United States Department of the Interior

FISH AND WILDLIFE SERVICE
Arctic National Wildlife Refuge
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Dear Reader:

This Draft Environmental Assessment (EA) for a proposed study at Lake Peters within Arctic National Wildlife Refuge is being made available for your review. Arctic Refuge has received 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. The proposed project would include three years of monitoring and sediment sampling in the lake, its tributary streams, and on Chamberlin Glacier.

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).

We are releasing this Draft EA for a 15-day public comment period. Your comments must be submitted no later than April 20, 2015. Public comments may be submitted by e-mail to: arctic_refuge@fws.gov or by postal service mail to: U.S. Fish and Wildlife Service, Arctic NWR, 101 12th Ave, Rm 236, Fairbanks, AK 99701. Comments may also be faxed to: (907) 456-0428. Additional information about Arctic Refuge is available on the Refuge website at http://arctic.fws.gov/ccp.htm.

Thank you for participating in our planning and permitting process!

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

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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 numerous 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), two temporary weather stations on or near the glacier, helicopter access, motorboat use, and temporary installations such as turbidity sensors and other instrumentation moored in Peters Lake and outflow streams. These actions are not permissible except 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): 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 standard special use permit conditions (Appendix A contains the project proposal). 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. 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 will 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.

- Helicopter: Because the glacier is not accessible by plane, the permit applicant requests permission to use a helicopter to deploy (May 2015), service (August 2016) and retrieve (August 2017) the weather station on Chamberlain Glacier. This would require one helicopter landing per year (unless installation requires additional landings).
- Fixed-wing access: The primary field camp will be deployed, services, 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 (zodiac style) 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 wind could easily blow the raft across the lake. At a minimum, field crews would need a 15-20 horsepower motor to accelerate the watercraft to achieve on-step operation.

- 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 drill through the ice. A diameter of 16" is needed to collect samples and deploy sediment traps.

- 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. Thus 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 to seven 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 will 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.

