would not be safe. Should an accident occur or someone fall into the water, they would need the ability to quickly return to the patrol cabin to avoid hypothermia. This would not be possible in a 18-foot boat powered with oars, sails or an electric motor, particularly under adverse weather conditions. Therefore this alternative was dismissed from further consideration.

A suggestion was also made to use inflatable zodiac boats that would be easier to bring into the site. This was considered however, working with nets and sharp tools would present a risk to damaging or puncturing an inflatable boat. Therefore this was dismissed from further consideration.

Another suggestion was made to consider using an adaptive management approach that would attempt this project on a more accessible lake first to determine the success. Lakes suggested were Lake McDonald, Kintla and Bowman. This was considered, but dismissed for the following reasons. According to work conducted by Mike Meeuwig (2008), it is very questionable whether Kintla and Lake McDonald have individual self sustaining bull trout populations due to the low abundance of bull trout found and genetic information. Therefore removal of lake trout would not necessarily result in bull trout re-population in those lakes. In regards to Bowman Lake, it appears that bull trout may be already gone based on no redd counts. Bull trout in that lake are either extinct or on the brink of extinction. Compared to these lakes, Quartz Lake is still in good shape in regards to its bull trout population and therefore is a

more pressing management issue because it presents an opportunity to prevent extinction of this population.

Poisoning the lake was another alternative that was raised during scoping. A piscicide such as rotenone, which has been used in other locations outside the park was suggested. Quartz Lake has a maximum depth of 273 feet and covers 869 acres. We estimated a total volume of water in Quartz Lake at approximately 95,000 acre-feet. It would require approximately three gallons of rotenone/acre-foot to achieve an effective concentration (1 ppm) to kill lake trout. This would require approximately 32,000 gallons of rotenone at an estimated cost of approximately $1,900,000. The cost associated with procuring and applying the volume of rotenone, coupled with detoxification costs (as yet undetermined) greatly exceeds current budgetary constraints. This approach would result in significant mortality (100%) to non-target native fish species including bull and westslope cutthroat trout. Given the total lake volume and remote nature of the lake, it would also be logistically difficult to treat Quartz Lake effectively.

In addition, even with an effective barrier at the outlet of Middle Quartz Lake, Quartz Lake is not a closed system. Fish move between Quartz and Cerulean lakes. Therefore it would be difficult to conclude that lake trout were absent from Cerulean lake and therefore, it would also likely be necessary to poison Cerulean Lake to insure success.

Such a treatment project would also require significant improvements to the existing barrier structure at the outlet of Middle Quartz Lake. It would require the construction of a 5 to 6 foot high fish passage barrier (dam) that would span the floodplain and prevent upstream fish passage over all anticipated streamflows (up to perhaps a 50 year flood event). Such a barrier would require significant financial and logistical commitments, beyond those that currently exist for the project. Therefore, poisoning was dismissed from further consideration.

Alternative Summaries

Table 1 summarized the major components of Alternatives A and B, and compares the ability of these alternatives to meet the project objectives (the objectives for this project are identified in the Purpose and need section). As shown in the following table, Alternative B (preferred) meets each of the objectives identified for this project, while Alternative A (no action) does not address any of the objectives

Table 1. Summary of Alternatives and Project Objectives

Objectives	Alternative A - No Action	Alternative B -Preferred
Preserve the native fish species assemblage	No. Lake trout would likely successfully reproduce and expand their population relatively rapidly, as was observed in other park waters. This would eventually overwhelm the native fish community due to predation and competition, and bull trout would likely be lost from the system.	Yes. Spawning locations would be identified in order to remove as many lake trout as possible to reduce competition with, and predation on, native fish such as bull and westslope cutthroat trout.
Determine the population dynamics and status of lake trout in Quartz Lake	No. Angling alone would not provide meaningful information on lake trout status and population dynamics	Yes. Information would be gained that would aid in evaluating the effectiveness of removal efforts on lake trout population status and dynamics.
Identify spawning locations of lake trout	No. At this time, park biologists do not know the location of spawning sites in the Quartz Lake system and angling would not provide this information.	Yes. Approximately 30 individual lake trout would be radio-tagged and tracked to locate spawning areas.
Determine the most efficient technique(s) to lethally remove lake trout	No. This would not be explored in the park and would rely on other agencies for development of control methods that may or may not be appropriate for the park.	Yes. The park would take an adaptive management approach to tailor netting times and approach's to seasons that on-site experience indicates are the most effective periods for catching and removing lake trout, while minimizing by-catch of non-target fish species.
Prevent the spread of an invasive species (lake trout and others)	No. Lake trout would be allowed to expand their population numbers and distribution in the system. Quartz Lake could then become a source for lake trout invasion to other park lakes (e.g. Cerulean Lake) further upstream. Rainbow trout would be free to enter the system from downstream areas as well.	Yes. The fish passage barrier would be improved to prevent/inhibit migration of lake trout and other non-native fish species (i.e. rainbow trout) from the Lower Quartz Lake/Flathead River system into the upper Quartz Lake system. Lake trout would be lethally removed from Quartz Lake during netting operations to suppress/eliminate the population.

Table 2 summarizes the anticipated environmental impacts for alternatives A and B. Only those impact topics that have been carried forward for further analysis are included in this table. Refer to the "Affected Environment and Environmental Consequences" section for a more detailed explanation of these impacts.

Table 2. Summary of Impacts By Alternative

Impact Topic	Alternative A No Action	Alternative B Preferred
Fisheries/Aquatic Threatened Species and Species of Concern	Major, short and long-term, adverse, site specific, local and regional impacts would be expected due to the eventual loss of native fish populations.	Moderate, localized, short-term adverse impacts would occur to bull trout because of by-catch potential. There would only be minor, localized, short-term adverse impacts to other native fish species because nets would generally be set sufficiently deep to reduce by-catch of other native fish species. However, moderate, long-term beneficial regional impacts would be expected to occur 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.
Recommended wilderness	Moderate, adverse, local and regional and long-term, impacts would be expected due to the loss of historic fishing opportunities in the recommended wilderness.	Minor to moderate, short-term and long term, adverse and beneficial, localized to regional impacts would be expected from the use of a motorized boat in the recommended wilderness.. However, the benefits of maintaining a native fishery under this alternative would persist for the long-term and maintain wilderness values.
Wildlife Species	Minor to moderate, long term adverse and site specific impacts due to eventual loss of available biomass of fish for terrestrial and avian predators.	Negligible to minor, localized short-term and long term adverse impacts during netting operations due to the use of a motorized boat in recommended wilderness and the extended presence of personnel during a time when visitation is otherwise low. Impacts would eventually be beneficial, localized and long term by maintaining an intact native fishery.
Threatened and Endangered		
Gray Wolf	Negligible. Under Section 7, No effect	Negligible to minor, adverse local and long term impacts would result from an increase in human activity during a time when visitation is low. Under Section 7, the determination would be "effect, not likely to adversely effect."

Impact Topic	Alternative A No Action	Alternative B Preferred
Grizzly Bear	Negligible. Under Section 7, No effect	Minor, adverse, local and potentially long-term impacts would result because proposed activities would take place when grizzly bears ascend to higher elevations during the den construction period. Under Section 7, the determination would be "effect, not likely to adversely effect."
Species of Concern		
Common Loon	Minor, long-term adverse and regional impacts would occur to common loons because they rely on shallow water dwelling fish for food like bull trout. Lake trout are deep water fish and would eventually outcompete bull trout, thus decrease the availability of food for loons.	Negligible to minor, adverse, and beneficial, regional, short term and long term because shallow water dwelling fish that are native would be preserved. Short term adverse impacts would occur from gill netting activity on the lake.
Bald Eagle	Minor to moderate, long-term adverse and regional impacts would occur to bald eagles because they forage for fish in shallower waters. Lake trout are deep water fish and would eventually out-compete bull trout, thus decrease the availability of food for bald eagles.	Minor, long term adverse, beneficial, regional impacts from preserving shallow dwelling fish for food. Adverse impacts would be short term from gill netting activity on lake.
Natural Sound	No effect	Minor to moderate, short-term and long term, adverse impacts would be localized around the lake during netting operations
Visitor Use and Experience	Negligible to moderate, localized, long-term, adverse impacts due to the degradation of fishing opportunities in a backcountry lake. The moderate threshold would address visitors who would like to fish or have fished Quartz Lake in the past. The negligible threshold would address visitors who do not fish.	Minor to moderate, short-term, localized, adverse impacts to visitors would occur during netting operation for the length of the project. However, upon completion of the project the area would appear no different than before the project began, which would result in long-term, moderate, beneficial impacts to visitor use and experience.

Identification of the Environmentally Preferred Alternative

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which guides the Council on Environmental Quality (CEQ). The CEQ provides direction that the "environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA §101":

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

Alternative A, no action, would not fulfill any of the criteria because over time the native fishery would be lost and replaced by a non native fishery that would affect other species as well. Alternative B is the environmentally preferred alternative because it best addresses five of the six criteria. Alternative B would best address criteria 1-4, as well as criteria 6. Criteria 5 is not directly applicable to this project. Successful implementation of Alternative B will provide for the long-term persistence of a native fish assemblage in Quartz Lake that is a key component in GNP's ecology, and represents the evolutionary legacy of aquatic communities in the ecosystem. Alternative B best meets the NPS trustee role as a steward of GNP's natural resources. Failure to act to attempt to eliminate or suppress lake trout in the Quartz Lake system would likely result in the loss of a significant proportion of GNP's remaining migratory bull trout resources in the Flathead River drainage portion of GNP. Protecting this ecosystem through implementation of Alternative B seeks to maintain the maximum productivity and diversity of the natural system, as well as its role in ecosystem processes. Traditional wilderness experiences and values would be preserved through successful implementation of the project as catching native westslope cutthroat trout, or simply knowing the native fish community in Quartz Lake remains in-tact, is one of the greatest intangible values of this project.

Because Alternative B meets the purpose and need for the project, the project objectives, and is the environmentally preferred alternative, Alternative B is recommended as the National Park Service preferred alternative.

AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES

Methodology

The effects of each alternative are assessed for direct, indirect, and cumulative effects, as well as impairment, on selected impact topics. Direct effects are impacts that are caused by the alternatives at the same time and in the same place as the action. Indirect effects are impacts caused by the alternatives that occur later in time or are farther in distance than the action. Potential impacts are described in terms of type, spatial context, duration, and intensity. General definitions are defined as follows, while more specific impact thresholds are given for each resource at the beginning of each resource section and listed in table 3.

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

Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations, which implement the National Environmental Policy Act of 1969 (42 USC 4321 et seq.), require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and preferred alternatives.

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

Past Actions

- Quartz Creek Fish Barrier Construction
- Belly River Utility Project

On-going Actions

- Unlimited harvest of lake trout on Quartz Lake by recreational anglers
- Administrative Flights
- Trail Maintenance Activities by Park's Trail Crew

- Lake trout removal actions currently underway in Yellowstone, Swan, Priest and Upper Priest lakes, as well as Lake Pend Oreille.

Future Actions

- Fish Management Plan
- Akokala Creek fish barrier
- Periodic assessment of fishery resources on Quartz and Cerulean lakes

Impairment of Park Resources or Values

NPS *Management Policies* require analysis of potential effects to determine whether or not actions would impair park resources or values (NPS 2006). The fundamental purpose of the National Park System, established by the Organic Act and reaffirmed by the General Authorities Act begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values.

