FINDING OF NO SIGNIFICANT IMPACT

Proposed Study of Hydrological, Glacial and Meteorological Factors that Control Water and Sediment Input to Lake Peters in Arctic National Wildlife Refuge

Arctic National Wildlife Refuge received an application for a special use permit to study the factors that control water and sediment input to Lake Peters within the Arctic Refuge Wilderness Area. At 69°N, Lake Peters is 65 km south of the Arctic Ocean in the northeastern Brooks Range, and 50 km west of the McCall Glacier. The lake receives meltwater from some of the largest glaciers in Arctic Alaska and some projections indicate that these glaciers may disappear within the next fifty years.

The proposed project would include up to three years of monitoring and sediment sampling in the lake, its tributary streams, and on Chamberlin Glacier, the glacier closest to the lake. The goal of the project is to improve understanding of how modern-day climate controls processes that affect fish and wildlife habitat in glacier-fed watersheds, and to provide a better basis for interpreting cores from lake sediments that reveal wealth of information about how glaciers, hydrology, physical processes and biota have responded to climate change on millennial time scales. Collected data would be used to create and validate a model that could be used to forecast future changes.

A Draft Environmental Assessment (EA) that analyzes potential environmental impacts that could result from not conducting this study (Alternative A, the No Action Alternative) and conducting this study (Alternative B) was prepared and made available in April 2015 for an initial 15-day public comment period, which was subsequently extended to 30 days. An analysis of public comments received, with responses, is included in the Final EA.

The U.S. Fish and Wildlife Service has selected Alternative B (Proposed Action), with modifications to mitigate impacts to wilderness character, and determined that preparation of an Environmental Impact Statement is not necessary. This alternative was selected over the no action alternative because conducting the study is necessary for establishing baseline measures of naturalness within the Arctic Refuge Wilderness, and monitoring and predicting future changes to wilderness character. Mitigation measures that will substantially reduce the potential for impacts to wilderness character include the following:

No use of helicopters. Rather than use a helicopter to install and service meteorological instruments on the Chamberlin Glacier, researchers will transport the instruments on foot.

No use of tracer dye for measuring stream discharge. The use of tracer dyes will not be authorized for this project.

Restricted motorboat use. Researchers will primarily rely on a human-powered, inflatable canoe for checking on monitoring instruments. Motorboat use will be limited to those occasions when weather makes canoe-travel unsafe or impractical, or the stable platform provided by a hard-bottomed boat is necessary for making precise measurements. The size of any motor used will be restricted to five horsepower or less, and the boat will be required to travel at no-wake speed.

Use of existing facilities whenever possible. Researchers will limit the footprint and potential impacts of their camp operations by using existing facilities at Lake Peters for storage, cooking, and other work. Meteorological monitoring equipment proposed to be located near the shore of Lake Peters will be mounted on one of the existing G. William Holmes Research Station structures. The proposed generator, which will only be used when

solar chargers fail to provide sufficient power, will be housed within an existing storage structure when in use, thereby mitigating noise impacts.

Use of protective materials to limit vegetative trampling. Researchers will use remnant building materials from the G. William Holmes Research Station or import "geoblock" or similar material to protect camping and travel areas against trampling.

In addition to these mitigation measures, the proposed project will be governed by the standard conditions that are part of all special use permits issued by Arctic Refuge. These conditions are listed in the Final EA and include, among other things: Prohibitions against interfering with wildlife or refuge visitor activities and requirements for bear-safety practices and notification in case of bear-incidents.

The Proposed Action with mitigation measures could temporarily impact wilderness character, but the positive benefits that accrue from improved understanding of the natural system will endure. All data gathered during the project will be permanently archived at the Advanced Cooperative Arctic Data and Information Service and be available to the public. The action does not impact endangered or threatened species, and it does not impact subsistence use. Additional explanation of the No Significant Impact Finding follows:

Finding of No Significant Impact

This determination is based upon consideration that the Proposed Action:

- Is not national or regional in scope, but will occur in a limited area.
- Does not create a risk to public safety.
- Will not have impacts on unique characteristics of geographic areas such as loss or destruction of historical, cultural and scientific resources, or disturb critical ecological areas.
- Is not highly uncertain and does not involve unique or unknown risk.
- Will not establish a precedent for any future action with significant effects.
- Does not have cumulative effects.
- Complies with the Endangered Species Act and the Marine Mammal Protection Act.
- Will have no known irreversible or irretrievable commitments of resources identified by this assessment.

Based on my review and evaluation of the enclosed Environmental Assessment and other supporting documentation, I have determined that issuing a special use permit for the proposed study, with mitigation measures described here, is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(C) of the National Environmental Policy Act of 1969. Accordingly, preparation of an Environmental Impact Statement on the proposed action is not required.

Sarena M Selby

Acting Chief of Refuges, Alaska Region

15 May 2015

Date

Enclosure

ENVIRONMENTAL ASSESSMENT
for

PROPOSED STUDY OF HYDROLOGICAL, GLACIAL AND METEOROLOGICAL FACTORS THAT CONTROL WATER AND SEDIMENT INPUT TO LAKE PETERS

in

ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA

Prepared by
United States Department of the Interior
U.S. Fish and Wildlife Service
Arctic National Wildlife Refuge

May 2015

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1.0 INTRODUCTION

Northern Arizona University has submitted an application for a special Use Permit to study the hydrological, glacial and meteorological factors that control water and sediment input to Lake Peters within the Arctic NWR Wilderness Area. At 69°N, Lake Peters is 65 km south of the Arctic Ocean in the northeastern Brooks Range, and 50 km west of the McCall Glacier. The lake receives meltwater from some of the largest glaciers in Arctic Alaska and some projections indicate that these glaciers may disappear within the next fifty years (Nolan et al 2011).

The proposed project would include three years of monitoring and sediment sampling in the lake, its tributary streams, and on Chamberlin Glacier. The project involves some actions prohibited by Section 4C of the Wilderness Act, including a temporary weather station near existing cabins on the lakeshore (the site of the G. William Holmes Research Station), a temporary weather station on or near the glacier, use of a five horsepower outboard motor, and temporary installations such as turbidity sensors and other instrumentation moored in Peters Lake and outflow streams. These actions are only permissible when "necessary to meet the minimum requirements for the administration of the area for the purpose of this Act," which is to preserve wilderness character. No permanent installations are required for this study.

This environmental assessment (EA) analyzes the potential environmental impacts that could result from not conducting this study (Alternative A, the No Action Alternative) and conducting this study (Alternative B) and was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, and the Fish and Wildlife Service NEPA for National Wildlife Refuges Handbook (2014).

2.0 PURPOSE AND NEED FOR ACTION

The purpose of the proposed action is to provide Northern Arizona University (NAU) access to Peters Lake to study the hydrological, glacial and meteorological factors that control water and sediment input to the Lake. The need for the proposed action is to respond to the request for a Special Use Permit by NAU to monitor and sample sediment in the lake, in its tributary streams and on the Chamberlain Glacier over a three-year period.

The stated goal of this work is to improve understanding of how modern-day climate controls processes that affect fish and wildlife habitat in glacier-fed watersheds, and to provide a better basis for interpreting cores from lake sediments that reveal a wealth of information about how glaciers, hydrology, physical processes and biota have responded to climate change on millennial time scales. Collected data will be used to create and validate a model that can be used to forecast future changes

and provide a basis for interpreting paleolimnological data from cores collected from the Lake sediments.

2.1 Purposes and Significance of the Refuge

Arctic National Wildlife Range (Arctic Range, Range) was created in 1960 by Public Land Order (PLO) 2214. In its brief statement of purpose, PLO 2214 proclaimed the Range was established "to preserve unique wildlife, wilderness, and recreational values." The brief description of establishment history and motivations provided here is drawn from the Arctic NWR Comprehensive Conservation Plan and Environmental Impact Statement (2015).

Leaders of the campaign to establish the Range intended the word '"wildlife" to refer to all indigenous species and that natural behavior, interactions, and cycles would continue without human manipulation. In the words of campaign leader Olaus Murie, the intention was to maintain "the whole assemblage of living things which go to make up the rich life of that piece of country" (Murie 1958).

In the context of the emerging science of ecology, “wildlife value" emphasized the interrelatedness of all life forms and their environments, and the integrity of the underlying ecological and evolutionary processes. The area's "great scientific value," as characterized by plant ecologist Leslie Viereck (1959), was that it could serve "as a basis for understanding changes that take place in other areas disturbed by man."

The wilderness purpose of the Range encompassed tangible and intangible values, including but not limited to preservation of the area's natural and scenic condition and the wild character of its creatures and natural processes. The Range was to serve as a natural laboratory-a place to study how nature functions when left alone. Also inherent in the wilderness purpose was a cultural heritage value. This was to be a living legacy, a remnant of the American wilderness that helped shape our national character and identity and the sense of a "great beyond" that people feared was vanishing. The Range's wilderness qualities were to be timeless and its benefits enduring.

The Range was intended to offer a special kind of recreation, an authentic wildlands experience of a type increasingly hard to find elsewhere. The recreation purpose provided for a range of activities, including backpacking, river floating, hunting, fishing, wildlife watching, photography, and base-camping. But it was the natural, undeveloped character of the setting that was seen to afford a unique experience. The Range's extreme remoteness, natural condition, and wild character, unsurpassed anywhere on American soil, were to provide physical and psychological separation from the reminders of modern civilization.

In 1980, Alaska National Interest Lands Conservation Act (ANILCA) re-designated the Range as part of Arctic National Wildlife Refuge and provided the following four additional purposes that guide management of the entire Refuge:

> *(i) to conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, the Porcupine caribou herd (including participation in coordinating the Western Arctic caribou herd), polar bears, grizzly bears, muskox, Dall sheep, wolves, wolverines, snow geese, peregrine falcons and other migratory birds, and Arctic char and grayling*

Consistent with the Refuge's original intent to be inclusive of all species, ANILCA Section 102(17) clarifies, "The term 'fish and wildlife' means any member of the animal kingdom ... "

> *(ii) to fulfill the inte1-national treaty obligations of the United States with respect to fish and wildlife and their habitats*

This purpose recognizes the role the Refuge plays in meeting several treaty obligations related to conservation of the fish and polar bears that inhabit both Alaska and Canada, and the migratory birds shared by many nations.

> *(iii) to provide, in a manner consistent with the purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents*

ANILCA Title VIII provides a number of provisions to ensure that, consistent with other Refuge purposes, rural residents have the continued opportunity to use Refuge lands and resources to meet their physical, economic, traditional, and other needs.

> *(iv) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the refuge*

This purpose recognizes the protection of water resources is central to conservation of fish and wildlife and their encompassing ecological systems and processes. This purpose establishes an explicit, but unquantified, Federal reserved water right for surface waters and groundwater in the Refuge.

2.2 Authorities

The primary authorities for this action are ANILCA, the National Wildlife Administration Act as amended by the National Wildlife Refuge Improvement Act, and the Wilderness Act. These laws and associated regulations provide guidance for the development of this EA, design of the

Proposed Action, analysis of impacts, and creation of the mitigation measures to be implemented as part of the Proposed Action.

For national wildlife refuges in Alaska, ANILCA, as amended, provides direction for management and, in some cases ANILCA supersedes provisions of the Refuge Administration Act and Refuge System Improvement Act. ANILCA defined provisions for refuge planning and management, and authorized studies and programs related to wildlife and wildland resources, subsistence opportunities, and recreation and economic uses. ANILCA also provided specific direction for the management of designated Wilderness areas and wilderness study areas in the State of Alaska.

The National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (Refuge Administration Act) serves as the "organic act" for the National Wildlife Refuge System. The act, as amended, consolidated the various categories of lands administered by the Secretary of the Interior (Secretary) through the Service into a single, national system. The act establishes a unifying mission for the Refuge System, a process for determining compatible uses of refuges, and a requirement for preparing comprehensive conservation plans. This act states, first and foremost, that the mission of the Refuge System be focused singularly on wildlife conservation.

The Wilderness Act of 1964 (Public Law 88-577) established the National Wildlife Preservation System and provided direction for management of designated Wilderness areas. The purposes of the Wilderness Act are within and supplemental to the purposes of the Refuge.

The Wilderness Act in Section 2A definition of Wilderness states:

> (c) A Wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of Wilderness if further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements of human habituation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

3.0 DESCRIPTION OF ALTERNATIVES

3.1 Alternative A: No Action Alternative

Under the No Action Alternative, the proposed study would not be conducted. Products of the study, including development of a model that furthers understanding of how glacier, hydrology, and lake dynamics interact would not be produced. Climate change science would continue in other regions; however, the applicability of these studies to the watersheds in the Arctic Refuge would be limited by some unknown level of uncertainty. Other activities in the Lake Peters area, including subsistence, recreation and administrative uses would continue at present levels.

3.2 Alternative B (Proposed Action with mitigation measures): Developing a system model of Arctic glacial-lacustrine sedimentation for investigating past and future climate change (Short Title: Arctic Glacial Lakes Study)

Under this alternative, the study would be conducted as proposed, with the addition of mitigation measures identified during the public comment period, and standard special use permit conditions (Appendix A contains the updated project proposal, amended to include mitigation measures). The applicant requests a three-year special-use permit to study the hydrological, glacial, and meteorological factors that control water and sediment input to Lake Peters (NOTE: If approved, the applicant would receive a one-year permit with options to renew in each of the two subsequent years, rather than a three-year permit at the outset). The field campaign would include three years of monitoring and sediment sampling within the lake and its tributary streams, and measurements on the glacier closest to the lake (Chamberlin Glacier). No permanent installations would be authorized. Two temporary meteorological installations would include a monitoring station on the lakeshore (near the USFWS cabin complex) and another on the Chamberlain Glacier. The meteorological station on the glacier would re-occupy the site that was used in 1957-58 and the applicant would use the same protocols and instruments as the long-term weather station on McCall Glacier, enabling a direct correlation with the McCall station. In addition to weather stations, various sensors within the channel of several inflow streams and Lake Peters would be temporally deployed during the 2015-2017 time period.

Following is a description of the proposed uses and instruments that are generally prohibited by section 4c of the Wilderness Act, except where they are determined to be the minimum necessary for administering the area as wilderness.

- Fixed-wing access: The primary field camp will be deployed, serviced, and retrieved annually by single-engine bush-plane.

- Motor boat: To quantify the mass of sediment deposited at the bottom of Peters Lake, and to relate it to the physical properties of the water column, the permit applicant requests permission to use an inflatable raft with an outboard motor on Lake Peters between June and August during the three summers. The applicant states the need for the zodiac raft due to its hard-bottom floor feature, which is necessary for a stable working platform to deploy instrumentation, and the motor is necessary because a broad, flat-bottomed raft is not suited for paddling and may not be practical for accessing distant sites. The proposed raft is a 14-foot Achilles brand boat with removable floorboards. The proposed motor is a Mercury four-stroke, five horsepower outboard. Most travel and activity on the lake would be conducted with a human-powered inflatable canoe.

- Ice-auger: To sample sediment at 10 to 15 sites across the lake and deploy sediment traps during the spring when the lake is still covered by ice, the applicant requests the use of a gas powered ice auger to cut through the ice. A diameter of 16" is needed to collect samples and deploy sediment traps. The auger would only be used if using hand tools to cut through thick ice proves impractical.

- Generator: Field crews would have a small solar power system that would supply most electronics needs, but this system may not be sufficient during extending periods of cloudiness and heavy use. A portable 2000-watt generator would be used as a backup.

- Lake sampling and instrumentation: The applicant's primary goal is to determine how weather and climate control the rate of sediment accumulation. Sensors and equipment to assess sedimentation rates and physical factors that influence these rates would be deployed in lakes and streams. Cores from lake sediments would be collected to reconstruct sedimentation rates and associated climate and glacial history. There would be five mooring stations in the lake and five to seven discharge and water quality monitoring stations in tributaries. Lake moorings (10"-diameter buoy anchored to the sediment with a large rock) would be deployed year-round. Each mooring would be equipped with a radio-transmitter for relocation – this may make it possible for moorings to be deployed below the water surface and still be relocated in turbid glacial-fed water. If not already positioned below the water surface, prior to freeze-up, moorings would be positioned 2-3 meters below the water surface to avoid loss of moorings due to ice-rafting. Sediment traps and water quality and quantity sensors would be attached to each mooring station. Sediment that would be deposited on the bottom of the lake would be captured in sediment traps. Water quality sensors and data loggers will measure and record temperature, water level, and other physical and chemical parameters. All instrumentation would be removed at the end of the study. Sediment cores up to 4-meters deep would be collected from up to 15 sites in Lake Peters and at additional sites in Lake Schrader.

