Pictured Rocks National Lakeshore
Michigan

US Department of the Interior
National Park Service

Personal Watercraft Use Environmental Assessment

October 2017

UNITED STATES DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE
PICTURED ROCKS NATIONAL LAKESHORE

PERSONAL WATERCRAFT USE ENVIRONMENTAL ASSESSMENT

The National Park Service (NPS) has prepared this environmental assessment (EA) to evaluate the impacts of personal watercraft (PWC) use at Pictured Rocks National Lakeshore (national lakeshore/park).

This EA evaluates three alternatives for managing PWC use at the national lakeshore, describes the environment that would be affected by the alternatives, and assesses the environmental consequences of implementing the alternatives. Under alternative 1, the NPS would continue to implement the 2005 Special Regulation for PWC Use at the national lakeshore (36 CFR § 7.32 (d)(1)). The NPS would amend this special regulation to include a requirement that all PWCs operating in the park must meet the 2010 Environmental Protection Agency (EPA) air quality emissions standards. Under alternative 2, PWC use would be allowed along the entire Lake Superior shoreline in the national lakeshore. This alternative would also require PWCs to meet the 2010 EPA emissions standards. Alternative 3 represents the no-action alternative, which would be the elimination of PWC use at the national lakeshore. Upon conclusion of this EA and decision-making process, one of the alternatives, or a combination of actions from multiple alternatives, will become the long-term PWC management plan and special regulation, should an alternative be selected that would allow PWC use to continue at the national lakeshore.

This EA has been prepared in compliance with the National Environmental Policy Act (NEPA) to provide the decision-making framework that 1) analyzes a reasonable range of alternatives to meet objectives of the proposal, 2) evaluates potential issues and impacts on the park's resources and values, and 3) identifies mitigation measures to lessen the degree or extent of these impacts. The NPS conducted internal, public, and agency scoping to assist with the development of this document.

PUBLIC COMMENT

This EA will be on public review for 30 days. If you wish to comment on this EA, you may enter your comments online using the National Park Service Planning, Environment, and Public Comment (PEPC) website at http://parkplanning.nps.gov/piropwc. You may also mail comments to: Superintendent, Pictured Rocks National Lakeshore, P.O. Box 40, Munising, MI, 49862 or hand-deliver to park headquarters at N8391 Sand Point Road, Munising, MI. Written comments will also be accepted during public meetings on the EA. All comments must be received by the end of the public comment period, which will be 30 days from the date the EA is published on the PEPC website above. Comments will not be accepted by fax, email, or in any format other than those specified above. Bulk comments in any format (hard copy or electronic) submitted on behalf of others will not be accepted.

Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment, including your personal identifying information, may be made publicly available at any time. While you can ask in your comment to withhold your personal identifying information from public review, the NPS cannot guarantee that it will be able to do so.

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CHAPTER 1: PURPOSE AND NEED

This "Purpose and Need" chapter describes why the National Park Service (NPS) is taking action at this time with respect to personal watercraft (PWC)[1] use at Pictured Rocks National Lakeshore (national lakeshore). This environmental assessment (EA) evaluates a range of alternatives and management actions for PWC use at the national lakeshore and analyzes the impacts that could result from the implementation of these alternatives. Upon conclusion of this EA and decision-making process, one of the alternatives, or a combination of actions from multiple alternatives, will become the long-term PWC management plan and special regulation, should an alternative be selected that would allow PWC use at the national lakeshore.

Specifically, this chapter includes the following:

- Statements of the purpose, need, and objectives for taking action, as developed during internal and public scoping for this project
- A description of the project location and of the establishment of the national lakeshore
- The purpose and significance of the national lakeshore
- A summary of PWC use and management
- Scope of the analysis
- A discussion of issues and impact topics identified during the scoping process and considered in preparation of this EA, as well as issues and impact topics dismissed from further analysis

PURPOSE OF THE PROJECT

The purpose of this EA is to evaluate PWC use in Lake Superior at the national lakeshore to ensure the protection of national lakeshore resources and values while offering a variety of visitor experiences consistent with the NPS Organic Act, the enabling legislation of the national lakeshore as amended, and the mission, purpose, and significance of the park unit as articulated in the 2004 Pictured Rocks National Lakeshore Final General Management Plan and Wilderness Study Environmental Impact Statement (GMP) (NPS 2004).

The purpose of this EA is to evaluate PWC use in Lake Superior at the national lakeshore to ensure the protection of national lakeshore resources and values while offering a variety of visitor experiences.

NEED FOR ACTION

The national lakeshore provides a variety of visitor experiences, including PWC use, which was formally authorized by an NPS special regulation in October 2005, following the 2002 EA for PWC use. The 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore (36 Code of Federal Regulations [CFR] § 7.32(d)(1)) allowed for the limited use of PWC on the surface of Lake Superior within the national lakeshore, between its western boundary near Sand Point, to the east end of Miners Beach (figure 1-1). As a result of litigation challenging the PWC authorization, a US District Court ruled that the impact

[1] Personal watercraft, as defined in 36 CFR 1.4(a), refers to a vessel, usually 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. Personal Watercraft are commonly referred to as "jet-skis".

analysis in the 2002 PWC EA was inadequate and remanded the case to the NPS "so that it may have an opportunity to provide adequate reasoning for its conclusions." Therefore, this EA is needed to address the inadequacies in the 2002 EA for PWC use at the national lakeshore (NPS 2002), as identified in the 2010 US District Court opinion.

OBJECTIVES IN TAKING ACTION

Pursuant to the NPS National Environmental Policy Act (NEPA) Handbook, objectives are "more specific statements of purpose that provide additional bases for comparing the effectiveness of alternatives in achieving the desired outcomes of the action" (NPS 2015a). Alternatives carried forward for detailed analysis must meet project objectives to a large degree and resolve the purpose and need for action.

The management objectives for this PWC EA are stated below:

- Evaluate whether PWC use is consistent with the national lakeshore's purposes and values as identified in the 2004 GMP.
- Provide a variety of recreational opportunities that allow visitors to experience and appreciate natural and cultural resources, consistent with the purpose for which the national lakeshore was established.
- Minimize adverse impacts to water and air quality.
- Minimize adverse impacts to wildlife and wildlife habitat.
- Provide protection of threatened, endangered, and other protected species and their habitats.
- Protect cultural resources from adverse impacts.
- Protect the wilderness character of the Beaver Basin Wilderness Area by providing outstanding opportunities for solitude and preserving natural conditions, including natural quiet.
- Ensure the safety of all national lakeshore visitors and reduce the potential for conflicts between uses.
- Minimize operational needs and costs associated with the management of PWC use.

PROJECT LOCATION AND SETTING

The national lakeshore encompasses 73,235 acres and is situated in the north-central section of the Upper Peninsula of Michigan along the southern shore of Lake Superior. The eastern half of the Upper Peninsula is bounded by Lakes Superior, Michigan, and Huron. Other national park units in the upper Great Lakes include Apostle Islands National Lakeshore and Isle Royale National Park on Lake Superior, and Sleeping Bear Dunes and Indiana Dunes National Lakeshores on Lake Michigan. The national lakeshore extends 42 miles along the south shore of Lake Superior between the communities of Munising and Grand Marais (figure 1-1).

The national lakeshore is noted for its multicolored sandstone cliffs, beaches, sand dunes, waterfalls, lakes, wildlife, and forested shoreline. The area offers year-round recreation activities such as hiking, camping, hunting, boating, swimming, snowshoeing, and cross-country skiing. The North Country National Scenic Trail passes through the national lakeshore, which has a variety of cultural resources that depict the maritime, iron, logging, and Native American histories of the area.

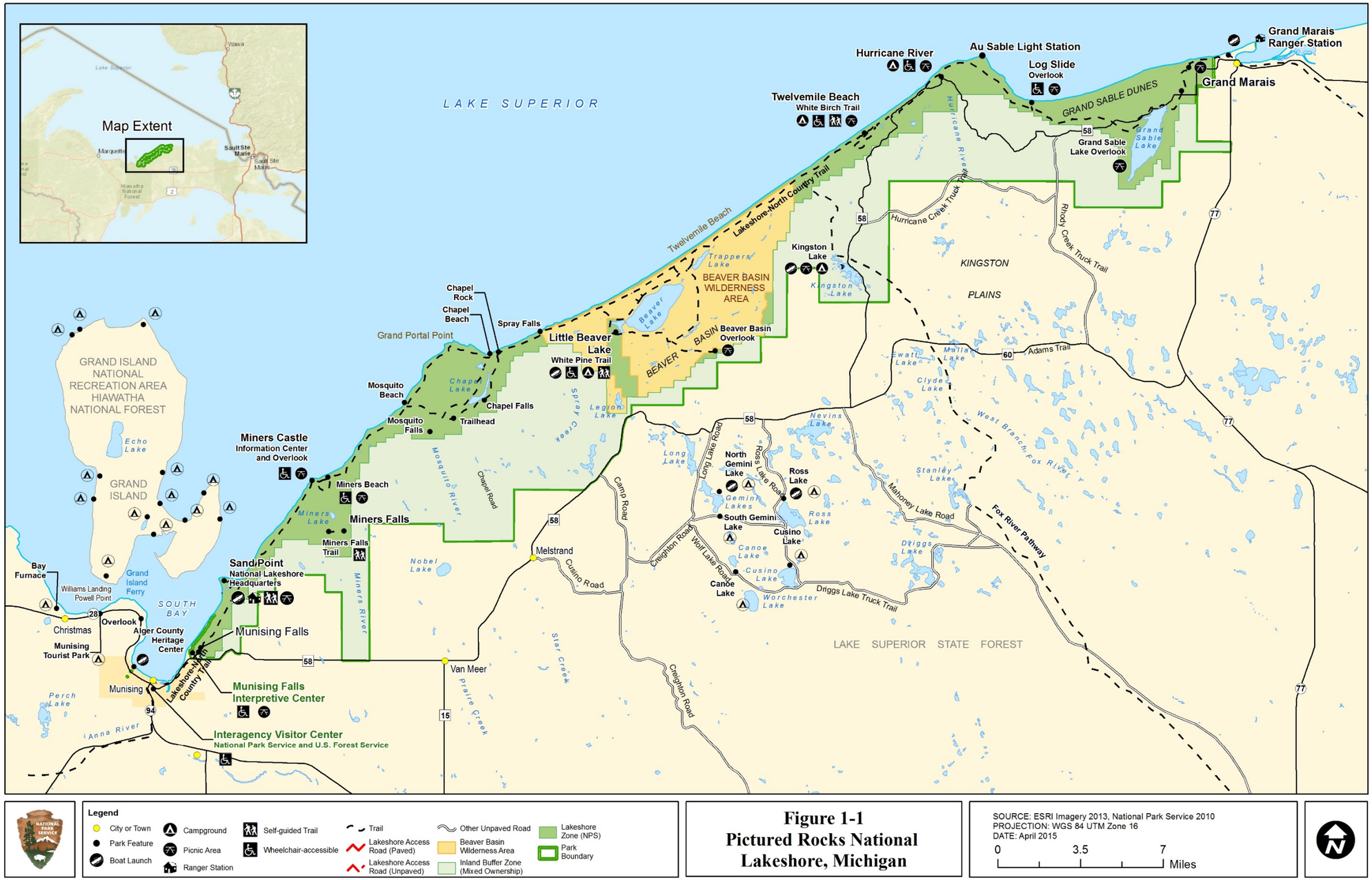

Figure 1-1
Pictured Rocks National Lakeshore, Michigan

SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
0 3.5 7 Miles

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SCOPE OF THE ANALYSIS

The scope of this analysis is to examine a range of management alternatives for PWC use.

Even though PWC use represents only a subset of the motorized watercraft use at the national lakeshore, the scope of this analysis is to examine a range of management alternatives for PWC use only. The NPS acknowledges that the use of other types of motorized watercraft may adversely affect national lakeshore resources. Although analyzing the management of all types of watercraft is outside the scope of this project, NEPA regulations require an analysis of cumulative effects of all ongoing and reasonably foreseeable actions when added to the effects of the proposal (40 CFR 1508.7). Therefore, for each impact topic, the effects of other watercraft (and other sources of impacts) are evaluated in the cumulative effects analysis in "Chapter 4: Environmental Consequences."

PURPOSE AND SIGNIFICANCE OF PICTURED ROCKS NATIONAL LAKESHORE

Congress establishes units of the national park system to fulfill specified purposes, based on the unique and significant resources of a geographic area. The purpose statement for a park unit provides the foundation for decision-making as it relates to the conservation of park resources and providing for the "enjoyment of future generations." The purpose statement identifies uses and values that individual NPS plans should support.

The national lakeshore was recognized as a potential outstanding public recreation site at least as far back as 1924, when the Michigan Conservation Commission created a state park at Miners Castle. Similar to other conservation projects, the lack of funding prevented acquisition of important acreage. After conducting a Great Lakes shoreline recreation area survey in 1957–1958, the NPS identified the national lakeshore as one of five areas with features of national significance. It was recommended for consideration as an addition to the national park system, and planning for the establishment of the national lakeshore began (NPS 2004).

On October 15, 1966, Congress established Pictured Rocks National Lakeshore to "preserve for the benefit, inspiration, education, recreational use, and enjoyment of the public a significant portion of the diminishing shoreline of the United States and its related geographic and scientific features" (Public Law (PL) 89-668).

PURPOSE OF PICTURED ROCKS NATIONAL LAKESHORE

As stated in the GMP, the purpose of the national lakeshore is to

- preserve a portion of the Great Lakes shoreline for its geographic, scientific, scenic, and historic features, and its associated ecological processes;
- provide opportunities for public benefit in recreation, education, enjoyment, and inspiration; and
- protect the character and use of the shoreline zone while allowing economic utilization of the inland buffer zone's renewable resources (NPS 2004).