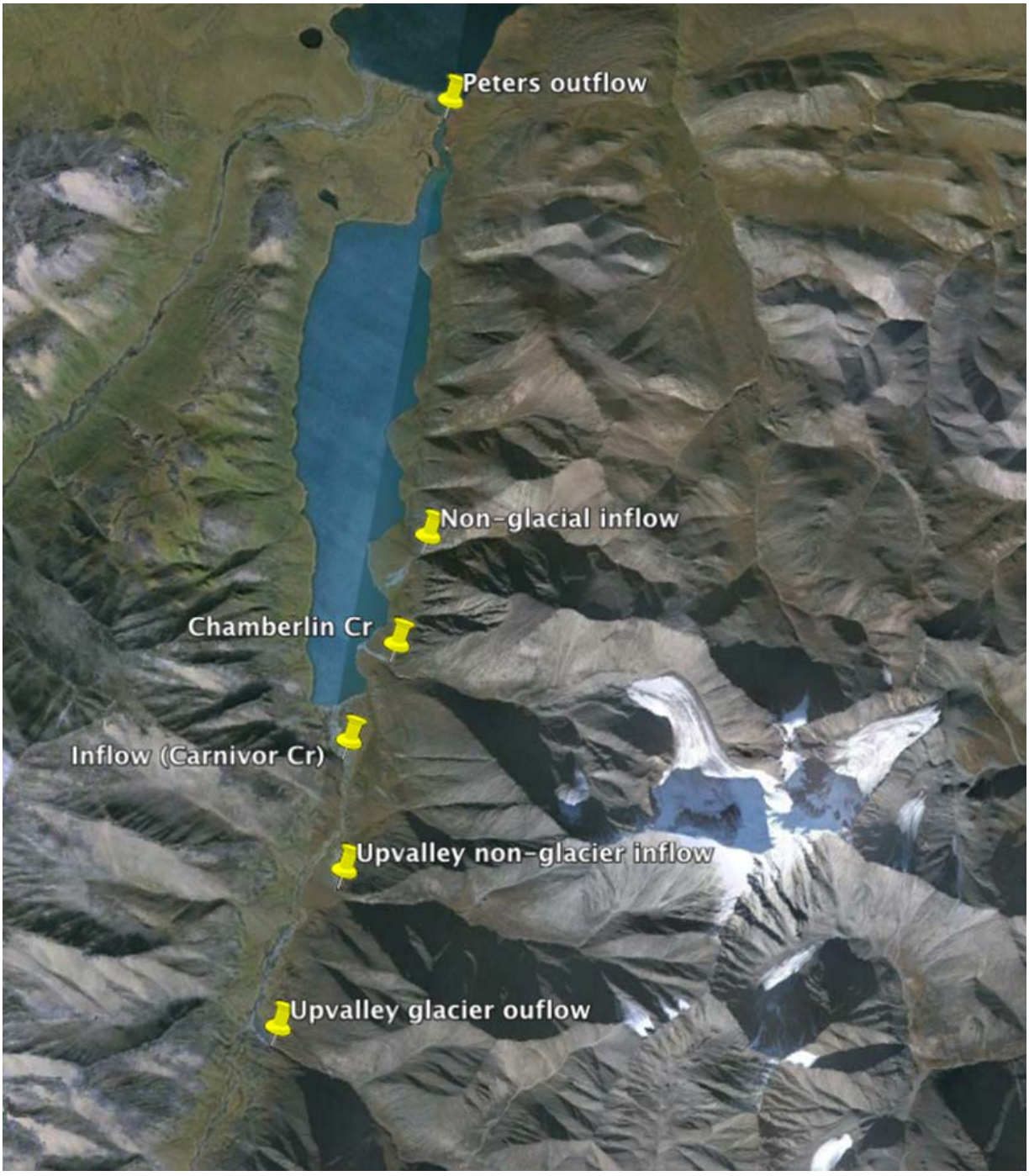

Figure 2. Isco 3700C Compact Portable Sampler that would be deployed alongside stream to capture water samples in a wide-range of flow conditions. Note, the instrument would be camouflaged in a rock enclosure.

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, aretes, 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 and contacts made in the field, annual visitor use is low and variable from year to year. It is likely that fewer than three recreational parties per year visit the area.

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 late 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 is accessed via ski plane in the winter and float plane during the summer.

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; helicopter 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) 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 authorized helicopter uses; (3) number of air taxi and transporter fixed wing aircraft drop-offs; and (4) 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>

- 3 weather stations, deployed year-around

Weighted .5 each, total = 1.5

- 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 fluorometer

  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 Petersweighed 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 11.5 to between 18.75 and 19.75.

Figure 5. Locations of meteorological stations on McCall Glacier. Initial operation of these stations began in 2003. (http://drmattnolan.com/mccall-glacier).

Measure 2: The number of authorized helicopter uses.

Proposed:

- 2-3 landings per year, for 3 years

  Weighted 1 each

Current: The 2013 baseline value for this measure is 2 helicopter landings

Change: This project would increase the index total for this measurefrom 2 to between 4 to 5 per year.

Measure 3: The number of Air Taxi and Transporter fixed wing aircraft drop-offs.

Proposed: Three drop-offs for each of the proposal's three years of operation.

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 4: 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 15-20 horsepower motorboat would 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 substantially 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.

Helicopter access – The sound of limited helicopter use would be brief and transient, therefore impacts on wildlife would be negligible.

Climate stations – Installation of the 2 – 3 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.

For wheeled plane access on the larger airstrip at the south end of the lake, any use would cause major, long term, site-specific impacts, due to non-durable surface.

Helicopter access - No impacts likely.

Climate stations - The presence of two or three climate stations would cause temporary disturbance to vegetation and soils (<3 years) of ~1 square meter at each station (cumulative footprint of 3 legs of structure). All three stations would be on durable surfaces and two would be on rocks or ice with no vegetation or soil. There would be negligible, short term, site specific impacts.

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) would cause trampling of plants and soil on trails, and the areas around cabins and tents.

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. If necessary to travel in bays that are protected from high waves, operators would travel at reduced speed unless safety is an issue. 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.Helicopter access – No impacts likely.