- Tributary sampling and instrumentation: Field crews would deploy instrumentation (Figure 1), collect water samples, and measure discharge to monitor water quantity and quality in tributaries. Field crew members would sample suspended sediments twice daily in the primary inflow stream to Lake Peters (Carnivore Creek) and less frequently in the tributary flowing from Chamberlin Glacier and other tributaries to Lake Peters. To obtain samples that represent a range of flow conditions an automated ISCO sampler would be deployed at either Carnivore Creek or the tributary flowing from Chamberlin glacier. The automated sampler will be concealed by a small rock enclosure to minimize its visibility. Because these samples are expected to contain large quantities of sediment it may be necessary to use a motorized pump to filter samples on site. Small volumes (30 ml) of water will be sampled from several streams on a regular basis to analyze for oxygen and hydrogen isotopes. Water level, turbidity, and temperature sensors will be deployed at each site, housed in a 2 x 2 x 2 foot mesh cage, and anchored with river rock (Figure 2). Instruments will be deployed during the open-water season. All instrumentation would be removed at the end of the study.

Figure 1. Proposed stream sampling sites.

Figure 2. Isco 3700C Compact Portable Sampler that would be deployed alongside stream to capture water samples in a wide-range of flow conditions. Note, the instrument would be camouflaged in a rock enclosure.

Figure 3. Cage to protect and stabilize instruments deployed in tributaries.

4.0 AFFECTED ENVIRONMENT

The Lake Peters and Schrader watershed is extraordinarily scenic. The two turquoise-colored, glacier-fed lakes in this watershed lie in a narrow, U-shaped valley with ridges and peaks rising over 4,900 feet on either side. The lakes are surrounded by prominent glacial features, including Chamberlin Glacier, arêtes, hanging glacial valleys, cirque glaciers, and surficial glacial deposits.

4.1 Wilderness Character

The proposed project, including three years of monitoring and sediment sampling within the lake and its tributary streams, and measurements on Chamberlin Glacier, and the temporary installation of weather stations and sampling instrumentation, would occur in the designated Wilderness area within Arctic National Wildlife Refuge. The fact that the proposal involves several actions and technologies normally prohibited in Wilderness is a primary reason for preparing this EA.

The overarching mandate of the Wilderness Act is to preserve a designated area's wilderness character. *Keeping It Wild*, the interagency protocol the U.S. Fish and Wildlife Service has adopted to monitor trends in wilderness character, describes wilderness character as "the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands" (Landres et al. 2008). Drawing upon the writings of Howard Zahniser, chief author of the Wilderness Act and one of the Arctic Range's founders, the protocol states that "fundamentally, wilderness character is the capacity of an area to elicit humility, awaken a sense of relationship and interconnectedness with the community of life, and evoke a feeling of restraint and obligation toward nature." Since first proposed as "The Last Great Wilderness" (Collins and Sumner 1953), the Arctic Refuge has become, as its founders intended, a symbolic landscape epitomizing wilderness character (Kaye 2006).

Wilderness character encompasses biophysical qualities and visitor experiences of them. But fundamental to understanding the effects of actions prohibited by the Wilderness Act (1964) is recognition that while designated Wilderness is a tangible place, it is also a symbolic landscape. It embodies intangible values and meanings for which the effects of allowing prohibited actions and technologies resist quantification. While critically important, criteria such as whether or the degree to which an action or technology might disturb flora, fauna, or visitors are not sufficient to judge their appropriateness in Wilderness.

The Wilderness Act prohibits the motorized tools, installations, and helicopter use and other actions for reasons that go beyond their physical impacts. The Act makes no exception for situations where prohibited actions and technologies may not cause a discernable impact or be encountered by visitors. They are at variance with a place that, as Service Wilderness Policy

(USFWS 2008) states, “represents a symbol of respect for the natural conditions and wildness that civilization has displaced” (610 1.13 C).

Intangible qualities are difficult to fairly consider against competing uses in analyses such as this. However, Service Wilderness Policy requires that we maintain both the tangible and intangible aspects of wilderness character. Recognizing both physical and intangible aspects of wilderness character, the Policy states that “We strengthen wilderness character with every decision to forego actions that have physical impact or would detract from the idea of wilderness as a place set apart . . . also by imposing limits on ourselves” (1.13 D).

4.2 Terrestrial Wildlife

The Lake Peters area supports a diverse array of birds and mammals. There have been 201 species of birds recorded on Arctic Refuge, and in the Brooks Range 107 species have been recorded. Of these, 68 are confirmed as breeding on the Refuge, and 38 are migrants, visitors or vagrants. Although some Refuge bird species have been well-studied, e.g., golden eagles and snow geese, distribution and abundance data are lacking for many. The Arctic Refuge Comprehensive Conservation Plan and Environmental Impact Statement (2015) summarizes what is known about the various species and species groups found on the Refuge.

Mammals are essential elements of Arctic Refuge ecosystems and they played an important role in establishment of the Refuge. The area proposed for Refuge establishment was often seen as a sanctuary for charismatic mammals (Kaye 2005), and now people from the local area and around the world come to the refuge to see or hunt large mammals in undisturbed habitats. Forty-seven species of mammals have been observed in Arctic Refuge, but with the exception of some large herbivores, few details are known about trends in abundance, distribution and habitat use.

Some of the terrestrial mammals used by humans or known to be important to ecosystem function that are likely to be found in the Lake Peters area include: Dall’s sheep, caribou, grizzly bear, wolf, river otter, wolverine, Alaska marmot, Arctic ground squirrel, and brown and collared lemmings.

4.3 Terrestrial Vegetation and Soils

Due to the cold, dry climate, the soils of the area are not well developed. Soil types of the Arctic Refuge have been described by Rieger et al. (1979). The Brooks Range consists mainly of very steep, exposed bedrock and coarse rubble surrounding alpine valleys and more gently sloping areas with shallow, very gravelly and stony soils. Steeper terrain has fewer, isolated bodies of

gravelly and stony soils. Gravelly glacial till and lake deposits underlie the Peters Lake basin and glacial outwash deposits extend from the mouths of creeks.

The vegetation of the area is adapted to the cold climate and the area's poorly developed soils. It is treeless alpine tundra, composed mainly of hardy dwarf shrubs, grasses, sedges, lichens and mosses. On mountain slopes, barren rock and sparse, dry dwarf shrub alpine tundra predominate. The lake basin has dry dwarf shrub tundra where soils are thin over glacial rubble and moist sedge-low shrub tundra on low, concave areas with deeper soils. Along the margins of rivers and creeks there are areas of low willow thickets.

4.4 Aquatic Ecosystems and Wildlife

Lake Peters is nearly four miles long, at least 100-feet deep, and lies at the base of what may be the tallest mountain in the Refuge (Mt. Chamberlin) where it receives water from numerous glacial and nonglacial tributaries. The nearly four-mile long lake was formed as till, outwash, and the broad delta of Whistler Creek dammed runoff in this drainage. A narrow 1.2 mile-long channel flows north from the lake and into Lake Schrader.

Most aquatic research projects in the watershed were based out of the G. William Holmes Research Station during the International Geophysical Years in the late 1950s. Meteorology in the surrounding watershed was studied during the summers of 1958-1961 (Larsson 1960, DePercin 1958, March 2009). From late June through August 1958, the USGS monitored discharge (USGS 1960) and associated hydrochemistry and sedimentation (Rainwater and Guy 1961) on two major tributaries to Lake Peters, Mt Chamberlin Creek, a glacier-fed tributary, and Neruokpukkoonga, a nonglacial tributary. The limnology of both lakes was the subject of John Hobbie's dissertation and several journal articles (1959, 1961, 1962, 1964). These studies had a large influence on the field of Arctic limnology and are still considered the most extensive limnological investigations conducted in the drainage, and possibly the Refuge.

Lake trout, arctic grayling, and arctic char have been documented in both lakes, but round whitefish have only been documented in Lake Schrader (Bendock and Burr 1985). The exceptionally large, deep, connected lakes provide the largest volume of overwintering habitat on the North Slope of the Refuge (Wilson 1977), where overwintering sites are few in number, restricted in area, and may be the major factor limiting populations of arctic fishes (Craig 1989). Arctic Grayling may migrate upstream from summer feeding areas in Itkilyariak Creek near the confluence of the Sadlerochit to overwintering habitat in Lake Schrader and the Kekituk River outflow (West and Wiswar 1984). Lake trout studies conducted in 1995 (Lubinski et al. 1999) indicated that lake trout density per unit area and weight to length ratios in Lake Schrader (Lubinski et al. 1999) are particularly high relative to comparable measurements in the other Brooks Range drainages.

There are no known invasive species in the Lake Peters watershed; however, to our knowledge, aquatic or terrestrial surveys have not been conducted.

4.5 Visitor Experience

The stunning beauty and central location for many recreational activities, including hiking, backpacking, mountain climbing, wildlife viewing, hunting and fishing have attracted visitors from around the world to the Neruokpuk Lakes complex. However, based on information reported by commercial service providers, annual visitor use is relatively low and variable from year to year. On average, at least three documented parties visit the area each year with support from authorized commercial service providers. An unknown number of additional parties also visit by accessing the area with personal airplanes or on foot from other locations.

4.6 Subsistence Use

Lake Peters and the larger Neruokpuk Lake complex are important subsistence use areas for residents of Kaktovik. However, subsistence activities are generally limited to winter and spring, when snow cover facilitates overland access from Kaktovik by snowmachine.

4.7 Neruokpuk Lakes Public Use Natural Area

The Neruokpuk Lakes Public Use Natural Area was established on May 2, 1977. It is approximately 212,000 acres and is the only Public Use Natural Area (PUNA) in the Refuge. It is located in the Brooks Range, entirely in the designated Wilderness area. It was chosen as a PUNA because of its relative ease of access, scenic beauty, and abundant wildlife.

The purposes of PUNAs are to preserve important natural areas for public use and to preserve these areas essentially unmodified by human activity for future use (Service 1988a). No management plan or objectives have been established for the Neruokpuk Lakes PUNA. However, it is managed as Wilderness, which ensures the integrity of this area.

4.8 History of the G. William Holmes Research Station

Administrative facilities at Lake Peters currently consist of four structures located on the east side of Lake Peters in the Franklin Mountains (figure x). Permanent administrative facilities were first constructed in 1958 when the US Geological Survey (USGS) established a permanent research station at Lake Peters (Dutro 1970). The Terrestrial Science Laboratory, U.S. Airforce (USAF) Cambridge Research Center owned the station, it was operated in cooperation with the USGS and the Office of Naval Research, and was one of several field research stations on the North Slope of Alaska. In 1970, this station was officially named the G. William Holmes Research

Station in dedication to the USGS staff member who selected the site and led the group who established the station (Dutro 1970).

Several notable studies based out of the station have made important contributions to various fields of science and have provided the Refuge with baseline data that could be used to assess changes in fish and wildlife habitat. Between 1958 and 1970, more than eighty scientists based out of the station while conducting research in twenty fields of science, including geology, meteorology, glaciology, hydrology, botany, archaeology, biology, and aquatic and terrestrial ecology. Some of these scientists included USFWS and Alaska Department of Fish and Game staff working on Dall's sheep, caribou and bears. Notable studies include John Hobbie's dissertation research on the limnology of Lake Peters and Schrader (Hobbie 1959, Hobbie 1961, Hobbie 1962, Hobbie 1964). In addition, the USGS based out of the station when doing survey work to create the 1:125,000 topography maps that are still used today. After the Naval Arctic Research Laboratory was closed down, the Refuge acquired and improved the facility. Later, the facility and surrounding area were included in the Wilderness area established by ANILCA (1980). In 1999, the Service altered and reduced the footprint from the original facility; it now includes a bunkhouse (448 square feet), a cookhouse (360 square feet) with a full kitchen, a warehouse (320 square feet) to store tools and equipment, and a newly renovated outhouse. The facility can be directly accessed via ski plane in the winter and float plane during the summer, and also by wheeled planes that can land a short distance away.

Figure 4. Administrative buildings at Lake Peters, August 2014.

5.0 ENVIRONMENTAL CONSEQUENCES

This section identifies, describes and compares possible environmental effects, or potential impacts, which could result from implementing the alternatives described. Specifically, effects on the following refuge resources were considered: Wilderness character, terrestrial wildlife, terrestrial vegetation and soils, aquatic ecosystems and wildlife, visitor experiences, and subsistence For each of these resources, we analyzed the impacts expected for the following list of activities identified from the Proposed Action: Motorized equipment on the lake (motor boat, augers); motorized equipment on shore (generator, water pump); airplane access; meteorological stations; camp use issues; sensors and gauges in streams; extracting cores from lake sediment. Effects listed are negative and direct unless stated otherwise.

5.1 Methodology

Current stewardship of the Arctic Refuge Wilderness and the Nuruokpuk Lakes Public Use Natural Area provides the basis for comparing the possible environmental effects of the alternatives. Possible effects of each alternative on various natural resources and opportunities for the public were compared using a set of general terms to describe the intensity, duration, scale, and nature of potential impacts. In this EA, these terms are defined as follows.

5.1.1 Intensity of the Impact

- No effect – Impacts resulting from the specified management action that would not affect resources on refuge lands or public use opportunities.
- Negligible – Impacts resulting from the specified management action that would have no measurable effect on refuge lands or public use opportunities.
- Minor – Impacts resulting from the specified management action that can be reasonably expected to have detectable though limited effect on resources on refuge lands or public use opportunities.
- Moderate – Impacts resulting from the specified management action that can be reasonably expected to have detectable and apparent effect on resources on refuge lands or public use opportunities.
- Major – Impacts resulting from the specified management action that can be reasonably expected to have readily apparent and substantial effect on resources on refuge lands or public use opportunities.

5.1.2 Duration of the Impact

- Temporary – Effects on resources on refuge lands or public use opportunities that would occur only during the three years of the project.
- Short-term – Effects on resources on refuge lands or public use opportunities that would extend beyond the three years of the project, but would not last more than two years after termination of the project.
- Long-term – Effects on resources on refuge lands or public use opportunities that would persist longer than two years after termination of the project.

5.1.3 Scale of the Impact

- Site-specific –impacts occurring at a specific site that is relatively small in size (e.g at individual lake and stream work sites, camping site or climate station sites).
- Local –impacts occurring throughout a specific area that is large in size (e.g., Nuruokpuk Lakes Public Use Natural Area).
- Wilderness Area –impacts occurring throughout the designated Wilderness area.

- Refuge-wide –impacts occurring throughout the refuge, but generally not affecting resources or public use opportunities outside the refuge.
- Regional –impacts occurring throughout or nearly throughout an area including, and much larger than, the refuge. For the Arctic Refuge, this would include the Alaskan North Slope, the Brooks Range, and eastern Interior Alaska.

5.1.4 Nature of the Impact

- Direct – Impacts resulting from the management action and occurring at the same time and place as the action.
- Indirect – Impacts resulting from the management action that are later in time and/or farther removed in distance, but are still reasonably foreseeable.
- Positive – Impacts resulting from management actions that maintain or enhance the quality and/or quantity of resources on refuge lands or public use opportunities.
- Negative – Impacts resulting from management actions that degrade the quality and/or quantity of resources on refuge lands or public use opportunities.

5.2 Cumulative Effects

We disclose the anticipated cumulative effects of each alternative on the biophysical and human environments and to reasonably foreseeable actions. Cumulative effects include the incremental effects of the actions for an alternative when these are added to past, present, and reasonably foreseeable future actions. Cumulative effects can be the result of individually minor impacts, which can be major when added over time.

5.3 Alternative A: No Action Alternative

5.3.1 Wilderness Character

Current stewardship actions (or inaction) aimed at preserving wilderness character will continue. Net change in wilderness character, as measured by the *Keeping it Wild* protocol, will be zero. However, estimates of change in character, especially to the naturalness quality, will be difficult because baseline data for describing past and present hydrologic conditions and inputs will not be available.

5.3.2 Terrestrial Wildlife

Current known impacts to wildlife are limited to habituation of small mammals (ground squirrels and porcupines) to the buildings at the research station. If the study is not done there will be no additional impacts.

5.3.3 Terrestrial Vegetation and Soils

The physical presence of buildings and the human trampling that has occurred from decades of occasional, short-term, concentrated use around the buildings has caused localized impacts to soils including: destruction of soil structure by compaction, removal of the uppermost organic layers of soil, delayed development of soils and soil organic layers, and soil erosion. Impacts to vegetation include: 1) direct effects of trampling of vegetation; 2) indirect effects of soil and snow compaction; 3) breakage of shrubs. The cabins have probably not caused impact to permafrost because they are built on gravelly ice-poor soil, which is not prone to subsidence when thawed.

Extensive research on trampling impacts has shown a curvilinear relationship between amount of use and amount of impact. In other words, most of the impacts occur with the first small amount of use, and additional use has limited additional impacts (Cole 2002). The government-owned administrative cabins at Lake Peters are used infrequently and for short periods, so impacts to vegetation and soils are at a low level and probably steady state, not deteriorating.

5.3.4 Aquatic Ecosystems and Wildlife

Under the No Action alternative, indirect effects of climate change on aquatic ecosystems and wildlife within the greater Lake Peters area will continue. These effects could be major, long-term, and extend to the regional scale. However, limited baseline or monitoring data will make impacts difficult to measure.

5.3.5 Visitor Experience

Current impacts on the experience of visitors at Lake Peters include the presence of the research station, which is visible from anywhere in the lake basin; occasional air plane traffic and landings; and rare, irregular helicopter traffic associated with authorized refuge research activities.