SIGNIFICANCE OF PICTURED ROCKS NATIONAL LAKESHORE

Park significance statements capture the essence of the importance of a park unit to America's natural and cultural heritage. Understanding park significance helps managers make decisions that preserve the resources and values necessary to the purpose of the park unit. As stated in the 2004 GMP, the national lakeshore is significant for the following reasons:

- Pictured Rocks National Lakeshore preserves and affords public access to a spectacular and diverse segment of the Lake Superior shoreline.
    - The scenic 200-foot-high Pictured Rocks cliffs rise perpendicularly from Lake Superior, creating a rock mosaic of form, color, and texture, which is enhanced by cascading waterfalls.
    - Grand Sable Dunes, perched atop 300-foot-high sand banks above Lake Superior, are one of two perched dune systems on the Great Lakes; within these dunes are unique plant communities resulting from geomorphic processes.
    - Twelve miles of unspoiled and undeveloped Lake Superior beach contrast the national lakeshore cliffs and Grand Sable Dunes.
- Bedrock geology and glacial landforms provide significant topographic relief marked by streams, inland lakes, and a diversity of associated vegetation.
- The shoreline offers extraordinary and inspirational scenic vistas of Lake Superior, the largest surface area of fresh water on earth.
- Pictured Rocks National Lakeshore offers a variety of affordable year-round recreational opportunities for appropriate public use.
- The national lakeshore contains a spectrum of cultural resources focused on the human use of Lake Superior and its shoreline.
- Lying in a transition zone between boreal and eastern hardwood forest, the national lakeshore's scientifically recognized assemblage of flora and fauna is representative of associations unique to the Lake Superior Basin.
- The national lakeshore is the only NPS unit with a legislated.

MISSION OF PICTURED ROCKS NATIONAL LAKESHORE

Mission statements describe the desired future conditions for the national lakeshore that exist when the legislative intent is being met. The mission of the national lakeshore is to conserve the ecosystem integrity of the national lakeshore, a mosaic of geologic, biologic, scenic, and historic features, offering opportunities for recreation, education, inspiration, and enjoyment forever (NPS 2004).

THE HISTORY OF PWC USE AND MANAGEMENT

Use of PWCs at the national lakeshore began in the 1990s and has remained relatively low, primarily as a result of the remoteness of the park and distance to large population centers, cold water temperature, cool ambient air temperature, sudden changes in weather conditions, and heavy winds and wave action on Lake Superior. At the national lakeshore, PWCs have only been allowed on the surface water of Lake Superior within the 0.25-mile boundary of the national lakeshore. Rivers and streams within the national lakeshore were not accessible to PWCs due to extremely small size, shallow depths, and rocky bottoms. On inland lakes within the national lakeshore boundaries, the size of powerboat engines was restricted to

engines of 50 horsepower or less, essentially eliminating PWC use in those areas. PWC operation at Pictured Rocks National Lakeshore is concentrated between Sand Point and Miners Beach along the Lake Superior shoreline. Park staff have noted few PWC operators traveling the entire length of the national lakeshore due to the long distance, rough waters, and potential for sudden changes in weather conditions. The NPS managed PWCs at Pictured Rocks National Lakeshore much like other traditional motorized watercraft until Michigan passed the Michigan Personal Watercraft Safety Act in 1998 (Michigan Compiled Law [MCL] 281 § 1401-1445), which imposed numerous restrictions on PWC use throughout the state. These restrictions included a flat-wake speed within 200 feet of the shoreline, in addition to other requirements intended to provide for the safe use of PWCs while near other boaters, swimmers, divers, and structures. This act was repealed in 2000 and replaced with the Natural Resources and Environmental Protection Act (MCL 324 § 80201-80222). Currently, the NPS staff enforce these state PWC laws within the national lakeshore.

On a national scale, the NPS recognized the need to address PWC use and its potential to impact park resources, values, and purposes in the 1990s, when PWCs gained popularity in areas such as Everglades National Park. The NPS conducted studies at Everglades National Park that showed that PWC use over emergent vegetation, shallow grass flats, and mud flats commonly used by feeding shorebirds damaged the vegetation, adversely impacted the shorebirds, and disturbed the life cycles of other wildlife. Consequently, managers at Everglades National Park determined that PWC use was inconsistent with the resources, values, and purposes for which the park was established. In 1994, the NPS prohibited PWC use by a special regulation at Everglades National Park (59 Federal Register [FR] 58781). The studies conducted at Everglades National Park recommended researching the potential impact of PWCs before allowing their use within other units of the national park system.

Other public entities have taken steps to limit and ban PWC use in certain waterways as national researchers study more about the effects of PWC use. At about the same time as the Everglades PWC regulations, the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) were addressing the impact of PWCs on similar sensitive resources and adopting regulations to manage PWCs. When NOAA regulated PWC use in most national marine sanctuaries, the agency was sued by the Personal Watercraft Industry Association (PWIA). In Personal Watercraft Industry Association v. Department of Commerce National Oceanic and Atmospheric Administration, 48 F.3d 540 (1995), a US Court of Appeals ruled that federal agencies could manage certain types of vessels (specifically PWCs) differently from other types of vessels if the agency explains its reasons for the differentiation. In this case, the reasoning was due to the size, maneuverability, and shallow draft of PWCs, which allowed them to operate in sensitive areas that larger conventional vessels could not access.

In carrying out its duties under the Organic Act and NPS *Management Policies 2006*, the NPS reevaluated its management of PWC use. Historically, the NPS had grouped PWC use with all vessels; thus, people could use PWCs in the same manner as other vessels. In May 1998, the Bluewater Network, a private, independent, nonprofit organization, filed a petition urging the NPS to initiate the rulemaking process to prohibit PWC use throughout the national park system. In response to the petition, the NPS issued an interim management policy requiring superintendents of park units where PWC use could occur but had never occurred to close the unit to PWC use until the NPS finalized a rule addressing PWC management in all national parks. In September 1998, the NPS published a proposed servicewide regulation for PWC use.

The NPS envisioned the servicewide regulation as an opportunity to evaluate impacts from PWC use before authorizing the use. The preamble to the servicewide regulation called the regulation a "conservative approach to managing PWC use" considering the resource concerns, visitor conflicts, visitor enjoyment, and visitor safety (65 FR 15077). During a 60-day comment period, the NPS received nearly 20,000 public responses on the proposed regulation.

As a result of public responses and further review, the NPS promulgated an amended regulation (36 CFR 3.24(a)) on March 21, 2000, that prohibited PWC use in most park units (see 65 FR 15077) and required the remaining units to determine the appropriateness of continued PWC use. Specifically, the regulation allowed the NPS to designate PWC use areas, to continue PWC use by promulgating a special regulation in 11 units, and to continue PWC use by authorizing use through the superintendent's compendium in 10 units (36 CFR 3.24(b)).

When the PWC final regulation was completed, the Bluewater Network sued the NPS under the Administrative Procedure Act and NPS Organic Act. The organization challenged the NPS decision to allow continued PWC use in certain units while they developed specific authorization for continued use. In addition, the organization disputed the NPS decision to allow 10 units to continue PWC use after 2002 by authorization through superintendents' compendiums (instead of by special regulations), which would not require public input through a notice and comment period. Further, Bluewater Network claimed that because PWC use causes water and air pollution, generates increased noise levels, and poses public safety threats, the NPS must evaluate the impacts before making the challenged decisions.

In response to the lawsuit, the NPS and the environmental group negotiated a settlement in 2001 that changed portions of the NPS PWC rule. While 21 units could continue PWC use in the short term, each of the parks desiring to continue long-term PWC use were required to promulgate park-specific special regulations. In addition, the settlement stipulated that the NPS must base its decision to issue a park-specific special regulation to continue PWC use on an environmental analysis conducted in accordance with NEPA. According to the settlement, the NEPA analysis, at a minimum, must evaluate PWC impacts on water resources, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

Subsequently, five units made administrative determinations not to complete the rulemaking process to allow PWC use. These determinations were based on an assessment of the legislative history, regulatory authorities, the purpose for the park unit as described in its authorizing legislation, and the required analysis of water resources, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety. Each determination was made with public participation, including public meetings, participation by advisory commissions, if applicable, and state and local governments.

In 2001, NPS *Management Policies* were revised and included the new management practices adopted in the NPS PWC regulations. NPS regulations prohibited PWC use in national park system units unless their use is determined to be appropriate for the specific park unit (NPS *Management Policies 2001*, section 8.2.3.3 [NPS 2001]). The policy statement reaffirmed that the use must be evaluated based on the enabling legislation, resources, values, other park uses, and overall management strategies of the park unit. A similar statement is included in the most recent version of the document, NPS *Management Policies 2006*, section 8.2.3.3 (NPS 2006).

Consistent with the settlement agreement, seven park units, including Pictured Rocks National Lakeshore, were closed to PWC use on April 22, 2002. These park units continued the special regulation promulgation process by preparing EAs to analyze PWC use alternatives and adopting special regulations to authorize that use in the future, if an alternative allowing PWC use was selected as part of the NEPA process.

The NPS published an EA for a special regulation to allow PWC use at Pictured Rocks National Lakeshore in July 2002 and a signed Finding of No Significant Impact (FONSI) in September 2005. In October 2005, the NPS implemented the special regulation that allowed for limited PWC use on the surface of Lake Superior, between the western boundary near Sand Point to the east end of Miners Beach.

The regulation also required that PWCs operate in full compliance with State of Michigan regulations pertaining to PWC use.

In 2008, a lawsuit was filed claiming that the PWC EA was deficient and violated NEPA, the NPS Organic Act, and the Administrative Procedure Act (Bluewater Network v. Kenneth Salazar, 721 F.Supp.2d 7 (D.D.C 2010)). On July 8, 2010, the US District Court for the District of Columbia issued a ruling, finding that the impact analysis in the EA was inadequate. The EA was found to be conclusory, internally inconsistent, and failed to adequately explain the connection between objective facts and conclusions reached. The court also found that the NPS failed to take the "hard look" required by NEPA. Regarding the water resources analysis in the EA, the court found that the NPS did not explain how the impact thresholds related to the impairment finding, or why the national water quality standards were used instead of site-specific standards for the national lakeshore. For the air quality and soundscape analysis, the court found similar problems because there was no apparent connection between the data and the conclusions reached. For the wildlife and shoreline vegetation impact analysis, the court indicated that the NPS failed to explain why the stated impacts would not rise to the level of impairment. Finally, with respect to the impacts on visitor experience, the court stated that the NPS failed to sufficiently explain why certain impacts did not rise to the level of impairment. The judge did not vacate the PWC rule at the national lakeshore, but remanded the case to the NPS "so that it may have an opportunity to provide adequate reasoning for its conclusions." The special regulation remains in effect at the national lakeshore, and PWCs are currently still allowed to operate under the restrictions identified in the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore (36 CFR § 7.32(d)(1)).

The NPS is addressing the deficiencies in the 2002 EA identified by the court by preparing this EA, which includes supplemental documentation, data, and impact analysis not present in the 2002 EA (NPS 2002). Supplemental information used in this EA includes water resources, air quality, acoustic modeling, and the collection of additional data on the amount of PWC and other watercraft use within the national lakeshore.

SCOPING PROCESS AND PUBLIC PARTICIPATION

NEPA regulations require an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). Issues are problems, opportunities, and concerns regarding PWC use at the national lakeshore. To determine the scope of issues to be analyzed in depth in this EA, NPS staff conducted internal scoping meetings in September 2012.

To bring the public into the planning process early, the NPS published and distributed a public scoping newsletter in October 2012. The newsletter contained information on the project purpose and background, potential PWC management issues, and preliminary alternatives for PWC management at the national lakeshore. The public was given the opportunity to learn more about the planning process and to provide input during three public scoping meetings held near the national lakeshore in October 2012. The meetings were open-house-style sessions to allow the public to ask questions and provide input to the NPS planning team in an informal atmosphere. The public were able to submit their comments on the project electronically through the NPS Planning, Environment, and Public Comment (PEPC) website, in person at the public meetings, or by mailing or faxing comments to the NPS. The public scoping period concluded on November 9, 2012. A detailed summary of the scoping process is provided in "Chapter 5: Consultation and Coordination."

ISSUES AND IMPACT TOPICS

As described above, numerous issues were identified during internal and public scoping. The Stipulated Settlement Agreement for Bluewater Network v. Stanton (Bluewater Network et al. v. Robert Stanton et al., No. 00-2093 (GK) (D.D.C. 2000)) indicates that this EA must, at a minimum, evaluate impacts of PWC use on water resources, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

This impact topics analyzed in this EA include water resources, air quality, soundscapes, wildlife, wildlife habitat, visitor experience, and visitor safety.

The impact topics discussed below were derived from the issues identified during the scoping process or were required by the aforementioned settlement agreement. It should be noted that the NPS determined that although shoreline vegetation was identified as a resource topic of concern in the ruling, it should be dismissed from full analysis. The rationale for this dismissal is presented in the following section. Impact topics are a more refined set of concerns analyzed for each of the project alternatives in this EA. The impact topics represent resources, such as air quality or soundscapes that could be impacted by PWC use at the national lakeshore. For example, in the case of air quality, such impacts would include emission of airborne pollutants generated from PWC exhaust. The following text describes these issues, which are the basis for the impact topics discussed in "Chapter 3: Affected Environment" and "Chapter 4: Environmental Consequences."

WATER RESOURCES

Section 4.6.3 of NPS *Management Policies 2006* states that the "pollution of surface waters and groundwaters by both point and nonpoint sources can impair the natural functioning of aquatic and terrestrial ecosystems and diminish the utility of park waters for visitor use and enjoyment. The Service will determine the quality of park surface and groundwater resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside the parks" (NPS 2006). Under NPS *Management Policies 2006*, the NPS must maintain or restore the quality of surface waters and groundwaters within the parks, consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations

Two-stroke and four-stroke PWCs are currently registered in the State of Michigan and assumed to be in use at the national lakeshore. PWCs with older carbureted two-stroke engines can discharge as much as 30% of their gas and oil emissions directly into the water (CARB 1999). These discharges contain contaminants such as hydrocarbons (HCs) and methyl tertiary butyl ether (MTBE), which could impact water quality at the national lakeshore.

All PWCs manufactured today contain direct injection four-stroke engines or direct injection two-stroke engines, which eliminate discharge to the water (NMMA 2013; PWIA 2006).

AIR QUALITY

NPS *Management Policies 2006* tasks managers of park units to protect air quality under both the 1916 Organic Act and the Clean Air Act. Section 4.7.1 of NPS *Management Policies 2006* indicates that the NPS will seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas (NPS 2006). NPS *Management Policies 2006* further state that the NPS will "…actively promote and pursue measures to protect air quality related values from the adverse impacts of air pollution." These policies provide guidance for the protection of air resources when considering management actions.

The national lakeshore is in a sparsely populated area of the Upper Peninsula of Michigan. Currently, the national lakeshore is in attainment for all criteria pollutants, including ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM), and sulfur dioxide (SO_2) (EPA 2016a-d, 2017a-b). Pollutant emissions such as nitrogen oxide (NO_x) and volatile organic compounds (VOCs) from PWC use could adversely affect air quality, depending on the level of PWC use. Although air quality within the national lakeshore is good, PWC emissions could have localized impacts.