Although Congress has given the NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value might constitute impairment, but an impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors and others operating in the park. A determination on impairment is made in the "Conclusion" section for each of the resource topics carried forward in this document.

Unacceptable Impacts

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

Virtually every form of human activity that takes place within a park has some degree of effect on park resources or values, but that does not mean the impact is unacceptable or that a

particular use must be disallowed. Therefore, for the purposes of these policies, unacceptable impacts are impacts that, individually or cumulatively, would

- be inconsistent with a park's purposes or values, or
- impede the attainment of a park's desired future conditions for natural and cultural resources as identified through the park's planning process, or
- create an unsafe or unhealthful environment for visitors or employees, or
- diminish opportunities for current or future generations to enjoy, learn about, or be inspired by park resources or values, or
- unreasonably interfere with
    - park programs or activities, or
    - an appropriate use, or
    - the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park.
    - NPS concessioner or contractor operations or services (NPS 2006).

To determine if unacceptable impact could occur to the resources and values of Glacier National Park, the impacts of proposed actions in this environmental assessment were evaluated based on the above criteria. A determination on unacceptable impacts is made in the "Conclusion" section for each of the physical resource topic.

Table 3. Impacts Thresholds

Impact Topic	Negligible	Minor	Moderate	Major	Duration
Fisheries/Aquatic Threatened, Endangered, and Sensitive Species	Impacts would be no more than negligible to any individuals of a sensitive species or other native species, or their habitat.	Impacts would affect a few individuals of 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 barely perceptible consequences to the species or habitat function.	Impacts would cause measurable effects on: (1) a relatively moderate number of individuals within a sensitive species or other native species population, (2) the existing dynamics between multiple species (e.g., predator-prey, herbivore-forage, vegetation structure-wildlife breeding habitat), or (3) a relatively large habitat area or important habitat attributes. A sensitive species or other native species population or their habitat might deviate from normal levels under existing conditions, but would remain indefinitely viable.	Impacts would have drastic and permanent consequences for a sensitive species or other native species populations, the dynamics between multiple species, or almost all available critical or unique habitats. A sensitive species or other native species population or its habitat would be permanently altered from normal levels under existing conditions, and the population would be at risk of extirpation.	Short-term: – Effects would last for four years (the length of the project). Long-term: - Effects would persist beyond the project period or would be permanent.
Recommended wilderness	Recommended wilderness would not be affected or the effects would not be measurable.	The effect on recommended wilderness would be detectable, but would be slight and localized.	The effects would be readily apparent, and would result in a substantial change to the localized recommended wilderness landscape that would be noticeable to the public.	The effects would be highly apparent and would change the character of the recommended wilderness area.	Short-term: – Effects persist for one year or less Long-term: – Effects persist for more than one year or are permanent

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

Impact Topic	Negligible	Minor	Moderate	Major	Duration
Natural Sound	There would be no introduction of artificial noise into the park.	A short-term introduction of artificial noise would occur at localized sites. The effect would be readily detectable, but would not adversely affect visitors or wildlife.	A widespread introduction of artificial noise would be readily detectable and would adversely affect nearby visitors and wildlife.	A long-term introduction of artificial noise would occur that would adversely affect visitors and wildlife.	Short-term: – Effects extend only through the periods of the netting operations. Long-term: – Effects extend beyond the periods of the netting operations.
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 or one month. Long-term: Occurs for more than one month or is permanent.

Fisheries/Aquatic Threatened Species and Species of Concern

AFFECTED ENVIRONMENT

After 14,000 years of dominance, Glacier National Park's greatest native aquatic predator is at high risk of extirpation in the majority of lakes along the western slopes of the Continental Divide. Bull trout declines across their range are largely attributed to introductions of nonnative species, and habitat degradation and fragmentation (Rieman et al. 1997). The decline of bull trout in GNP is directly attributed to the invasion and establishment of nonnative lake trout populations, which consistently displace bull trout in systems where they have been introduced (Donald and Alger 1993, Fredenberg 2002).

Though the species has declined over much if its range, there is a relative stronghold of bull trout populations. Among the 100 lakes in the contiguous United States with bull trout populations, about 50 of those are in naturally functioning (i.e. undammed) ecosystems, including the upper Flathead River system. Glacier National Park is within this remaining population stronghold for bull trout and supports approximately one-third of the remaining natural habitat supporting the adfluvial life history of bull trout (Fraley and Shepard 1989, Fredenberg 2007).

The proposed project would occur on Quartz Lake which flows into the North Fork of the Flathead River in the headwaters of the Columbia River Basin. The propose project would also impact 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 the two glacially carved lakes, 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, westslope cutthroat trout mountain whitefish *(Prosopium williamsoni)*, longnose sucker *(Catostomus catostomus),* largescale sucker *(Catostomus macrocheilus)*, sculpin *(Cottus sp.)*, and redside shiner *(Richardsonius balteatus)*. The only known nonnative fish species known to be present in Quartz Lake is the 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. The outflow from Cerulean Lake feeds Quartz Lake, where lake trout have recently been detected. Water flows from Quartz Lake into Middle Quartz Lake which is assumed to also have lake trout. Further downstream is Lower Quartz Lake, with well-documented lake trout presence. Between Lower and Middle Quartz lakes, the park initiated construction of a barrier in 2004 to limit the number of lake trout moving between those lakes.

Bull Trout

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 GNP, 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; Schill et al. 1994; 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 between late August and early November (USFWS 1998), but more commonly in September and October in the Flathead Lake system (Block 1953; Fraley and Shepard 1989).

Eggs over-winter in spawning streams until the following spring, when newly hatched fry emerge from the gravel. Age-0 bull trout can often be found in side-channels and along channel margins following emergence (Fraley and Shepard 1989). Adfluvial juvenile bull trout typically migrate out of natal streams between the ages of 1 and 5, and outmigration of juveniles occurs in two pulses in some systems, one in the spring and another in late fall (Downs et al. 2006). Age-0 outmigrants have been reported in some adfluvial populations, but these outmigrants do not appear to survive well to adulthood (Downs et al. 2006).

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

Bull trout 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 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. An adult bull trout spawning population of 260 would be estimated using a ratio of 3.2 adult bull trout per redd in the Quartz Lake system.

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

Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) is 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., in press). They typically spawn at age four or five, from March to July at water temperatures near 10^0C (Shepard et al. 1984). Resident fish complete their life history in tributaries and seldom exceed 300 mm in length. Resident westslope cutthroat males begin mature between the ages of two and four, with females maturing between age three and five (Downs et al. 1997). Downs (1995) reported a maximum age of eight years for 32 isolated headwater populations of westslope cutthroat trout in Montana.

Spawning habitat had been characterized as gravel substrates with particle sizes ranging from 2 to 75 mm, mean depths ranging from 17 to 20 cm, and mean velocities ranging from 0.3 to 0.4 m/s (Shepard et al. 1984). 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, Muhlfeld et al., in press). Both Lower Quartz and Quartz Lakes were stocked with cutthroat trout between 1934 and 1944. These were presumably Yellowstone cutthroat trout, but there is no evidence those fish persisted in this drainage; there is no evidence of brook or rainbow trout in the system.

IMPACT ANALYSIS

METHODOLOGY

Existing biological data for the species and the project area was reviewed. Experts in native species biology and ecology as well as experts in areas of exotic fish species suppression and control were consulted.

Negligible: Impacts would be no more than negligible to any individuals of a sensitive species or other native species, or their habitat.

Minor: Impacts would affect a few individuals of 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 barely perceptible consequences to the species or habitat function.

Moderate: Impacts would cause measurable effects on: (1) a relatively moderate number of individuals within a sensitive species or other native species population, (2) the existing dynamics between multiple species (e.g., predator-prey, herbivore-forage, vegetation structure-wildlife breeding habitat), or (3) a relatively large habitat area or important habitat attributes. A sensitive species or other native species population or their habitat might deviate from normal levels under existing conditions, but would remain indefinitely viable.

Major: Impacts would have drastic and permanent consequences for a sensitive species or other native species populations, the dynamics between multiple species, or almost all available critical or unique habitats. A sensitive species or other native species population or its habitat would be permanently altered from normal levels under existing conditions, and the population would be at risk of extirpation.

Short-term: Effects would last for four years (the length of the project)

Long-term: Effects would last beyond the project period or would be permanent

IMPACT ANALYSIS OF ALTERNATIVE A – NO ACTION

This alternative would rely on the existing recreational fishing activity to suppress lake trout at Quartz Lake. 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. This regulation change is largely expected to benefit native fish resources in the park through angler education, 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/year on Quartz Lake (USFWS 1987). This represents the minimum average angling pressure on Quartz Lake for that time-period. Creel census data collected from 1984 through 1986 (USFWS 1987) reported anglers turned in an average of 9.3 creel cards/year from Quartz Lake and estimated that a park-wide average of 264 hours were fished for each creel card returned. Using these values, we can estimate an 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) that estimated 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, located South of Quartz Lake, from 1984 through 1986 was 0.041 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 anglers may catch approximately 100 lake trout/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. 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 problem lake trout waters such as Yellowstone Lake, Flathead Lake, Lake Pend Oreille, Priest Lake, and Upper Priest Lake despite significant fishing effort with excellent boat access. Creel survey estimates indicate Flathead Lake supports 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. Lake trout population growth would likely accelerate if left unchecked, and they would eventually overwhelm the native fish community under this alternative.

Bull Trout

Glacier's ecologically unique bull trout populations would continue to decline at a park-wide scale, and both the Quartz Lake and Cerulean 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) and at a local GNP scale. 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. The fifth lake in the study was Quartz Lake, 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 GNP, 10 have been invaded by lake trout and two more are at-risk of invasion because there are no physical barriers to preclude lake trout invasion.

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 NP, 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 GNP 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 nonnative 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 nonnative lake trout (Fredenberg 2002). However, the catch data for bull trout in Quartz Lake remained the same. Presumably this was 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 Bowman and Logging lakes (Downs and Stafford 2009). 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 these populations have less than 20 spawning adults remaining. In contrast, redd

counts in Quartz Lake have remained stable and at relatively strong during this same time period (Downs and Stafford 2009).

When adult count and redd count data are viewed together, these trend data indicate that native bull trout populations have drastically declined in the park. We conclude the bull trout are at imminent risk of extirpation in several lakes due to competitive/predation interactions with introduced lake trout.

Bull trout have long been an integral component of biodiversity, culture and visitor use of Glacier. They 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 GNP and 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". Further, the authors concluded that the upper Quartz Lake system is the highest priority for conservation and preservation of bull trout among 17 lakes examined.

Quartz Lake was considered to be among the best natural bull trout lakes prior to 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 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. We do not have abundance data for lake trout in Quartz Lake, and only a few have been captured to date using gill nets and fishing gear. 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 suggests an increasing population. Under the "no action" alternative, it is likely that the current low numbers of lake trout would grow, eventually overwhelm the system, and replace bull trout within 30 years as they have done in other park lakes (Fredenberg 2002). No action would likely result in significant decline or loss of the Quartz Lake bull trout population. In addition, future management actions to preserve bull trout would not be viable if the park waited until the lake trout have become firmly established in Quartz Lake before responding. If lake trout were allowed to reproduce and expand their numbers in Quartz Lake unchecked, then the entire upper Quartz Lake system would be severely and permanently compromised for native fish. In addition, loss of the Quartz Lake bull trout population 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 unacceptable major, long-term adverse impacts on bull trout.