5.3.6 Subsistence Use

There are currently no known impacts on this resource. Two cabins on inholdings on Schrader Lake are used by residents of Kaktovik for subsistence activities, primarily in the late winter and spring.

5.4 Alternative B: (Proposed Action with mitigation) Developing a system model of Arctic glacial-lacustrine sedimentation for investigating past and future climate change

Climate is a primary driver of the natural physical and ecological processes occurring within Arctic NWR. Climate change is amplified in the Arctic, and many natural processes that shape fish and wildlife habitat are vulnerable to changes in temperature and precipitation regime (Martin et al. 2009). The influence of humans on global and regional climate is expected to bring significant changes to ecosystems of the Arctic NWR. Collecting, analyzing, interpreting and reporting on data that document these changes will help achieve the following Refuge purposes: To conserve fish and wildlife populations and habitats in their natural diversity; ensure necessary water quantity and quality and continued subsistence uses; and fulfill international treaty obligations with respect to fish and wildlife and their habitats.

In addition to improving our ability to understand long-term changes in the Lake Peters drainage, model results may also improve our understanding of processes that affect fish and wildlife habitat in nearby drainages. Some of the largest deltas in Arctic Alaska are fed by sediments that flow from glaciers near the Lake Peters watershed. These estuarine deltas provide important fish and wildlife habitat. Lake Peters also receives water from non-glaciated tributaries and may improve our understanding of how climate controls processes in these watersheds as well. Furthermore, because Lake Peters is close to the Arctic Ocean, the effects of changes in sea-ice cover on terrestrial conditions may be clearly represented at Lake Peters.

No other drainage basin in northern Alaska fulfills the requirements of this study. Lake Peters is the only deep lake with glaciers covering a large portion of its catchment. Because of the high sediment input and anoxic conditions that typify the bottom of deep glacier-fed lakes, Lake Peters is likely the only lake in northern Alaska with well-resolved (i.e. easily defined) annual layers. Relative to lakes farther from the Beaufort Sea, the sediment record from Lake Peters, may be more likely to reveal changes in ice cover in the Arctic Ocean, in particular, the Beaufort Sea. The study of Lake Peters also benefits from the long-term glaciological and meteorological monitoring at nearby McCall Glacier – the only glacier in Arctic Alaska with a long-term mass-balance record, which is needed for validating the system model. It also builds on the observations and analyses conducted at Chamberlin Glacier and Lake Schrader during the mid-late 1950s and early 1960's (De Percin 1958, Larsson 1960). Numerous studies of the Pleistocene

geology and mapping of bedrock geology in this region may provide background data to aid interpretation of study results.

The following sub-sections analyze specific impacts of the proposed action on each of the resources considered under Alternative A.

5.4.1 Wilderness Character

The *Keep It Wild* protocol has identified an area's Undeveloped Quality as one of five major components of wilderness character. In describing the undeveloped quality, the protocol cites the ideal definition of wilderness provided by Senator Hubert Humphrey, an original sponsor of the Wilderness Act: "the native condition of the area, undeveloped . . . untouched by the hand of man or his mechanical products."

The proposed actions and technologies degrade the following measures of the undeveloped quality of wilderness character: (1) authorized physical structures, installations or developments; (2) number of air taxi and transporter fixed wing aircraft drop-offs; and (3) number of authorized motor and mechanical uses.

Each of the proposed actions and technologies would be at variance with the idea of restraining technology as a gesture of respect for what Wilderness represents. Most would lessen the function of this wilderness as a place of forbearance, humility, and deference to nature's primacy—a place intended to provide for recreation, subsistence, and study, but in a manner that does not alter its undeveloped condition and leaves nothing behind. Each would diminish the area's symbolism, as Refuge founder Olaus Murie (1960) said, as "a little portion of our planet left alone and undeveloped . . . ."

The following lists each affected measure of the undeveloped quality, and the proposed actions, installations, and technologies included in that measure. It includes the most recent index of actions, installations and technologies now occurring in the Refuge Wilderness so comparisons can be made to the proposed situation. Each is weighted, from 1 to .25, based on subjective evaluation of its relative effect, and then further described in terms of intensity, duration and scale.

Measure 1: Index of authorized physical structures, installations, or developments.

<u>Proposed:</u>

- 2 weather stations, deployed year-around

Weighted .5 each, total = 1.0

- 5-7 sediment traps, deployed year-around, each installed on moorings, with buoys, radio transmitters, and data loggers

  Weighted .5 each, total = 2.5 – 3.5

- 6 gauging station installations with three instruments each, located on 2 or more streams, deployed spring-summer

  Weighted .5 each, total = 3

- 1 submersible vibracorer, used intermittently, for one month

  Weighted .25, total = .25

- 1 automated ISCO sampler

  Weighted .25, total = .25

Current: The 2013 index total for this measure is 12.5, based on 4 administrative structures on Lake Peters weighted as 1 each, and fourteen active weather stations and one tent platform weighed as .5 each.

Change: This project would increase the index total from 12.5 to between 18.0 and 19.0.

Figure 5. Locations of existing meteorological stations on McCall Glacier.

Measure 2: The number of Air Taxi and Transporter fixed wing aircraft drop-offs.

Proposed: Numerous drop-offs during the three-year term of the project

Current: The 2009 baseline number of drop-offs is estimated to be about 103.

Fixed-wing aircraft transportation in Alaska wilderness is not prohibited and its effects are brief and transient. Therefore its effect is not considered significant enough to be considered.

Measure 3: The number of authorized motor and mechanical uses

Proposed:

- 1 each: generator, water pump, ice auger

  Weighted 1 each

Current: The 2013 baseline is 1, for a generator.

Change: This project would increase the index total for this measure from 1 to 4.

The proposed project would involve one other action for which there is no currently established measure. From June to August, a five horsepower motorboat could be used on Lake Peters. While motorboat use to provide access for certain purposes is permissible in Alaska wilderness, this type of use is not. Such use has occurred on rare occasions, most recently in 2005.

In summary, the proposed project would increase the number and types of activities and technologies normally prohibited in Wilderness. The combined, direct negative effect on wilderness character would be moderate to major, but would also be temporary and local in nature.

5.4.2 Terrestrial Wildlife

Motorized equipment on lake (motor boat, augers) – The sound of motorized equipment could be heard by wildlife in the whole lake basin, because sound may carry long distances over water. Assuming that motor use would be for short periods, there would be minor, temporary, local impacts to wildlife that are sensitive to noise disturbance.

Motorized equipment on shore (generator, instruments, water pump) – The sound of motorized equipment could be heard by wildlife in the whole lake basin, because sound may carry long distances over water. Assuming that use would be for short periods, there would be minor, temporary, local impacts to wildlife that are sensitive to noise disturbance.

Airplane access – The sound of limited aircraft use would be brief and transient, therefore the impact on wildlife would be negligible.

Climate stations – Installation of the two climate stations might displace wildlife in the immediate vicinity during installation. Disturbance would be temporary as installation would require less than one day at each site. There would be negligible, temporary, site specific impacts.

Camp issues – A 14-week camp in 2015 could displace small mammals and other wildlife such as bears and birds. There would be minor, temporary, site specific or possibly local impacts to wildlife.

Sensors and gauges in streams – No impacts likely.

Extracting cores from lake sediment – No impacts likely.

5.4.3 Terrestrial Vegetation and Soils

Motorized equipment on lake (motor boat, augers) - No impacts likely.

Motorized equipment on shore (generator, instruments, water pump) - No impacts likely.

Airplane access - For access by ski plane on lake ice or float plane after ice melts, there would be no impacts on vegetation and soils.

For wheeled plane access on the airstrip on the alluvial fan, impacts would depend on the type of plane, number of landings and whether they occur before the tundra dries out. Landings late July thru Sept probably would cause much less damage than in earlier summer. If airstrip is used before mid-July or when the tundra soil is saturated from previous rain, there could be moderate, short to long-term, site specific impacts to vegetation and soils on the strip. If the airstrip is used only by Super Cubs (or similar small aircraft on large tires), less than four times per summer, only after mid-July and only when the tundra is not saturated, impacts would be negligible, short term, and site specific.

Climate stations - The presence of two climate stations would not be likely to impact vegetation and soils. One station would be located on rocks or ice with no vegetation or soil, and the second station will be mounted on an existing structure at the G. William Holmes Research Station.

Camp issues - There would be moderate impacts to vegetation and soils in the immediate vicinity of the camp area. Continuous occupation (14 weeks in 2015) could cause trampling of plants and soil on trails, and the areas around cabins and tents. Impacts will be mitigated by using existing structures for most camp activities and using protective mats where non-durable surfaces are threatened.

5.4.4 Aquatic Ecosystems and Wildlife

Motorized equipment on lake (motor boat, augers, and water pump) – Motorboats could have negligible or minor, short-term, site-specific, direct impacts on wildlife in aquatic ecosystems. Effects could be due to sound, vibration, physical disruption of ecosystems (e.g. erosion), fuel leakage, or introduction of invasive species and disease from unclean equipment. Motorboat use could cause increased rates of shoreline erosion in some waterbodies; however, in this nearly four-mile long mountain lake,

wave heights due to high wind-speed likely far exceed those that would be generated temporarily by one small motorboat with a five horsepower engine. Motors would not be used in areas where emergent vegetation could be damaged. To minimize the potential impacts of fuel the following would be required: an efficient four-stroke motor, efforts to minimize fuel use (e.g. reduce idling), proper fuel containment, and adequate spill response capabilities.

Motorized equipment on shore (generator, instruments, water pump) – No impacts likely.

Airplane access –These effects would be similar to those of visitors using aircraft to access the Refuge. No additional impacts are likely.

Climate stations - No impacts likely.

Camp issues –No impacts likely.

Sensors and gauges in lakes and streams –Clean instruments and moorings are not expected to impact aquatic ecosystems.

Protective cages surrounding instruments deployed in tributaries could have an influence on flow and channel shape in a small portion of the reach; however, the resulting change would be less than that caused by a boulder with similar dimensions. Deploying instruments in known or suspected spawning areas would be avoided.

Extracting cores from lake sediment – Extraction of cores would cause small disturbances in the lake bed; total impacts would be negligible.

5.4.5 Visitor Experience

Motorized equipment on lake (motor boat, augers) – The sound of motors could negatively impact visitor experiences, if there are visitors present. Noise will be minimized by the limited use of a four-stroke, five horsepower motor. Impacts would be minor to moderate, temporary, and restricted to the local area.

Motorized equipment on shore (generator, instruments, water pump) – The sound of motors could negatively impact visitor experiences, if there are visitors present. Noise will be minimized by operating equipment within the existing buildings. Impacts would be minor to moderate, temporary, and restricted to the local area.

Airplane access – The sight and sound of airplanes landing in the area could negatively impact visitor experiences, if there are visitors present. Impacts would be minor to moderate, temporary, and restricted to the local area.

Climate stations – Stations located on the mountainside would not be easily seen by visitors and the lakeside station would be located within the footprint of the existing facilities. Additional impacts related to these facilities would be negligible.

Camp issues – Visitors travelling in the greater Lake Peters area could encounter the sights and sounds of camp residents, and those seeking solitude would be negatively impacted. Depending on the nature of encounters and the expectations of visitors, impacts could be minor to major, but they would also be temporary and limited to the local area.

Sensors and gauges in streams – Visitors may occasionally encounter monitoring equipment when hiking. Impacts would be minor, temporary, and site specific.

Extracting cores from lake sediment - No impacts likely.

5.4.6 Subsistence Use

ANILCA (Section 810) requires federal land managers to identify whether a proposed land management action has potential to significantly restrict subsistence uses and consult with local subsistence users to minimize such restrictions. If the proposed action is not likely to result in significant restrictions on subsistence uses, no further activities are required for compliance with this section. The potential effects of scientific research, such as the project analyzed in this EA, are analyzed in the Refuge Comprehensive Conservation Plan and Environmental Impact Statement (2015) and in Appendix C: ANILCA Section 810 Evaluation. The proposed action would not restrict subsistence uses in the greater Lake Peters area, because subsistence uses occur almost exclusively when there is adequate snow cover to permit overland travel by snowmachine to the area.

6.0 CUMULATIVE EFFECTS

Scientific research and monitoring is important for realizing the purposes of Arctic Refuge as well as the Arctic Refuge Wilderness Area. However, some research activities and related installations and instrumentation may be inconsistent with the goal of preserving wilderness character. It is reasonably foreseeable that near-term future science proposals will include requests for meteorological stations and other instrumentation like the kind analyzed here. There are currently a number of semi-permanent instruments in the greater Lake Peters area, and their continued presence and use, combined with the Proposed Action, could threaten the undeveloped quality of wilderness character.

The Proposed Action, however, includes only temporary installations and temporary activities. No negative effects are likely to persist beyond the three-year term of the project. Policies and procedures currently in place, including the requirement to conduct a Minimum Requirements Analysis (MRA) for management actions in Wilderness and the *Keeping it Wild* monitoring protocol help guard against a proliferation of installations or other violations of the Wilderness Act. No significant cumulative effects due to the Proposed Action are anticipated.

7.0 CONSULTATION AND COORDINATION

This assessment has been conducted in accordance with the National Environmental Policy Act (NEPA) and procedures detailed in the NEPA for National Wildlife Refuges Handbook (2014). A 30-day public review and comment period for this document was open from April 6 through May 5, 2015. A notice of availability was posted on the Arctic Refuge website, and sent to potentially interested parties including the State of Alaska and the following organizations: Wilderness Watch, the Wilderness Society, the Northern Alaska Environmental Center, the Arctic Landscape Conservation Cooperative, and the Northwest Boreal Landscape Conservation Cooperative.

8.0 LIST OF PREPARERS

Brian Glaspell, Refuge Manager, Arctic National Wildlife Refuge

Joanna Fox, Deputy Refuge Manager, Arctic National Wildlife Refuge

Heidi Helling, Wildlife Biologist, Arctic National Wildlife Refuge

Greta Burkart, Aquatic Ecologist, Arctic National Wildlife Refuge

Roger Kaye, Wilderness Specialist, Arctic National Wildlife Refuge

Alfredo Soto, Permits Specialist, Arctic National Wildlife Refuge

Janet Jorgenson, Botanist, Arctic National Wildlife

9.0 REFERENCES CITED

Bendock and Burr 1985. Catalog of North Slope Lake and Stream Surveys

Cole, D. N. 2002. Ecological impacts of wilderness recreation and management. In: Wilderness management: stewardship and protection of resources and values. J. Hendee and C. Dawson. Fulcrum Publishing, Golden, CO: 413-459.

Collins, G. L., and L. Sumner. 1953. Northeast Arctic: The Last Great Wilderness. Sierra Club Bulletin, 38 (October 1953); 13-26.

Craig, P.C. 1989. An introduction to anadromous fishes in the Alaskan Arctic. Biological Papers of the University of Alaska 24:27-54.

De Percin, F. P. 1958. The summer climate of the Lake Peters area, Brooks Range, Alaska: an interim report. Natick, Mass: Headquarters Quartermaster Research & Engineering Command, U.S. Army, Quartermaster Research & Engineering Center, Environmental Protection Research Division.

Dutro, J.T. 1970. The G. William Holmes Research Station, Lake Peters, Alaska. Library of the Naval Arctic Research Laboratory.

Hobbie, J. E. 1959. Limnological studies on Lakes Peters and Schrader, Alaska. University of California.

-------- 1961. Summer temperatures in Lake Schrader, Alaska. Limnology and Oceanography 6:326-329.

-------- 1962. Limnological cycles and primary productivity of two lakes of the Alaskan arctic. Indiana University. 124 pp.

-------- 1964. Carbon 14 measurements of primary production in two arctic Alaskan lakes. Verh. Internat. Verein. Limnol. XV 360-364.

-------- 1964. Carbon 15 measurements of primary production in two arctic Alaskan lakes. International Association of Theoretical and Applied Limnology. Verhandlungen 15:360-364.

Holmes, G.W. and C.R. Lewis. 1961. Glacial Geology of the Mount Chamberlin area, Brooks Range, Alaska: International Symposium on Arctic Geological Processes. Vol 2, p848-864.

Kaye, R. 2006. Last great wilderness: the campaign to establish the Arctic National Wildlife Refuge. University of Alaska Press, Fairbanks, Alaska, USA.

Landres, P; Barns, C; Dennis, J. G.; Devine, T; Geissler, P.; McCasland, C.S.; Meriglino, L.; Seastrand, J.; Swain, R. 2008. Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character

Across the National Wilderness Preservation System. USDA Forest Service, Rocky Mountain Research Station General Technical Report RMRS-GTR-212, Fort Collins, CO.

Landers, D.H., J. Ford, C. Gubala, M. Monetti, B.K. Lasorsa, and J. Martinson. 1995. Mercury in vegetation and lake sediments from the U.S. Arctic. Water, Air, and Soil Pollution 80: 591-601.

Larsson, P. 1960. A preliminary investigation of the meteorological conditions of the Chamberlin glacier, 1958: Arctic Institute of North America Research Paper 2, 89 p.