ACOUSTIC ENVIRONMENT AND SOUNDSCAPES

Section 4.9 of NPS *Management Policies 2006* states that the NPS "will preserve, to the greatest extent possible, the natural soundscapes of the park, including both biological and physical sounds. Natural sounds are intrinsic elements of the environment that are vital to the functioning of ecosystems and can be used to determine the diversity and interactions of species within communities. Soundscapes are often associated with parks and are considered important components of natural wildlife interactions, as well as visitor experience" (NPS 2006).

Soundscapes are an intrinsic part of a national park experience, something many visitors are seeking. For this reason, the NPS must carefully consider the impact of human-caused sounds at from a variety of activities, including the many types of watercraft (including PWC), automobile, aircraft, snowmobile, and forestry activities.

These human-caused noises must be managed to reduce negative impacts and to protect the experience of visitors recreating on land and water. Although existing federal regulations establish maximum noise levels for motorized vessels, the nature of the noise generated from PWCs can be more disturbing than other vessels. Noise generated by PWC use is often characterized by rapid acceleration, frequent changes in direction, and the sound of the hull hitting the surface of the water, which can result in a greater level of disturbance than a vessel moving at constant speed from one location to another. Sound disturbance from PWCs can impact visitors in many areas of the national lakeshore, including beaches, on the water, backcountry locations, the Lakeshore-North Country National Scenic Trail, and viewing platforms. Potential noise impacts on visitor experience, wilderness, and wildlife are discussed in those sections of this document.

WILDLIFE AND WILDLIFE HABITAT

Section 4.4.1 of NPS *Management Policies 2006* states that the NPS "will minimize human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them" (NPS 2006). Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2006).

The forest, dune, and lake communities at the national lakeshore provide important habitat for wildlife, including extensive numbers of mammals, birds, and fish. The presence and sound of PWCs can impact wildlife by disturbing breeding, feeding, and other wildlife behaviors. PWCs tend to have varying speeds and course, resulting in frequent changes in engine noise. PWC use can cause alarm or flight, with avoidance of habitat and effects on reproductive success of waterfowl and shorebirds.

PWCs can also introduce invasive species into Lake Superior, including zebra mussel (*Dreissena polymorpha*), quagga mussel (*Dreissena rostriformis*), and exotic grasses. These invasive species can impact native species through competition for food and habitat, and may directly harm native species. (MDEQ 2014). Exotic plants and animals could be attached to the hull of the PWC or other components that come in contact with lake water, and can also be found on boat trailers. Due to the design of the PWC

engine, it is more difficult to decontaminate than other watercraft engines. When PWCs and trailers are used in more than one waterbody without proper decontamination, invasive species can be easily transported.

SPECIAL-STATUS SPECIES

Section 4.4.2.3 of NPS *Management Policies 2006* states that the NPS "will fully meet its obligations under the NPS Organic Act and the Endangered Species Act (ESA) to both proactively conserve listed species and prevent detrimental effects on these species" (NPS 2006). The national lakeshore provides potential habitat for many wildlife species listed by the USFWS or the Michigan Department of Natural Resources (MDNR). Special-status species such as peregrine falcons (*Falco peregrinus*), merlins (*Falco columbarius*), piping plovers (*Charadrius melodus*), bald eagles (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and common loons (*Gavia immer*) are known to exist at the national lakeshore and could be impacted by PWC use. Noise or physical disturbance associated with PWC use could affect feeding, nesting, and other behaviors of special-status species.

ETHNOGRAPHIC RESOURCES

Ethnographic resources are defined as the natural and cultural materials, features, and places that are linked by a subject community to the traditional practices, values, beliefs, history, or ethnic identity of that community. Native Americans have a cultural affiliation to the land within the national lakeshore. Section 5.3.5.3 of NPS *Management Policies 2006* commits the NPS to adopt "a comprehensive approach towards appreciating the diverse human heritage and associated resources that characterize the national park system." Several areas or landform types have religious or cultural significance to the Ojibway (also commonly spelled Ojibwe or Ojibwa), a woodland Indian tribe who lived on the margins of Lake Superior. Members of the Ojibway village fished, hunted, and harvested maple sugar from areas within the national lakeshore. Ethnographic resources within the national lakeshore also include sacred sites such as dunes, mouths of rivers, and creeks. PWC use around these resources could impact ethnographic resources and tribal fishing parties. Noise associated with PWCs and the visual intrusion of PWCs can be a disturbance to the traditional users of these areas and can detract from their enjoyment and use. Consultation with local tribes has been conducted to identify additional impacts from PWC use.

VISITOR USE AND EXPERIENCE

NPS *Management Policies 2006* states that "[t]he fundamental purpose of all parks also includes providing for the enjoyment of park resources and values by the people of the United States" (NPS 2006). The NPS encourages visitor activities that "provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the superlative natural and cultural resources found in the park…. are appropriate to the purpose for which the park was established… and can be sustained without causing unacceptable impacts to park resources or values" (NPS 2006). The NPS also monitors new or changing patterns of use or trends in recreational activities and assesses their potential impacts on park resources.

The national lakeshore remains a relatively undeveloped park. Summer visitors engage in activities including camping, hiking, backpacking, picnicking, boating, fishing, and swimming. One of the goals of the GMP (NPS 2004) is to maintain natural quiet to enhance the visitor experience. The associated noise and environmental effects of PWC use can impact the experience of some visitors. Concerns with noise generated from PWCs include changes of pitch and volume due to the way the PWCs are operated. PWC use at the national lakeshore could have adverse impacts on visitors seeking solitude and a more primitive experience. However, the use of PWCs is a recreational activity that some visitors enjoy. Prohibiting or substantially restricting PWC use could adversely impact the visitor experience of PWC users.

VISITOR SAFETY

NPS *Management Policies 2006* states that "the Park Service strives to protect human life and provide for injury-free visits" (NPS 2006). The NPS seeks to provide a safe and healthful environment for employees, as well as visitors. The NPS also "strives to identify and prevent injuries from recognizable threats to the safety and health of persons and to the protection of property" (NPS 2006). PWC use in proximity to other lake users can pose conflicts and safety hazards. Conflicts between PWC operators and other visitors at the national lakeshore have been documented through incident reports and visitor surveys. Incidents have included PWCs operating too close to other visitors, operating at high speeds near other visitors, and operating too close to other motorized boats. There are also safety concerns associated with NPS law enforcement staff interacting with PWC users on the open water. Having two vessels side by side in open water can be problematic and present safety concerns for the people operating the vessels. Operating small craft on the open waters of Lake Superior also presents some safety considerations for park visitors. Quick moving storms and rapidly building waves can create dangerous conditions for small craft operating in areas where no shelter is available. The potential for impacts to human health from pollutants associated with PWC use is discussed in the air quality and water resources sections of this EA.

WILDERNESS

The Wilderness Act of 1964 was established to enable Congress to set aside, preserve, and protect areas of pristine wilderness for the public to enjoy. The act defines wilderness as an area that has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." Activities including commercial operations, roads, structures, motorized vehicles or equipment, or any other form of mechanical transport are prohibited in wilderness areas. Section 6 of NPS *Management Policies 2006* indicates that when evaluating environmental impacts, the NPS "will take into account (1) wilderness characteristics and values, including the primeval character and influence of the wilderness; (2) the preservation of natural conditions (including the lack of man-made noise); and (3) assurances that there will be outstanding opportunities for solitude, that the public will be provided with a primitive and unconfined type of recreational experience, and that wilderness will be preserved and used in an unimpaired condition" (NPS 2006).

The 11,740-acre Beaver Basin Wilderness Area was designated by Congress on March 30, 2009. The wilderness area includes 13 miles of Lake Superior shoreline from Spray Falls on the west to Sevenmile Creek on the east (see figure 1-1). The wilderness area begins at the shoreline of Lake Superior and extends 3.5 miles inland to include all of Beaver Basin and its varied habitats. The wilderness area provides opportunities for quiet, solitude, wilderness recreation, and spiritual renewal in the national lakeshore. Recreational opportunities in this wilderness area include hunting, fishing, day hiking, backpacking, canoeing, kayaking, cross-country skiing, and snowshoeing.

Noise generated from PWC use on Lake Superior could adversely impact the wilderness character and values of the Beaver Basin Wilderness Area. Due to the potential for impacts to designated wilderness from PWC use at the national lakeshore, wilderness is evaluated as an impact topic in this EA.

ISSUES ELIMINATED FROM FURTHER CONSIDERATION

The Stipulated Settlement Agreement issued by the US District Court for the District of Columbia indicated that the NPS must evaluate impacts to specific resources in their NEPA analysis. In completing this EA, the NPS has re-analyzed the impacts to the following resource topics identified in this ruling: water resources, air quality, soundscapes, wildlife, wildlife habitat, and visitor conflicts (safety). These topics were discussed in the preceding section. The NPS determined that shoreline vegetation, also

identified in the ruling, should be eliminated from further consideration; the rationale for this determination is presented below. While shoreline vegetation was not analyzed in detail in the EA, the analysis below presents a "hard look" at the potential for impacts to the resource.

The following issues were eliminated from further analysis for the reasons stated below.

SOILS AND GEOLOGIC RESOURCES

PWC use along the shoreline would not impact soils, geology, or the topography of the national lakeshore. Therefore, this topic was dismissed from further analysis in this EA.

FLOODPLAINS

PWC use at the national lakeshore would have no adverse impacts on floodplains. There is no development proposed within the floodplain that would alter the functionality of the floodplain. Therefore, this topic was dismissed from further analysis in this EA.

WETLANDS

Wetlands would not be directly affected by PWC use. PWC users that beach their vessels and travel to upland areas of the national lakeshore could affect wetlands by trampling vegetation; however, these actions are not expected to result in measurable effects. PWC use is low and impacts on wetlands would be minimal and localized. Impacts from PWC use would not alter the size or function of wetlands at the national lakeshore. For these reasons, this topic was dismissed from further analysis in this EA.

SCENIC RIVERS

The Nationwide Rivers Inventory is a listing of more than 3,400 free-flowing river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance by the NPS (NPS 2011a). Within the national lakeshore, Miners and Mosquito Rivers were listed on the Nationwide Rivers Inventory in 1993 (NPS 2009). PWC use would not be permitted within Miners and Mosquito Rivers; therefore, no adverse impacts would occur and this topic was dismissed from further analysis in this EA.

SHORELINE VEGETATION

Pursuant to section 4.4.1 of NPS *Management Policies 2006*, the NPS will maintain native vegetation as a part of the natural ecosystems of parks (NPS 2006). Section 4.4.1 of NPS *Management Policies 2006* also provides general principles for the maintenance of vegetation in the park by (1) preserving and restoring the natural abundance, diversities, dynamics, distributions, habitats, behaviors of native plant populations and communities and ecosystems in which they occur; (2) restoring native plant populations in parks when they have been extirpated by past human-caused actions; and (3) minimizing human impacts on native plants, communities, and ecosystems, and the processes that sustain them.

The natural shoreline along the national lakeshore is made up of spectacular sandstone cliff faces, long sandy beaches, and natural dune environments. These features, combined with steep water depth drop-off, do not provide the calm, shallow water conditions necessary to support the growth of aquatic vegetation in most areas of the national lakeshore. In most cases, aquatic vegetation is in deeper waters and would not be directly impacted by PWC use. In shallow areas where aquatic vegetation is present, the 200-foot

flat-wake zone would minimize impacts from PWC use. For these reasons, this topic was dismissed from further analysis in this EA.

WILDLIFE AND WILDLIFE HABITAT – FISH AND OTHER AQUATIC SPECIES

As previously stated, management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2006). Increased turbidity from PWCs could impact sight-based feeding and success of reproduction of fish and benthic organisms. Although nearshore habitat could be impacted by the use of PWCs in these areas, Michigan state law and the action alternatives include a flat-wake zone extending 200 feet from the shoreline, which would minimize the adverse impacts to benthic organisms and finfish. Therefore, this topic was dismissed from further analysis in this EA.

HISTORIC STRUCTURES

According to NPS Director's Order 28: *Cultural Resource Management*, structures are defined as material assemblies that extend the limits of human capability (NPS 1998). Examples are buildings, monuments, dams, roads, railroad tracks, bridges, tunnels, locomotives, nautical vessels, and forts. Two structures within the national lakeshore have been listed on the National Register of Historic Places (NRHP): the Au Sable Light Station (in 1978) and the Schoolcraft Blast Furnace (in 1977). Two additional properties have been determined to be eligible for listing but have not yet been nominated: the Grand Marais Coast Guard Station (determined eligible in 1990) and the Munising (Sand Point) Coast Guard Station (determined eligible in 1999). Currently, 37 structures are on the List of Classified Structures for the national lakeshore, all of which relate to the structures already listed or determined eligible for listing on the NRHP (NPS n.d.a). Given that the majority of historic structures within the park are either located outside the study area or in areas already experiencing heavy visitor use from both land and water vehicles, the impacts (if any) resulting from the proportionately low number of PWCs would be extremely difficult to distinguish or quantify. Therefore, this topic was dismissed from further analysis in this EA.

ARCHEOLOGICAL RESOURCES

Pursuant to section 5.3.5 of NPS *Management Policies 2006*, archeological resources will be protected against human agents of destruction and deterioration whenever practicable (NPS 2006). A total of 75 archeological sites have been recorded within the national lakeshore (NPCA n.d.). Of these sites, 61 are terrestrial sites and 14 are underwater shipwrecks within the waters of Lake Superior; the underwater shipwrecks are discussed separately in the following section. Currently, no archeological sites are listed on the NRHP. The majority of pre-contact period sites are associated with Woodland and Archaic period seasonal habitations and are primarily along the shoreline, on high sand bluffs overlooking Lake Superior, in sandstone bedrock coves along the national lakeshore, near streams and the mouths of creeks and rivers, and along inland lake shorelines. Because the archeological resources of the national lakeshore are not located in areas that are currently experiencing high visitor use or are not within the waters of Lake Superior, the use of PWCs would not increase existing impacts or introduce new impacts and therefore would not adversely impact these resources. Therefore, this topic was dismissed from further analysis in this EA.

SUBMERGED CULTURAL RESOURCES

Section 5.3.5 of NPS *Management Policies 2006* states that "historic shipwrecks and other submerged cultural resources will be protected, to the extent permitted by law, in the same manner as terrestrial archeological resources" (NPS 2006).

Fourteen underwater shipwrecks have been identified at varying depths within national lakeshore boundaries. The impact of primary concern is the collection and damage of shipwreck artifacts by visitors. Michigan law and NPS policy allow people to visit shipwrecks and protects them from tampering or disturbance.