Westslope Cutthroat Trout populations would also likely be significantly compromised by expansion of lake trout in the upper Quartz Lake system. Westslope cutthroat trout feed primarily on aquatic and terrestrial invertebrates, and lake-dwelling cutthroat would be particularly vulnerable to predation by lake trout in spring and fall when lake trout use shallower habitats (Dux 2005). Other native fish (e.g. mountain whitefish) may offer a buffer between lake trout and westslope cutthroat trout, but it is likely that population growth of lake trout would eventually be sufficient to overwhelm the native fish community.

Lake trout differ considerably in their biology from bull and westslope cutthroat trout in that they spawn in the lake, and would be presumed to benefit from expansive high-quality rearing habitat for young lake trout available in the lakes of GNP. 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 significantly impact a lake trout population than a stream spawning/rearing bull or westslope cutthroat trout population. Lake trout have the potential to live significantly 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 this alternative, westslope cutthroat trout would also likely be reduced to the point where they no longer play a meaningful role in the lake ecosystem. The lake-dwelling form of westslope cutthroat trout could be lost from the system entirely, adversely affecting the ecology of the ecosystem as well as the species. Therefore the no action alternative would have unacceptable major, long-term adverse impacts on westslope cutthroat trout.

Cumulative Impacts of Alternative A – No Action

Active fishery management and human habitat manipulation are largely absent from the Quartz Lake system. As such, cumulative impacts under this alternative are minimal. A partial fish passage barrier was constructed on the outlet to Middle Quartz Lake in 2004 using native rock material and steel wire gabion baskets. Construction of the barrier required the removal of cobble and small boulders from the stream channel immediately adjacent to the barrier location. Removal of the rocks likely impacted individual aquatic macroinvertebrates, but would not have had a population-level impact on macroinvertebrates. 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.

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 mis-identification of bull trout and other trout species has been documented in angler surveys. In a study of three Idaho waters, Schill (1999) determined that the majority of anglers interviewed while fishing were unable to correctly identify four of the five species of trout found in Idaho. In that study, anglers correctly identified bull trout only 29% of the time. Data from the lower Clark Fork River in Montana indicated that about half of the anglers interviewed could correctly identify a bull trout and even fewer could correctly identify a lake trout (Avista 2009). If angling pressure increased dramatically on Quartz Lake, mis-identification of lake and bull trout could result in illegal harvest of bull trout. However, due to the remote nature of Quartz Lake and the prohibition of open fires at Quartz Lake, we do not expect the regulation change to result in significantly increased unintentional harvest of bull trout in the system.

Cumulatively, this alternative would contribute to the demise of bull trout in the majority of historically occupied lakes on the west side of the park. Lake trout have colonized 10 of 17 bull trout lakes on the west side of the park, and threaten to colonize Cerulean Lake through lake trout expansion upstream from Quartz Lake. Five lakes have been evaluated with long-term netting data, and in four of them, lake trout have replaced bull trout as the dominant aquatic predator in only 30 years. The fifth system evaluated with the netting data is Quartz Lake, where lake trout would likely expand to dominate the system if left unchecked.

Conclusion

Impacts would be major, adverse, short and long-term to the native fishery in Quartz Lake, including bull and westslope cutthroat trout. These impacts would be site specific, local and regional for both species. Cumulatively this alternative would contribute to the demise of bull trout in a large majority of n the west side lakes in the park and result in a major adverse long

term cumulative impact. Bull and westslope cutthroat trout are key to the natural integrity of the park, and represent the evolutionary legacy of native salmonids in the park. Further, both NPS *Management Policies* 2006 and the GNP general management plan call for actions to conserve native species, including the removal of deleterious non-native species where feasible.

Because the no action alternative would result in major adverse impacts to fisheries, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, cumulatively there would be impairment of park fisheries resource values related to this alternative. Implementation of this alternative would result in unacceptable impacts and is not consistent with §1.4.7.1 of NPS *Management Policies* 2006. Taken alone, the loss of native fish populations within the Quartz Lake system would not constitute an impairment of park resources, but cumulatively this loss would contribute to the likely eventual loss of the majority of the bull trout populations on the west side of GNP. Only five of seventeen lakes within GNP currently occupied by bull trout on the west side of park can be considered secure in the long-term because physical barriers are present that exclude lake trout. Where data on recently invaded bull trout lakes in the park are available, they show the replacement of bull trout by lake trout in the span of about 30 years.

IMPACT ANALYSIS OF ALTERNATIVE B

Gill netting has occurred periodically on Quartz Lake in the past. Fredenberg (2002) set three sinking gill nets overnight in 2000. The nets used in 2000 were multifilament nylon, 38 meters long by 2 meters high and consisted of five panels of variable sized mesh. The nets captured 20 bull trout, six westslope cutthroat trout, 85 mountain whitefish, 32 longnose suckers, and two large-scale suckers. Meeuwig (2008) sampled Quartz Lake with similar nets and techniques in 2005 and 2006 as part of a bull trout study. The 2005 sampling operation deployed six nets and captured 40 bull trout, 23 westslope cutthroat trout, 254 mountain whitefish, one lake trout, 45 longnose suckers, nine large-scale suckers, and one redside shiner. The 2006 sampling operation deployed only two nets and captured 14 bull trout, five westslope cutthroat trout, 78 mountain white fish, 17 large-scale suckers, and six redside shiners. Nets were set by hand using a float tube with one end either attached to the shore or anchored in shallow water. The nets were placed in both shallow (as shallow as six feet deep) and deeper-water habitats, as the intent of the research was to characterize the entire fishery in the Quartz Lake system. Shallow net sets catch many more non-target fish species (i.e. westslope cutthroat trout, mountain whitefish, suckers), than deeper sets intended to capture lake trout (Fredenberg and Rumsey 2007).

Actions proposed under this alternative would entail using dramatically increased netting efforts that are not possible with non-motorized watercraft, as well as different netting approach's to reduce by-catch of native fish species including bull trout, westslope cutthroat trout, mountain whitefish, longnose sucker, and redside shiner. First, lake trout would be radio-tagged to track individual lake trout and more effectively target concentrations of lake trout, particularly during the spawning period in the fall. A number of monofilament gill nets would be used to capture lake trout at spawning locations. This type of net is more difficult for fish to see in the water and should improve lake trout catch rates. To the greatest extent practical, nets would be set at depths deeper than 60 feet using mesh sizes similar to other projects that have been effective in capturing lake trout, while minimizing by-catch and mortality of bull trout. Net mesh sizes selected for this effort at Quartz Lake would be based on results of netting on Swan Lake where smaller mesh nets caught a disproportionate number of lake trout compared to bull trout. Bull trout caught in smaller mesh may also have a higher survival rate when compared to those

captured in larger mesh (W. Fredenberg, USFWS, personal communication). Nets would be set for short periods of time (a target time of about 1 hour or less) and would be checked frequently in an attempt to remove any non-target fish from the nets and release them alive. NPS and USGS biologists have developed estimates of the total adult population of bull trout inhabiting Quartz Lake, and would use these estimates in close coordination with the USFWS to ensure long-term harm to the Quartz Lake bull trout population through the netting efforts would not occur.

When compared to overnight gill net sets used on Quartz Lake in earlier studies, the actions proposed would result in fewer non-target fish caught and would have lower mortality rates as well. Another study on salmonids showed a significant 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 (Buchanan et al. 2002). Other lake trout removal programs using similar methods to those proposed have estimated mortality rates of bull trout captured from as low as 20% on Lake Pend Oreille (Dux, Idaho Department of Fish and Game, personal communication) to as high as 40% on Swan Lake (Fredenberg, USFWS, personal communication). Under this assumption, it is anticipated the mortality rate for by-catch of bull trout would range from 20 – 40%. By-catch mortality rates for other native species would likely be higher than have been observed for bull trout. Based on earlier netting efforts, it is reasonable to assume, that netting mortality could approach 20-40 adults/year, which would result in a population mortality rate of 8-15% per year.

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. GNP 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 (% of the adult bull trout population removed) is remarkably similar to the assessment for Swan Lake.

Netting would cause by-catch mortality of non-target fish species such as bull trout, but frequent net checks and regular communication with the USFWS regarding acceptable limits of bull trout mortality would minimize the risk of having a long-term population level impact on bull trout. Our priority would be examining the nets to remove any live bull and westslope cutthroat trout due to their current conservation status, and other species may remain in the nets longer while these species priority species are removed from the nets.

Under this alternative, there would be moderate short-term negative impacts to the Quartz Lake bull trout population through incidental netting mortality, but if the project is successful, there would be moderate long-term benefits for bull trout observed at multiple scales (i.e. local, park-wide, and range-wide). Additionally, moderate long-term benefits from successful implementation of Alternative B would be anticipated for all native fish species present in Quartz Lake. There is the potential for minor short-term negative impacts to westslope cutthroat trout and other native fish species due to netting by-catch mortality, but similarly to bull trout, there would be moderate long-term benefits to these species from successful implementation of the project.

Impacts from completing the fish barrier construction would be minor adverse localized disturbance of the stream bed. The use of heavy equipment is not anticipated, and the improvements to the structure would primarily involve setting additional gabions and a fish screen in place on the streambed surface. There would be some local impacts to the streambed

as substrate is moved to make level spots for gabions, or to anchor various parts of the structure to the streambed. The potential exists to use relatively small amounts of rock removed from the streambed for additional gabion repair/construction, as was done with the original structure. Ten to fifteen trips with a helicopter are estimated to be needed to move material (i.e. gabion, rock, fish screen, etc.) to the work site on Quartz Creek. Any foreign rock material would be treated/cleaned to ensure weeds would not be imported into the work site.

Cumulative Impacts of Alternative B

Active fishery management and human habitat manipulation are largely absent from the Quartz Lake system. As such, cumulative impacts under this alternative are minor. Construction of the fish barrier required the removal of cobble and small boulders from the stream channel immediately adjacent to the barrier location. Removal of the rocks likely impacted individual aquatic macroinvertebrates, but would not have had a population-level impact on macroinvertebrates. 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.

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. In a study of three Idaho waters, Schill (1999) determined that the majority of anglers interviewed while fishing were unable to correctly identify 4 of 5 species of trout found in Idaho. In that study, anglers correctly identified bull trout only 29% of the time. Data from the lower Clark Fork River in Montana indicated that about half of the anglers interviewed could correctly identify a bull trout and even fewer could correctly identify a lake trout (Avista 2009). If angling pressure increased dramatically on Quartz 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. However, due to the remote nature of Quartz Lake and the prohibition of open fires at Quartz Lake, we do not expect the regulation change to result in significantly increased unintentional harvest of bull trout in the system.

GNP would continue to implement a periodic monitoring program using gill nets set by hand from the shoreline using float tubes or canoes on the larger lakes on the west side of the park including Quartz Lake. This netting is intended to inform fishery management of these waters by providing information on changes in fish species composition over time. The number of nets set would continue to be low (up to 10 nets/lake with sampling conducted every five years), and nets would continue to be set in the evening and left in the water overnight. The nets would continue to be removed from the lake the following morning and cleared of fish. The technique is different in that the sampling occurs only once every five years, is relatively small scale (low numbers of nets), the nets are set overnight and higher fish mortality rates result, and the netting operations are weather dependent. The next gill net monitoring sampling would be scheduled to occur in 2010 on Quartz Lake. The potential exists to forego this sampling in 2010 in Quartz Lake to avoid additional netting mortality of bull trout.