Climate stations - No impacts likely.

Camp issues –No impacts likely.

Sensors and gauges in lakes and streams – Deploying equipment in lakes and streams could have major, long-term, site-specific, direct and indirect, negative impacts if deployments result in the introduction and establishment of invasive species. Clean

instruments and moorings are not expected to impact aquatic ecosystems. When possible, new instruments and mooring lines that have not been deployed elsewhere would be used.

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. 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. 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.

Helicopter access – The sight and sound of helicopters 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 is being conducted in accordance with the National Environmental Policy Act NEPA) and procedures detailed in the NEPA for National Wildlife Refuges Handbook (2014). A 15-day public review and comment period for this document will be open from April 6 to April 20. A notice of availability will be posted on the Arctic Refuge website, and sent to the village of Kaktovik and other potentially interested parties.

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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:

Scientific:
The Arctic NWR recognized that an understanding of ecosystem function is important to fulfill its legislative mandate to manage Federal Refuge Lands in a manner that leaves them unimpaired for fish and wildlife and satisfies visitor expectations.

Various studies have investigated the effects of climate change, but on a regional scale it is important to understand the effects in the northeastern corner of Alaska to contribute to a broad cross-comparison effort. Since a long-term climatological record does not exist for Arctic NWR, this study is necessary to document historical changes over time. This research effort will ultimately provide scientific data that quantifies and evaluates the predicted future climatic changes in the Arctic Refuge wilderness. Additionally, these data

will be used by a wide audience of researchers and governmental land managers to further understand ecosystem response to climate change.

Education:
The National Wildlife Refuge System including Arctic NWR has a significant interpretive mission. Education and outreach are the primary tools used to engage the public and other outside entities on wilderness stewardship and the ecological processes that define Arctic Refuge's wilderness. Given that the public values our Nation's arctic landscape in northeastern Alaska, and climate has always been a component of interpretative messaging, a more sophisticated understanding of consequences of climate change for Arctic Refuge wilderness is needed, and would be provided by this project.

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.

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 helicopter
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 helicopter	☐	☐	☒
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 helicopter	☐	☐	☒
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 helicopter	☐	☐	☒
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 helicopter	☐	☐	☒
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 via helicopter	☐	☐	☒
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
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 via helicopter	☐	☐	☒
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 travel by 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 7 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	Personnel will travel by 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 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
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 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 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	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	Personnel will travel by 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 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	5	NE
Natural Total Rating		**-1**		

Explain:

Given the number of Wilderness Act prohibitions this study requires, the "Full Proposal" alternative negatively affects 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 by 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 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	9	NE
Solitude or Primitive & Unconfined Rec. Total Rating		**-4**		

Explain:

The Mollie Beattie wilderness would be impacted by the sight and sound of helicopter flights, climate stations, glacier mass-balance installations, motor boats, and personnel during the summers of 2015-2017. Access to Peters Lake during these time periods would 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 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 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		7	0	NE
Other Features of Value Total Rating		**7**		

Explain:

Scientific Value:
The Arctic NWR recognizes that an understanding of ecosystem function is important to fulfill its legislative mandate to manage Federal Refuge Lands in a manner that leaves them unimpaired for fish and wildlife while satisfying visitor expectations.

Since the circumpolar arctic climate is currently influenced by changes, Arctic Refuge land managers are in need of ecological baseline information and an understanding of the ecological indicators that contribute to, or are affected by, these processes. Since the Mollie Beattie wilderness is subject to current and future climatic and ecosystem changes, it is important to provide the opportunity of scientific study in an otherwise undisturbed ecosystem.

Educational Value:
The FWS Refuge system and specifically Arctic NWR has a significant interpretive mission with education and outreach being the primary means used to engage the public and other outside entities on land management and wilderness stewardship. The research products achievable in Alternative 2 (Full proposal) positively contribute to wilderness character given that research findings would be used for outreach and public educational purposes.