Lodge, D.M., S. Williams, H. MacIsaac, K. Hayes, B. Leung, L. Loope, S. Reichard, R.N. Mack, P.B. Moyle, M. Smith, D.A. Andow, J.T. Carlton, and A. McMichael. 2006. Biological invasions: recommendations for policy and management [Position Paper for the Ecological Society of America]. Ecological Applications 16:2035-2054.

Lubinski, B.R., M.J. Millard, R. Schneidervin, J.L. Melegari. A mark-recapture experiment to estimate abundance of lake trout in Lake Schrader, Arctic National Wildlife Refuge, Alaska, 1995. Unpublished Alaska Fisheries Technical Report. U.S. Fish and Wildlife Service, Fairbanks Fishery Resource Office. Fairbanks, Alaska.

March, J.R. 2009. Synoptic Climatology of the Eastern Brooks Range, Alaska: a Data Legacy of the International Geophysical Year. Thesis. University of Alaska-Fairbanks. 115 pages.

Martin, Philip D., Jennifer L. Jenkins, F. Jeffrey Adams, M. Torre Jorgenson, Angela C. Matz, David C. Payer, Patricia E. Reynolds, Amy C. Tidwell, and James R. Zelenak. 2009. Wildlife Response to Environmental Arctic Change: Predicting Future Habitats of Arctic Alaska. Report of the Wildlife Response to Environmental Arctic Change (WildREACH): Predicting Future Habitats of Arctic Alaska Workshop, 17-18 November 2008. Fairbanks, Alaska: U.S. Fish and Wildlife Service. 138 pages.

Murray, D.F. 1979. Natural landmark site evaluation-Alaska. Institute of Arctic Biology. University of Alaska, Fairbanks, USA.

Murie, O. J. 1958. Arctic wilderness. Outdoor America, January 1958, 10:10-11.

Murie, O. J. 1961. Wilderness philosophy, science, and the Arctic National Wildlife Range. In Proceedings: Twelfth Alaska Science Conference , College, Alaska, 28 August through 1 September 1961, Science in Alaska (College: Alaska Division, American Association for the Advancement of Science. Ed. G. Dahlgren Jr., 1961): 58-69.

Nolan, M., R. Churchwell, J. Adams, J. McClelland, K. D. Tape, S. Kendall, A. Powell, K. Dunton, D. Payer, and P. Martin. 2011. Predicting the impact of glacier loss on fish, birds, floodplains, and estuaries in the arctic national wildlife refuge. Pages 49-54 in C. N. Medley, technical coordinator. Observing, studying

and managing for change. proceedings of the fourth interagency conference on research in the watersheds. U.S. Geological Survey Scientific Investigations Report 2011-5169.

Rainwater, F. H., and H. Guy. 1961. Some observations on the hydrochemistry and sedimentation of the chamberlin glacier area, alaska. U.S. Geological Survey Professional Paper 414:1-14.

Rieger, S. D., D. Schoephorster, and C.E. Furbush. 1979. Exploratory soil survey of Alaska. U.S. Department of Agriculture, Soil Conservation Service.

USFWS. 2008. Policy: Wilderness Stewardship. Service manual, 610 FW 1.

USFWS. 1988a. Arctic National Wildlife Refuge final comprehensive conservation plan, environmental impact statement, wilderness review, and wild river plans. U.S. Fish and Wildlife Service, Anchorage, Alaska, USA.

USGS. 1960. Quantity and Quality of Surface Waters of Alaska, 1958. Geological Survey Water-Supply Paper 1570.

Viereck, L. A. 1959. Testimony before U.S. Congress, Senate, Committee on Interstate and Foreign Commerce, Subcommittee on Merchant Marine and Fisheries, Hearings, S. 1899, A Bill to Authorize the Establishment of the Arctic Wildlife Range, Alaska, 86th Congress, 1st session, Part 2, 29 October 1959. Washington, D.C.: GPO, 1960:408.

Vörösmarty, C.J., L.D. Hinzman, B.J. Peterson, D.H. Bromwich, L.C. Hamilton, J.Morison, V.E. Romanovsky, M.Sturm, and R.S. Webb. 2001. The Hydrologic Cycle and its Role in Arctic and Global Environmental Change: A Rationale and Strategy for Synthesis Study. Fairbanks, Alaska: Arctic Research Consortium of the U.S., 84 pp.

West, R. L., and D. W. Wiswar. 1985. Fisheries investigations on the arctic national wildlife refuge, alaska, 1984. Pages 729-777 in G. W. Garner, and P. E. Reynolds, editors. 1984 update report baseline study of the fish, wildlife, and their habitats. Volume 2. U. S. Fish and Wildlife Service, Anchorage, Alaska.

Wilson, W. J., E. H. Buck, G. F. Player, and L. D. Dreyer. 1977. Winter water availability and use conflicts as related to fish and wildlife in arctic alaska – a synthesis of information. Arctic Environmental Information and Data Center, University of Alaska FWS/OBS-77/06. Arctic Environmental Information and Data Center, University of Alaska-Anchorage.

APPENDIX A: Special use permit request project summary

(Amended to include mitigation measures)

Project working title: Arctic glacial lakes, catchments and climate linkages

Based on a newly funded collaborative National Science Foundation proposal: Developing a system model of Arctic glacial-lacustrine sedimentation for investigating past and future climate change

[This section containing names and personal information redacted]

Project duration: Three years (January 2015 to December 2017); final project reports will likely be written in 2018 and published in 2019.

Summary: We request a three-year special-use permit to study the hydrological, glacial and meteorological factors that control water and sediment input to Lake Peters. The field campaign includes three years of monitoring and sediment sampling within the lake and its tributary streams, and measurements on the glacier closest to the lake (Chamberlin Glacier). No permanent installations are required. Instrumentation includes a temporary weather station on the lakeshore (at the USFWS camp) and one on the glacier, plus various sensors anchored within the channel of several inflow streams and moored within Lake Peters. The short-term weather station on the glacier will re-occupy the site that was used during the1957-58 geophysical year and will use the same protocols and instruments as the long-term weather station on McCall Glacier, thereby enabling a direct correlation with the McCall station. In addition, we request permission to access (for annual maintenance and data retrieval) the existing weather stations at McCall and Esetuk Glaciers. The temperature sensor in the primary inflow to Lake Peters will comply with the "Guidelines for the Collection of Continuous Stream Water-Temperature Data in Alaska" (USFS OFR 2014-1182).

Scientific motivation and objectives: Sediments that accumulate in Arctic lakes contain a wealth of information about how major features of the Arctic system vary on seasonal to millennial time scales, as well as how they respond to natural and anthropogenic forcings. Lakes in glaciated watersheds also record changes in the melt rate of upstream glaciers, which are among the most dynamic components of the evolving Arctic system. The sediment stored in glacier-fed lakes often comprise distinct rhythmic layers that represent annual cycles. This project will develop the first system model to simulate the full chain of processes that control how weather and climate are filtered via the glacier-hydrology-lake-sedimentation system and are recorded in physical components of lake deposits in glaciated catchments. A major field-based initiative will provide the input data to run the system model and to ground-truth its output.

Why Lake Peters? Lake Peters is the only deep lake with glaciers covering a large portion of its catchment in all of northern Alaska. Because of the high sediment input from the most heavily glaciated sector of the Brooks Range, and because of the anoxic conditions that typify the bottom of deep lakes,

Lake Peters is likely the only lake in northern Alaska with well-resolved annual layers. Neighboring glaciated drainages lack large lakes to trap the sediment; they have built the largest deltas in Arctic Alaska. Our goal of foreseeing the influence of future climate change on sediment production at Lake Peters will be transferable to neighboring drainages. In addition, the lake is ideally situated near the inflow of one of the largest glaciers in the Brooks Range, Chamberlin Glacier. This enables us to study the melt water and sediment that issues directly from the glacier and to compare them with non-glacial tributaries. Furthermore, our study of Lake Peters benefits from the long-term glaciological and meteorological monitoring at nearby McCall Glacier, and from the measurements and analyses conducted at Chamberlin Glacier and Lake Schrader during the mid-late 1950s. Finally, the lake is the deepest lake in proximity of the Arctic Ocean. This research aims to understand how sea-ice changes influence terrestrial conditions onshore.

Schedule and personnel: We request permission to camp at Lake Peters beginning around 12 May 2015, and to occupy the camp continuously until around 16 August 2015. We plan to rotate four crews of three people (possibly a fourth) over the three-month study period. We intend for one of the project PIs to lead each of the field teams, with students from NAU and APU (and possibly a high school teacher) comprising the rest of the field team. This includes students who will use this project as the basis of their graduate thesis research. During 2016 and 2017, we plan to camp at Lake Peters for a month, from mid-may until mid-June and again in middle of August for three weeks when we will recover and redeploy instruments.

Working and living accommodations: The camp will comprise one family camping or WeatherPort camp style tent each for use as: (1) kitchen, (2) storage, and (3) sample and equipment handling. Instead of using a tent for one or more of these functions, we request permission to use one or more of the existing USFWS structures. This would improve safety and avoid damage by bears to equipment and supplies. If suitable, using one of the structures for sleeping would also improve safety and avoid having to use bear fencing.

Access

– *Fixed wing:* We request permission to use chartered fixed-wing aircraft for access to Lake Peters. We intend to use Coyote Air's Beaver from Coldfoot. In May, the landing will be on skis on the lake. Subsequent landings will use the existing airstrip on the alluvial fan along the southeast shore. We anticipate 11 landings during 2015, which will include equipment and personnel (crew changes), with relatively light loads. During 2016 and 2017, we expect a total of 4-5 landings.

- *Helicopter:* [This section has been amended. No helicopter use is requested]

Motorized tools

- *Inflatable raft and motor:* We request permission to use a 5 hp outboard motor on Lake Peters between June and August during the three summers.

- *Ice auger:* In May 2015, we will install instruments through the lake ice using a gas-powered auger, only as necessary, to access the water.

- *Generator:* Solar panels will be the primary source of power for battery charging. A generator is needed for backup in the event of an extended period of cloud cover. It is also needed to run the small lab pump, which does not use batteries (see below). We request permission to occasionally operate a portable Honda 2000 generator.

- *Lab pump:* A small vacuum pump is needed to filter the suspended sediment from water samples to measure the mass of sediment transported to the lake by rivers.

Instrument installations

We request permission to maintain the following instruments in and around Lake Peters for the duration of the study (May 2015 to August 2017):

- *Weather stations:* Two weather stations will house instruments to log air temperature, barometric pressure, wind speed, solar radiation, rainfall, and snow depth. We presently expect to use the station made by Onset and mounted on a 8' tripod. One station will be positioned on Chamberlin Glacier and the other at the camp on the southeast shore of Lake Peters. The existing structures at the lake could be used for mounting the meteorological instruments instead of a tripod. This would prevent interference with wildlife and reduce the need for any protective fencing.

- *River water level, temperature and turbidity sensors:* Pressure transducers and turbidity meters and temperature sensors will be installed in four to six rivers within the Lake Peters watershed. Multiple streams need to be monitored to investigate the influence of different watershed physiographic features on water and sediment discharge, including glacier size, which is the primary control on glacier thermal regime and therefor sediment production. The instruments will be housed in a mesh cage and anchored with river rock. They will be largely invisible from the surface. The temperature sensor in the primary inflow to Lake Peters will comply with the "Guidelines for the Collection of Continuous Stream Water-Temperature Data in Alaska" (USFS OFR 2014-1182) by using a NIST-certified thermometer and other specified protocols.

- *Glacier mass-balance stake:* One mass-balance pole will be installed on Chamberlin Glacier along with the weather station. The design will match the one being used by Nolan at McCall Glacier, thereby maximizing the comparability of the data.

- *Lake instrument moorings:* The rate of sediment accumulation in Lake Peters will be measured using sediment traps installed on three to five moorings located across the long axis of the lake. Each mooring will be anchored by a rock at the lake bottom, and will be held vertically by a 10" diameter buoy. The buoy will be positioned 2-3 m below the lake surface so that it does not freeze into the lake ice and is not visible from the lake surface or from the air. The moorings will be equipped with a radio-transmitter for relocation. They will also support loggers to record water temperature and lake level.

Sampling program

- *River water and sediment:* We will sample the suspended load of the primary inflow stream to Lake Peters approximately twice daily during the three field seasons, and the outflow of Chamberlin Glacier and other tributaries to Lake Peters less frequently, using standard procedures. We will augment the manual sampling schedule using an automated ISCO sampler in one river. All river water samples will be filtered on site. The sediment samples will be shipped to Northern Arizona University where they will be consumed in analysis of grain-size distribution. We will also collect small volumes (30 ml) of water from several streams on a regular basis to analyze for oxygen and hydrogen isotopes, which will be used to infer the proportion of rain versus glacier melt that comprises the river water. Discharge will be measured by conventional procedures (in-stream hand-operated current meter). The discharge data combined with river level will be used to develop stage-discharge rating curves, and pressure transducers will be installed in the rivers for continuous automated logging of stage.

- *Lake sediment:* In addition to collecting sediment as it settles into traps at the mooring stations, we request permission to take sediment samples from the lake bottom. Cores up to 1 m long will be taken from the ice surface in May 2014 from 10 to 15 sites across the lake. This will enable us to estimate the rate of sedimentation over the past several hundred years. In addition to surface cores, we intend to collect three longer sediment cores (up to 5 m long) from three sites using a vibracorer from the ice surface in May of 2016 or 2017. All cores will be split, photographed and logged at the University of Minnesota's LacCore laboratory. One half of each core will be shipped to Northern Arizona University for further sampling and analysis and the other half will remain within the archives at LacCore.

APPENDIX A: Special use permit request project summary

Project title: Arctic glacial lakes, catchments and climate linkages

Based on a newly funded collaborative NSF proposal: Developing a system model of Arctic glacial-lacustrine sedimentation for investigating past and future climate change

[This section containing names and personal information redacted]

Project duration: Three years (January 2015 to December 2017); final project reports will likely be written in 2018 and published in 2019.

Summary: We request a three-year special-use permit to study the hydrological, glacial and meteorological factors that control water and sediment input to Lake Peters. The field campaign includes three years of monitoring and sediment sampling within the lake and its tributary streams, and measurements on the glacier closest to the lake (Chamberlin Glacier). No permanent installations are required. Instrumentation includes a temporary weather station on the lakeshore (at the USFWS camp) and one on the glacier, plus various sensors anchored within the channel of several inflow streams and moored within Lake Peters. The short-term weather station on the glacier will re-occupy the site that was used during the1957-58 geophysical year and will use the same protocols and instruments as the long-term weather station on McCall Glacier, thereby enabling a direct correlation with the McCall station. In addition, we request permission to access (for annual maintenance and data retrieval) the existing weather stations at McCall and Esetuk Glaciers. The temperature sensor in the primary inflow to Lake Peters will comply with the "Guidelines for the Collection of Continuous Stream Water-Temperature Data in Alaska" (USFS OFR 2014-1182).

Scientific motivation and objectives: Sediments that accumulate in Arctic lakes contain a wealth of information about how major features of the Arctic system vary on seasonal to millennial time scales, as well as how they respond to natural and anthropogenic forcings. Lakes in glaciated watersheds also record changes in the melt rate of upstream glaciers, which are among the most dynamic components of the evolving Arctic system. The sediment stored in glacier-fed lakes often comprise distinct rhythmic layers that represent annual cycles. This project will develop the first system model to simulate the full chain of processes that control how weather and climate are filtered via the glacier-hydrology-lake-sedimentation system and are recorded in physical components of lake deposits in glaciated catchments. A major field-based initiative will provide the input data to run the system model and to ground-truth its output.

Why Lake Peters? Lake Peters is the only deep lake with glaciers covering a large portion of its catchment in all of northern Alaska. Because of the high sediment input from the most heavily glaciated sector of the Brooks Range, and because of the anoxic conditions that typify the bottom of deep lakes, Lake Peters is likely the only lake in northern Alaska with well-resolved annual layers. Neighboring glaciated drainages lack large lakes to trap the sediment; they have built the largest deltas in Arctic Alaska. Our goal of foreseeing the influence of future climate change on sediment production at Lake Peters will be transferable to neighboring drainages. In addition, the lake is ideally situated near the inflow of one of the largest glaciers in the Brooks Range, Chamberlin Glacier. This enables us to study the melt water and sediment that issues directly from the glacier and to compare them with non-glacial tributaries. Furthermore, our study of Lake Peters benefits from the long-term glaciological and meteorological monitoring at nearby McCall Glacier, and from the measurements and analyses

conducted at Chamberlin Glacier and Lake Schrader during the mid-late 1950s. Finally, the lake is the deepest lake in proximity of the Arctic Ocean. This research aims to understand how sea-ice changes influence terrestrial conditions onshore.

Schedule and personnel: We request permission to camp at Lake Peters beginning around 12 May 2015, and to occupy the camp continuously until around 16 August 2015. We plan to rotate four crews of three people (possibly a fourth) over the three-month study period. We intend for one of the project PIs to lead each of the field teams, with students from NAU and APU (and possibly a high school teacher) comprising the rest of the field team. This includes students who will use this project as the basis of their graduate thesis research. During 2016 and 2017, we plan to camp at Lake Peters for a month, from mid-may until mid-June and again in middle of August for three weeks when we will recover and redeploy instruments.