Conclusion

Moderate local short-term adverse impacts to bull trout from implementation of Alternative B would be anticipated. Netting would cause by-catch mortality of non-target fish species such as bull trout and westslope cutthroat trout, but frequent net checks and regular communication

with the USFWS regarding acceptable limits of bull trout mortality would minimize the potential of having any long-term population level impacts on bull trout. Nets would be set sufficiently deep to reduce by-catch of other native fish species including westslope cutthroat trout, mountain whitefish, longnose sucker, and redside shiner. Therefore, the park would anticipate minor adverse, short term impacts to these other native species. Moderate, beneficial, long term impacts would occur from successful implementation of Alternative B for all native species. These benefits would be local, park-wide, and regional for bull and westslope cutthroat trout.

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

Recommended Wilderness

AFFECTED ENVIRONMENT

Glacier National Park completed a study and environmental impact statement in 1973 to comply with the 1964 Wilderness Act. That document was reviewed by the public and recommended that over 90% of the park should be formally designated as wilderness. President Nixon forwarded that recommendation to Congress on June 13, 1974. A bill was subsequently introduced to designate the land as wilderness. That bill was never enacted, but since that time, the lands have been defined as recommended wilderness and managed as designated wilderness by the NPS in accordance with NPS Policy. National Park Service policy requires management of proposed or recommended wilderness as designated wilderness until the land is either formally designated or rejected by Congress. Until, that time all the area identified as recommended wilderness will continue to be managed as wilderness. Amendments to the wilderness recommendation of 1974 were made in 1984 and 1994 that made minor adjustments to the original proposal and increased the amount of proposed wilderness to 95% of the park's total area (NPS1999). Wilderness in GNP is defined as lands that are essentially undeveloped or are natural in character and lie 200 feet from centerline of established roadways and development zones.

The backcountry zone is managed to retain the distinctive characteristics of the recommended wilderness area by delineating a set of desired resource conditions, visitor experiences, types of management activities and development (NPS 2006). Primitive facilities such as trails, designated campsites, and historic structures are maintained while the natural resources in this zone remain in their pristine state. Management of natural resources is limited to necessary restoration activities and protection. Cultural resources are preserved and protected in accordance with the law and NPS policy. It is managed to maintain natural processes. Visitor may participate in several activities including hiking, horseback riding, and backcountry camping. "Leave no trace" skills and ethics are encouraged. Developments in the backcountry zone include trails, designated campsites, primitive signs, sanitation facilities and patrol cabins.

Quartz Lake is within the North Fork District in Glacier. This District was chosen as a special trial area for comprehensive Limits of Acceptable Change (LAC) type planning in 1992. This is when carrying capacities for given areas are tied to measurable conditions of selected resource or social indicators rather than a fixed number. This concept is used for the backcountry campground, river corridor, and high use area evaluations. Management zones (road, trail, lake,

and wilderness remote) were delineated with particular parameters for resource, visitor use, and management settings. Management goals for each zone are referenced to social (encounters per 8 hour day) and resource (bare ground, tree damage, social trails, and tree regeneration) indicators with desired standards set for each.

There are two trailheads for Quartz Lake. One begins along the inside North Fork Road and follows Quartz Creek to Lower Quartz Lake along the shore past Middle Quartz Lake for ten-miles where it ends at the south end of Quartz Lake and turns north towards Bowman Lake. The other trail head is a six-mile hike from the foot of Bowman Lake to Quartz Lake. There is a backcountry patrol cabin at the southern end of Quartz Lake and three developed campsites. An undeveloped trail extends beyond Quartz Lake to Cerulean Lake; it is not maintained by the park. Quartz Lake is a popular destination for hikers in GNP as it is a "loop trail" that passes over a Quartz Creek Ridge offering stunning views and fishing opportunities in a mountain lake.

IMPACT ANALYSIS

METHODOLOGY

The methodology used to analyze the potential impacts on recommended wilderness is an analysis of expected changes to the character of recommended wilderness under the different alternatives. Changes to the defining qualities of recommended wilderness are assessed. The affected environment for recommended wilderness is limited to the Quartz Lake area since the project would not have impacts that would persist throughout the park.

Negligible: Recommended wilderness would not be affected or the effects would not be measurable.

Minor: The effect on recommended wilderness would be detectable, but would be slight and localized

Moderate: The effects on recommended wilderness would be readily apparent, and would result in a substantial change to the localized recommended wilderness landscape that would be noticeable to the public.

Major: The effects to recommended wilderness would be highly apparent and would change the character of the recommended wilderness area.

Short-term: Effects would persist for one year or less.

Long-term: Effects would persist for more than one year or are permanent.

IMPACT ANALYSIS OF ALTERNATIVE A - NO ACTION

Under the no action alternative, lake trout would continue to out-compete native fish. This would change the dynamics of lake fishing for the entire upper Quartz Lake system, including Quartz Creek and Cerulean Lake. Fishing is considered a heritage of wilderness. For much of the fishing season in GNP, lake trout inhabit deep water which is not readily accessed by anglers fishing from the lake shore. Fishing opportunities would eventually become too difficult and would the quality would diminish; decreasing the value of the wilderness experience. All other characteristics of wilderness would continue to be protected and preserved as directed by NPS *Management Policies* (NPS 2006). Recommended wilderness would experience moderate, adverse, local and regional and long-term impacts.

Cumulative Impacts of Alternative A – No Action

No additional action would take place for this alternative therefore there are no cumulative impacts for the No Action.

Conclusion

The no action alternative would have moderate, adverse, local and regional and long-term impacts to recommended wilderness resources due to the loss of historic fishing opportunities in the recommended wilderness. There would not be any cumulative impacts.

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

IMPACT ANALYSIS OF ALTERNATIVE B – THE PREFERRED

According to GNP's 2003 *Backcountry Management Plan* (NPS 2003), "the use of motorized tools, boats, or aircraft will be kept to a minimum in the backcountry and utilized only for safety, extraordinary need, and administrative purposes, when no other means is feasible. All uses will be carefully considered balancing disturbance against need."

Section 4(c) of the 1964 Wilderness Act states: " Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Under Alternative B, the use of a motorized boat to protect a threatened species and prevent the spread of an invasive species (lake trout) would be an acceptable minor to moderate, short-term adverse impact from motorized disturbance that would prevent a species from extirpation and preserve a wilderness characteristic for future generations. Motorized-use would create noise during netting operations, the viewshed would be disrupted by the presence of the boat, whether on the water or stored by the cabin, and the presence of a field crew might infringe on wilderness solitude. Preservation of a native fishery would have a moderate, long term, regional beneficial impact on wilderness experience.

Cumulative Impacts of Alternative B

Cumulatively, this alternative would have localized to widespread, minor to moderate, adverse, and short and long-term impacts on recommended wilderness values when considered with past, present and future administrative flights, trail maintenance and visitor use in recommended wilderness areas.

Conclusion

Impacts to recommended wilderness under Alternative B would be localized to widespread, minor to moderate, adverse and beneficial and short and long term impacts due to the use of a motorized boat and gill netting operation on a lake within recommended wilderness and eventual restoration and preservation of the native fishery. Cumulative impacts would be the same.

Because Alternative B would not result in major adverse impacts to recommended wilderness resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for

enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park wilderness resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Wildlife

Affected Environment

Over 300 species of terrestrial wildlife occupy Glacier National Park either seasonally or year-round, and an unknown number of aquatic species inhabit park waters. The Quartz Lakes area is remote and offers suitable habitat for many of these species. Of particular interest to many species of wildlife are lakes, lake shores, riparian areas, travel corridors, avalanche chutes, shrublands, snags, old-growth forests, and cliff areas. Mammal species include red squirrels, Columbian ground squirrels, red-tailed chipmunks, moose, elk, mule and white-tail deer, black and grizzly bear, mountain lion, lynx, fisher, wolverine, marten, river otter, mink and long-tailed weasels, to name a few. Several species of birds have been observed in the Quartz Lake drainage system including bald eagles, northern goshawk, great blue herons, thrush, spruce grouse, common loons, osprey, chickadees, three-toed woodpecker, and owls.

Impact Analysis

Methodology

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

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

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

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

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

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

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

Impact Analysis of Alternative A – No Action

Terrestrial wildlife impacts from the no action alternative would be minor to moderate, long term, and adverse because the anticipated reduction and/or loss of the native fish community would reduce available biomass of fish for terrestrial and avian predators such as osprey and river otters. This reduction could be reflected in lower productivity up the food chain to the top

predators. Lower productivity would mean lower numbers of fish-dependent species. Lower prey biomass could cause predators to switch to other more available species thus having other unpredictable consequences up and down the food chain. Anticipated changes in the fish community could be reflected in changes in richness and abundance of invertebrate species which, again, manifests itself as unpredicted changes in populations of amphibians and insectivorous birds, and even disease prevalence. Our state of knowledge is insufficient to predict the outcomes of anthropogenic perturbations of natural systems.

Cumulative Impacts of the No Action Alternative

The no action alternative would not contribute to the cumulative impacts of other park projects because there would be no actions taken. However, the long-term consequences, as described above, would act cumulatively with other exotic invasions of park waters to more widely disrupt native ecosystems regionally.

Conclusion

Impacts on wildlife would be minor to moderate long term, site specific and adverse because no action would lead to eventual loss of available biomass of fish for terrestrial and avian predators.

Because there would be no major adverse impacts to resources or values whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park wildlife resource values related to this alternative. Because natural conditions would be irreversibly altered, Implementation of this alternative would likely result in unacceptable impacts, possibly rising to the level of impairment.

IMPACT ANALYSIS OF ALTERNATIVE B – THE PREFERRED

By maintaining an intact native fishery, the negative consequences of the no-action alternative may be avoided. The impacts on terrestrial wildlife of implementing this alternative are much less than the impacts of the no-action alternative. There could be some minor displacement of wildlife due to noise generated during netting operations, however, the motorized boat would not run at high speeds and the noise would be minimal. Because the proposed project would be accomplished during a less sensitive period of the year for most species (autumn and winter when nesting and natal periods have concluded and most migrant bird species have departed), and would be limited to a relatively small area, impacts would be negligible to minor and long term.

Cumulative Impacts of Alternative B

Implementation of alternative B combined with other past, present and future actions would constitute a minor adverse, localized, short term impact. No other major projects are planned for the immediate area around Quartz Lake.

Conclusion

The potential and likely negative consequences of no action outweigh the minor impacts of implementing the preferred alternative. Alternative B would result in negligible to minor, adverse localized, short and long term during netting operations due to the use of a motorized boat in recommended wilderness and the extended presence of personnel during a time when visitation is otherwise low. However impacts would eventually be beneficial, localized and long term by maintaining an intact native fishery.

Because the preferred alternative would not result in major adverse impacts to wildlife resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's

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

Federally Threatened, Endangered, and State Listed Species of Concern

AFFECTED ENVIRONMENT

Three of the five threatened species (grizzly bear, Canada lynx, and bull trout (critical habitat) and one endangered species (gray wolf) listed by the U.S. Fish and Wildlife Service (FWS) in Glacier National Park make use of the project area. Gray wolves (*Canis lupus*), a federally listed endangered species (as of July 28, 2008; status pending litigation), are known to occupy the Quartz Lake drainage. The threatened grizzly bear (*Ursus arctos horribilis*) has been documented within the project area and the threatened Canada lynx (*Lynx canadensis*) has been documented in the Granite park area, approximately 3 miles (5 km) from the project area and likely travels through or forages near the site. The threatened bull trout (*Salvelinus confluentus*) is present in Quartz Lake where critical spawning and rearing habitat is available; impacts to bull trout are discussed under the Fisheries/Aquatic Threatened Species and Species of Concern.