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 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 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	-1
Solitude or Primitive & Unconfined Recreation	-4
Other Features of Value	7
Wilderness Character Summary Rating	**-7**

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"

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	No personnel will travel by helicopter
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
4	Sampling equipment requiring a generator and vacuum pump	Personnel will use solar panels and hand-operated and motorized pumps for water samples
5	Temporary installations to collect weather data	Installations would be located on existing structures; therbye reducing the impact of additional installations
6	Sampling equipment to quantify river discharge	Rivers will be instrumented with fewer (1 less) river gauge installations and no staff gauge installation
7	Sampling equipment to quantify river turbidity	Rivers will be instrumented with fewer (3 less) river gauge 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 mooredat Peters Lake with cables / anchors installations. Fewer sites will be sampled (less than 10) compared to full proposal.

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 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 moored at Peters Lake with cables / anchors installations. And, fewer sites will be sampled (less than 10)	☐	☐	☒
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 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	☐	☒	☐
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 moored at Peters Lake with cables / anchors installations. And, fewer sites will be sampled (less than 10)	☐	☒	☐
Total Number of Effects		0	6	NE
Undeveloped Total Rating		**-7**		

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	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 moored at Peters Lake with cables / anchors installations. And, fewer sites will be sampled (less than 10)	☒	☒	☐
Total Number of Effects		0	7	NE
Natural Total Rating		**-1**		

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. However, the reduced proposal substantially reduces the quality and quantity of biophysical information gathered during this study to understand these processes. This alternative would not be as effective in providing land managers baseline information needed to understand and monitor the natural quality 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 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 moored at Peters Lake with cables / anchors installations. And, fewer sites will be sampled (less than 10)	☐	☐	☒
Total Number of Effects		0	1	NE
Solitude or Primitive & Unconfined Rec. Total Rating		**-1**		

Explain:

The Mollie Beattie wilderness would be impacted by the presence of climate stations, glacier mass-balance installations, 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	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		7	0	NE
Other Features of Value Total Rating		**7**		

Explain:

Scientific Value:
The Arctic NWR recognizes that an understanding of ecosystem function is important to fulfill its legislative mandate to manage Federal Refuge Lands in a manner that leaves them unimpaired for fish and wildlife while satisfying visitor expectations.

Since the circumpolar arctic climate appears to be changing rapidly, Arctic Refuge land managers are in need of ecological baseline information and an understanding of the ecological indicators that contribute to, or are affected by, these processes. The Mollie Beattie wilderness is subject to current and future climatic and ecosystem changes, and it is important to provide the opportunity of scientific study in an otherwise undisturbed ecosystem. Therefore, the scientific value in Alternative 3 (Reduced proposal) positively contributes to wilderness character given scientific information would be gathered to project objectives. However, the reduced efforts would constrain the research project scope which would limit the scientific value contribution to wilderness character.

Educational Value:
The FWS Refuge system and specifically Arctic NWR has a significant interpretive mission with education and outreach being the primary means used to engage the public and other outside entities on land management and wilderness stewardship. The research products achievable in Alternative 2 (Full proposal) positively contribute to wilderness character given that research findings would be used for outreach and public educational purposes.

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: Marginal: compensable injury, illness, treatment, or lost work.

Summary Ratings for Alternative 3

Wilderness Character	
Untrammeled	0
Undeveloped	-9
Natural	-1
Solitude or Primitive & Unconfined Recreation	-1
Other Features of Value	7
Wilderness Character Summary Rating	**-4**

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?

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						
Undeveloped		0		-9		-9
Natural		0		-1		-1
Solitude/Primitive/Unconfined		0		-4		-4
Other Features of Value		0	7		7	
Total Number of Effects			7			
Wilderness Character Rating	0		-7		-7	
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 2, the "full 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.

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:	Up to 3 helicopter and 3 fixed-wing landings/yr + motorboat use
☒	Motorized Equipment:	Various scientific sampling equipment
☐	Motor Vehicles:	
☒	Motorboats:	Periodic use during summer season

☒	Landing of Aircraft:	See previous
☐	Temporary Roads:	
☐	Structures:	
☒	Installations:	Meterological stations, stream gauges and lake sensors

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

APPENDIX B: Minimum Requirements Decision Guide

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