Visitors can access shipwrecks by motorized vessels, either boats or PWCs. Current policy permits the operation of motorized vessels, including PWCs, within the national lakeshore. Potential impacts to submerged cultural resources from PWC users would be negligible and similar to those caused by visitors using motorboats. However, impacts from PWC users would be much less frequent due to the low levels of PWC use at Pictured Rocks National Lakeshore when compared to other vessel use. These potential impacts were considered when allowing motorboat operation in the vicinity of shipwrecks. The alternatives considered in this EA would not change this potential for impact; therefore, this topic was dismissed from further consideration.

CULTURAL LANDSCAPES

The NPS defines cultural landscapes as geographic areas associated with historic events, activities, or people that reflect the history of the park unit, development patterns, and the relationship between people and the park. To date, only one cultural landscape, the Au Sable Light Station, has been surveyed and documented within the national lakeshore (NPS 2013a). There is heavy visitor use in this area. Several potential landscapes have been identified and are awaiting further study. These include the coast guard stations at Munising (Sand Point) and Grand Marais, various farmsteads and apple orchards, and the Michigan-Wisconsin consolidated pipeline camp. Current policy allows motorized vessels to operate in the park. Potential impacts to cultural resources associated with the use of motorized vessels were considered when allowing motorboat operation in the park, including areas identified as cultural landscapes. Any potential impacts from PWCs on cultural landscapes would be similar to those from motorboats, although impacts from PWCs would be expected to be much less frequent due to the low level of PWC use in the park. The alternatives considered in this EA would not change this potential for impact; therefore, this topic was dismissed from further consideration.

MUSEUM COLLECTIONS

The museum collection includes more than 15,000 catalogued items representing a variety of natural and cultural themes. The collection is housed at the NPS Lake Superior Collection Management Center, a full-service museum and archives collection management provider for three national park units: Isle Royale National Park, Keweenaw National Historical Park, and Pictured Rocks National Lakeshore. Museum collections would not be impacted by PWC use. Therefore, this topic was dismissed from further analysis in this EA.

INDIAN TRUST RESOURCES

Secretarial Order 3175, "Departmental Responsibilities for Indian Trust Resources," requires that any anticipated impacts on Indian trust resources from a proposed project or action by Department of the Interior agencies be explicitly addressed in environmental documents. Departmental responsibilities are identified in 512 DM section 2. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal and allotted lands, assets, resources, and treaty rights; it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. There are no Indian trust resources in Pictured Rocks National Lakeshore. The lands comprising the park are not held in trust by the Secretary of the Interior for the benefit of Indians due to their status as Indians. Therefore, the impact topic of Indian trust resources was not retained for further analysis.

ENVIRONMENTAL JUSTICE

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" requires federal agencies to make achieving environmental justice part of its mission. Specifically, each agency must identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The intent is to prevent minority and low-income populations from being disproportionately affected by adverse human health and environmental impacts of federal actions. Residents near the national lakeshore could include low-income and minority populations. However, these populations would not be particularly or disproportionately affected by continuing or discontinuing PWC use within the national lakeshore. Therefore, this topic was dismissed from further analysis in this EA.

SOCIOECONOMICS

Munising and Grand Marais provide the gateways into the national lakeshore, and provide services to visitors who come to the national lakeshore. Recreational activities, including the use of motorized vessels, attract thousands of visitors to the national lakeshore each year. Visitors to the national lakeshore provide an economic benefit to Munising, Grand Marais, and other surrounding communities through their spending on dining, lodging, and recreation.

Pictured Rocks National Lakeshore experiences relatively low levels of PWC use. Most of the PWC users in the national lakeshore are believed to be local residents or owners of summer homes in the area who are using their personal machines. PWC rentals are not available within the park or adjacent towns of Munising and Grand Marais. There were three local PWC rental shops in the Munising area before 1999. All three shops have since eliminated PWC rentals. In recent interaction with PWC users at the national lakeshore, law enforcement officers have encountered rented PWCs from Michigamme, which is approximately 75 miles west of Munising (Patmore 2015 pers. comm.). Rentals are also available from the Forest Glen Store, located about 15 miles south of Munising along Forest Highway 13. There are areas near Pictured Rocks National Lakeshore where personal watercraft may be used, such as inland lakes in Lake Superior State Forest, Hiawatha National Forest, and Indian Lake State Park, as well as other locations on Lake Superior.

Because of the low PWC use at the national lakeshore and the absence of PWC rental facilities within the park or the gateway communities, PWC management at the national lakeshore is not expected to have a perceptible or quantifiable impact on socioeconomics. Therefore, this topic was dismissed from further analysis in this EA.

NPS MANAGEMENT POLICIES RELATED TO PWC USE

NPS *Management Policies 2006* states that parks "will strive to understand, maintain, restore, and protect the inherent integrity of the natural resources, processes, systems, and values of the parks" and that the NPS "manages the natural resources of parks to maintain them in an unimpaired condition for present and future generations" (NPS 2006).

More specifically, NPS *Management Policies 2006* addresses PWC management in sections 8.2.2, 8.2.3, and 8.2.3.3.

Section 8.2.2, Recreational Activities, states the following:

> Service-wide regulations addressing aircraft use, off-road bicycling, hang gliding, off-road vehicle use, personal watercraft, and snowmobiling require that special, park-specific regulations be developed before these uses may be allowed in parks.

Section 8.2.3, Use of Motorized Equipment, states the following:

> The Service will strive to preserve or restore the natural quiet and natural sounds associated with the physical and biological resources of parks. To do this, superintendents will carefully evaluate and manage how, when, and where motorized equipment is used by all who operate equipment in the parks, including park staff. Uses and impacts associated with the use of motorized equipment will be addressed in park planning processes. Where such use is necessary and appropriate, the least impacting equipment, vehicles, and transportation systems should be used, consistent with public and employee safety.

Subsection 8.2.3.3, Personal Watercraft Use states the following:

> Personal watercraft use is generally prohibited by 36 CFR 3.24 (now 36 CFR 3.9). However, it may be allowed within a park by special regulation if it has first been determined through park planning to be an appropriate use that will not result in unacceptable impacts.

CHAPTER 2: ALTERNATIVES

This "Alternatives" chapter describes the various actions that could be implemented for managing PWC use at Pictured Rocks National Lakeshore. NEPA requires federal agencies to consider a range of reasonable alternatives that address the purpose of and need for action. Reasonable alternatives include alternatives that are "technically and economically practical or feasible and meet the purpose and need of the proposed action" (43 CFR § 46.420(b)). Action alternatives may originate from the proponent agency, local government officials, members of the public, or during the early stages of project development. Alternatives may also be developed in response to comments from coordinating or cooperating agencies.

The action alternatives include continued PWC use and incorporate management measures to improve visitor experience and protect park resources.

Alternatives analyzed in this document were developed based on the Pictured Rocks National Lakeshore Personal Watercraft Use Environmental Assessment (NPS 2002), the results of internal scoping, and agency and public input. The action alternatives include continued PWC use and incorporate management measures to improve visitor experience and protect park resources. Under the no-action alternative, the NPS would discontinue PWC use within the national lakeshore. Table 2-1 presents a comparison of the elements of the alternatives.

Alternatives and actions that were considered but are not technically or economically feasible, do not meet the purpose of and need for the project, create unnecessary or excessive adverse impacts to resources, or conflict with the overall management of the national lakeshore or its resources were dismissed from detailed analysis. These alternatives or alternative elements and their reasons for dismissal are discussed at the end of this chapter.

ELEMENTS COMMON TO THE ACTION ALTERNATIVES

The action alternatives allow some level of PWC use at the national lakeshore. The following alternative elements would be common to the action alternatives (alternatives 1 and 2):

Access Restrictions

The superintendent has the ability to restrict or terminate access to areas of allowed PWC use for considerations of health and safety, natural and cultural resource protection, and other management activities or objectives (36 CFR § 7.32 d.4).

Speed Limit

PWCs would be permitted to operate at up to 55 miles per hour (mph) unless in close proximity to shoreline, swimmers, or other vessels, in which a flat-wake speed is required. Within 200 feet of the shoreline, PWC users would be required to operate at a flat-wake speed and travel perpendicular to the shoreline (MCL 324 § 80209 (1)). The flat-wake speed restrictions would also be required in areas where the water is less than 2 feet deep, including areas surrounding offshore islands and sandbars. PWCs would also be required to maintain a flat-wake speed when within 150 feet of another vessel (except for PWCs traveling together), and within 100 feet of a moored or anchored vessel, shoreline, dock or raft, or any marked swimming area or person in the water (MCL 324 § 80209(2)) (MDNR 2014a). These speed limits would be consistent with the Michigan state law, which also applies in state waters adjacent to the national lakeshore.

TABLE 2-1: SUMMARY OF ALTERNATIVE ELEMENTS

	Alternative 1: PWC Use from Western Boundary to Miners Beach	Alternative 2: Entire Shoreline Open to PWC Use	Alternative 3: No Action / No PWC Use[a]
PWC Use Area	• Western national lakeshore boundary to east end of Miners Beach	• Entire Pictured Rocks National Lakeshore shoreline	• No PWC use within the national lakeshore boundary
PWC Landing Sites	• Sand Point, Miners Beach	• Sand Point, Miners Beach, and on all sandy beaches along the shoreline.	N/A
Speed Limit	• 55 mph speed limit (outside of flat-wake zones) • No PWC use within 200 feet of the shoreline unless traveling perpendicular to the shoreline at a flat-wake speed	• Same as alternative 1	N/A
Hours of Operation	• No PWC use between sunset and 8:00 a.m.	• Same as alternative 1	N/A
PWC Equipment and Education	• Personal flotation device (PFD) required • PWC operators must attach the PWC safety ignition switch lanyard to themselves • Boating Safety Certificate for individuals born after December 31, 1978	• Same as alternative 1	N/A
Ethnographic Resource Protection	• No PWC use during the permitted use of ethnographic resources	• Same as alternative 1	N/A
Minimum Age Requirements	• Compliance with Michigan state law regarding minimum age requirements for PWC operators and passengers	• Same as alternative 1	N/A
PWC Operation and Behavior	• No reckless operation: - No jumping in the wake, weaving in congested traffic, or swerving at the last possible moment to avoid collision - No operation in waters less than 2-feet deep unless traveling at flat-wake speed - PWCs may not become partially or fully airborne while crossing the wake of another vessel within 100 feet of the vessel creating the wake	• Same as alternative 1	N/A
Launch Sites	• Sand Point is only launch site within the national lakeshore	• Same as alternative 1	N/A

	Alternative 1: PWC Use from Western Boundary to Miners Beach	Alternative 2: Entire Shoreline Open to PWC Use	Alternative 3: No Action / No PWC Use[a]
Improved Education and Outreach Program	• Increase education and outreach program to inform visitors about PWC use and changes	• Same as alternative 1	N/A
Phase Out Carbureted Two-Stroke PWCs	• Phase out the use of carbureted two-stroke PWCs after a two-year period	• Same as alternative 1	N/A
PWC Use Adjacent to Wilderness	• PWCs would be restricted to the area between Sand Point and Miners Point, which is west of the Beaver Basin Wilderness Area	• PWCs would be allowed along the entire shoreline and would be able to land on any sandy beach, including the beaches along the Beaver Basin Wilderness	N/A

[a.] Rescind the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore (36 CFR § 7.32) and implement the NPS PWC general regulation (36 CFR § 3.9(a)) PWC use not authorized without a special regulation.

Hours of Operation

The NPS general regulation for PWC operation (36 CFR § 3.9(b)(3)) states that no person may operate a PWC anytime between sunset and sunrise. If a park is located within a state with more restrictive regulations for the operation of PWC, then applicable state laws apply. In this case, the Michigan state law, which prohibits PWC use between sunset and 8:00 a.m. (MCL 324 § 80205(5)), is more restrictive than NPS regulations. Implementing the Michigan state law would reduce confusion to riders coming into the national lakeshore from outside areas. Therefore, the Michigan state law, which prohibits PWC use from sunset to 8:00 a.m., would be implemented at the national lakeshore.

PWC Equipment and Safety

PWC users would be required to follow Michigan state law and NPS general regulations pertaining to PWC safety, which state the following:

- PFDs must be worn by PWC users. Each person riding on or being towed behind a PWC must wear a US Coast Guard (USCG)-approved type I, II, III, or V PFD (MCL 324 § 80205(1) and 36 CFR § 3.9(b)(1)).
- The lanyard of a PWC ignition safety switch must be attached to the person, clothing, or PFD of the operator (MCL 324 § 80205(3-4) and (36 CFR § 3.9(b)(2)).
- A boating safety certificate is required for some individuals based on the PWC age requirements discussed below, and the PWC operator must have this certificate on his or her person while operating a PWC (MCL 324 § 80210; MCL 324 § 80212(1-3); MCL 324 § 80215). Michigan offers two online boating safety classes and an exam, as well as an 8-hour class from the USCG Auxiliary Division 18.

Ethnographic Resources Protection

PWC use would be restricted at specific locations during the permitted use of ethnographic resources. For example, the Grand Sable Dunes have been used for burials and vision quests by the Ojibway tribe. Many areas at the national lakeshore are significant as ceremonial places, including Hurricane River, Beaver Basin, Sable Falls, Miners Beach, and Miners Castle (Zedeño et al. 2001). Boat patrols would be conducted in the vicinity of the ethnographic resource use to reduce the potential for PWC-related intrusion into the ceremonial activity.

Minimum Age Requirements

The NPS would continue to follow Michigan state law regarding age requirements for PWC operators and passengers (MCL 324 § 80215), as follows:

- PWC operators over 16 years of age and born after December 31, 1978 may operate a PWC legally if they have obtained a boating safety certificate. Individuals born before December 31, 1978, may operate a PWC legally without restrictions.
- PWC operators may not be less than 14 years of age; PWC operators of 14 and 15 years of age may operate a PWC if they have obtained a boating safety certificate and

  - Are accompanied on the vessel by a parent, legal guardian, or an individual of at least 21 years of age who has been designated by a parent or legal guardian.
  - Are operating a PWC at a distance of no more than 100 feet from a parent or legal guardian, or an individual of at least 21 years of age who has been designated by a parent or legal guardian.
- Individuals of less than seven years of age may not ride on or be towed behind a PWC unless with a parent, legal guardian, or a designee of the parent or legal guardian.