Gray Wolf

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

The population dynamics of recolonizing wolves are extremely variable. Inadequate prey densities and a high level of human persecution are the two most important factors that can limit wolf distribution and prevent a complete recovery of wolf populations in the Northern Rocky Mountains (USFWS 1987). Glacier's predominantly natural landscape contains some of the most secure and productive wolf habitat in the western part of its range. Despite fluctuating wolf numbers since 1986, the park's established wolf population continues to serve as a source for natural recolonization in northwest Montana and southern Canada (Boyd-Heger 1997).

Management and recovery of wolves in the Northwest Montana Recovery Zone, of which GNP is a part, is directed by the *Northern Rocky Mountain Gray Wolf Recovery Plan* (USFWS 1987).

Wolves have been reported along major drainages in the park during recent years including the Quartz Lake drainage (NPS files). There are no known den sites in the project area.

Grizzly Bear

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

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

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

Research-based habitat modeling shows that the mountain sides surrounding the upper Quartz Lake drainage contain medium to high value grizzly bear foraging habitat during the spring. During late summer and autumn (after mid-July), habitat value of most of the drainage is decreased as grizzly bears move toward higher elevations for denning and areas with less human disturbance. Grizzly bear breeding season occurs from May 1 until July 1. Early morning, evening, and night are especially critical times for grizzly bears to travel or forage as bears are less likely to be disturbed, displaced, or human habituated during these times.

Species of Concern. State listed species of concern to GNP are those species that are rare, endemic, disjunctive, vulnerable to extirpation, in need of further research, or likely to become threatened or endangered if limiting factors are not reversed. Likewise, a species may be of concern because of characteristics that make them particularly sensitive to human activities or natural events. In addition, species of concern may also include big game, upland game birds, waterfowl, carnivores, predators, and furbearers whose populations are protected in the park but subject to hunting and trapping outside of the park. Westslope cutthroat trout is also a Montana Species of Concern and is present in Quartz Lake; impacts to westslope cutthroat trout are under the Fisheries/Aquatic Threatened Species and Species of Concern.

Common loons (*Gavia immer*) occur from spring through fall, but rarely during winter, on large and small lakes throughout the park. Glacier National Park is inhabited by a high proportion of Montana's nesting pairs, making the park especially important to the viability of the state's loon population. Males and females are monomorphic based on plumage; however, 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 are very

particular about nesting habitat which requires accompanying nursery areas for the chicks. Nest can be found on islands or grassy lake shores on lakes larger than 13 acres in size or over 5000 feet in elevation. Typically, they begin laying their eggs in early-spring, which in GNP is around the beginning of June. Common loons usually feed on fish they dive for, small amphibians or invertebrates. Common loons have been sighted regularly in the Quartz Lake drainage, including frequent observations at Quartz Lake. Observations include adults and young, swimming, diving/feeding, preening, and calling.

Bald eagles (*Haliaeetus leucocephalus*) use portions of GNP on a year-round basis as nesting and wintering residents (Yates 1989), and as seasonal migrants (McClelland et al. 1982, Yates et al. 2001). There are 12 known bald eagle breeding areas in the park, including six in the North Fork Valley; bald eagles have been observed nesting along the north shore of Quartz Lake. There is another nest within five kilometers of the western park boundary in the North Fork Valley, and it is likely that these eagles forage inside the park as well. Glacier National Park is within a major bald eagle migration corridor (McClelland et al. 1994, Yates et al. 2001). Some eagles remain to forage near Lake McDonald and winter in the area, especially along the Middle and North Forks of the Flathead River.

The *Montana Bald Eagle Management Plan* (Montana Bald Eagle Working Group 1994) provides the guide for conservation and management efforts for bald eagles in Montana. The plan promotes conservation of bald eagles and their habitat by providing landowners and resource managers with information about the biology of bald eagles. This information is then used to make informed decisions regarding land-use management. The Montana plan is an extension of the *Pacific States Bald Eagle Recovery Plan* (USFWS 1986) developed by the U.S. Fish and Wildlife Service, and identifies nest site management zones and general guidelines to be used in lieu of more site-specific data. The plan also provides guidance for management based on minimum human disturbance and provides for various levels of protection within nesting territories. Glacier National Park's *Bald Eagle Operational Plan and Habitat Management Guidelines* (NPS 1999b) provides site-specific information and outlines habitat management actions for the protection and perpetuation of bald eagle use areas in the park.

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 bald eagle nest site occurs along the northern shore of Quartz Lake. Use of this nest site has been documented since at least 1965 and monitored annually since 1985. Since 1985, only 3 birds have successfully fledged from 9 incubations at this nest.

IMPACT ANALYSIS

METHODOLOGY

The methodology used to analyze the potential impacts on Federally Threatened, Endangered, and State Listed Species of Concern is an analysis of expected changes to wildlife under the different alternatives that is or would be present in the project area. Glacier National Park wildlife databases and current research or monitoring were used to determine if and how Federally Threatened, Endangered, and State Listed Species of Concern use the project area. Potential changes in behavior, movement patterns, and disturbance were evaluated. The following levels of impacts were defined.

Negligible: The alternative would affect an individual of a listed species or its critical habitat, but the change would be so small that it would not be of any measurable or

perceptible consequence to the protected individual or its population. Negligible effect would equate with a "no effect" determination in U.S. Fish and Wildlife Service terms.

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

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

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

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

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

IMPACT ANALYSIS OF ALTERNATIVE A – NO ACTION

Gray Wolf

Quartz Lake is within the home range of the Dutch Pack and wolves have been observed in the area. However, they do not den or have rendezvous sites within the vicinity of the project area. Therefore, the no action alternative would have negligible impacts on gray wolves. The Quartz Lake area does not include identified ungulate winter range for big game; however drainages to the north and south include ungulate winter range which makes up the prey base for wolves; therefore wolves might pass through the area but actions associated with the proposed project would not take place during the winter. As a result, the section 7 determination for the activities proposed under the no action alternative would be "no effect" on gray wolves.

Grizzly Bear

The no action alternative would have negligible impacts on grizzly bears since there would not be an extended human presence in the Quartz Lake area. As a result, the section 7 determination for the activities proposed under the no action alternative would be "no effect" on grizzly bears.

Species of Concern

Common Loons

Common Loons dive from the surface of shallow lakes and feed mostly on small fish and minnows. Lake trout spawn in cold and deep waters; which generally are not complimentary to common loon feeding preferences. Bull trout spawn in shallow tributaries or the headwaters of Quartz Lake. Should lake trout continue outcompeting bull trout in the upper Quartz Lake system, a major component of the common loons' diet would be compromised, therefore the no action alternative would have minor, long-term, adverse regional impacts.

Bald Eagles

Productivity of Glacier's nesting bald eagle population is considered low and is about half that of the productivity documented for the rest of Montana (NPS 1999b), and also about half that recommended in the *Pacific States Bald Eagle Recovery Plan* (USFWS 1986) for maintaining viable populations of nesting bald eagles. Reasons for lower productivity in the park may include severe winter and spring weather, deterioration of native fisheries (prey species), and human disturbance near nest and forage sites. The no action alternative would facilitate the deterioration of the native fish assemblage in Quartz Lake thereby further reducing the productivity of the nesting eagles at the north end of the lake. Foraging opportunities would also decrease as bull and cutthroat trout are replaced by lake trout. Lake trout tend to inhabit deeper waters of Quartz Lake and would be less accessible to foraging bald eagles. The no action alternative would have minor to moderate, long-term adverse regional impacts to bald eagles.

Cumulative Impacts of the No Action Alternative

Gray wolf

The no action alternative, in combination with past, ongoing, and future activities, would have little to no cumulative impacts on gray wolves because no activity would occur from implementation of this alternative. Other past, current, or future activities are not anticipated to affect wolves, and changes in the aquatic community do not directly affect wolves.

Grizzly Bear

The no action alternative, in combination with past, ongoing, and future activities, would have no cumulative effect on grizzly bears because no activity would occur from implementation of this alternative. Other past, current, or future activities are not anticipated to affect grizzly bears, and changes in the aquatic community do not directly affect grizzly bears.

Common Loon

The no action alternative, in combination with past, ongoing, and future activities, would not likely result in a cumulative impact on common loons, because while no action would have a direct effect on the loon's food supply, other actions taking place in the area would not contribute to an effect.

Bald eagle

The no action alternative, in combination with past, ongoing, and future activities, would not result in a cumulative impact on bald eagles because while no action would have a direct effect on the eagle's food supply, other actions taking place in the area would not contribute to an effect.

Conclusion

Impacts on gray wolves and grizzly bears would be negligible because no additional activity would take place in the project area. In accordance with Section 7 this would be a "no effect" determination. Common loons and bald eagles are the only federally or state listed terrestrial wildlife species likely to suffer measureable affects due to implementation of the no-action alternative. Impacts to Common loons would be minor, long-term, adverse and regional because they rely on shallow water dwelling fish for food. Impacts on the bald eagle would be minor to moderate, long-term and regional because they also forage for fish in shallower waters. Lake trout are deep water fish and thus food would be depleted for both species. The additional cumulative impacts of other past, current, or future projects are unlikely to contribute substantially to the impact of the no-action alternative.

Because the no action alternative would result in major adverse impacts to threatened, endangered or species of concern resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be

impairment of park threatened, endangered or species of concern resource values related to this alternative. However, implementation of this alternative would may result in unacceptable impacts consistent with §1.4.7.1 of NPS *Management Policies* 2006.

IMPACT ANALYSIS OF ALTERNATIVE B – THE PREFERRED

Gray Wolf

The project area is near established ungulate winter range and is within the home range of the Dutch pack. Wolves depend on ungulates for food, especially during the winter - the proposed activity would take place primarily during late fall. Noise generated by the motorized boat would last most of the day but would be minimal since the boat would operate at low speeds during netting. The presence of a field crew would be a potential disturbance to wolves additive to typical visitor use, but likely not substantial since the field crew would mostly stay on or around Quartz Lake. There are no known dens or rendezvous sites in the vicinity of the project area. Impacts from the preferred alternative would be negligible to minor, adverse, local, and long-term.

Grizzly Bear

Impact to grizzly bears from this alternative would be negligible to minor due to potential displacement of bears from a relatively small area of seasonal habitat during the spring and fall. Occupation of the area by a field crew and near-shore operations for up to 4 years could displace bears from seasonal habitats in an area that is otherwise seldom visited. Also, fuel and fish nets would pose a potential attractant for bears that, while manageable, could influence grizzly bear movements and potentially increase the risk of encounter or conflict. This would result in negligible to minor adverse, long-term, local impacts to grizzly bears.

Species of Concern

Common Loon. The hook-and-line fishing would take place during the egg laying period. Nests are often located in tall grasses. Common loons may select nest sites along the shores of Quartz Lake that would be inconspicuous to staff conducting the hook-and-line fishing operation. Human disturbance at nest and nursery sites could cause brood failure through egg or nest abandonment. Without mitigation actions, project operations conducted during the spring could have site specific, moderate, adverse, long term impacts on loons, however mitigation actions would be implemented reducing the impacts to negligible to minor, adverse, regional, long term.