Working and living accommodations: The camp will comprise one family camping or WeatherPort camp style tent each for use as: (1) kitchen, (2) storage, and (3) sample and equipment handling. Instead of using a tent for one or more of these functions, we request permission to use one or more of the existing USFWS structures. This would improve safety and avoid damage by bears to equipment and supplies. If suitable, using one of the structures for sleeping would also improve safety and avoid having to use bear fencing.

Access

– *Fixed wing:* We request permission to use chartered fixed-wing aircraft for access to Lake Peters. We intend to use Coyote Air's Beaver from Coldfoot. In May, the landing will be on skis on the lake. Subsequent landings will use the existing airstrip on the alluvial fan along the southeast shore. We anticipate 11 landings during 2015, which will include equipment and personnel (crew changes), with relatively light loads. During 2016 and 2017, we expect a total of 4-5 landings.

- *Helicopter:* We will use fixed wing aircraft as much as possible. Chamberlin Glacier is not accessible by plane, and conditions in June/July are likely too hazardous to hike on the glacier because of loose rock and unstable bridges across crevasses. We therefore request permission to use a helicopter to install and to remove a weather station on Chamberlin Glacier. Installation would likely take place in early May 2015 and removal in August 2017. The same helicopter charter will be used for the annual maintenance of the weather stations on McCall and Esetuk Glaciers. The aircraft will likely be commissioned through the Toolik Field Station; any fuel caches would be managed by the logistics provider, CPS.

Motorized tools

- *Inflatable raft and motor:* We request permission to use a 15 hp outboard motor on Lake Peters between June and August during the three summers. If the water level is high enough, we would also use the boat to float to Lake Schrader to sample surface sediment there.

- *Ice auger:* In May 2015, we will install instruments through the lake ice using a gas-powered auger to access the water.

- *Generator:* Solar panels will be the primary source of power for battery charging. A generator is needed for backup in the event of an extended period of cloud cover, or for aircraft preheating if needed May. It is also needed to run the small lab pump, which does not use batteries (see below). We request permission to occasionally operate a portable Honda 2000 generator.

- *Drill:* A battery-operated drill is needed to install the ablation stake in the surface of Chamberlin Glacier

- *Lab pump:* A small vacuum pump is needed to filter the suspended sediment from water samples to measure the mass of sediment transported to the lake by rivers.

Instrument installations
We request permission to maintain the following instruments in and around Lake Peters for the duration of the study (May 2015 to August 2017):

- *Weather stations:* Two weather stations will house instruments to log air temperature, barometric pressure, wind speed, solar radiation, rainfall, and snow depth. We presently expect to use the station made by Onset and mounted on a 8' tripod. One station will be positioned on Chamberlin Glacier and the other at the camp on the southeast shore of Lake Peters. The existing structures at the lake could be used for mounting the meteorological instruments instead of a tripod. This would prevent interference with wildlife and reduce the need for any protective fencing.

- *River water level, temperature and turbidity sensors:* Pressure transducers and turbidity meters and temperature sensors will be installed in four to six rivers within the Lake Peters watershed. Multiple streams need to be monitored to investigate the influence of different watershed physiographic features on water and sediment discharge, including glacier size, which is the primary control on glacier thermal regime and therefor sediment production. The instruments will be housed in a mesh cage and anchored with river rock. They will be largely invisible from the surface. The temperature sensor in the primary inflow to Lake Peters will comply with the "Guidelines for the Collection of Continuous Stream Water-Temperature Data in Alaska" (USFS OFR 2014-1182) by using a NIST-certified thermometer and other specified protocols.

- *Glacier mass-balance stake:* One mass-balance pole will be installed on Chamberlin Glacier along with the weather station. The design will match the one being used by Nolan at McCall Glacier, thereby maximizing the comparability of the data.

- *Lake instrument moorings:* The rate of sediment accumulation in Lake Peters will be measured using sediment traps installed on three to five moorings located across the long axis of the lake. Each mooring will be anchored by a rock at the lake bottom, and will be held vertically by a 10" diameter buoy. The buoy will be positioned 2-3 m below the lake surface so that it does not freeze into the lake ice and is not visible from the lake surface or from the air. The moorings will be equipped with a radio-transmitter for relocation. They will also support loggers to record water temperature and lake level.

Sampling program
- *River water and sediment:* We will sample the suspended load of the primary inflow stream to Lake Peters approximately twice daily during the three field seasons, and the outflow of Chamberlin Glacier and other tributaries to Lake Peters less frequently, using standard procedures. We will augment the manual sampling schedule using an automated ISCO sampler in one river. All river water samples will be filtered on site. The sediment samples will be shipped to Northern Arizona University where they will be consumed in analysis of grain-size distribution. We will also collect small volumes (30 ml) of water from several streams on a regular basis to analyze for oxygen and hydrogen isotopes, which will be used to infer the proportion of rain versus glacier melt that comprises the river water. Discharge will be measured by conventional procedures (in-stream hand-operated current meter). In addition, we will use a fluorometer in the event that discharge is too high to safely enter the rivers; it has been used by

Nolan in nearby rivers and found to work accurately in both low and high flows and in turbid water. We will use the same non-toxic dye (uranine yellow) that Nolan has used and was previously approved for use in the Refuge. The discharge data combined with river level will be used to develop stage-discharge rating curves, and pressure transducers will be installed in the rivers for continuous automated logging of stage. [Note, use of this tracer dye has not been evaluated for this project]

- *Lake sediment:* In addition to collecting sediment as it settles into traps at the mooring stations, we request permission to take sediment samples from the lake bottom. Cores up to 1 m long will be taken from the ice surface in May 2014 from 10 to 15 sites across the lake. This will enable us to estimate the rate of sedimentation over the past several hundred years. In addition to surface cores, we intend to collect three longer sediment cores (up to 5 m long) from three sites using a vibracorer from the ice surface in May of 2016 or 2017. All cores will be split, photographed and logged at the University of Minnesota's LacCore laboratory. One half of each core will be shipped to Northern Arizona University for further sampling and analysis and the other half will remain within the archives at LacCore.

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENTS DECISION GUIDE WORKBOOK

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

-- The Wilderness Act of 1964

Project Title: **Understand Arctic Paleoclimate through Natural and Anthropogenic Climate Forcings found in Lake Sedimentation**

MRDG Step 1: Determination

Determine if Administrative Action is Necessary

Description of the Situation
What is the situation that may prompt administrative action?

Arctic National Wildlife Refuge (Arctic NWR) is considering a special use permit application from Northern Arizona University to study the hydrological, glacial and meteorological factors that control water and sediment input to Lake Peters within the Arctic NWR Wilderness Area. The proposed project would include three years of monitoring and sediment sampling in the lake, its tributary streams, and on Chamberlin Glacier. **The goal of this work is to improve our understanding of how modern-day climate controls processes that affect fish and wildlife habitat in glacier-fed watersheds, and to provide a better basis for interpreting cores from lake sediments that reveal a wealth of information about how glaciers, hydrology, physical processes and biota have responded to climate change on millennial time scales**. Collected data will be used to create and validate a model that can be used to forecast future changes and provide a basis for interpreting paleolimnological data from cores collected from the lake sediments.

Climate is a primary driver of the natural physical and ecological processes occurring within the Arctic National Wildlife Refuge (Arctic NWR). Climate change is amplified in the Arctic, and natural processes are highly vulnerable to changes in temperature and precipitation regime. The influence of humans on global and regional climate is expected to bring significant changes to ecosystems of Arctic NWR. Documenting those changes and understanding their impacts on Arctic NWR would support refuge purposes, including conservation of fish and wildlife populations and habitats in their natural diversity, which is an

important component of Arctic NWR's wilderness character. This documentation relies on biological and physical monitoring data that that must be collected, analyzed, interpreted, and reported. In order to evaluate the status and trends of ecosystem function, climate monitoring data are required to define baseline conditions and bounds of natural variability.

Sediments that accumulate in Arctic lakes are a particularly sensitive and valuable indicator of past changes in climate and the response of ecosystems to those changes. These sediments contain a wealth of information about how major features of the Arctic system vary on seasonal to millennial time scales, as well as how they respond to natural and anthropogenic forcings such as climate change. Lakes in glaciated watersheds also record changes in the melt rate of upstream glaciers, which are among the most dynamic components of the evolving Arctic system. The sediments stored in glacier-fed lakes often comprise distinct layers that represent annual cycles.

This proposed system-science project builds on existing well-developed glacier, hydrologic and sediment-deposition models to create an integrated system model that will be validated against field measurements from three Arctic glacier-fed lakes. On-going process studies near the Peters Lake study site (McCall Glacier) will provide the input data to drive the models and validate Peters Lake model output. Measurements will distinguish sediments that are derived from glaciated and non-glaciated sub-basins within the Peters Lake watershed which will enable us to develop and test models for those sediment sources independently, based on a variety of driving forces including snow melt, glacier melt and rainfall, and then mix their relative contributions under changing conditions. An integrated model will simulate how weather events and longer-term climate trends are influenced by glacier, river and lacustrine processes that affect the physical properties (varve thickness and grain-size distribution) of sediment deposited in the lake, such that future studies of those sediments will yield new insights into the climatic conditions responsible for their deposition. **Therefore, this study will contribute to understanding how lakes and their glaciated catchment have been impacted by a changing climate on a paleo-climatic scale and how watersheds will evolve under continued climate change in coming decades and centuries.**

Understanding these changes is consistent within the context of the Arctic National Wildlife Refuge Comprehensive Conservation Plan (CCP) Appendix D: 3.3 Climate Change, the following is stated:

"Numerous changes have occurred on the Refuge in response to climate change (Chapter 4, Sections 4.2.3, 4.3.2, and 4.3.3). Climate change is expected to continue to affect Refuge resources and the associated human environment for the foreseeable future . . . However, in recognition of the importance of climate changes to Arctic Refuge and the people who live there or visit there, Refuge goal six and its associated objectives, 6.1 through 6.4, relate directly to climate change."

> "We will strengthen collaboration with others on climate change research and monitoring. Our efforts will include evaluation of abiotic and biotic components, plus modeling efforts to predict environmental changes. Management decisions will incorporate the best available science, but we will acknowledge the uncertainty of predictions and be adaptive to accommodate changing situations." (CCP 2.1.6 Objective 6.3)
>
> "Strategies to mitigate effects of stressors may be implemented, consistent with

Refuge goals, objectives, and management guidelines." (CCP 2.1.6 Objective 6.2)

Objective 7.1: Collaborative Research—Refuge staff will support and/or participate in collaborative studies of arctic and subarctic ecological and physical systems that depend upon the essentially undisturbed environments and ecological processes on the Refuge.

When the ecological staffing capabilities of the Refuge are stretched and we cannot meet the standard of, "[a]ll monitoring will employ appropriate disciplines, new technologies, and scientific capabilities whenever practical," (CCP 2.4.10) then we have a need to turn to other resources.

There are defined coverage gaps that preclude the ability to assess weather and climate across a north to south and west to east gradient (given that present monitoring tools exist at 3 stations on the coastal plain, McCall Glacier, and 1 installation on Red Sheep Creek within the 19 million acre Arctic Refuge). Therefore, this report concludes that due to the lack of existing climate monitoring efforts within the 8 million acre Mollie Beattie Wilderness Area, we do not have adequate data for understanding climate and system process change within this region.

Options Outside of Wilderness

Can action be taken outside of wilderness that adequately addresses the situation?

☐ YES	**STOP – DO NOT TAKE ACTION IN WILDERNESS**
☒ NO	**EXPLAIN AND COMPLETE STEP 1 OF THE MRDG**

Explain:

The study is proposed to occur in the Lake Peters area, which is entirely within the Mollie Beattie Wilderness Area. To successfully collect data that are needed to depict long-term climatic trends in Arctic Refuge by using lake sedimentation as paleo-climatic proxy, samples must be taken from a deep lake with glaciers that has a high sediment input from the most heavily glaciated sector of the Brooks Range, and is deep enough to produce anoxic conditions at the bottom. Peters Lake which resides in Wilderness fulfills these requirements; however there is no other northern Alaska drainage basin that would meet these criteria.

The proposed study at Peters Lake requires system model validation. Therefore this research cannot be conducted at other various arctic glaciated lakes due to an absence of historical and current monitoring efforts at those locations. The Peters Lake watershed has available input variables from historical data collected on site at Chamberlin Glacier and Schrader Lake during the mid to late 1950s, and the ongoing long-term glaciological and meteorological monitoring research on the nearby McCall Glacier.

Criteria for Determining Necessity

Is action necessary to meet any of the criteria below?

A. Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that ***requires*** *action? Cite law and section.*

☐ YES ☒ NO

Explain:

There is no provision in any wilderness legislation that requires FWS to conduct this study.

B. Requirements of Other Legislation

Is action necessary to meet the requirements of other federal laws? Cite law and section.

☐ YES ☒ NO

Explain:

Studying environmental effects of climate change and forecasting future conditions is not required by federal law. However, this type of research is supported by refuge purposes to conserve fish and wildlife populations and habitats in their natural diversity and to ensure water quality and necessary water quantity within the refuge. Further, this study would be consistent with the intent of the Wilderness Act to "…maintain opportunities for scientific research and undisturbed ecosystems".

C. Wilderness Character

Is action necessary to preserve one or more of the qualities of wilderness character, including: Untrammeled, Undeveloped, Natural, Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation, or Other Features of Value?

UNTRAMMELED

☐ YES ☒ NO

Explain:

The study is not necessary to preserve the untrammeled character of Arctic NWR wilderness.

UNDEVELOPED

☐ YES ☒ NO

Explain:

The study is not necessary to preserve the undeveloped character of Arctic NWR wilderness.

NATURAL

☒ YES ☐ NO

Explain:

The study would support enhanced understanding of baseline environmental conditions in the Arctic NWR and ecosystem responses to climate change. It would also strengthen the ability to forecast future changes, including implications for fish, wildlife and their habitats. Scientific information that investigates the past, present, and potential future responses to climate change is needed by land managers to evaluate the attribution of changes to naturalness. Without knowledge of baseline ecosystem function and responses to broad-scale and/or non-anthropogenic forcings, the impact of regional and local factors such as human use on the refuge cannot be accurately evaluated or managed.

SOLITUDE OR PRIMITIVE & UNCONFINED RECREATION

☐ YES ☒ NO

Explain:

The study is not necessary to preserve the primitive character or opportunities for unconfined recreation in Arctic NWR wilderness.

OTHER FEATURES OF VALUE

☐ YES ☒ NO

Explain:

Step 1 Decision
Is administrative action necessary in wilderness?

Decision Criteria

A.	Existing Rights or Special Provisions	☐ YES	☒ NO
B.	Requirements of Other Legislation	☐ YES	☒ NO
C.	Wilderness Character		
	Untrammeled	☐ YES	☒ NO
	Undeveloped	☐ YES	☒ NO
	Natural	☒ YES	☐ NO
	Outstanding Opportunities	☐ YES	☒ NO
	Other Features of Value	☐ YES	☒ NO

Is administrative action necessary in wilderness?

☒ YES	**EXPLAIN AND PROCEED TO STEP 2 OF THE MRDG**
☐ NO	**STOP – DO NOT TAKE ACTION IN WILDERNESS**

Explain:

Climate is a primary driver of the natural physical and ecological processes occurring within the Arctic NWR. Climate change is expected to cause significant changes to ecosystems; therefore, documenting those changes and understanding their impacts in Arctic Refuge's Wilderness is in support of Refuge purposes, including wilderness purposes. It is important to note that documentation of environmental processes such as climate change relies on biophysical monitoring and research, and it is our responsibility as wilderness stewards to understand baseline conditions and develop the ability to predict future changes in the face of known threats—even where we may not be able to effectively protect against those threats, as may be the case with climate change.

This project proposal is aimed towards providing deliverables that would contribute to additional ecological insights on the baseline conditions of natural variability in the Mollie Beattie Wilderness. As stated in Step 1, the Lake Peters system is uniquely suited to this study. To successfully collect data that is needed to depict long-term climatic trends in Arctic Refuge by using lake sedimentation as a paleo-climatic proxy, samples must be taken from a deep lake with glaciers that has a high sediment input from the most heavily glaciated sector of the Brooks Range with available input variables from historical data collected on site and an ongoing long-term glaciological and meteorological monitoring. Lake Peters, which resides in completely in the Mollie Beattie Wilderness, fulfills these requirements; however there is no other northern drainage basin that would meet these criteria.

MRDG Step 2

Determine the Minimum Activity

Other Direction

*Is there "special provisions" language in legislation (or other Congressional direction) that explicitly **allows** consideration of a use otherwise prohibited by Section 4(c)?*

AND/OR

Has the issue been addressed in agency policy, management plans, species recovery plans, or agreements with other agencies or partners?