PWC Operation and Behavior

PWC operators would be required to operate PWCs in a reasonable and prudent manner at all times, and would be required to follow both Michigan state law and NPS general regulations (36 CFR § 3.8). The following behaviors are considered unsafe and are prohibited:

- Jumping in the wake of another vessel unnecessarily close to the other vessel (MCL 324 § 80205(9)(b)). No PWC may jump the wake, or become partially airborne or completely leave the water while crossing the wake of another vessel within 100 feet of the vessel creating the wake (36 CFR § 3.9(b)(4)).
- Weaving a PWC through congested traffic (MCL 324 § 80205(9)(a)).
- Swerving at the last possible moment to avoid collision (MCL 324 § 80205(9)(c)).
- Crossing within 150 feet behind another vessel other than another PWC (MCL 324 § 80205(6)).
- Operating in waters less than 2 feet deep unless operating at a flat-wake speed or while docking or launching the PWC (MCL 324 § 80205(7)(a)(b)).
- Operating a vessel within 100 feet of a diver's flag (36 CFR § 3.8(b)(1)).
- Failing to observe restrictions established by a regulatory marker (36 CFR § 3.8(b)(2)).
- Operating a vessel in excess of a flat-wake speed within 100 feet of a downed water skier (36 CFR § 3.8(b)(4)(i)), person swimming, wading or fishing from shore or floating with the aid of a floatation device (36 CFR § 3.8(b)(4)(ii)), a designated launch site (36 CFR § 3.8(b)(4)(iii)), or anchored or drifting vessel (36 CFR § 3.8(b)(4)(iv)).
- Operating a vessel within 500 feet of a shoreline designated as a swimming beach, unless otherwise designated (36 CFR § 3.8(b)(5)).
- Reckless or negligent operation of a vessel (36 CFR § 3.8(b)(6-9)).

Launch Sites

According to NPS general regulations (36 CFR § 3.8), launching or recovering a vessel is prohibited except at a launch site designated by the superintendent. Currently, PWCs are only allowed to launch from a designated site at Sand Point, and may only beach craft at Sand Point Beach and Miners Beach (36 CFR § 7.32(d)). Under the action alternatives, Sand Point would remain as the only PWC launch point on Lake Superior within the national lakeshore. Visitors could continue to launch at existing sites outside of the national lakeshore boundary and could ride PWCs into the national lakeshore.

Vessel Decontamination

The Superintendent's Compendium (NPS 2016) includes national lakeshore-specific rules established under 36 CFR 1.5. Specific to PWC use, the Superintendent's Compendium prohibits the launching of any watercraft that has not been decontaminated prior to launch into NPS-administered waters within the Lakeshore Zone (federally owned lands and waters, including the surface waters of Lake Superior) within the national lakeshore. This restriction is in place to prevent the introduction or spread of aquatic invasive species, including viral hemorrhagic septicemia virus, a viral fish disease that has caused large scale fish mortalities, into park waters.

Improved Education and Outreach Program

The NPS would implement an increased education and outreach program to inform visitors about PWC use and changes to the use of PWCs at Pictured Rocks National Lakeshore. The NPS would increase the amount of PWC information available to the public, and would educate those who use PWCs on safety protocols. The website, publications, and brochures would be updated to reflect changes to PWC use at the national lakeshore. The NPS would also work with PWC recreational groups to increase education of PWC users on new regulations and safety. While on the water, NPS law enforcement staff would be responsible for engaging PWC users to educate them on the new regulations. Additionally, safety signs regarding PWCs would be installed at the Sand Point launch site and at the launch site in Munising.

Phase out Carbureted Two-Stroke PWCs after Two Years

To minimize environmental impacts from PWCs, the NPS would prohibit the use of carbureted two-stroke engines at the national lakeshore after a two-year period. The phase-out of this engine type would be consistent with the NPS PWC use plans at Lake Mead National Recreation Area and Glen Canyon National Recreation Area. In 2006 and again in 2008, the US Environmental Protection Agency (EPA) finalized and adopted more stringent regulations for air quality emissions standards for spark ignition marine engines, which were effective beginning with the 2010 model year. Providing a two-year period to phase-out carbureted engines would allow national lakeshore visitors time to acquire PWCs that meet 2010 EPA air quality emissions standards. The two-year period would begin immediately following the publication of the final rule in the Federal Register. Following the two-year period after implementation of the new rule, only PWCs that comply with the EPA 2010 standards (EPA 2008a) would be permitted to be used within the national lakeshore. For consistency, the two-year phase-out period will be referred to as the time *during the phase-out* and the period after the phase out will be referred to as *post phase-out*.

The difference in two-stroke and four-stroke engine types can only be determined by looking at the engine of the PWC. In order to enforce the phase-out of carbureted two-stroke engines, national lakeshore staff would require California Air Resources Board (CARB) stickers for machines meeting EPA requirements. When an engine meets the EPA requirements, the manufacturer applies the CARB sticker on the vessel (CARB 2008). CARB stickers include star ratings to indicate the level of air emissions produced by a PWC, and the equivalent standards. CARB stickers include a ranking based on the number of stars, which indicates the level of air emissions produced by the PWC, as indicated in table 2-2. A one-star or two-star CARB sticker indicates the PWC meets the 2006 EPA air quality emissions standards, while a three-star CARB sticker identifies engines that meet the CARB 2008 and EPA 2010 standards, and four- and five-star CARB stickers indicate even greater air emissions reductions (CARB 2008).

TABLE 2-2: CARB STICKER AIR EMISSIONS STANDARDS AND EPA EQUIVALENCY

CARB Sticker	Emissions Equivalent	EPA Air Quality Emissions Equivalency
1 Star – Low Emissions	Meets CARB PWC 2001 exhaust emissions standards; 75% lower emissions than conventional carbureted two-stroke PWC	2006 air quality emissions standards
2 Star – Very Low Emissions	Meets CARB 2004 emission standards; 20% lower emissions than 1 star engines	2006 air quality emissions standards
3 Star – Ultra Low Emissions	Meets CARB 2008 emission standards; 65% lower emissions than 1 star engines	2010 air quality emissions standards
4 Star – Super Ultra Low Emissions	Meets CARB 2008 emissions standards and 2009 exhaust emissions standards; 90% lower emissions than 1 star engines	2010 air quality emissions standards
5 Star – Level Five Extremely Clean	Meets CARB voluntary standards; 50% lower emissions than 4 star engines	2010 air quality emissions standards

Source: CARB 2008.

The NPS would implement efforts focused on educating PWC users during the phase-out. Brochures and other material would inform visitors about changes and the schedule for these changes. At the conclusion of the two-year phase-out period, the enforcement period would begin. Enforcement would include issuing warnings or citations for visitors with PWCs not displaying the appropriate CARB sticker for PWCs compliant with the EPA 2010 standards.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Under alternative 1, the NPS would continue to implement the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore (36 CFR § 7.32 (d)(1)). The NPS would amend the 2005 special regulation to include a requirement that all PWCs operating in the park must meet the 2010 EPA air quality emissions standards, as described above. This requirement would take effect two years from the time that the revised special regulation is promulgated. In addition to the items discussed above in the "Elements Common to the Action Alternatives" section, the following PWC provisions would be implemented under alternative 1:

Under alternative 1, the NPS would amend the 2005 special regulation to include a requirement that all PWCs operating in the park must meet the 2010 EPA air quality emissions standards two years from the time the revised special regulation is promulgated.

PWC USE AREA

Under alternative 1, PWC use would be permitted on Lake Superior from the western boundary of the national lakeshore to the east end of Miners Beach (figure 2-1), as described in the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore (36 CFR § 7.32(d)).

PWC LANDING SITES

PWCs would be allowed to beach or land on the sandy beaches at Sand Point or Miners Beach (figure 2-1). The beaches at Sand Point and Miners Beach are the only safe places to beach along the national lakeshore within the proposed PWC use areas under alternative 1. Remaining areas within the PWC use area under alternative 1 are rocky and thus are not suitable for beaching.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Under this alternative, the NPS would amend the 2005 special regulation to allow PWC use along the entire Lake Superior shoreline in the national lakeshore. In addition to the elements discussed under "Elements Common to the Action Alternatives" above, the following would be implemented under alternative 2:

Under alternative 2, the NPS would amend the 2005 special regulation to allow PWC use along the entire Lake Superior shoreline.

PWC USE AREA

All waters along the entire Lake Superior shoreline within the national lakeshore would be open to the use of PWCs under alternative 2 (figure 2-2).

PWC LANDING SITES

PWCs would be allowed to beach or land on the sandy beaches at Sand Point, Miners Beach, or any other sandy beaches along the shoreline, including those beaches along the Beaver Basin Wilderness.

ALTERNATIVE 3: NO ACTION / NO PWC USE

The NPS has identified the no-action alternative to mean there would be no PWC use allowed in the park. Typically for a management plan such as this, the no-action alternative represents the continuation of current management direction or level of intensity. In this case, that would mean continuing PWC use at the park pursuant to the existing special regulation in 36 CFR section 7. However, special circumstances associated with this management plan resulted from the 2010 ruling by the US District Court for the District of Columbia. That court ruling invalidated the previous NEPA compliance document that supported the existing special regulation allowing PWC use at the park. The court allowed the park to continue PWC use under the special regulation in place at the time of the ruling, and in effect through the present day, while the NPS corrects the deficiencies of the previous NEPA document.

Under alternative 3, the NPS identified the no-action alternative as "no PWC use" in the park, the same no-action alternative presented in the 2002 EA authorizing PWC use in the park.

The court found that the analysis in the 2002 EA was inadequate and did not provide enough information for the court to determine the validity of the NEPA document, specifically the FONSI and the conclusion that an environmental impact statement was not required. The court remanded and directed the NPS to complete a new NEPA assessment to provide the required reasoned explanation and analysis of the impacts necessary for taking a hard look at the proposed action of authorizing PWC use. To meet the requirements of the court's ruling and to provide for a comparable analysis of impacts among proposed alternatives, the NPS has again identified the no-action alternative as "no PWC use" in the park, the same as presented in 2002 EA considering the authorization of PWC use in the park.

Figure 2-1
Alternative 1

SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
0 1 2 Miles

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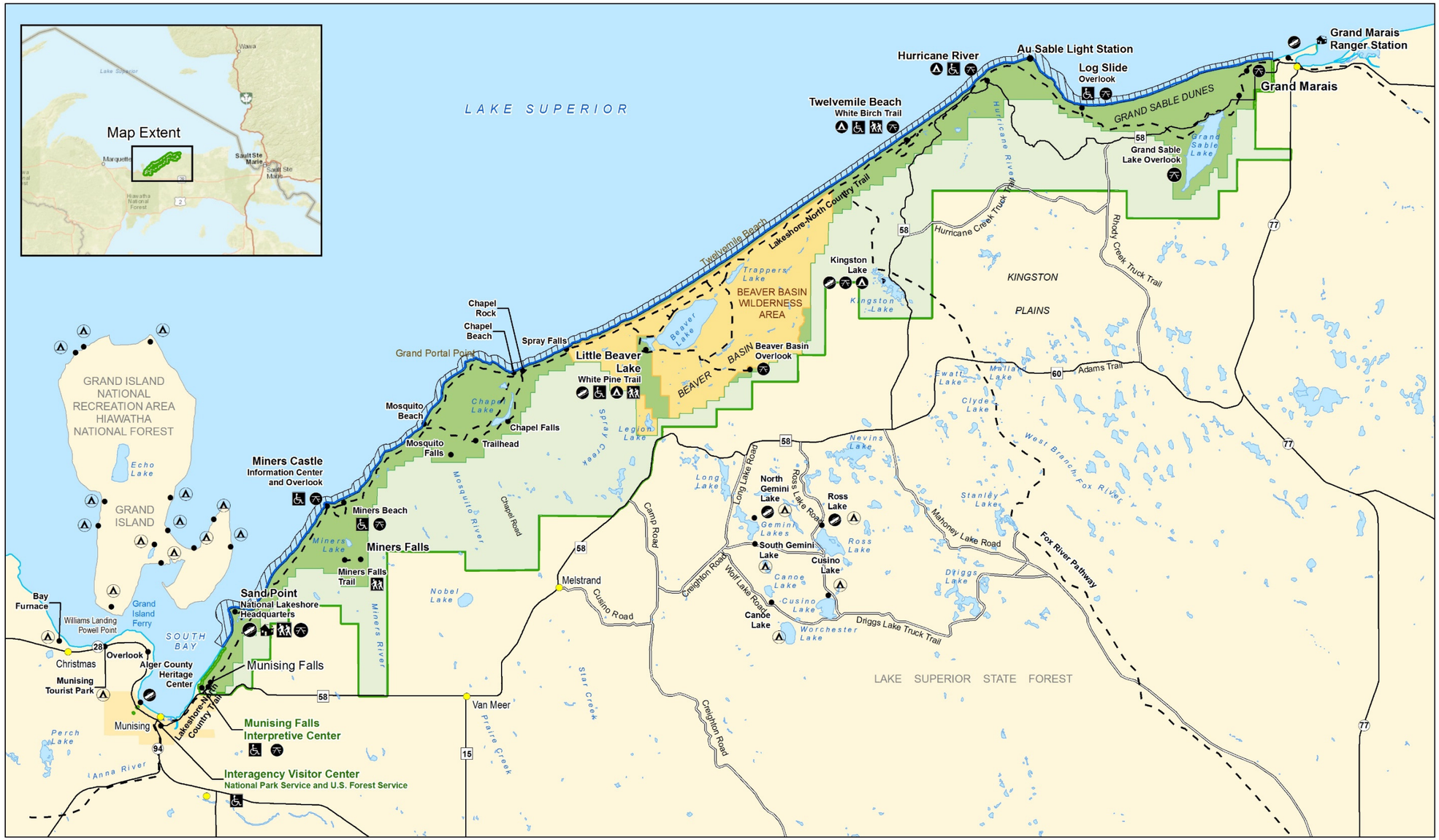
Map Extent
LAKE SUPERIOR
Hurricane River
Au Sable Light Station
Log Slide
Overlook
Grand Marais
Ranger Station
Grand Marais
Twelvemile Beach
White Birch Trail
GRAND SABLE DUNES
Grand Sable Lake Overlook
Grand Sable Lake
Hurricane River
Hurricane Creek Truck Trail
Rhody Creek Truck Trail
Twelvemile Beach
Lakeshore-North Country Trail
Trappers Lake
BEAVER BASIN WILDERNESS AREA
Kingston Lake
KINGSTON PLAINS
Chapel Rock
Chapel Beach
Spray Falls
Grand Portal Point
Little Beaver Lake
White Pine Trail
Beaver Basin Overlook
BEAVER BASIN
Beaver Lake
Chapel Lake
Chapel Falls
Trailhead
Mosquito Beach
Mosquito Falls
Legion Lake
Spray Falls Creek
Adams Trail
Ewatt Lake
Mallard Lake
Clyde Lake
West Branch Fox River
Nevins Lake
Long Lake
Long Lake Road
North Gemini Lake
Ross Lake Road
Ross Lake
Stanley Lake
Gemini Lakes
Ross Lake
Mahoney Lake Road
Fox River Pathway
South Gemini Lake
Cusino Lake
Canoe Lake
Driggs Lake
Driggs Lake Truck Trail
Worchester Lake
Creighton Road
Wolf Lake Road
Camp Road
Cusino Road
Melstrand
Miners Castle
Information Center and Overlook
Miners Beach
Miners Falls
Miners Falls Trail
Miners Lake
Miners River
Mosquito River
Chapel Road
Nobel Lake
Sand Point
National Lakeshore Headquarters
Munising Falls
Munising Falls Interpretive Center
Interagency Visitor Center
National Park Service and U.S. Forest Service
Van Meer
Prairie Creek
Star Creek
LAKE SUPERIOR STATE FOREST
GRAND ISLAND NATIONAL RECREATION AREA
HIAWATHA NATIONAL FOREST
GRAND ISLAND
Echo Lake
Bay Furnace
Williams Landing
Powell Point
Grand Island Ferry
SOUTH BAY
Christmas
Overlook
Alger County Heritage Center
Munising Tourist Park
Munising
Perch Lake
Lanna River
Legend
City or Town
Park Feature
Boat Launch
Campground
Picnic Area
Wheelchair-accessible
Ranger Station
Self-guided Trail
Trail
Proposed PWC Use Area
Proposed PWC Flat-Wake Zone (200 Ft. From Shore)
Lakeshore Access Road (Paved)
Lakeshore Access Road (Unpaved)
Other Unpaved Road
Beaver Basin Wilderness Area
Inland Buffer Zone (Mixed Ownership)
Lakeshore Zone (NPS)
Park Boundary
Figure 2-2
Alternative 2
SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
0
3.5
7
Miles