Bald eagles. Nest areas are critical, and human activity or development may cause abandonment of the breeding area, affect successful completion of the nesting cycle, and reduce productivity. Designated nest areas extend within a 0.25-mile (400 m) radius of all nest sites that have been active within 5 years. The objectives of designating nest-site areas are to minimize human disturbance and to maintain or enhance nest-site habitat suitability.

Bald eagles are especially sensitive to human disturbance during the breeding period (Hamann et al. 1999). The breeding period includes courtship, late February to mid-April; egg laying and incubation, late March to late May; nestling, mid-May to early August, and fledging, early August to late September (least sensitive period). 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 GNP). 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). 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). Activities proposed would take place during the spring nestling period and fall migration period. Mitigation measures that would direct project activities away from sensitive areas would reduce the possibility of disturbance so that impacts would be minor, long-term, adverse, and regional

Cumulative Impacts of Alternative B

Gray wolf

Actions proposed in combination with past, ongoing, and future activities would be insufficient to increase the impact level beyond that identified for the preferred alternative alone; negligible to minor, adverse, local, and long-term.

Grizzly Bear

Actions proposed in combination with past, ongoing, and future activities would be insufficient to increase the impact level beyond that identified for the preferred alternative alone; negligible to minor, adverse, local, and long-term.

Common Loon

Actions proposed in combination with past, ongoing, and future activities would be insufficient to increase the impact level beyond that identified for the preferred alternative alone; negligible to minor, adverse, regional, and long-term.

Bald eagle

Actions proposed in combination with past, ongoing, and future activities would be insufficient to increase the impact level beyond that identified for the preferred alternative alone; minor, adverse, regional, and long-term.

Conclusion

Alternative B would have negligible to minor effects on wolves, grizzly bears, loons, and eagles. These are all wide-ranging species so effects range from local to regional. Impacts on grizzly bears and gray wolves would be adverse and long term because the netting activity would take place during a time when human activity is usually low and both species are preparing for the winter. Impacts on the common loon and bald eagle would be adverse and beneficial and short and long term because while they would be affected by the netting operation, in the long term the actions would maintain the native fishery and their food source. Under Section 7, the determination would be "effect, not likely to adversely affect" for grey wolves and grizzly bears. Because this alternative would not result in major adverse impacts to threatened, endangered or species of concern resources, whose conservation is 1) necessary to fulfill specific purposes identified in the park's enabling legislation, 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or 3) identified as a goal in the park's *General Management Plan* or other relevant NPS planning documents, there would be no impairment of park threatened, endangered or species of concern resource values related to this alternative. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS *Management Policies* 2006.

Natural Sound

AFFECTED ENVIRONMENT

An important policy of the NPS is "to preserve, to the greatest extent possible, the natural soundscapes of parks" (NPS 2006). NPS strives to preserve the natural sounds associated with the biological resources of the Glacier National Park. Natural soundscapes can be transmitted in a mixture of all nature's elements and in a wide audible range. They are an important resource and have intrinsic value as a part of the unique environment of the park. Natural sounds of wind, water, animals and other natural phenomena predominated through most of the park. Natural quiet exists when the sound of these natural components of the park prevail.

Human activities generate artificial noise depending on time and place. In the visitor use zone, noise may come from cars, motorboats, high concentrations of visitors, scenic air tours, railroad traffic, developed area activity and general maintenance and administration. The project area is found entirely in the backcountry zone of the park (NPS 1999). The backcountry zone is dominated by natural quiet. About 95% of the park is recommended wilderness where natural quiet is considered an important resource. Scenic air tours may still be heard on occasion but, for the most part, other artificial noise would not be detectable; only the natural sounds preserved in wilderness areas.

IMPACT ANALYSIS

METHODOLOGY

Natural soundscapes are defined as the variety of natural sounds comprising an ecosystem including the physical capacity for transmitting those natural sounds and the interrelationships among park natural sounds of different frequencies and volumes in the absence of human-caused sound. Impacts on natural sounds were evaluated based on park staff knowledge of the project area and amount and type of activity that occurs. The proposed activity would take place in recommended wilderness where the natural ambient soundscape is of high importance for visitors and wildlife.

Negligible: There would be no introduction of artificial noise into the park.

Minor: A short-term introduction of artificial noise would occur at localized sites. The effect would be readily detectable, but would not adversely affect visitors or wildlife.

Moderate: A widespread introduction of artificial noise would be readily detectable and would adversely affect nearby visitors and wildlife.

Major: A long-term introduction of artificial noise would occur that would adversely affect visitors and wildlife.

Short-term: Effects extend only through the period of netting operations.

Long-term: Effects extend beyond the period of netting operations.

IMPACTS OF ALTERNATIVE A – NO ACTION

There would be no impacts to the natural sound around Quartz Lake under the no action alternative as there would be no introduction of additional human generated artificial noise.

Cumulative Impacts

Cumulatively, this alternative would have no cumulative impacts on natural sound based on no additional changes to the artificial noise that already occurs from scenic air tours and visitor use in the project area.

Conclusion

The no action alternative would not directly or indirectly generate artificial noise. There would be no effect on natural sound. There would be no cumulative impacts.

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

IMPACT ANALYSIS OF ALTERNATIVE B – THE PREFERRED

The preferred alternative would result in moderate impacts to natural sound during the netting operation while the motorized boat would be in use. The majority of the time the engine of the motor boat would be operating at its lowest speeds, generating as little noise as possible. However, given the remote setting and high level of quietude, this noise would be highly audible and could adversely affect nearby visitors. Field crews would be present during times (October – November) when human presence is usually low to non-existent. This would be an additional impact but would not elevate the level of impact. The preferred alternative would have localized, moderate, short-term, and adverse impacts to the natural soundscape of the Quartz Lake area.

Cumulative Impacts of Alternative B

Cumulatively, this alternative would have localized to widespread, minor to moderate, adverse, and short and long-term impacts on natural sound. This project would add additional unnatural sound to other sounds already periodically present at Quartz Lake including scenic air tours, administrative flights, trail maintenance, and visitor use in recommended wilderness areas.

Conclusion

The impacts of Alternative B on natural sound resources would be minor to moderate, adverse, and localized, short and long-term because of the addition of 10-12 weeks of activity and noise at the project site.

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

Visitor Use and Experience

AFFECTED ENVIRONMENT

Glacier National Park was established in 1910. Interest of the park grew as the Great Northern Railway provided wilderness advocates, conservationist, and general outdoor enthusiast access to the confluence of the Middle and North forks of the Flathead River, leading the way into the park. Early visitors created a heritage of hiking, fishing, and wildlife viewing in the park. Today, an average of 1.8 million visitors (according to the last 10 years, NPS files) enjoys the spectacular scenery and world class recreation opportunities in Glacier every year. The park is 95% recommended wilderness, giving ample opportunities for visitors to experience the importance of wild places whether on extended backcountry wilderness hikes, day hikes, or simply enjoying

the views from the roads or lodges. In 2007 approximately 28% of visitors stayed overnight in the backcountry parkwide. This represented a 9% increase from 2006. From 1997 through 2007 there was an average of 482 camper use nights at Quartz Lake. Quartz Lake campground is not within the top 20 campsites used in Glacier National Park.

IMPACT ANALYSIS

METHODOLOGY

Potential impacts to visitors associated with backcountry visitation within the project area were evaluated based on staff knowledge of visitor use levels and preferences.

Negligible: Visitors would not be affected or changes in visitor use and 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 experience would be detectable, although the changes would be minor. The visitor would be aware of the effects associated with the alternative, but the effects would be minor.

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

Major: Changes in visitor use and 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 or one month.

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

IMPACTS OF ALTERNATIVE A – THE NO ACTION

Under the no action alternative, visitors to Middle Quartz, Quartz, and Cerulean lakes could be disappointed in the lack of readily available fishing opportunities. Lake trout would eliminate the native fish assemblage currently present. Lake trout inhabit deeper waters which are hard to reach by conventional shore based fishing methods, especially during high use summer months when lake trout use deeper habitats. Visitors might be deterred by this; which would result in minor to moderate, adverse impacts to visitors wishing to fish in the recommended wilderness lakes. Other visitors might not notice this change; which would result in negligible impacts to visitors. Overall, visitors would experience negligible to moderate, localized, long-term adverse impacts.

Cumulative Impacts of the No Action Alternative

The no action alternative combined with past, on-going, and future actions would result in a wide range of impacts varying on visitor awareness and frequency of visits. First time visitors might not know the value of fishing in wilderness lakes, appreciate the rewards of yearly trail maintenance, nor notice the noise generated by administrative over flights. Returning visitors might be more accustomed to conditions available previously which would result in moderate impacts as changes would be apparent. Impacts could be short-term as in the case of over flights or trail clearing. Or impacts could be long-term as in the case of loss of fishing opportunities. Impacts would also be both beneficial and adverse. Trail maintenance would benefit the visitor but use of chainsaws and over flights might cause an adverse reaction from a visitor. Therefore the cumulative impacts of the no action alternative would be negligible to moderate, short and long-term, beneficial and adverse.

Conclusion

The no action alternative would result in negligible to moderate, localized long term adverse impacts on visitor experience due to the loss of the native fishery and cumulative impacts would be negligible to moderate, short and long-term, beneficial and adverse.

IMPACT ANALYSIS OF ALTERNATIVE B – THE PREFERRED

Under Alternative B, native fishing opportunities would be protected in Middle Quartz, Quartz, and Cerulean lakes. The use of a motorized boat and the presence of a field crew for an extended period of time would diminish the wilderness experience being sought by visitors. The trailhead and backcountry permit office would be posted with a notification of operations occurring at Quartz Lake to inform visitors of what is occurring to mitigate actions in the preferred alternative that might interfere with visitor use and experience. In general, visitors would experience minor to moderate, short-term, adverse impacts from the motorized boat and presence of a field crew. However this experience could also have long-term impacts which could be beneficial if they understand the importance of preserving a native fishery or adverse if they were seeking a non-motorized wilderness experience. Overall, impacts to visitor use and experience would be minor to moderate, adverse, and short-term because of the presence of the motorized boat but would also be long-term beneficial by protecting the native fishery.

Cumulative Impacts of Alternative B

The impacts of Alternative B combined with other activities present at the lake such as trail work would have negligible to moderate, beneficial and adverse, short and long term localized impacts on visitor experiences because of potential disturbance caused by the project activity and other activities in the area and long term preservation of the native fishery.

Conclusion

Impacts on visitor experience from Alternative B would be minor to moderate, short-term, localized adverse impacts to visitor from the netting operation for the length of the project. However, upon completion, the area would appear no different than before the project began which would result in long term moderate, beneficial impacts to visitor use and experience.

COMPLIANCE WITH FEDERAL AND STATE REGULATIONS

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. If the environmental effects are undetermined then an Environmental Assessment is prepared to evaluate potential impacts. This Environmental Assessment meets the requirements of the NEPA and regulations on 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 impact (FONSI) would be prepared. If significant impacts are identified, then a notice of intent (NOI) would be filed for preparation of an Environmental Impact Statement.

The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) – Section 7 of the Endangered Species Act is designed to ensure that any action authorized, funded, or carried out

by a federal agency likely would not jeopardize the continued existence of any endangered or threatened plant or animal species. If a federal action may affect threatened or endangered species, then consultation with the U.S. Fish and Wildlife Service is required. The National Park Service has determined that the preferred alternative would have no effect, on Spalding's catchfly, water howellia, Canada lynx, or gray wolf and "may affect, but not likely to adversely affect" grizzly bears. Effects on bull trout are addressed under an existing programmatic Section 10 permit for bull trout conservation and recovery actions issued by the USFWS to GNP on September 30, 2008.