☐ YES **DESCRIBE OTHER DIRECTION BELOW**

☒ NO **SKIP AHEAD TO TIME CONSTRAINTS BELOW**

Describe Other Direction:

Time Constraints

What, if any, are the time constraints that may affect the action?

The proposed work is scheduled to be initiated on site May 2015 and end August 2017.

Components of the Action

What are the discrete components or phases of the action?

Component X:	*Example: Transportation of personnel to the project site*
Component 1:	Transportation of personnel to high elevation or glacial sampling sites within the Peters Lake Basin
Component 2:	Transportation of personnel to project sites via lake access
Component 3:	Sampling equipment to obtain samples under ice
Component 4:	Sampling equipment requiring a generator and vacuum pump
Component 5:	Temporary installations to collect weather data
Component 6:	Sampling equipment to quantify river discharge
Component 7:	Sampling equipment to quantify river turbidity
Component 8:	Sampling equipment to quantify glacier flow and behavior

Component 9:	Gear and sampling equipment associated with lake mooring

Proceed to the alternatives.

Refer to the **MRDG Instructions** regarding alternatives and the effects to each of the comparison criteria.

MRDG Step 2: Alternatives

Alternative 1: No Action

Description of the Alternative
What are the details of this alternative? When, where, and how will the action occur? What mitigation measures will be taken?

Under this alternative no climate stations, glacial melt studies, and lake sedimentation research would be conducted at Peters Lake within the Mollie-Beattie Wilderness Area.

Component Activities
How will each of the components of the action be performed under this alternative?

Component of the Action		Activity for this Alternative
X	*Example: Transportation of personnel to the project site*	*Example: Personnel will travel by horseback*
1	Transportation of personnel to high elevation or glacial sampling sites within the Peters Lake Basin	No transportation of personnel via aircraft
2	Transportation of personnel to project sites via lake access	No transportation of personnel via motor boats
3	Sampling equipment to obtain samples under ice	No samples collected from ice auger use
4	Sampling equipment requiring a generator and vacuum pump	No samples collected that are in need of a generator or vacuum pump
5	Temporary installations to collect weather data	No meteorological sensors would be installed and no climate data collected
6	Sampling equipment to quantify river discharge	No data river discharge data collected with river gauges
7	Sampling equipment to quantify river turbidity	No data water turbidity collected with river turbidity sensors
8	Sampling equipment to quantify glacier flow and behavior	No data collected from mass-balance instruments
9	Gear and sampling equipment associated with lake mooring	No lake sampling or boat equipment housing via cables, etc.

Wilderness Character
What is the effect of each component activity on the qualities of wilderness character? What mitigation measures will be taken?

UNTRAMMELED

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No transportation of personnel via aircraft	☐	☐	☒
2	No transportation of personnel via motor boats	☐	☐	☒
3	No samples collected from ice auger use	☐	☐	☒
4	No samples collected that are in need of a generator/vacuum pump	☐	☐	☒
5	No meteorological sensors would be installed and no climate data collected	☐	☐	☒
6	No data river discharge data collected with river gauges	☐	☐	☒
7	No data water turbidity collected with river turbidity sensors	☐	☐	☒
8	No data collected from mass-balance instruments	☐	☐	☒
9	No lake sampling or boat equipment housing via cables, etc.	☐	☐	☒
Total Number of Effects		0	0	NE
Untrammeled Total Rating			**0**	

Explain:

The ecological systems with in the Mollie Beattie Wilderness Area would not be manipulated or controlled.

UNDEVELOPED

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No transportation of personnel via aircraft	☐	☐	☒
2	No transportation of personnel via motor boats	☐	☐	☒

3	No samples collected from ice auger use	☐	☐	☒
4	No samples collected that are in need of a generator/vacuum pump	☐	☐	☒
5	No meteorological sensors would be installed and no climate data collected	☐	☐	☒
6	No data river discharge data collected with river gauges	☐	☐	☒
7	No data water turbidity collected with river turbidity sensors	☐	☐	☒
8	No data collected from mass-balance instruments	☐	☐	☒
9	No lake sampling or boat equipment housing via cables, etc.	☐	☐	☒
Total Number of Effects		0	0	NE
Undeveloped Total Rating		**0**		

Explain:

The Peters Lake watershed in the Mollie Beattie Wilderness Area would remain undeveloped from further actions.

NATURAL

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No transportation of personnel via aircraft	☐	☐	☒
2	No transportation of personnel via motor boats	☐	☐	☒
3	No samples collected from ice auger use	☒	☒	☐
4	No samples collected that are in need of a generator/vacuum pump	☒	☒	☐
5	No meteorological sensors would be installed and no climate data collected	☒	☒	☐
6	No data river discharge data collected with river gauges	☒	☒	☐
7	No data water turbidity collected with river turbidity sensors	☒	☒	☐
8	No data collected from mass-balance instruments	☒	☒	☐

9	No lake sampling or boat equipment housing via cables, etc.	☐	☐	☒
Total Number of Effects		6	-6	NE
Natural Total Rating		**0**		

Explain:

The natural quality of wilderness character in the Mollie Beattie wilderness area would free from the effects of modern civilization, however it may not be free from the indirect or unintended effects of modern people on the ecological systems inside wilderness.

In the "Keeping it Wild" guidelines (An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservations System), the monitoring trends of the natural character are:

> "What are the trends in terrestrial, aquatic, and atmospheric natural *resources* inside wilderness?"
>
> The indicator for monitoring these trends: plant, animal species, communities and physical resources.
>
> "What are the trends in terrestrial, aquatic, and atmospheric natural *processes* inside wilderness?"
>
> The indicator for monitoring these trends: biophysical processes.

Therefore, if land managers do not monitor the ecological indicators that contribute to the natural quality of wilderness character, we will lack the baseline information within the Arctic Refuge wilderness to adequately provide information on climate change processes that compromise and are predicted to compose the natural character of the Mollie Beattie wilderness.

SOLITUDE OR PRIMITIVE & UNCONFINED RECREATION

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No transportation of personnel via aircraft	☐	☐	☒
2	No transportation of personnel via motor boats	☐	☐	☒
3	No samples collected from ice auger use	☐	☐	☒
4	No samples collected that are in need of a generator/vacuum pump	☐	☐	☒
5	No meteorological sensors would be installed and no	☐	☐	☒

	climate data collected			
6	No data river discharge data collected with river gauges	☐	☐	☒
7	No data water turbidity collected with river turbidity sensors	☐	☐	☒
8	No data collected from mass-balance instruments	☐	☐	☒
9	No lake sampling or boat equipment housing via cables, etc.	☐	☐	☒
Total Number of Effects		0	0	NE
Solitude or Primitive & Unconfined Rec. Total Rating		**0**		

Explain:

Users of the Mollie Beattie wilderness would continue to experience opportunities for solitude or primitive and unconfined recreation.

OTHER FEATURES OF VALUE

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No transportation of personnel	☐	☐	☒
2	No transportation of personnel via motor boats	☐	☐	☒
3	No samples collected from ice auger use	☐	☐	☒
4	No samples collected that are in need of a generator/vacuum pump	☐	☐	☒
5	No meteorological sensors would be installed and no climate data collected	☐	☐	☒
6	No data river discharge data collected with river gauges	☐	☐	☒
7	No data water turbidity collected with river turbidity sensors	☐	☐	☒
8	No data collected from mass-balance instruments	☐	☐	☒
9	No lake sampling or boat equipment housing via cables, etc.	☐	☐	☒
Total Number of Effects				NE
Other Features of Value Total Rating		**0**		

Explain:

The Mollie Beattie Wilderness would not be affected by other features of value.

However, (as stated in the natural quality explanation), by not effectively monitoring climate or biophysical processes in wilderness, managers would not be able to establish reference conditions to evaluate ecosystem function in the Mollie Beattie Wilderness. With the no action alternative, we would lack the capacity to provide educational and outreach materials on paleo-climate and systems science in the Arctic Refuge wilderness and we would not contribute to one of the purposes of the wilderness designation as stated in The Alaska National Interest Lands Conservation Act (ANILCA) ". . . maintain opportunities for scientific research in undisturbed ecosystems."

Traditional Skills

What is the effect of each component activity on traditional skills?

TRADITIONAL SKILLS

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No transportation of personnel	☐	☐	☒
2	No transportation of personnel via motor boats	☐	☐	☒
3	No samples collected from ice auger use	☐	☐	☒
4	No samples collected that are in need of a generator/vacuum pump	☐	☐	☒
5	No meteorological sensors would be installed and no climate data collected	☐	☐	☒
6	No data river discharge data collected with river gauges	☐	☐	☒
7	No data water turbidity collected with river turbidity sensors	☐	☐	☒
8	No data collected from mass-balance instruments	☐	☐	☒
9	No lake sampling or boat equipment housing via cables, etc.	☐	☐	☒
Total Number of Effects		0	0	NE
Traditional Skills Total Rating		**0**		

Explain:

Traditional skills character of the Mollie Beattie Wilderness Area would not be affected.

Economics
What is the estimated cost of each component activity?

COST

Component Activity for this Alternative		Estimated Cost
X	*Example: Personnel will travel by horseback*	*$1,900*
1	N/A	
2		
3		
4		
5		
6		
7		
8		
9		
Total Estimated Cost		

Explain:

N/A

Safety of Visitors & Workers
What is the risk of this alternative to the safety of visitors and workers? What mitigation measures will be taken?

RISK ASSESSMENT	Probability of Accident				
Severity of Accident	Frequent	Likely	Common	Unlikely	Rare
Catastrophic: Death or permanent disability	1	1	2	2	3
Critical: Permanent partial disability or temporary total disability	1	2	2	3	4

Marginal: Compensable injury or illness, treatment, lost work	2 ☐	3 ☐	3 ☐	4 ☐	4 ☐
Negligible: Superficial injury or illness, first aid only, no lost work	3 ☐	4 ☐	4 ☐	4 ☐	4 ☒
Risk Assessment					

Risk Assessment Code

1 = Extremely High Risk	**2 = High Risk**	**3 = Moderate Risk**	**4 = Low Risk**

Explain:

Low Risk: There is zero risk of accident if the action does not take place.

Summary Ratings for Alternative 1

Wilderness Character	
Untrammeled	0
Undeveloped	0
Natural	0
Solitude or Primitive & Unconfined Recreation	0
Other Features of Value	0
Wilderness Character Summary Rating	**0**

Traditional Skills	
Traditional Skills	0

Economics	
Cost	N/A

Safety	
Risk Assessment	Low (Zero)

MRDG Step 2: Alternatives

Alternative 2: Conduct work as prescribed in the "Full Proposal"

Description of the Alternative
What are the details of this alternative? When, where, and how will the action occur? What mitigation measures will be taken?

See attachement.

Component Activities
How will each of the components of the action be performed under this alternative?

Component of the Action		Activity for this Alternative
X	*Example: Transportation of personnel to the project site*	*Example: Personnel will travel by horseback*
1	Transportation of personnel to high elevation or glacial sampling sites within the Peters Lake Basin	Personnel will access the glacier via helicopter
2	Transportation of personnel to project sites via lake access	Personnel will travel by motor boat
3	Sampling equipment to obtain samples under ice	Personnel will use motorized ice augers
4	Sampling equipment requiring a generator and vacuum pump	Personnel will use a motorized generator/vacuum pump
5	Temporary installations to collect weather data	Weather data will be collected by 2 new,temporary meteorological stations
6	Sampling equipment to quantify river discharge	Rivers will be instrumented with river gauge installations
7	Sampling equipment to quantify river turbidity	Rivers will be instrumented with turbidity sensor installations
8	Sampling equipment to quantify glacier flow and behavior	Glaciers will be instrumented with mass-balance installations
9	Gear and sampling equipment associated with lake mooring	Equipment will be moored at Peters Lake with cables / anchors installations

Wilderness Character
What is the effect of each component activity on the qualities of wilderness character? What mitigation measures will be taken?

UNTRAMMELED

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Access via helicopter	☐	☐	☒
2	Personnel will travel by motor boat	☐	☐	☒
3	Personnel will use motorized ice augers	☐	☐	☒
4	Personnel will use a motorized generator/vacuum pump	☐	☐	☒
5	Weather data will be collected by 2 meteorological stations	☐	☐	☒
6	Rivers will be instrumented with river gauge installations	☐	☐	☒
7	Rivers will be instrumented with turbidity sensor installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance installations	☐	☐	☒
9	Equipment will be stabilized at Peters Lake with cables / anchors installations	☐	☐	☒
Total Number of Effects		0	0	NE
Untrammeled Total Rating		**0**		

Explain:

The ecological systems with in the Mollie Beattie Wilderness Area would not be manipulated or controlled.

UNDEVELOPED

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Access via helicopter	☐	☒	☐

2	Personnel will travel by motor boat	☐	☒	☐
3	Personnel will use motorized ice augers	☐	☒	☐
4	Personnel will use a motorized generator/vacuum pump	☐	☒	☐
5	Weather data will be collected by 2 meteorological stations	☐	☒	☐
6	Rivers will be instrumented with river gauge installations	☐	☒	☐
7	Rivers will be instrumented with turbidity sensor installations	☐	☒	☐
8	Glaciers will be instrumented with mass-balance installations	☐	☒	☐
9	Equipment will be stabilized at Peters Lake with cables / anchors installations	☐	☒	☐
Total Number of Effects		0	9	NE
Undeveloped Total Rating		**-9**		

Explain:

Meteorological stations, river gauges, turbidity sensors, mass-balance, and additional mooring devices are all installations that are considered to negatively affect the undeveloped value of wilderness.

NATURAL

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Access via helicopter	☒	☒	☒
2	Personnel will travel by motor boat	☒	☒	☒
3	Personnel will use motorized ice augers	☒	☒	☒
4	Personnel will use a motorized generator/vacuum pump	☒	☒	☒
5	Weather data will be collected by 2 meteorological stations	☒	☒	☐
6	Rivers will be instrumented with river gauge installations	☒	☒	☐
7	Rivers will be instrumented with turbidity sensor	☒	☒	☐

	installations			
8	Glaciers will be instrumented with mass-balance installations	☒	☒	☐
9	Equipment will be stabilized at Peters Lake with cables / anchors installations	☒	☒	☐
Total Number of Effects		9	-9	NE
Natural Total Rating		**0**		

Explain:

The "Full Proposal" would have negative impacts on the natural quality of wilderness character. Proposed installations would be signs of modern civilization in the Peters Lake drainage.

However, prohibited tools would provide information about current and historic ecological processes, while enhancing the ability to forecast future changes for fish, wildlife and their habitats in wilderness.

Therefore, if land managers do not monitor the ecological indicators that contribute to the natural quality of wilderness character, we will lack the baseline information and ecological understanding within the Arctic Refuge wilderness to adequately provide information on climate change processes that compose and are predicted to compose the natural character of the Mollie Beattie wilderness.

SOLITUDE OR PRIMITIVE & UNCONFINED RECREATION

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel via helicopter	☐	☒	☐
2	Personnel will travel by motor boat	☐	☒	☐
3	Personnel will use motorized ice augers	☐	☒	☐
4	Personnel will use a motorized generator/vacuum pump	☐	☒	☐
5	Weather data will be collected by2 meteorological stations	☐	☐	☒
6	Rivers will be instrumented with river gauge installations	☐	☐	☒
7	Rivers will be instrumented with turbidity sensor installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance	☐	☐	☒

	installations			
9	Equipment will be stabilized at Peters Lake with cables / anchors installations	☐	☐	☒
Total Number of Effects		0	4	NE
Solitude or Primitive & Unconfined Rec. Total Rating		**-4**		

Explain:

The Mollie Beattie wilderness could be impacted by the sight and sound of helicopters, motor boats, and personnel during the summers of 2015-2017. Access to Peters Lake during these time periods could impact the experiential quality of wilderness character.

OTHER FEATURES OF VALUE

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel by foot	☐	☐	☒
2	Personnel will travel by motor boat	☐	☐	☒
3	Personnel will use motorized ice augers	☐	☐	☒
4	Personnel will use a motorized generator/vacuum pump	☐	☐	☒
5	Weather data will be collected by 2 meteorological stations	☐	☐	☒
6	Rivers will be instrumented with river gauge installations	☐	☐	☒
7	Rivers will be instrumented with turbidity sensor installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance installations	☐	☐	☒
9	Equipment will be stabilized at Peters Lake with cables / anchors installations	☐	☐	☒
Total Number of Effects		0	0	NE
Other Features of Value Total Rating		**0**		

Explain:

Traditional Skills
What is the effect of each component activity on traditional skills?

TRADITIONAL SKILLS

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel by foot	☐	☐	☒
2	Personnel will travel by motor boat	☐	☐	☒
3	Personnel will use motorized ice augers	☐	☐	☒
4	Personnel will use a motorized generator/vacuum pump	☐	☐	☒
5	Weather data will be collected by 7 meteorological stations	☐	☐	☒
6	Rivers will be instrumented with river gauge installations	☐	☐	☒
7	Rivers will be instrumented with turbidity sensor installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance installations	☐	☐	☒
9	Equipment will be stabilized at Peters Lake with cables / anchors installations	☐	☐	☒
Total Number of Effects		0	0	NE
Traditional Skills Total Rating		**0**		

Explain:

Traditional skills character of the Mollie Beattie Wilderness Area would not be affected.