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ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER CONSIDERATION

For various reasons, some alternatives or actions were initially considered for managing PWC use in Pictured Rock National Lakeshore, but were eliminated from further study. Those alternatives and actions dismissed from further consideration did not meet the definition of a reasonable alternative, as defined by the Forty Most Asked Questions Concerning the Council on Environmental Quality's (CEQ) National Environmental Policy Act Regulations (46 FR 18026). The document states that "Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant" (CEQ 1981). In addition, reasonable alternatives meet project objectives, resolve need, and alleviate potentially significant impacts to important resources. An alternative is not automatically rendered unreasonable if it requires the amending of a park plan or policy; causes a potential conflict with local, state, or federal law; or lies outside the scope of what Congress has approved or funded or outside the legal jurisdiction of the NPS. The rationales for dismissal are presented in this section.

The following alternatives were considered but dismissed. These dismissed alternatives, when combined with the alternatives fully evaluated above, constitute the full range of alternatives the NPS is required to consider under NEPA. These alternatives were dismissed from further analysis due to technical feasibility, potential for too great of an environmental impact to the national lakeshore, conflicts with the purpose and need of the project, or for other reasons specified below.

REDUCE THE SPEED LIMIT TO 35 MILES PER HOUR

A reduction in the speed limit for PWCs was considered but dismissed. Currently under Michigan state laws, all vessels are allowed to operate up to 55 mph in certain areas, though slower speeds are required in proximity to other vessels, swimmers, and along the shoreline. Although PWCs can reach a maximum speed of 65 mph, it is nearly impossible for most PWCs to reach this speed on Lake Superior due to rough lake surface conditions. The NPS enforces safe operation requirements based on observation of PWCs and other vessels by law enforcement staff. Behaviors considered unsafe or reckless include operating above the speed limit, lack of the use of a PFD, jumping the wake of another vessel unnecessarily close to the vessel, weaving through congested traffic, swerving at the last possible moment to avoid collision, crossing within 150 feet of another vessel other than another PWC, operating at speeds higher than flat-wake speed in areas where such speeds are prohibited, or operation in a restricted or closed area. NPS records indicate that of all the citations and warnings given to PWC users at the national lakeshore in the summer of 2015, most of them were for safety inspections and operation in a closed area. Two incidents were reported for operating a PWC carelessly by generating a wake near shore, but no incidents were reported for speeding. Therefore, speeding does not currently present a safety concern with the current speed limit under Michigan state law, as long as the operator is adhering to state and federal regulations regarding safe operation of PWCs. Reducing the speed limit was dismissed from further consideration because it would be inconsistent with Michigan state laws, and because excessive speeds have not been an issue associated with PWC use within the national lakeshore boundaries.

SEASONAL USE RESTRICTIONS

Seasonal use restrictions were considered as a potential method for providing resource protection and visitor safety. In terms of visitor safety, the peak season for PWC use at the national lakeshore is typically Memorial Day through Labor Day, when the weather and water temperatures are warmer. Therefore, most PWC use at the national lakeshore is already essentially limited to a single season.

The NPS also considered implementing a seasonal restriction for PWC use to protect sensitive species, including piping plovers. There is a small portion of the land that is managed by the park on the eastern portion of the peninsula in Grand Marais; this land is not physically connected to the remainder of the park and is not included in the portion of the shoreline open to PWC use under alternative 2. Piping plover critical habitat has been designated on this small portion of land near the Grand Marais ranger station, and a seasonal restriction could provide protection for piping plovers during nesting, which occurs from mid-April through August. However, a seasonal restriction in this area was dismissed from further consideration because it is outside the area being considered for PWC use.

Additionally, the NPS has the authority to implement temporary resource and safety closures as warranted, in accordance with the superintendent's compendium, which would minimize the potential for resource damage and visitor safety issues. Therefore, a seasonal PWC use restriction was considered but dismissed from further analysis.

REDUCE HOURS OF PWC OPERATION

Currently, visitors can operate PWCs in the national lakeshore from 8:00 a.m. until sunset. A reduction in the operating hours for PWCs could benefit other user groups at the national lakeshore, because it would increase the opportunities for recreation in or near the lake without the presence of PWCs. Alternatives considered in this EA provide times (after sunset and before 8:00 a.m.) and areas within the national lakeshore that offer visitors a non-PWC experience. Additionally, a reduction in the operation hours for PWCs would be inconsistent with the hours of PWC operation in areas adjacent to the national lakeshore. This could result in confusion for PWC users and a lack of consistent regulations for state and federal law enforcement staff to administer. For these reasons, reduced hours of PWC operation was dismissed from further analysis.

LIMIT THE NUMBER OF PWCS IN THE NATIONAL LAKESHORE

This element was dismissed from further evaluation for several reasons. Because there are no clearly marked water boundaries or entrances, there is no way to determine how many PWCs are in the national lakeshore at any one time. Therefore, regulating the number of PWCs allowed within the national lakeshore at one time would present substantial enforcement difficulties. Limiting the number of PWCs launched at the NPS-managed Sand Point launch site would not be effective because PWC users can launch from outside of the national lakeshore. Additionally, PWC use in the park continues to be low, and there have been no documented issues with overcrowding or conflicts due to excessive numbers of PWCs in use that would necessitate a limit on the number of PWCs. Therefore, limiting the number of PWCs in the national lakeshore does not appear to be warranted. If PWC use increased substantially in the future, the NPS has the authority to implement temporary resource and safety closures as warranted, per the superintendent's compendium, and could implement these closures for specific areas if overuse or overcrowding became an issue.

REQUIRE A PERMIT/FEE FOR PWC USE IN THE NATIONAL LAKESHORE

Permit systems can be beneficial because they can provide PWC use statistics, opportunities for visitor education, measures to reduce overcrowding, and enforcement of regulations. However, a fee or permit requirement for PWC users at Pictured Rocks National Lakeshore was considered but dismissed from further analysis for several reasons. The national lakeshore lacks a controlled entry point where visitors would be required to pay a fee or obtain a permit, which would make enforcement of a permit/fee system extremely difficult if not technically infeasible. Requiring a permit was dismissed from consideration because the effort and resources required to introduce and enforce a permit system would not be warranted given the current low level of PWC use and scarcity of visitor conflicts at the national

lakeshore. In addition, improvements to education and outreach efforts included in the action alternatives should increase awareness and compliance with PWC regulations, reducing the need for a permit system.

CONTINUE CURRENT MANAGEMENT

Continuing current PWC management at Pictured Rocks National Lakeshore is included in the action alternatives for the first two years of implementation and is therefore included in the impact analysis for the phase-out period. As a stand-alone alternative over the long-term, continuing current management, which allows the use of carbureted two-stroke PWCs, duplicates another less environmentally-damaging alternative, alternative 1, which contains the provisions of current management but adds another level of protection regarding compliance with the 2010 EPA air quality standards. Therefore, pursuant to Section 4.3-A of the NPS NEPA Handbook (2015), an alternative that would continue current PWC management has been dismissed from detailed analysis in this EA.

CREATE SPECIFIC PWC NOISE LIMITS

All motorized vessels create some level of noise at the national lakeshore. PWCs can be particularly disruptive because of their high-pitched whine and sometimes erratic stop and go operation, which creates cycles of noise disruptive to humans and wildlife (MA Office of Coastal Zone Management n.d.). The newer direct injection two-stroke and four-stroke PWC engines are quieter than the older carbureted two-stroke engines (PWIA n.d.). Sound emissions from PWCs have been reduced by 70% compared to models produced before 2007, due to improvements including the use of intake/exhaust system redesign, active noise-canceling devices, engine/drive train isolation, hull insulation, and other muffling techniques (PWIA 2011). Noise limits for watercraft operation in park units are established in 36 CFR § 3.15, which states that "A person may not operate a vessel at a noise level exceeding 75 A-weighted decibels (dBA) measured utilizing test procedures applicable to vessels underway (Society of Automotive Engineers – J1970); or 88 dBA measured utilizing test procedures applicable to stationary vessels (Society of Automotive Engineers – J2005)" (36 CFR § 3.15). The creation of PWC-specific noise restrictions was dismissed from further consideration because of the existing noise limits in the CFR, the low level of PWC use at the national lakeshore, and the elements in the project alternatives that are designed to reduce noise in the park (i.e., requiring the use of newer, direct injection PWCs, flat-wake speeds and perpendicular travel within 200 feet of a shoreline).

CREATE A NPS BOATER SAFETY PROGRAM AND AGE RESTRICTIONS

As stated in the "Elements Common to the Action Alternatives" section, all PWC operators born after December 31, 1978 are required to complete a boating safety course and obtain a boating safety certificate, as mandated in Michigan state law (MCL 324 § 80215). In addition, PWC operators may not be younger than 14 years of age, and operators 14 and 15 years of age must complete the boater safety course and be accompanied by a designated individual 21 years of age or older. Individuals younger than seven years of age are not allowed to ride on or be towed behind a PWC unless with an adult. Based on records of citations and warnings issued to PWC users at the national lakeshore from 2009 through 2012, underage use of PWCs is not currently an issue. This element was dismissed from further consideration because the NPS would continue to enforce Michigan law, which already includes age restrictions for PWC users and requires a boater safety course for operators born after December 31, 1978.

Additionally, the action alternatives would include increased visitor education and enforcement of unsafe operation requirements.

LIMIT THE NUMBER OF PWCS RIDING TOGETHER

The largest number of PWCs observed traveling together at the national lakeshore was four; however, PWCs were typically observed traveling in pairs (NPS 2013b). Limiting the number of PWCs travelling together is not warranted because PWC use at the national lakeshore is low, and there have been no documented safety issues associated with PWCs traveling in groups.

With regard to the noise generated by PWCs traveling together, acoustic analysis indicates that each additional PWC increases the noise level by 7 dBA. While there is an increase in noise with additional PWCs in a group, it is a small increase. Limiting the number of PWCs traveling together was dismissed from further consideration because of the low level of PWC use at the national lakeshore, the small increase in noise from two PWCs riding together, and the elements in the project alternatives that are designed to reduce noise in the park (i.e., requiring the use of newer, direct injection PWCs, and flat-wake speeds and perpendicular travel within 200 feet of a shoreline).

PROHIBIT PWC LANDING IN AREAS WHERE OTHER VISITORS ARE PRESENT

Operation of motorized vessels in excess of a flat-wake speed within 100 feet of people swimming, wading, or fishing from shore, or floating with the aid of a flotation device is already addressed by existing federal regulations (36 CFR 3.8(4, 5). It was determined that existing flat-wake zone regulations are sufficient to protect visitors; additional regulations would be difficult to enforce and provide little additional benefit.

BUILD ADDITIONAL LAUNCH SITES IN THE NATIONAL LAKESHORE

Sand Point is the only PWC launch site within the national lakeshore. Sand Point does experience heavy use on nice summer weekends; exact numbers are not available, but the parking lot is typically full on these weekends. The construction of a PWC launch site within the national lakeshore was suggested during the public scoping period for this EA. However, there are no other feasible or logical locations within the national lakeshore for constructing a new PWC launch site, due to the topography or the environmental impacts associated with constructing a new access point along the shoreline. Therefore, this option was eliminated from further consideration.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

The environmentally preferable alternative is the alternative "that causes the least damage to the biological and physical environment and best protects, preserves, and enhances historic, cultural, and natural resources" (43 CFR Part 46.30). After completing the environmental analysis, the NPS identified alternative 3, the no-action alternative, as the environmentally preferable alternative in this EA because it best meets the definition established by CEQ. Alternative 3 best protects the natural and cultural resources of the national lakeshore by eliminating the environmental impacts associated with PWC use at the national lakeshore. Alternatives 1 and 2 would both allow PWC use at the national lakeshore, which would result in a greater environmental impact than if PWC use were eliminated under alternative 3.

HOW THE ALTERNATIVES MEET THE OBJECTIVES

Action alternatives were assessed based on the objectives for this management plan/EA, stated in "Chapter 1: Purpose and Need." These alternatives must address the stated purpose of taking action and resolve the need for action. Alternatives that did not meet the objectives were not analyzed further (see the "Alternatives Considered but Dismissed from Further Consideration" section in this chapter).

Table 2-1 in this chapter is a comparison of the elements of the alternatives. Table 2-3 compares how each of the alternatives described in this chapter would meet the management plan objectives. "Chapter 4: Environmental Consequences" describes the effects of each alternative on each impact topic.

NPS PREFERRED ALTERNATIVE

The preferred alternative is the alternative that the NPS determines "would best accomplish the purpose and need of the proposed action while fulfilling its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors" (43 CFR 46.420(d)).The NPS has identified alternative 1 as its preferred alternative upon consideration of factors, such as the extent to which alternatives meet the purpose and need for the project, the project objectives (see table 2-3), and the environmental impacts of the alternatives (see chapter 4). The preferred alternative allows visitors to continue to enjoy the benefits of PWC use within a portion of the national lakeshore while protecting resources in the eastern side of the park, such as the Beaver Basin Wilderness Area and habitat for sensitive wildlife species.