Clean Water Act (CWA) and State and Local Water Quality and Floodplain Regulations—If the preferred alternative is implemented, all necessary federal, state and local permits would be obtained to ensure compliance with the Clean Water Act. These include a Section 404 permit from the Army Corps of Engineers, a Montana DEQ 3A permit, a Nondegradation Review Permit from Montana DEQ and a Montana Fish, Wildlife and Parks 124 Permit (Stream Protection Act). The proposed fish barrier is functionally dependent upon water and is exempt from compliance with Executive Order 11988 according to National Park Service Floodplain Management Guidelines, 1993. The structure would not modify or occupy the floodplain in such a way that it would have a meaningful affect on flood floodplain processes.

National Historic Preservation Act of 1996, as amended (16 U.S.C. 470, et Seq.) – Section 106 of the National Historic Preservation Act of 1966 (as amended) requires federal agencies to consider effects of any federal action on cultural resources eligible for or listed in the National Register of Historic Places (NHRP), prior to initiating such actions. Glacier National Park, the Advisory Council on Historic Preservation, and the Montana State Historic Preservation Officer (SHPO) have executed a Programmatic Agreement (PA) for the management of historic properties in the park. The Agreement outlines procedures for complying with Section 106 identification and evaluation and findings of effect in defined instances. The proposed project falls under the Programmatic Agreement, therefore no further Section 106 review is required. However, if a boat house is required, the park would perform an archeological survey and site the boat house so it is not visible from the historic cabin. Consultation would occur with the SHPO with the anticipation of reaching a finding of "no adverse effect." No further consultation is required with the Confederated Salish and Kootenai Tribes or the Blackfeet Tribe per their comments received during scoping. Glacier National Park prepares an annual report to the SHPO that lists the activities carried out under the terms of the PA. This project would be documented in the park's FY04 annual report.

Wilderness Act of 1964. Section 4(c) of the 1964 Wilderness Act states: " Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area." The use of a motorboat on Quartz Lake would be addressed using the "Minimum Requirement/Minimum Tool" assessment process. (Appendix A).

CONSULTATION / COORDINATION

Preparers and Consultants

Mary Riddle, Team Captain – project description, alternative development, document compilation, editing, formatting, supervision, quality review, coordinate internal and regional reviews and agency consultation.
Chris Downs, Fisheries Biologist, co-Team Captain – project description/plan concept design, alternative development, Fisheries/T&E/Water Resources sections
Kyle Johnson, Wilderness Coordinator – wilderness section
Karen Stockmann, Compliance Biological Science Technician – assisted with wildlife section, T&E species section, visitor use and experience, natural sound and biological assessment. Also assisted with editing, formatting, and compilation
John Waller, Wildlife Biologist – wildlife and T&E sections

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

Federal and International

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

State

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

Tribes

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

County and City

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

Organizations

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

Individuals

A complete list is available upon request

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APPENDIX A
Minimum Requirement/Minimum Tool Analysis

GLACIER NATIONAL PARK

MINIMUM REQUIREMENT DECISION GUIDE

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act."

– Wilderness Act, 1964

Instructions and worksheets for the Minimum Requirement Analysis for actions, projects, and activities in Wilderness

The Minimum Requirement Decision Guide (MRDG) is designed for wilderness administrators to effectively analyze proposed actions to minimize negative impacts to wilderness character and values. It assumes a basic knowledge of the Wilderness Act of 1964, agency policies, and specific provisions of the wilderness designation legislation for each unit. This guide is suggested for wilderness administrators for the four federal land management agencies, the Bureau of Land Management, the National Park Service, the U.S. Fish & Wildlife Service and the U.S. Forest Service.

Section 4(c) of the Wilderness Act of 1964 prohibits certain activities in wilderness by the public, and, at the same time allows the agencies to engage in those prohibited activities in some situations. Section 4(c) states:

> "… except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Therefore, unless a generally prohibited use is allowed by specific unit designation, most of these activities are prohibited. However, in the above language, Congress acknowledged that there are times when exceptions are allowed to meet the minimum required administration of the area as wilderness.

How to Use This Guide

The MRDG displays a two-step process to assist in making the right decision for wilderness. First, the administrator must decide if a problem or issue in the wilderness unit needs administrative action, and then, and only then, the administrator must decide what tool/action/method, available from a range of identified alternatives, would minimize negative impacts on wilderness character and values. This guide includes templates for documenting both steps of the decision-making process, instructions for completing each step, and a cover sheet for signatures

STEP 1 – DETERMINING THE MINIMUM REQUIREMENT

SHEET 1

Is Administrative Action Needed?

What is the problem/issue that **may** require administrative action? Do not include methods or tools here. This sheet only refers to the issue or problem, not proposed action/project, or tools to be used. Include references from other legislation, policy, or plans, decisions, analyses, and how this issue is addressed in those documents.

Briefly describe the issue/problem: Lake trout have invaded Quartz Lake and threaten native bull and westslope cutthroat trout populations. Lake trout consistently displace bull trout wherever they are introduced, and have already replaced bull trout as the dominant aquatic predator in most of the large west-side lakes in Glacier NP (GNP). The NPS Organic Act which established the NPS to manage National Park lands directs managers to conserve the wildlife of the parks in a manner unimpaired for future generations. NPS management policies have interpreted this to mean conservation of native plants and animals and the natural processes that sustain them. The presence of non-native fish (e.g. lake trout) threatens both the animals themselves (i.e. native fish through predation and competition) and the processes that sustain them (i.e. food webs will be disrupted). Research is needed to understand lake trout population dynamics, lake trout population status, lake trout spawning locations, and to develop and test effective control methods. Direct removal of fish is the only tool currently available to deal with lake trout invasions in large lakes, and in light of this, is the approach we are pursuing for Quartz Lake. This will be a challenging endeavor due to in large part to the remote nature of the lake system and the lack of road access to readilydeliver the necessary equipment/supplies. However, if the population is newly established and is fairly small as is suspected, some advantages to eradication/suppression may be conferred if spawning and rearing areas can be identified and effectively targeted by nets.

The following questions assist in analyzing whether the issue needs to be resolved in wilderness. Do not consider what tools are to be used here. Please circle **Yes** or **No**, and explain your reasoning:

1. Is this an emergency? Yes No **X** If yes, follow established procedures for Search and rescue (SAR), fire or other plans/policies. If no, please continue.

2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc? Yes No X
   If no, continue with **Sheet 1**.
   If yes, briefly explain here and then proceed to **Sheet 3**

3. Can the problem/issue be addressed by administrative actions outside a wilderness area? (For example, the administrative actions could be an information program at the visitor center or trailhead instead of a physical action in the wilderness, etc) Yes NoX
   If yes, conduct actions outside wilderness. If no, continue with **Sheet 1**.

4. Is there a special provision in legislation (the 1964 Wilderness Act or subsequent laws), that allows this project or activity? (For example, maintenance of dams or water storage facilities, access to private inholdings, etc.) Yes No X **If yes, Go to SHEET 3; if no, Go To SHEET 2.**

STEP 1: DETERMINING THE MINIMUM REQUIREMENT (Continued)
SHEET 2

Is Administrative Action Needed? (Continued)

The following questions are provided to evaluate whether resolving the issue protects wilderness character and values identified in the Wilderness Act. Answer the questions in terms of the need to resolve the issue/problem. If the answer to most of the questions is yes, then the issue/problem probably requires administrative action. **Please circle Yes or No for each answer, and briefly explain.**

1. If the issue/problem is not resolved, or action is not taken, will the natural processes of the wilderness be adversely affected?

   Yes X No **Why/How?**

   Native fish will be adversely impacted, up to the point of possible extinction from the Quartz Lake system if we are not able to successfully suppress the lake trout population. Native fish (both bull and westslope cutthroat trout) are a key component of the wilderness experience in GNP, and the loss of the native fishery from this system will significantly lessen the wilderness experience for visitors. Such impacts are not consistent with the NPS Organic Act, as these wilderness resources would not be passed on to future generations in an unimpaired state. Food web processes will also likely be impacted. As stream spawning salmonids, bull and westslope cutthroat trout provide for a transfer of energy from the lake environment to the terrestrial environment. By spawning (and sometimes dying) in stream environments, both bull and westslope cutthroat trout provide valuable nutrients to stream systems and the surrounding riparian zone that would otherwise be unavailable. Their offspring are available to terrestrial and avian predators such as mink, otter, and loons in tributary streams and shallow areas of the lake. In contrast, adult lake trout are a lake spawning fish and generally inhabit deep water, as do their offspring. As such, they will not be readily available to fish-eating birds and mammals. Lake trout have elevated levels of mercury in park waters, and maintaining populations of native fish such as westslope cutthroat trout will provide a safer food source for park wildlife and visitors. Currently, removal netting is the only technique available to manage non-native lake trout. To safely and efficiently accomplish such a project, it will require the use of a motor boat on Quartz Lake.

2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened?

   Yes X No **Why/How**

   Quartz Lake supports native bull and westslope cutthroat trout, which contribute to the values of solitude or primitive or unconfined recreation. People visit Quartz Lake for quiet enjoyment of the wilderness as well as its native aquatic resources. If native fish are lost or severely impacted in this system, we will lose an important component of the unique wildness experience that GNP affords. The opportunity to catch a wild, native fish in a wilderness setting draws many back-country visitors to remote areas of GNP, including Quartz Lake. Lake trout are not as readily accessible to the average angler and often require specialized gear to target consistently and effectively. Cutthroat and bull trout are readily caught on fly and light spinning tackle, the preferred fishing methods for wilderness anglers. Visitors to Quartz Lake who choose to fish will certainly notice the difference if native fish are replaced with non-native lake trout.

See attached pages for responses to questions 3-6

STEP 2: DETERMINIMG THE MINIMUM TOOL
SHEET 3: Determining the Minimum Tool: Fill out a Sheet 3 for each alternative.

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

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Alternative # ____1__

Describe briefly or attach description:

– 1. Utilize the canoe currently located at Quartz Lake, or other non-motorized watercraft, to conduct telemetry and experimentally suppress lake trout. Researchers would need to transport staff (2-3) and gear (multiple tubs of gill nets, radio telemetry gear, survival/safety gear) and work in and from the canoe/non-motorized boat. It would be necessary to set and deploy the nets from the canoe/non-motorized boat, and travel around the lake in a timely fashion to retrieve them to prevent excessive mortality of bull trout (potentially set and retrieve individual nets within the hour). It would be necessary to catch the lake trout for tagging, remove them from the net, transport them to shore in a live-well or tub, and implant the transmitter into the lake trout using a hand propelled canoe/boat. It would be necessary to conduct portions of the project in October when weather conditions can change quickly, lake surface conditions can be very rough, and water/air temperatures are dangerously cold. Due to project requirements for expeditous travel around the lake (to tend nets frequently, fish sufficient amounts of net, and track fish) it would not be safe, efficient, or effective to attempt this project from a canoe or non-motorized watercraft.

Circle yes or no:

Does this alternative involve:

use of temporary road?	Yes	No X
use of motor vehicles?	Yes	No X
use of motorized equipment?	Yes	No X
use of motorboats?	Yes	No X
landing of airplanes?	Yes	No X
landing of helicopters?	Yes	No X
use of mechanical transport?	Yes	No X
creating a structure or installation?	Yes	No X
Other impacts to wilderness character? _____	Yes	No X

The next set of descriptions may be put on Optional SHEET 3a, if desired:

Summarize the biophysical effects/benefits of this alternative:

Summarize the social/recreation effects/benefits

Summarize health and safety concerns/benefits**:**

Summarize economic and timing considerations/benefits.