Economics
What is the estimated cost of each component activity?

COST

Component Activity for this Alternative		Estimated Cost
X	*Example: Personnel will travel by horseback*	*$1,900*
1	N/A	
2		
3		
4		
5		
6		
7		
8		
9		
Total Estimated Cost		

Explain:

N/A

Safety of Visitors & Workers
What is the risk of this alternative to the safety of visitors and workers? What mitigation measures will be taken?

RISK ASSESSMENT	Probability of Accident				
Severity of Accident	Frequent	Likely	Common	Unlikely	Rare
Catastrophic: Death or permanent disability	1	1	2	2	3
Critical: Permanent partial disability or temporary total disability	1	2	2	3	4
Marginal: Compensable injury or illness, treatment, lost work	2	3	3	4	4
Negligible: Superficial injury or illness, first aid only, no lost work	3	4	4	4	4
Risk Assessment	**3=Critical**				

Risk Assessment Code

1 = Extremely High Risk	2 = High Risk	3 = Moderate Risk	4 = Low Risk

Explain:

Summary Ratings for Alternative 2

Wilderness Character	
Untrammeled	0
Undeveloped	-9
Natural	0
Solitude or Primitive & Unconfined Recreation	-4
Other Features of Value	0
Wilderness Character Summary Rating	**-13**

Traditional Skills	
Traditional Skills	0

Economics	
Cost	N/A

Safety	
Risk Assessment	3=Moderate Risk: Critical

MRDG Step 2: Alternatives

Alternative 3:	Conduct work as prescribed in the "Reduced Proposal" with mitigations

Description of the Alternative
What are the details of this alternative? When, where, and how will the action occur? What mitigation measures will be taken?

See attachment.

Component Activities
How will each of the components of the action be performed under this alternative?

Component of the Action		Activity for this Alternative
X	*Example: Transportation of personnel to the project site*	*Example: Personnel will travel by horseback*
1	Transportation of personnel to high elevation or glacial sampling sites within the Peters Lake Basin	Personnel will travel by foot
2	Transportation of personnel to project sites via lake access	Personnel will travel by motor boat / and non-motorized canoe
3	Sampling equipment to obtain samples under ice	Personnel will use manual (non-motorized) ice augers when possible
4	Sampling equipment requiring a generator and vacuum pump	Personnel will use motorized pumps for water samples (same as full proposal)
5	Temporary installations to collect weather data	One weather installation would be located on existing structures; thereby reducing the impact of additional installations
6	Sampling equipment to quantify river discharge	Rivers instrumented with gauge installations
7	Sampling equipment to quantify river turbidity	Rivers instrumented with turbidity sensor installations
8	Sampling equipment to quantify glacier flow and behavior	Glaciers will be instrumented with mass-balance installations

9	Gear and sampling equipment associated with lake mooring	Equipment will be moored at Peters Lake with cables / anchors installations.

Wilderness Character
What is the effect of each component activity on the qualities of wilderness character? What mitigation measures will be taken?

UNTRAMMELED

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel by foot	☐	☐	☒
2	Personnel will travel by motor boat / and non-motorized canoe	☐	☐	☒
3	Personnel will use manual (non-motorized) ice augers	☐	☐	☒
4	Personnel will use motorized pumps for water samples	☐	☐	☒
5	Installations would be located on existing structures	☐	☐	☒
6	Rivers instrumented with gauge installations	☐	☐	☒
7	Rivers instrumented with turbidity sensor installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance installations	☐	☐	☒
9	Lake mooring equipment	☐	☐	☒
Total Number of Effects		0	0	NE
Untrammeled Total Rating		**0**		

Explain:

The ecological systems with in the Mollie Beattie Wilderness Area would not be manipulated or controlled.

UNDEVELOPED

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel by foot	☐	☐	☒

2	Personnel will travel by motor boat / and non-motorized canoe	☐	☐	☐
3	Personnel will use manual (non-motorized) ice augers	☐	☐	☒
4	Personnel will use motorized pumps for water samples	☐	☒	☐
5	Installations would be located on existing structures	☐	☒	☐
6	Rivers will be instrumented with river gauge installations	☐	☒	☐
7	Rivers will be instrumented with turbidity sensor installations	☐	☒	☐
8	Glaciers will be instrumented with mass-balance installations	☐	☒	☐
9	Equipment will be moored at Peters Lake with cables / anchors installations.	☐	☒	☐
Total Number of Effects		0	6	NE
Undeveloped Total Rating		**-6**		

Explain:

Meteorological stations, river gauges, turbidity sensors, mass-balance installations, and additional mooring devices are all installations that are considered to negatively affect the undeveloped value of wilderness.

NATURAL

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel by foot	☐	☐	☒
2	Personnel will travel by motor boat / and non-motorized canoe	☒	☒	☒
3	Personnel will use manual (non-motorized) ice augers	☒	☒	☐
4	Personnel will use motorized pumps for water samples	☒	☒	☐
5	Installations would be located on existing structures	☒	☒	☐
6	Rivers instrumented with gauge installations	☒	☒	☐

7	Rivers instrumented with turbidity sensor installations	☒	☒	☐
8	Glaciers will be instrumented with mass-balance installations	☒	☒	☐
9	Equipment will be moored at Peters Lake with cables / anchors installations.	☒	☒	☐
Total Number of Effects		8	8	NE
Natural Total Rating		**0**		

Explain:

If land managers do not monitor the ecological indicators that contribute to the natural quality of wilderness character, we will lack the baseline information and ecological understanding within the Arctic Refuge wilderness to adequately provide information on climate change processes that compose and are predicted to compose the natural character of wilderness.

The prohibition list is comprised of research tools that provide information pertaining to current and historic ecological processes, while enhancing the ability to forecast future changes for fish, wildlife and their habitats in wilderness.

SOLITUDE OR PRIMITIVE & UNCONFINED RECREATION

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel by foot	☐	☐	☒
2	Personnel will travel by motor boat / and non-motorized canoe	☐	☒	☐
3	Personnel will use manual (non-motorized) ice augers	☐	☐	☒
4	Personnel will use motorized pumps for water samples	☐	☒	☐
5	Installations would be located on existing structures	☐	☐	☒
6	Rivers instrumented with gauge installations	☐	☐	☒
7	Rivers instrumented with turbidity sensor installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance installations	☐	☐	☒
9	Equipment will be moored at Peters Lake with cables / anchors installations.	☐	☐	☒
Total Number of Effects		0	2	NE

Solitude or Primitive & Unconfined Rec. Total Rating	**-2**

Explain:

The Mollie Beattie wilderness would be impacted by motorized equipment and motor boats, and personnel during the summers of 2015-2017. Access to Peters Lake during these time periods would impact opportunities for solitude and primitive recreation.

OTHER FEATURES OF VALUE

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	Personnel will travel by foot	☐	☐	☒
2	Personnel will travel by motor boat / and non-motorized canoe	☐	☐	☒
3	Personnel will use manual (non-motorized) ice augers	☐	☐	☒
4	Personnel will use motorized pumps for water samples	☐	☐	☒
5	Installations would be located on existing structures	☐	☐	☒
6	Rivers instrumented with gauge installations	☐	☒	☒
7	Rivers instrumented with turbidity sensor installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance installations	☐	☐	☒
9	Equipment will be stabilized at Peters Lake with cables / anchors installations.	☐	☐	☒
Total Number of Effects		0	0	NE
Other Features of Value Total Rating		**0**		

Explain:

Traditional Skills
What is the effect of each component activity on traditional skills?

TRADITIONAL SKILLS

Component Activity for this Alternative		Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒

1	No personnel will travel by helicopter	☐	☐	☒
2	Personnel will travel by motor boat / and non-motorized canoe	☐	☐	☒
3	Personnel will use manual (non-motorized) ice augers	☐	☐	☒
4	Personnel will use solar panels and hand-operated and motorized pumps for water samples	☐	☐	☒
5	Installations would be located on existing structures; therefore no additional installations	☐	☐	☒
6	Rivers will be instrumented with fewer (1 less) river gauge installations and no staff gauge installation	☐	☐	☒
7	Rivers will be instrumented with fewer (3 less) river gauge installations	☐	☐	☒
8	Glaciers will be instrumented with mass-balance installations	☐	☐	☒
9	Equipment will be stabilized at Peters Lake with cables / anchors installations. And, fewer sites will be sampled (less than 10)	☐	☐	☒
Total Number of Effects		0	0	NE
Traditional Skills Total Rating			**0**	

Explain:

Traditional skills character of the Mollie Beattie Wilderness Area would not be affected.

Economics

What is the estimated cost of each component activity?

COST

Component Activity for this Alternative		Estimated Cost
X	*Example: Personnel will travel by horseback*	*$1,900*
1	N/A	
2		
3		
4		

5		
6		
7		
8		
9		
Total Estimated Cost		

Explain:

N/A

Safety of Visitors & Workers

What is the risk of this alternative to the safety of visitors and workers? What mitigation measures will be taken?

RISK ASSESSMENT	Probability of Accident				
Severity of Accident	Frequent	Likely	Common	Unlikely	Rare
Catastrophic: Death or permanent disability	1	1	2	2	3
Critical: Permanent partial disability or temporary total disability	1	2	2	3	4
Marginal: Compensable injury or illness, treatment, lost work	2	3	3	4	4
Negligible: Superficial injury or illness, first aid only, no lost work	3	4	4	4	4
Risk Assessment	**4= Marginal**				

Risk Assessment Code

1 = Extremely High Risk	**2 = High Risk**	**3 = Moderate Risk**	**4 = Low Risk**

Explain:

4=Low Risk. Helicopters are a prime risk factor and would not be used in this alternative

Summary Ratings for Alternative 3

Wilderness Character	
Untrammeled	0

Undeveloped	-6
Natural	0
Solitude or Primitive & Unconfined Recreation	-2
Other Features of Value	0
Wilderness Character Summary Rating	**-8**

Traditional Skills	
Traditional Skills	0

Economics	
Cost	N/A

Safety	
Risk Assessment	4= Low Risk : Marginal

MRDG Step 2: Alternatives Not Analyzed

Alternatives Not Analyzed
What alternatives were considered but not analyzed? Why were they not analyzed?

Alternatives that reduced or eliminated instruments/installations were not considered because the proposed instruments are essential for collecting data on natural conditions.

MRDG Step 2: Alternative Comparison

Alternative 1: No Action

Alternative 2: Conduct work as prescribed in the “Full Proposal”

Alternative 3: Conduct work as prescribed in the “Reduced Proposal”

Wilderness Character	Alternative 1		Alternative 2		Alternative 3	
	+	-	+	-	+	-
Untrammeled	0	0	0	0	0	0
Undeveloped	0	0	0	-9	0	-6
Natural	6	6	9	-9	8	-8
Solitude/Primitive/Unconfined	0	0	0	-4	0	-2
Other Features of Value	0	0	0	0	0	0
Total Number of Effects	6	6	9	22	8	16
Wilderness Character Rating	0		-13		-8	
Traditional Skills	Alternative 1		Alternative 2		Alternative 3	
	+	-	+	-	+	-
Traditional Skills						
Traditional Skills Rating						
Economics	Alternative 1		Alternative 2		Alternative 3	
Cost	N/A		N/A		N/A	
Safety of Visitors & Workers	Alternative 1		Alternative 2		Alternative 3	
Risk Assessment						

MRDG Step 2: Determination

Refer to the **MRDG Instructions** before identifying the selected alternative and explaining the rationale for the selection.

Selected Alternative

☐	Alternative 1:	
☐	Alternative 2:	
☒	Alternative 3:	

Explain Rationale for Selection:

Alternative 3, the "reduced proposal," meets refuge science and education objectives and supports stewardship of the naturalness quality by providing critical baseline information to measure future changes against, as well as improving our understanding of past and likely future climate effects on the wilderness ecosystem. While wilderness character will be temporarily reduced by these actions, the negative impacts are short-term (three years or less), and the positive impacts will be long-lasting and additive. The numerical scoring system in the MRDG does not fully account for the temporary nature of negative impacts to wilderness character versus the long term benefits of understanding baseline conditions and monitoring and predicting change.

Describe Monitoring & Reporting Requirements:

The proposed project will be subject to all the terms and conditions of a special use permit, including annual reporting. The field camp and representative instrumentation sites will be visited by refuge personnel at least one annually for the three year term of the project, and following the project to ensure that equipment has been removed and sites restored as specified in permit conditions.

Approvals

Which of the prohibited uses found in Section 4(c) of the Wilderness Act are approved in the selected alternative and for what quantity?

	Prohibited Use	Quantity
☐	Mechanical Transport:	
☒	Motorized Equipment:	Various scientific sampling equipment as specified in attached EA

APPENDIX B: Minimum Requirements Decision Guide

☐	Motor Vehicles:	
☒	Motorboats:	Motorboat use: 5 hp motor maximum, used only as necessary
☒	Landing of Aircraft:	As allowed by ANILCA
☐	Temporary Roads:	
☐	Structures:	
☒	Installations:	2 meterological stations, stream gauges and lake sensors. All temporary, NTE 3 years

Record and report any authorizations of Wilderness Act Section 4(c) prohibited uses according to agency policies or guidance.

Refer to agency policies for the following review and decision authorities:

Prepared	Name	Position	
	A. Soto; H. Helling; D. Payer	Refuge staff	
	Signature		Date

Recommended	Name	Position	
	Signature		Date

Recommended	Name	Position	
	Signature		Date

Approved	Name	Position	
	Brian Glaspell	Refuge Manager	
	Signature		Date
			5/8/15

APPENDIX C: ANILCA Section 810 Evaluation

Arctic National Wildlife Refuge
Evaluation of the Effects on Subsistence Uses and Needs
(ANILCA Section 810 Evaluation)

Arctic Glacial Lakes Project

The U.S. Fish and Wildlife Service, acting for the Secretary, is required by Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) to evaluate the effects on subsistence uses and needs when considering an action on national wildlife refuges in Alaska. The evaluation of effects of this proposed action on subsistence uses and needs is documented below.

Proposed Action:

The Service is proposing to authorize a three-year research study centered at Lake Peters, located within the Neruokpuk Lakes Public Use Natural Area and the Arctic Refuge Wilderness. The purpose of the study is to evaluate hydrological, glacial and meteorological factors that control water and sediment input to Lake Peters in order to better understand how weather and climate are recorded in lake deposits. This effort will add to our understanding of how weather and climate have influenced ecosystem changes in the past, and how the present system may change in the future.

Evaluation:

1. **Subsistence Resources, Uses, and Needs in the Affected Area.**

The Neruokpuk Lakes area is used by residents of the north slope village of Kaktovik for both hunting and fishing. The primary species of interest are Dall's sheep, as well as Dolly varden and whitefish. Moose and muskox may also be taken but very rarely occur in the area (Arctic Refuge Comprehensive Conservation Plan and Environmental Impact Statement 2015). Subsistence activities occur almost exclusively in winter and spring, when overland travel by snowmachine is possible. At other times of year, there is no practical means for subsistence users to travel from Kaktovik to the Neruokpuk Lakes area (Twitchell, pers. comm.). Use is limited to those with the means and ability to make the more than 30-mile (one-way) trip from the coast into the mountains and back.

2. **Effect of Proposed Action on Subsistence Uses and Needs.**

Is there likely to be a reduction in subsistence uses due to:
Direct Impacts on the resource, habitat, or increased competition for resources? NO

Changes in the availability of the resource caused by alteration in distribution, migration, or location? NO

Limitations on access to harvestable resources, such as physical or legal barriers? NO

3. Availability of other lands for the purpose to be achieved.

Are there other lands that could meet the purpose and need of the proposed action? NO

4. Alternatives which would reduce or eliminate the proposed action from lands needed for subsistence purposes.

Are there other ways to accommodate the proposed action (not to other sites) that are reasonable, physically and technically possible, economically feasible, and capable of reducing or eliminating the proposed action from lands needed for subsistence purposes? NO

Finding:

Based on review and evaluation of information indicated above and in supporting references, I have determined that the proposed action will not result in a significant restriction of subsistence uses.

Agency Decision:

A finding of no significant restriction in subsistence uses completes the Section 810 requirements. The proposed action may be authorized.

Supporting References:

Alaska Department of Fish and Game [ADFG]. 1985. Data for Kaktovik 1985. Community Subsistence Information System (CSIS). ,http://www.adfg.alaska.gov/sb/CSIS/>.

Brower, H.K., T.P. Olemaun, and T.R. Hepa. 2000. *North Slope Borough subsistence harvest documentation project: data for Kaktovik, Alaska for the period December 1, 1994 to November 30 1995*. Department of Wildlife Management, North Slope Borough, Barrow, Alaska.

Twitchell, H. 2015. Personal Communication on March 26, 2015. Fairbanks, Alaska.