TABLE 2-3: HOW THE ALTERNATIVES MEET THE OBJECTIVES

Objective	Alternative 1: PWC Use from Western Boundary to Miners Beach	Alternative 2: Entire Shoreline Open to PWC Use	Alternative 3: No Action / No PWC Use
Evaluate whether PWC use is consistent with the national lakeshore's purposes and values as identified in the national lakeshore's 2004 GMP.	Alternative meets the objective; PWC use would remain the same as current conditions, allowing a variety of recreation opportunities while retaining a large portion of the shoreline that is devoid of PWC activity.	Alternative partially meets the objective; recreation opportunities would remain the same as current conditions. However, PWCs would be permitted along the entire lakeshore, potentially affecting important natural and cultural resources.	Alternative partially meets the objective; eliminating PWC use would protect resources of the national lakeshore. A recreational activity would be eliminated; however, the park offers a wide variety of other opportunities.
Provide a variety of recreation opportunities that allow visitors to experience and appreciate natural and cultural resources, consistent with the purpose for which the national lakeshore was established.	Alternative meets the objective; the PWC use area would remain the same, allowing the continuation of all current recreation activities at the national lakeshore.	Alternative meets the objective; PWC use would continue at the national lakeshore with a larger use area, allowing the continuation of all current recreation activities.	Alternative partially meets the objective; eliminating PWC use would reduce recreation opportunities for those visitors that explore the national lakeshore using PWCs. However, visitors would still be able to explore the national lakeshore using other watercraft and other types of recreation.
Minimize adverse impacts to water and air quality.	Alternative meets the objective to a large degree; post phase-out, all PWCs used at the national lakeshore would be required to have direct injection two-stroke or four-stroke engines, which would essentially eliminate pollutant loadings to surface water and reduce air emissions.	Alternative partially meets the objective. Improvements would occur for the current PWC use area, as described for alternative 1. The area of potential impact would increase under alternative 2.	Alternative fully meets the objective; no PWCs would be permitted at the national lakeshore, thereby eliminating water and air pollution from PWC use.

Objective	Alternative 1: PWC Use from Western Boundary to Miners Beach	Alternative 2: Entire Shoreline Open to PWC Use	Alternative 3: No Action / No PWC Use
Minimize adverse impacts to wildlife and wildlife habitat.	Alternative moderately meets the objective; PWC use would remain the same as current conditions (low), with some impacts to wildlife and wildlife habitat from PWC noise and presence and trampling of habitat from PWC users.	Alternative partially meets the objective. The impacts would be of a similar nature to alternative 1, but with the increased PWC use area, a much larger area would be affected, resulting in impacts to wildlife in areas where PWCs are not currently permitted.	Alternative fully meets the objective; no PWCs would be permitted at the national lakeshore, eliminating impacts on wildlife and wildlife habitat from PWC use.
Provide protection of threatened, endangered, and other protected species and their habitats.	Alternative meets the objective to a large degree; PWC use would remain the same as current conditions (low), with some impacts to special-status species from PWC noise and presence and trampling of habitat from PWC users. Species affected include American dune wild-rye (*Elymus mollis*), piping plover, common loon, peregrine falcon, merlin, and bald eagle.	Alternative partially meets the objective. Impacts would be of a similar nature to alternative 1. However, the increased PWC use area that would disturb wildlife in areas where PWCs are not currently permitted, resulting in a greater impact than alternative 1. Two additional plants would be affected under alternative 2, pitcher's thistle (*Cirsium pitcheri*) and Lake Huron tansy (*Tanacetum huronense*).	Alternative fully meets the objective; no PWCs would be permitted at the national lakeshore, eliminating impacts on special-status species and their habitat.
Protect ethnographic resources from adverse impacts.	Alternative mostly meets the objective; PWC use would remain low and the NPS would continue to perform boat patrols during ethnographic ceremonies. NPS patrols would be needed to ensure avoidance of impact.	Alternative mostly meets the objective. Impacts would be of a similar nature to alternative 1 impacts. The expended PWC use area would subject more resources to potential impacts than alternative 1, and require more effort by NPS boat patrols to ensure the avoidance of impact.	Alternative fully meets the objective; no PWCs would be permitted at the national lakeshore, eliminating potential impacts on ethnographic resources from PWC use.
Protect the wilderness character of the Beaver Basin Wilderness Area by providing outstanding opportunities for solitude and preserving natural conditions, including natural quiet.	Alternative meets the objective; the PWC use area would remain the same as current conditions, ending at the east end of Miners Beach, 8 miles from the Beaver Basin Wilderness Area.	Alternative does not meet the objective; PWCs would be permitted to operate in the water adjacent to and beach along the shoreline of the wilderness area. The sights, sounds, and odors associated with PWC use would detract from the wilderness character of the Beaver Basin Wilderness Area.	Alternative meets the objective; no PWCs would be permitted at the national lakeshore, eliminating the sights, sounds, and odors associated with PWC use, which could alter visitors' wilderness experience.

Objective	Alternative 1: PWC Use from Western Boundary to Miners Beach	Alternative 2: Entire Shoreline Open to PWC Use	Alternative 3: No Action / No PWC Use
Ensure the safety of all national lakeshore visitors and reduce the potential for conflicts between uses.	Alternative meets the objective to a large degree; PWC use would remain the same as under current conditions. The potential for collisions with other boaters and swimmers as well as capsizing kayaks exists; however, due to the low levels of PWC use, the impacts are negligible.	Alternative partially meets the objective. The expended PWC use area would result in the potential for conflicts between PWCs and other visitors in new areas. The eastern area of the national lakeshore is less protected from sudden weather changes and would have more potential for safety concerns.	Alternative fully meets the objective; eliminating PWC use would remove the possibility for collisions with and creating wake around other boaters and swimmers.
Minimize operational needs and costs associated with the management of PWC use.	Alternative partially meets the objective; time and money would be required for the duties of park resource staff and law enforcement due to the new education and outreach program and continued boat patrols and search and rescue efforts.	Alternative does not meet the objective; same as alternative 1 but with an increased PWC use area that would require more staff and law enforcement.	Alternative meets the objective; no PWCs would be permitted at the national lakeshore, reducing staffing needs for patrols and search and rescue operations.

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CHAPTER 3: AFFECTED ENVIRONMENT

This "Affected Environment" chapter describes the existing conditions of the resources at the national lakeshore that would be affected by implementing the alternatives in this EA. Affected resources include water resources, air quality, acoustic environment and soundscapes, wildlife and wildlife habitat, special-status species, ethnographic resources, visitor use and experience, visitor safety, and wilderness. The existing conditions include the effects of previous and ongoing PWC use at the national lakeshore as visitors have been using PWCs there since the 1990s.

WATER RESOURCES

PHYSICAL CHARACTERISTICS OF LAKE SUPERIOR

The shoreline of Lake Superior varies physically, with areas of shallow sandy shelves adjacent to beaches and deeper waters offshore of large cliffs and ravines. Although the lake reaches a maximum depth of 1,335 feet, the depths are relatively shallow along the shoreline. The nearshore depths within 50 feet of the shoreline are typically 4–6 feet, while waters 50–100 feet offshore are typically about 10 feet deep. Depths beyond 200 feet offshore increase and are generally between 30 and 100 feet deep, though there are areas where shallow waters extend farther from the shoreline. Winds typically blow from the northwest, which results in wave action on the shoreline. Near the national lakeshore, currents flow in a west to east direction. Because of the prevailing wind direction and currents, the national lakeshore has some of the largest wave exposure of any area on Lake Superior (Mechenich et al. 2006).

Lake Superior is an oligotrophic lake, meaning that the nutrients available within the ecosystem are relatively low in relation to the size of the lake and volume of water. Oligotrophic lakes are typically cool and clear, and the characteristically low nutrient level results in low algal growth. Typical surface water temperatures in Lake Superior are around 55°F in the mid-summer (NOAA NCEI 2017); however, the temperatures decrease with depth, with bottom temperatures closer to 40°F (NOAA GLERL 2017). Although there are numerous distinct biological communities within Lake Superior, including plankton (zooplankton and phytoplankton), littoral plants (rooted plants), benthos (organisms living in the bottom sediments), and fish, biological activity is relatively low in comparison to other lakes because of the limited nutrient availability (Limnetics, Inc., 1970; Mechenich et al. 2006). Aquatic plant growth is low in Lake Superior due to these oligotrophic conditions and because of wave action along the shore (Mechenich et al. 2006; Limnetics, Inc. 1970). The benthic community is relatively sparse due to the low concentrations of nutrients within the sediments. However, the cold and clear water of the oligotrophic lakes are ideal for many fish species, including lake trout (*Salvelinus namaycush*), whitefish (*Coregonus* sp.), and walleye (*Sander vitreus*). Other coolwater species include brook trout (*Salvelinus fontinalis*), white suckers (*Catostomus commersonii*), minnows, darters, sculpin, and sunfish.

WATER QUALITY

Water Quality of Lake Superior

Water quality in Lake Superior is considered to be good, and general indicators of water quality have shown stable or favorable results in the Great Lakes since 1987 (LAMP 2013). By most measures, it is the cleanest of the Great Lakes and has the least developed coastline (EPA 2013a). Drinking water quality in the lake is generally considered good, and the risk of exposure to chemical or microbiological contaminants is low. In Lake Superior, 97% of monitored beaches were open and safe for swimming in the United States from 2008 through 2010 (LAMP 2013).

Specific conductance, or the ability for the water to conduct electrical current, and turbidity have been increasing from 1992 through 2008, but there has been no change in total chloride, pH, and total alkalinity (LAMP 2013). Although concentrations of some toxic chemicals are lowest in Lake Superior, the lake has several persistent chemicals contributed primarily through atmospheric deposition that are found at higher concentrations than in the other Great Lakes (LAMP 2013). Since the 1970s, programs have helped reduce many legacy contaminants in the lake, including pollutants such as mercury and dioxin (EPA 2013a; LAMP 2013). However, contaminants in the environment such as mercury and polychlorinated biphenyls (PCBs) still result in fish consumption advisories and exceed water quality guidelines in some areas of the lake. Additionally, pharmaceuticals and other chemicals are now being detected at some locations in Lake Superior (EPA 2013a).

The Lake Superior Lakewide Management Plan identifies areas of concern and tracks progress of remediation in these areas (EPA 2008b). In 2012, eight areas of concern within Lake Superior were outlined as hotspots of contamination where beneficial uses are impaired, including drinking water, fish consumption, and fish and wildlife habitat. It is important to note that this use of the term "impair" is based on the Clean Water Act definition, and is not the same as the NPS Organic Act definition of "impair." The Clean Water Act defines impaired waters as "waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes" (EPA 2015). The closest area of concern to the national lakeshore is in Deer Lake, but the site is not considered a threat to national lakeshore resources because it is roughly 43 miles away from the national lakeshore (Mechenich et al. 2006). Additionally, two of the three "beneficial uses" impairments at that site were removed in 2011 as a result of improved conditions (EPA 2013b).

Michigan Department of Environmental Quality Use Designations and Water Quality Standards

Under Michigan water quality regulations, ambient water quality standards are developed to support specific designated uses. These designated uses include aquatic life, wildlife support, agricultural, industrial, and municipal water supply, navigation, and partial and total body contact recreation. According to the 2012 Water Quality and Pollution Control in Michigan report, Lake Superior within the national lakeshore fully supports its designated uses for navigation, industrial water supply, agriculture, and partial body contact recreation, but there was insufficient information to assess total body contact recreation (MDEQ 2012). At the national lakeshore, Lake Superior was not assessed for warm water fisheries, other indigenous aquatic life and wildlife, cold water fisheries, or fish consumption (MDEQ 2014, Rule 57). The Michigan areas of the Great Lakes, including Lake Superior, do not fully support the designated use for fish consumption and other indigenous aquatic life and wildlife due to the high levels of PCBs and mercury in the water column, as explained in the previous section. Contaminant levels in the Great Lakes are influenced by atmospheric deposition, which is considered to be the major source of these pollutants (MDEQ 2012).

The portion of Lake Superior that includes the national lakeshore was designated by the Michigan Department of Environmental Quality (MDEQ) as an outstanding state resource water (MDEQ 2006). Few water bodies in the state of Michigan are classified as outstanding state resource waters. These water bodies are considered high quality, and there are additional regulatory antidegradation requirements to protect existing water quality, such as the prevention of new or increased loadings of nine bioaccumulative substances that have been identified as concerns for the health of Lake Superior, including mercury, PCBs, dioxins, and several pesticides. The antidegradation requirements also mandate that even if designated uses of the water body are not attained, the water quality will be maintained. In addition, economic development will be restricted to protect the water quality of the outstanding state resource water.

Baseline Water Quality Data at Pictured Rocks National Lakeshore

The NPS Water Resources Division and Servicewide Monitoring Program compiled water quality data for Lake Superior in 1995. Water samples were analyzed for nutrients, metals, fecal coliforms, mercury, and turbidity. Results of this study indicated overall good water quality with no exceedances of EPA water quality screening criteria for ecological and human health (NPS 1995).

In 2006, the NPS assessed the watershed conditions at the national lakeshore. Water quality concerns identified in the report included PCBs, the pesticide dichlorodiphenyltrichloroethane (DDT) and its metabolites, mercury, and other banned pesticides (Mechenich et al. 2006). Potential sources of regional pollution include atmospheric deposition, shipping along the Great Lakes, motorboats, stormwater runoff, marinas, and landfills (Mechenich et al. 2006). Two facilities with National Pollutant Discharge Elimination System permits are near the national lakeshore: the Munising Wastewater Treatment Plant and Neenah Paper Inc. These two facilities discharge treated wastewater in the general vicinity of the national lakeshore and have the potential to influence water quality.

In August 2012, baseline water quality samples were collected at the national lakeshore to better understand concentrations of motorcraft-related chemicals of concern and to compare measured concentrations to ambient water quality standards and other non-regulatory screening values for the protection of ecological and human health. Samples were analyzed for benzene, toluene, ethyl benzene, xylene, MTBE and total polycyclic aromatic hydrocarbons (PAHs), pollutants associated with the gas used by the PWCs. All results from analysis of the water samples were reported as "not detected" (i.e. below laboratory reporting limits) (Test America 2012), indicating that pollutant loadings attributed to PWC use would be largely undetected. This sampling event is discussed in more detail in appendix A.