Summarize heritage resource considerations/benefits.

How would the project contribute to the protection of wilderness character as defined by the Wilderness Act Section 2(c): Untrammeled, Undeveloped, Natural, Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation and other unique components that reflect the character of each wilderness

Would the project adversely affect wilderness character as defined by the Wilderness Act Section 2(c)?
Does the project or any of its alternatives involve the use any of the Wilderness Act Section 4(c) prohibited uses: commercial enterprise, permanent road, temporary road, motor vehicles, motorized equipment, motorboats, landing of aircraft, mechanical transport, structure, or installation?

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

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Alternative # ____2___

2. This alternative utilizes a motor boat approximately 18' long to capture lake trout using gill nets, conduct radio telemetry, and experimentally remove lake trout. This boat would need to be flow in by helicopter and stationed at Quartz Lake for the duration of the project (currently 4 years). Fuel for the boat would either need to be packed or flown in. This boat would allow for a 2-3 person crew to safely capture, tag, and track lake trout under a variety of weather conditions and seasons on Quartz Lake. It would also allow such a crew to safely deploy and retrieve gill nets under a variety of weather conditions. Such a boat could be removed from the lake during winter and stored on site. However, effectiveness at experimentally removing lake trout would be limited by the amount of net that could be deployed and retrieved by hand each day (hundreds of meters of net/day).

Circle yes or no:

Does this alternative involve:

use of temporary road?	Yes	No X
use of motor vehicles?	Yes	No X
use of motorized equipment?	YesX	No
use of motorboats?	Yes X	No
landing of airplanes?	Yes	No X
landing of helicopters?	Yes	No
use of mechanical transport?	YesX	No
creating a structure or installation?	Yes	No
Other impacts to wilderness character? _____	Yes	No X

The next set of descriptions may be put on Optional SHEET 3a, if desired:

Summarize the biophysical effects/benefits of this alternative:

Summarize the social/recreation effects/benefits

Summarize health and safety concerns/benefits**:**

Summarize economic and timing considerations/benefits.

Summarize heritage resource considerations/benefits.

How would the project contribute to the protection of wilderness character as defined by the Wilderness Act Section 2(c): Untrammeled, Undeveloped, Natural, Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation and other unique components that reflect the character of each wilderness

Would the project adversely affect wilderness character as defined by the Wilderness Act Section 2(c)?
Does the project or any of its alternatives involve the use any of the Wilderness Act Section 4(c) prohibited uses: commercial enterprise, permanent road, temporary road, motor vehicles, motorized equipment, motorboats, landing of aircraft, mechanical transport, structure, or installation?

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

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Alternative # ____3___

3. This alternative utilizes a combination of two motor boats, one approximately 18' long and the other approximately 26' long to capture lake trout using gill nets, conduct radio telemetry, and experimentally remove lake trout. The 18' boat would be used for radio tracking lake trout over an extended period of time (as well as for netting), and the bigger boat would be used for short duration (several weeks/year) intensive gill netting efforts in which large amounts of gill net are deployed to capture and experimentally remove lake trout (similar to Yellowstone or Swan lakes lake trout removal programs). Fuel for the boats would either need to be packed or flown in. These boats would allow for two 2-3 person crews to safely capture, tag, and track lake trout under a variety of weather conditions and seasons on Quartz Lake. It would also allow such a crew to safely and quickly deploy and retrieve large amounts of gill nets under a variety of weather conditions. This combination of boats is likely to offer the highest chance of success at eradicating/suppressing lake trout in Quartz Lake because the bigger boat would be equipped with hydraulics able to set and pull miles of gill net each day quickly, capturing more lake trout and at the same time reducing stress on any native fish captured in the nets incidentally through rapid deployment and retrieval of nets. We do not currently have funding to pay for a 26' contractor boat and crew, and additional logical issues would make this a more challenging option to implement.

Circle yes or no:

Does this alternative involve:

use of temporary road?	Yes	No X
use of motor vehicles?	Yes	No X
use of motorized equipment?	YesX	No
use of motorboats?	Yes X	No
landing of airplanes?	Yes	No X
landing of helicopters?	Yes	No
use of mechanical transport?	YesX	No
creating a structure or installation?	Yes	No
Other impacts to wilderness character? _____	Yes	No X

The next set of descriptions may be put on Optional SHEET 3a, if desired:

Summarize the biophysical effects/benefits of this alternative:

Summarize the social/recreation effects/benefits

Summarize health and safety concerns/benefits**:**

Summarize economic and timing considerations/benefits.

Summarize heritage resource considerations/benefits.

How would the project contribute to the protection of wilderness character as defined by the Wilderness Act

STEP 2: DETERMINING THE MINIMUM TOOL

Sheet 4: Selection of the Minimum Tool Alternative
Attach all alternative sheets to this summary page.

What is the method or tool that will allow the issue/problem to be resolved or an action to be implemented with a minimum of impacts to the wilderness?

The Selected alternative is # 2 Describe the rationale for selecting this alternative.

Alternative 3 would likely give the best chance of success for the project overall, but we currently do not have the funding to hire the additional short-term contractor boat. Also, the logistics required to move a larger (heavier) boat in to the lake requires specialized air support. The air support option exists, but requires additional technical assistance from either another U.S. Government agency, or a costly private contractor. Therefore, under the existing set of budgetary and logistical conditions, Alternative 2 is the selected alternative. It affords the ability to safely conduct radio-telemetry and gill netting on Quartz Lake across a wide seasonal range in lake conditions. The boat is large enough for the necessary crew and gear to safely work and travel on the lake, and accomplish tasks with a reasonable degree of efficiency. As the project develops further over time, alternative scenarios to increase effectiveness may be developed or revisited within this analysis.

Describe the specific operating requirements for the action. Include information on timing, locations, type of actions, etc. (Use this space or attach a separate sheet)
See attached.

What are the maintenance requirements?
See attached.

What standards and designs will apply? Develop and describe any mitigation measures that apply. **See attached.**

What will be provided for monitoring and feedback to strengthen future effects and preventative actions to be taken to help in future efforts? **See attached.**

Prepared by:_____Date:_____
Recommended by:
_____Wilderness Manager Date:_____
_____Chief Ranger Date:_____
Approved by:

_____Superintendent Date:_____

Minimum Tool Analysis for Quartz Lake Lake Trout Status and Experimental Suppression Project
Questions 3-6

3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable ?

Yes X No **Why/How**

The lake trout problem currently faced by GNP in the Flathead River drainage (including the Quartz Lake system) is a direct result of human manipulation. Two factors have directly contributed to this problem. The first factor was the introduction of lake trout into Flathead Lake in 1905 to enhance the recreational fishery. The second key factor was the introduction of opossum shrimp, mysis relicta, to the system in 1968. Shrimp were stocked into Whitefish, Swan, Ashley, and Tally lakes starting in 1968. From there they spread into Flathead Lake, significantly altering the foodweb. It is hypothesized that the shrimp failed to meet their original objective to stimulate kokanee growth, but provided abundant food for juvenile lake trout. This allowed the lake trout population to expand rapidly, and has resulted in fish spreading up into the forks of the Flathead River and into remote areas of Glacier National Park. The results of lake trout invasion are already evident to park users in other park waters (e.g. Logging, Bowman, Kintla, and McDonald lakes) where bull trout have been replaced by lake trout. If successful action is not taken, Quartz Lake will likely be adversely impacted by an increasing lake trout population and evidence of human manipulation will be substantially and clearly noticeable.

4. Does addressing the issue/problem or taking action protect the wilderness as a whole as opposed to a single resource?

Yes X No **Why/How**

We are focusing this project on protecting the aquatic ecosystem in one lake system, but the problem has been manifested at a wide scale across the park in the Flathead River drainage. What we learn in this project will help guide management of other waters, and the park's aquatic ecosystems as a whole. This project is broader than protecting a single resource, as terrestrial and aquatic ecosystems are tied together. A healthy aquatic system will support a healthy terrestrial system. The opposite is also true. As such, protecting populations of native fish species, such as bull and westslope cutthroat trout supports good wilderness management and protection, and is one measure of our effectiveness in managing wilderness. That is, if populations of these species are stable or improving, we are likely doing a good job of managing the wilderness.

5. Does addressing this issue/problem or taking action contribute to protection of an enduring resource of wilderness for future generations?

Yes X No **Why/How**

Native fish conservation in the Quartz Lake system represents protection of an enduring resource of wilderness for future generations. Non-native lake trout in Quartz Lake threaten to damage the native Quartz Lake ecosystem permanently. If allowed to do so, a significant portion of the

evolutionary legacy of GNP's aquatic systems will be lost from the system. Successful implementation of a project that keeps the lake trout population in Quartz Lake at low levels protects an enduring resource (native fish populations) of wilderness for future generations

6. Is this an issue for reasons other than convenience or cost of administration?

Yes No X **Why/How**

The only viable approach to addressing the issue is to understand the existing population dynamics of Quartz Lake lake trout, identify their spawning areas, and attempt to remove as many lake trout as possible. This can only be accomplished effectively and safely by the use of motorized boats and nets. The only way to get a motor boat into Quartz Lake that would meet project needs would be to fly it in using a helicopter.

Operation and Maintenance Requirements

Attachment to Minimum Tool Analysis for experimental Quartz Lake lake trout suppression project

Describe the specific operating requirements for the action. Include information on timing, locations, type of actions, etc. (Use this space or attach a separate sheet)

This project will require the operation of a helicopter in proposed wilderness in Glacier NP. We project we will need one flight into the lake with the boat, and a second flight in with the boat motor due to aircraft weight limits. The flight in with the boat and equipment would occur during summer/fall. The boat would remain on-site for the duration of the project. A flight would be required at the end of the project to haul the boat and motor out. The boat would be used to capture, tag, track, and selectively remove lake trout from Quartz Lake. The majority of the motorized activity on the lake will occur during September and October, to coincide with lake trout staging and spawning activity. This timing would also reduce bull trout by-catch as many adults would be in the tributaries spawning. By focusing our much of our effort in September and October, we would minimize visibility to visitors as well.

What are the maintenance requirements?

We anticipate being able to service the boat and motor at the lake location, assuming no unanticipated major equipment failures occur. We will have to pack or fly fuel into the project site as needed. Beyond the four-year experimental phase of the project, the project would likely require continued use of motor boats on Quartz Lake into the future to continue suppression efforts.

What standards and designs will apply? Develop and describe any mitigation measures that apply.

We anticipate using a 4 stroke motor on the 18' boat, which will reduce noise and exhaust emissions. By stationing the boat at the lake, we will minimize the number of helicopter flights

associated with the project. By concentrating project operations in September and October, we will reduce impacts to visitors as well as nesting birds.

What will be provided for monitoring and feedback to strengthen future effects and preventative actions to be taken to help in future efforts?

This project represents an experimental attempt to control lake trout in a remote wilderness lake. We will learn from our efforts and adjust our approach as more information on effective lake trout control methods is developed. We are currently exploring options for construction of fish passage barriers to prevent new invasions of non-native fish in other systems. Pro-active conservation methods such as establishing conservation populations of native salmonids in areas of the park secure from non-native fish invasions are also being evaluated.