U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge. 2015. *Revised Comprehensive Conservation Plan, Final Environmental Impact Statement, Wilderness Review, Wild and Scenic River Review, Volume 1.*

Signature:

3/28/15

Refuge Manger

APPENDIX D: Comments Received on Draft Environmental Assessment

We received 892 comments on the draft Environmental Assessment (EA). About 98 percent of these comments appear to have been generated from "Action Alerts" issued by the Northern Alaska Environmental Center, the Wilderness Society and Wilderness Watch (Arctic Refuge supplied copies of the draft EA directly to these organizations at the beginning of the public comment period). About half of the comments (444) were received on April 22 (Earth Day) and contained nearly identical language. Detailed comments were also received from the following organizations: Wilderness Watch, the Alaska Chapter of Sierra Club, Northern Alaska Environmental Center, the Wilderness Society, Friends of Alaska National Wildlife Refuges, and the Northwest Boreal Landscape Conservation Cooperative.

Most commenters were opposed to the Proposed Action, citing potential impacts to wilderness character and dissatisfaction with the public process. Comments in favor of the Proposed Action cited the science value of data that would be collected and related educational opportunities. Below is a characterization of the comments, with Agency responses as appropriate.

The proposed project will degrade the wilderness character of the Arctic Wilderness. Our analysis concludes that the Proposed Action would have some limited negative impacts to wilderness character, but those impacts will be temporary and local in scale, and will be substantially mitigated with amendments to the plan of operations that was initially proposed. Helicopter use will not be authorized. Use of tracer dye for measuring stream discharge will not be authorized. Fixed-wing airplane access will occur on the durable lake-ice surface and/or at times of year when the alluvial-fan landing area adjacent to Lake Peters is dry and durable. The number of flights will be limited to the minimum practical while maintaining light payloads to further limit the potential for impacts. Motorboat use will be limited in favor of an inflatable canoe, and the authorized outboard motor will be limited to a five horsepower, four-stroke model that will minimize noise impacts and fuel-use. Camp activities will be largely contained within the footprint of existing facilities at Peters Lake.

The draft EA and Minimum Requirements Analysis fail to justify that the prohibited actions are necessary to protect wilderness. The Final EA and Minimum Requirements Analysis have been amended to further clarify the need for the Proposed Action. Temporary installation of scientific instruments and limited use of motorized equipment to deploy, service and retrieve those instruments is necessary to understand the baseline natural condition of the wilderness. It is our responsibility as wilderness stewards to understand baseline conditions and develop the ability to predict future changes in the face of known threats—even where we may not be able to effectively protect against those threats, as may be the case with climate change. In our best professional judgment, the Proposed Action, with mitigation measures, is necessary to meet these responsibilities.

The inadequate public notification and comment opportunity fail to fulfill the intent of the National Environmental Policy Act. The draft EA was sent directly to those organizations we believed would be most likely to have an interest in the Proposed Action, and posted on the Arctic Refuge website. Only one commenter, Wilderness Watch, requested an extension of the initial 15-day comment period, and

the period was subsequently extended to 30 days. We received 892 comments, from wilderness advocacy groups generally opposed to the Proposed Action and also from individual scientists and science organizations generally in favor of it. We reviewed all comments and made numerous changes to the Proposed Action and the final EA as a result. This process is consistent with the National Environmental Policy Act (NEPA) and the U.S. Fish and Wildlife Service NEPA for National Wildlife Refuges Handbook.

The Proposed Action will set a precedent for wilderness-degrading actions in the future. All actions with the potential to degrade wilderness character, whether they are proposed by the Fish and Wildlife Service or by an outside organization, are reviewed on their individual merits. Decisions made regarding the Proposed Action apply to this action only and are not intended as general statements of policy or future intention.

The Proposed Action could take place at some other location outside of wilderness. One of the first questions we ask during the initial review of any proposal that involves activities in wilderness is whether or not it could take place somewhere else. The size of Lake Peters, its proximity to the Chamberlin and McCall glaciers and the Arctic Ocean, and the habitats supported by this system make the area unique. There is no other location where this work could be conducted, so it did not make sense to analyze a non-wilderness alternative.

The Minimum Requirements Analysis improperly credits "other features of value." The MRA has been amended to reflect the mitigated Proposed Action and to incorporate this correction. It is attached to the Final EA.

The estimated number of visitors to Lake Peters referenced in the draft EA is too low. Our best resource for estimating visitor numbers is the set of annual reports provided by authorized air taxis. These reports document exact visitor numbers and drop-off locations with dates, but they only capture visitors who arrive by air taxi and not those who arrive by private plane or on foot from some other location. Therefore, air-taxi reports represent the minimum number of visitors but the actual number could be higher. The final EA has been changed to include this clarification.

Not enough information about the proposed inflatable boat, motor, and fuel is provided. The boat that will be used is a 14-foot inflatable, Achilles-brand raft with removable floor boards. The motor is a Mercury-brand, four-stroke, five horsepower outboard. Fuel for the motor will be stored in approved, five-gallon fuel containers, within an existing storage shed that is part of the G. William Holmes facility. A standard emergency kit with absorbent pads and containment materials will be on hand at all times during fueling and boat operations. The final EA has been updated to include these details.

Use of a gas-powered ice-auger is not necessary. The auger is intended to be used only as necessary (where researchers are unable to penetrate thick lake ice with hand-tools) and only for initial deployment of instruments that will occur over a period of days at the beginning of the three-year term of the study. A maximum of five mooring holes and up to 10 other test holes could be cut.

A float plane could be used instead of a wheeled plane to reduce impacts on vegetation and soils. Float planes landing at Lake Peters would have significantly-reduced performance and smaller payload potential, thus requiring more total flights and landings. In addition, float planes are only useful during the period of time that the Lake is ice-free. Wheeled-plane landings will only occur on the ice or when soils are dry and relatively durable. If moist soils or other conditions prevent, for any reason, minimum-impact wheeled landings, then a float plane will be required.

Researchers should be required to take measures to minimize vegetative trampling impacts. Researchers will be required to use existing materials at the G. William Holmes Research station or transport material such as "geoblock" to the site if their activities threaten to impact non-durable, vegetated surfaces.

In order to maximize the public benefit of the Proposed Action, researchers should be required to make collected data and other educational materials publicly available. The project proponents have submitted a data-sharing plan as part of their permit application. The Advanced Cooperative Arctic Data and Information Service (ACADIS) will provide data archival, preservation, access, and metadata authoring services for their project. ACADIS is an open-source, community resource for National Science Foundation-funded Arctic data. All data will be publicly available with no restrictions. In addition, the researchers will be required to prepare and deliver a recorded public presentation in Fairbanks, Alaska at the conclusion of each field season. They are required to submit a report of activities to the Refuge Manager at the end of each season as well.

ARCTIC NATIONAL WILDLIFE REFUGE
Special Conditions
Special Use Permit #:

1. Failure to abide by any part of this special use permit; violation of any refuge related provision in Titles 43 (Part 36) or 50(sub-chapters B and C), Code of Federal Regulations; or violation of any pertinent state regulation (e.g., fish or game violation) will, with due process, be considered grounds for revocation of this permit and could result in denial of future permit requests for lands administered by the U.S. Fish and Wildlife Service. This provision applies to all persons working under the authority of this permit (e.g., research assistants). Appeals of decisions relative to permits are handled in accordance with Title 50 Code of Federal Regulations Part 36.41.

2. The permittee is responsible for ensuring that all employees, party members, aircraft pilots, and any other persons working for the permittee and conducting activities allowed by this permit are familiar with and adhere to the conditions of the permit.

3. A copy of this permit shall be in the permittee's or field party chief's possession at all times while exercising the privileges of the permit.

4. This permit may be cancelled or revised at any time by the refuge manager in case of emergency (e.g., high fire danger, flooding, unusual resource problems, etc.).

5. The permittee shall notify the refuge manager during refuge working hours in person or by telephone before beginning and upon completion of annual activities allowed by this permit.

6. Prior to beginning any activities allowed by this permit, the permittee shall provide the refuge manager with 1) the name(s) and method of contact for the field party chief/supervisor; 2) aircraft and other vehicle types to be used and identification information for these vehicles; 3) names of assistant guides and helpers; and 4) any changes in information provided in the original permit application.

7. The Refuge Manager or designee, upon request, shall be afforded the opportunity and logistical support from the nearest commercial transportation site to accompany the permittee for the purpose of inspection and monitoring permittee activities. A final inspection trip provided by the permittee of the areas of use may be required by the Refuge Manager to determine compliance with the terms of this permit.

8. An annual report of activities conducted on the Refuge (normally 1-2 pages) shall be provided to the Refuge Manager within 30-days of the permit expiration. Copies of all final reports and publications will be forwarded to the Refuge Manager.

9. This permit authorizes use only on Arctic National Wildlife Refuge lands and waters. Use of land selected by a Native corporation or individual is not authorized by this permit.

10. The permittee and permittee's employees, coworkers, or contractors do not have the exclusive use of the site(s) or lands covered by this permit.

ARCTIC NATIONAL WILDLIFE REFUGE
Special Conditions
Special Use Permit #:

11. The permittee shall take no action that interferes with subsistence activities of rural users or restricts the reasonable access of subsistence users to Refuge lands. This may include but is not limited to disturbance of wildlife and their movements near subsistence hunters, and damage to cabins, trails, traditional campsites or caches used by subsistence users.

12. Any action by a permittee or the permittee's employees which unduly interferes with or harasses other refuge visitors or subsistence users, or impedes access to any site, is strictly prohibited. Examples of prohibited acts include, but are not limited to, low flights over camps or persons at less than 500 feet (unless taking-off or landing) and parking aircraft or placing other objects (rocks, tents, etc.) on any landable area so as to restrict use by other aircraft or persons. Ghost camps - unoccupied tents indicating the false use of an area - are prohibited.

13. In accordance with the Archaeological Resources Protection Act (16 U.S.C. 470 ee), no person may excavate, remove, damage or otherwise alter or deface, or attempt to excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public lands or Indian lands unless permitted or exempted (see 16 U.S.C 470cc for permit or exception guidance). No person may sell, purchase, exchange, transport, receive, or offer to sell, purchase, or exchange any archaeological resource if such resource was excavated or removed from public lands.

14. The operation of aircraft resulting in herding, harassment, hazing, or driving of wildlife is prohibited except to accomplish the authorized research. It is recommended that all aircraft, except for take-off and landing, and as necessary for safety, shall maintain a minimum altitude of 2000 feet above ground level.

15. Helicopter use may be authorized in some instances. Those authorized with helicopter access shall comply with the following:

a. Landing is prohibited except for the direct support of the activity covered by this permit and emergencies. No recreational use of helicopters is permitted.
b. Overnight stays shall be pre-authorized by the Refuge Manager.
c. Personnel transported are restricted to only those necessary to accomplish the authorized activity.
d. If helicopters are used, the annual report (required by Condition 8) shall contain a detailed summary of helicopter activities for inclusion in the Refuge helicopter landing database. The summary shall contain the following data:

1. Aircraft model
2. Operator company and/or ownership
3. Date and time of flights
4. Number of hours flown
5. Landing locations (GPS coordinates in decimal degrees)
6. Date and time of each landing

ARCTIC NATIONAL WILDLIFE REFUGE
Special Conditions
Special Use Permit #:

16. Fuel storage sites shall be approved in advance and in writing by the Refuge Manager. Preparations to prevent and respond to a fuel spill shall be fully adequate at all sites for the amount of fuel stored on site. Fuel storage sites shall conform to the following:

a. Storage sites shall be above the high water line.

b. Storage shall be in containers approved for gasoline and labeled with the permittee's name, phone number, and type of fuel.

17. The construction or clearing of landing strips or pads is prohibited. Incidental hand removal of rocks and other minor obstructions is allowed.

18. Snowmobiles, dog teams, watercraft, and other means of transportation shall be operated in such a manner as to prevent the herding, harassment, hazing, or driving of wildlife.

19. The use of off road vehicles is prohibited. The use of snowmobiles, dog teams, and other means of surface transportation may only be used when adequate snow cover is present and in such a manner as to prevent damage to the Refuge. The phrase "adequate snow cover" means the snow is deep enough to protect the underlying vegetation and soil.

20. Any human-wildlife interactions of the permittee, persons working under the authority of this permit, and clients, that have resulted in animals obtaining food; destroying property; or posing a threat to human safety shall be reported to the Refuge Manager immediately at (907) 456-0250, as soon as communication becomes available. You are required to submit a written report within 30 days to the Refuge Manager for all interactions with grizzly bears that have resulted in bears obtaining food; destroying property; posing a threat to human safety; or the death of a grizzly bear, so that this data can be used to help prevent future human-bear conflicts. You may use the attached Bear Incident Report form. Animals taken in defense of life or property shall be reported to the Refuge Manager immediately, and to the Alaska State Troopers at (907) 451-5350, and salvaged in accordance with State regulations.

21. Live wood may not be used for any purpose. Standing dead wood may only be used on the south side of the Brooks Range Mountains. Dead and downed wood may be used for any purpose across the Refuge. Use of fuel stoves is encouraged over use of wood for cooking and heating.

22. In general and where possible, camps shall be located on durable surfaces (snow, sand or gravel). Camps located on vegetation shall be relocated at intervals adequate to prevent site impacts. Sites at popular aircraft access points that are already heavily impacted can continue to be used. Along high use rivers and lakes, camps shall not be located on vegetated sites that show human caused scuffing or matting of vegetation.

23. Construction of cabins, platforms, or other permanent structures is prohibited. Wall tents with floors that are completely removed from the refuge at the end of field season are allowed.

ARCTIC NATIONAL WILDLIFE REFUGE
Special Conditions
Special Use Permit #:

24. No discharge of petroleum products or toxic materials shall be made within the refuge. All hazardous substances utilized and/or generated by permitted activity shall be contained, controlled and cleaned up. Such measures shall take precedence over all other matters except human safety. All spills or leakage of petroleum products or toxic materials, fires, fatalities, and any other conditions which threaten the refuge's resources, the environment or human safety, shall be reported by the permittee to the refuge manager immediately or as soon as communication can be established.

25. Permitees shall maintain their use areas in a neat and sanitary condition. Food, garbage, and other materials shall be stored to minimize attraction to bears and other wildlife. All evidence of your camp shall be obliterated prior to your departure from the site. Equipment and other property, including garbage, shall be removed from the Refuge upon completion of the season's permitted activities.

26. Human waste shall not be left less than 150 feet from springs, lakes, and streams. Bury waste under soil (or under snow at the ground level during periods when the ground is frozen). Paper toilet tissue, if used, shall be packed out or burned completely to ash. Moist towelettes or sanitary products shall be removed as trash. In high use areas, especially the Kongakut and Hulahula river corridors and extended base-camps, we encourage packing-out of human waste.

27. Refuge regulated services that are sub-contracted shall be provided by a service with a Refuge Special Use Permit. For example, if a research permittee requires air transportation services for their gear and scientists, the air operator shall have or obtain a Refuge Special Use Permit.

28. Base camp locations shall be approved in advance and in writing by the Refuge Manager and be located on durable surfaces.

29. Equipment caches and locations shall be approved in advance and in writing by the Refuge Manager. The cache shall be clearly marked with the permittee's name and phone number; blend in with the surrounding environment; and be bear-resistant.

30. Motorboat operators shall have in their possession a U.S. Coast Guard (USCG) license for all passenger-carrying operations, if required by USCG regulations.

31. Legal take and harassment of polar bears is limited to defense of life. Any killing or harassment of a polar bear in defense of life shall be reported to the Refuge Manager and to the US Fish and Wildlife Service Office of Law Enforcement at (907) 456-2335 immediately, as soon as communication becomes available. You are also required to submit a report to the Refuge Manager for all interactions with polar bears that have resulted in bears obtaining food; destroying property; posing a threat to human safety; or the death of a polar bear, so that this data can be used to help prevent future human-bear conflicts.

ARCTIC NATIONAL WILDLIFE REFUGE
Special Conditions
Special Use Permit #:

32. For activities occurring within 25 miles of the coast, the permittee shall read the Polar Bear Interaction Guidelines (Interaction Guidelines) attached to these permit Special Conditions. The Guidelines shall also be distributed to all employees and clients of the permittee before engaging in any activities on the Refuge. In addition, the following conditions shall be met:

A) When operating in spring time, protection of den sites and minimizing disturbance to sows with small cubs is of critical importance. Guides operating under this permit shall become knowledgeable of the signs and behaviors indicating the presence of a den and avoid those areas. No person shall approach, or remain, within 1 mile of a polar bear den, or of a sow with small cubs. If at any time the permittee becomes aware of signs indicating their close proximity to a polar bear den, or encounters a sow with small cubs, all members of the guided party shall immediately retreat to a distance of at least one mile. If, at any time, the location of a den becomes known to the permittee, no approach shall be made closer than one mile.

B) When operating within 25 miles of the Beaufort Sea coastline, the permittee will store attractants (human food, dog food, garbage, etc.) in "bear-resistant" containers to minimize attracting polar bears and avoid conditioning bears to human food. Containers shall be approved as "bear-resistant." Information about certified "bear resistant" containers can be found at http://www.igbconline.org/html/container.html.

Permittee: _____

Issuing Officer: _____

Brian Glaspell
Refuge Manager