Sources of Water Pollution

Water quality in Lake Superior is affected by human uses and activities, including industry and recreational use. Pollutants that degrade water quality can be introduced into Lake Superior directly or indirectly. The NPS is responsible for controlling water-polluting activities within the national lakeshore boundaries and for meeting state and federal water quality standards. The NPS must also comply with state antidegradation requirements, including additional antidegradation requirements for waters designated as an outstanding state resource water. Although the national lakeshore does not have specific water quality standards, water resources are managed by section 4.6 of NPS *Management Policies 2006.* As stated in chapter 1, NPS *Management Policies 2006* maintains that "the Service will determine the quality of park surface and groundwater resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside the parks" (NPS 2006).

Nine substances have been identified as critical bioaccumulative atmospheric pollutants for Lake Superior, including mercury, PCBs, dioxins, and several pesticides. Many local sources of these pollutants have been eliminated; however, waters at the national lakeshore are still affected by long-range atmospheric deposition of pollutants (Mechenich et al. 2006). Compounds such as SO_2, NO_x, and ammonia, emitted through burning fossil fuels and agricultural activities, can enter the waters of the national lakeshore through acid deposition.

Point sources of pollutants near the national lakeshore include Neenah Papers and the Munising Wastewater Treatment Plant, both of which have permits to discharge to Lake Superior and Anna River, a tributary, respectively. Pollutants from the wastewater of these facilities include fecal coliform bacteria, suspended solids, and metals (Mechenich et al. 2006). Other sources of pollutants include shipping vessels and their cargo, fuel, bilge water and ballast water, as well as tour boats, PWCs, motorboats, marinas, and stormwater. Pollutants at marinas can include fuel, oil, sewage, garbage, and washing,

repair, and maintenance materials. Stormwater also transports pollutants, including metals and PAHs, from impervious surfaces into the surface waters of the park. Motorized boats have the potential to contribute fuel into surface waters. The primary pollutants contributed by PWCs and other marine engines include specific organic compounds (PAHs, benzene, toluene, ethylbenzene, and xylenes), and several heavy metals. These pollutants have *potential* concerns for aquatic life and human health. A detailed model of current water quality as a result of PWC use is presented in "Appendix A: Water Quality Assessment and Calculations."

AIR QUALITY

The Clean Air Act established National Ambient Air Quality Standards (NAAQS) to protect the public health and welfare from the effects of air pollution. Pictured Rocks National Lakeshore is in an area designated as "attainment" of the NAAQS for all six criteria pollutants, including carbon monoxide (CO), lead, nitrogen dioxide (NO_2), ozone, particulate matter (PM), and sulfur dioxide (SO_2) (appendix B). "Attainment" means that the concentrations of criteria pollutants are below the levels established by the NAAQS. The criteria pollutants are the most common air pollutants that threaten human and environmental health; these pollutants originate from a variety of sources. The Clean Air Act also established the prevention of significant deterioration program to protect the air in attainment areas from excessive degradation resulting from new sources of air emissions (appendix B). Areas designated as Class I under the 1977 Clean Air Act include 156 national parks over 6,000 acres, and national wilderness areas and national memorial parks larger than 5,000 acres. These areas are afforded the greatest protection from air quality deterioration. The rest of the country is currently designated as Class II, where moderate deterioration of air quality in attainment areas is permitted, except in specified cases. Violations of the NAAQS are not permitted in either Class I or Class II areas. The national lakeshore is in an area designated as Class II. Although there is no baseline information on ambient air quality parameters within the park boundary, an assessment based on lichen flora and elemental analysis suggested that air quality in the vicinity is quite good (NPS n.d.b).

REGIONAL AIR EMISSION SOURCES

Alger County, where the national lakeshore is located, is not densely populated or heavily developed. Its population is less than one tenth of one percent of the state's population. Table 3-1 presents the stationary sources of air emissions near the national lakeshore. These sources are distributed widely; there is only one major stationary source of air emissions in Alger County, the Munising Mill of Neenah Paper, Inc., a paper mill.

TABLE 3-1: STATIONARY SOURCES OF AIR POLLUTION NEAR PICTURED ROCKS NATIONAL LAKESHORE

Source	County	Distance to National Lakeshore (miles)	CO	NO_x	SO_2	VOC	PM	Hazardous Air Pollutants
Munising Mill of Neenah Paper, Inc.	Alger	1	x	x	x			x
Graymont Western Lime, Inc.	Schoolcraft	40	x	x				
MPI Acquisition, LLC	Schoolcraft	40		x	x			
Wisconsin Electric Power Company Presque Isle Power Plant	Marquette	47	x	x	x			
Marquette Board of Light and Power Shiras Steam Plant	Marquette	47			x			

Source	County	Distance to National Lakeshore (miles)	CO	NO_x	SO_2	VOC	PM	Hazardous Air Pollutants
Tilden Mining Company L.C.	Marquette	62	x	x	x	x		
Empire Iron Mining Partnership	Marquette	62	x	x	x			
Escanaba Paper Company	Delta	62	x	x	x	x	x	
City of Escanaba Power Plant	Delta	62	x	x	x			

Sources of air emissions local to the national lakeshore consist primarily of residential and commercial fuel burning for heat (seasonal), motor vehicles, and recreational vehicles such as campers, motorized boats, and PWCs. These air emissions sources burn fuel and produce emissions of criteria and hazardous air pollutants and greenhouse gases. The Alger County Road Highway 58 was paved to allow easier access to the national lakeshore. This project resulted in ongoing adverse air quality impacts through increased amounts of traffic that travels parallel to the boundary of the national lakeshore and into the park in some areas. PWC emissions include PM, CO, nitrogen oxides (NO_X), unburned hydrocarbons (HC, a form of volatile organic compound [VOC]), carbon dioxide (CO_2), and trace amounts of organic hazardous air pollutants. PWCs have been in use at the national lakeshore since the 1990s and are still in use today, and therefore have contributed to the existing air quality conditions at the national lakeshore. In 1996, EPA established standards for spark ignition marine engines, beginning with the Emissions Standards for New Gasoline Marine Engines. In 2006 and again in 2008, EPA finalized and adopted more stringent regulations for air quality emissions standards for spark ignition marine engines, which were effective beginning with the 2010 model year. See appendix B for details of the 2006 and 2008 regulations. The EPA emissions standards apply to the manufacture of PWCs, not the use of PWCs. Therefore, PWCs used at the national lakeshore do not currently need to meet the most recent EPA emissions standards.

ACOUSTIC ENVIRONMENT AND SOUNDSCAPES

The acoustic environment is a resource with intrinsic value. It is important as a natural resource, a cultural resource, and as both a natural and cultural resource. It is a critical component of wilderness character and plays an important role in wildlife communication, behavior, and other ecological processes. Results from multiple surveys of the American public indicate that hearing the sounds of nature is an important reason for visiting national parks.

For environmental analysis, it is important to distinguish and define certain key terms. *Acoustic resources* are physical sound sources, including both natural sounds (wind, water, wildlife, vegetation) and cultural and historic sounds (battle reenactments, tribal ceremonies, quiet reverence). The *acoustic environment* is the combination of all the acoustic resources within a given area (i.e., natural sounds and human-caused sounds) as modified by the environment. The acoustic environment includes sound vibrations made by geological processes, biological activity, and even sounds that are inaudible to most humans, such as bat echolocation calls. *Soundscape* is the component of the acoustic environment that can be perceived and comprehended by the humans. The character and quality of the soundscape influence human perceptions of an area, providing a sense of place that differentiates it from other regions. *Noise* refers to sound which is unwanted, either because of its effects on humans and wildlife, or its interference with the perception or detection of other sounds.

NPS Management Policies 2006 and Director's Order 47: *Soundscape Preservation and Noise Management* establish policy regarding the preservation of soundscapes and noise reduction in park units. The protection of soundscapes is of high importance to the NPS mission. The acoustic environment is

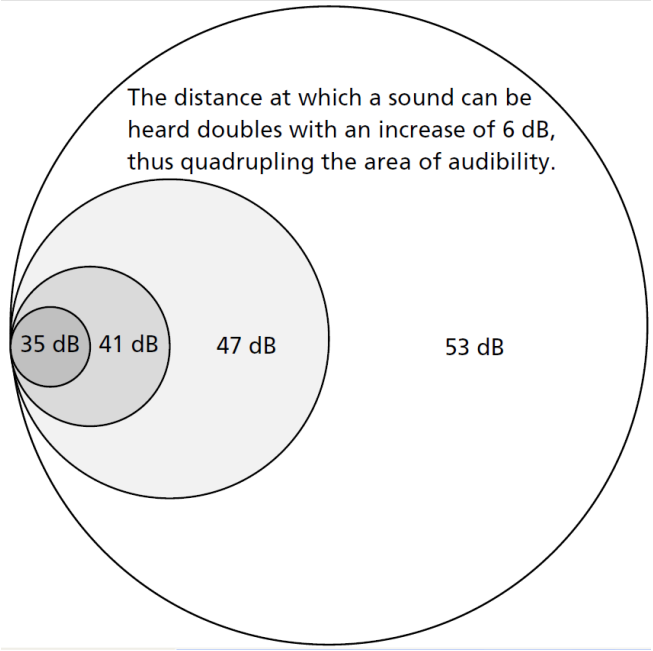
vital to both the function of natural ecosystems and the experience of park visitors. This section describes the existing soundscapes and acoustic environment at the national lakeshore.

ACOUSTIC TERMINOLOGY

Several metrics can be used to describe the acoustic environment. Some used in this document are:

- **Amplitude:** Amplitude refers to the magnitude of sound waves (transmitted vibrations), which are perceived as loudness, or volume. Amplitude is measured in decibels (dB), which refer to the sound pressure level (SPL) or the intensity of the sound (NPS 2012a).
- **Decibel (dB):** Decibels are a unit of measurement that refers to amplitude or energy. Decibels are on a logarithmic scale, which means that an increase of 10 dB represents a ten-fold increase in sound energy. In addition, as sound levels increase, so does the distance at which they can be heard. For example, a 6 dBA increase in sound doubles the distance at which the sound can be heard and quadruples the area of audibility (figure 3-1) (NPS n.d.c).
- **Frequency:** The frequency of a sound is the number of times a sound pressure wave repeats itself per second or the rate at which an object vibrates. Frequency is measured in units called Hertz (Hz) (NPS 2012a) and is commonly experienced as acoustic pitch.
- **Hertz (Hz):** Hertz is a measurement unit used to measure the frequency of a sound. Normal human hearing includes frequencies between 12.5 and 20,000 Hz, and humans are most sensitive to frequencies between 1,000 and 6,000 Hz (NPS 2012a; NPS n.d.c). A range of 20 to 1,250 Hz generally corresponds with transportation noise, as vehicles emit sounds in lower frequencies; therefore, it is more appropriate for identifying transportation and noise levels in parks than the full 12.5 to 20,000 Hz range (NPS 2012a; NPS n.d.c).
- **Sound Pressure Level (SPL):** The SPL is a measure of sound energy in a stated frequency band referenced to an atmospheric standard pressure (20 microPascals) and is measured in dB (NPS n.d.c). Sometimes, SPLs are weighted to account for differences in hearing abilities (NPS 2012a). A-weighted SPL, or dBA, is commonly employed in sound measurements and is an adjustment of sound measurement that is weighted for human hearing levels.
- **A-Weighted Decibel (dBA):** A-Weighted decibels are modified to account for normal human hearing. Sound levels are often weighted or adjusted to match the hearing abilities of humans, as the way the acoustic environment is experienced depends on the interactions of the frequencies and amplitudes of several sounds. A-weighted decibel discounts sounds below 1,000 Hz and above 6,000 Hz, which is approximate to the variation in human hearing sensitivity.
- **Audibility:** Audibility is the ability of animals with normal hearing (including humans) to hear a given sound. The main factors that affect audibility are the hearing ability of the animal, other simultaneous interfering sounds or stimuli, and the frequency content and amplitude of the sound. Audibility is often measured according to the percent of time that a sound can be heard during a certain period. This is called percent time audible.
- **Percent time audible:** The percent of time during a given period that a sound source is audible to humans with normal hearing.
- **Natural ambient sound level:** The sound level of all natural sounds in an area, excluding all human-caused sounds. This demonstrates a no-noise condition.

- **Existing ambient sound level:** The existing ambient sound level represents the median sound level based on many data ranging from lowest sound level measured to highest sound level measured. Put another way, half the time the measured levels of sound are greater than the existing ambient sound level value and half the time they are lower.
- **Maximum sound level:** The maximum instantaneous sound level during the analysis period. In the case of PWC or other motorized vehicle measurements, this is the maximum sound level during one pass-by of the vehicle/vessel.
- **Sound exposure level:** Sound exposure level is an indicator describing the *cumulative* sound energy exposure during a specific period.



Source: NPS n.d.c.

FIGURE 3-1: DECIBEL INCREASE WITH DISTANCE

SOUND PERCEPTION

The acoustic environment is complex, and sounds are not always perceived the same depending on the interactions of the frequencies and amplitudes of other sounds and the background sound level. Because of this, sounds are often weighted to account for differences in hearing abilities, as mentioned above (NPS 2012a). Factors such as climate, vegetation, and topography contribute to the acoustic environment, soundscape experience and how far sounds travel (NPS n.d.c). Noise modeling software can be used to account for topography, atmospheric conditions, and vegetation. The following factors can affect sound travel:

- **Climatic factors**: The amount of sound absorbed by the atmosphere is dependent on climatic factors, including temperature and humidity.
- **Ground cover**: Sounds are reflected by hard surfaces like bare rock, water, or ice. The reflection of sound off hard surfaces allows it to travel great distances. Alternately, soft surfaces, such as leaf litter or duff, generally absorb sound (NPS n.d.c).

- **Frequency**: High-frequency sounds (e.g., bird calls or crickets) generally travel shorter distances than low-frequency sounds because high frequency sounds are better absorbed by the atmosphere, and are more scattered by obstructions than low frequency sounds. Low-frequency sounds (e.g., engine sounds) are more effectively diffracted around obstructions, allowing them to travel farther (NPS n.d.c).

Some sounds may block or "mask" others, depending on the frequencies and amplitudes involved. For mammalian listeners, high-frequency sounds are more effectively masked by low-frequency sounds than the reverse (the "upward spread" of masking) (NPS n.d.c). As SPLs increase with louder noise, the listening area of wildlife and humans is reduced (NPS 2013c). It is important to note that changes in the SPL do not proportionately translate to changes in perceived loudness, as changes in loudness are complex, and dependent on the stimulus causing the noise (SPL, frequency, bandwidth, duration, background, etc.). Each 10 dB increase in SPL causes a doubling of perceived loudness at a minimum. Figure 3-2 is a schematic representation of this masking effect; as background sound increases, the areas in which natural sounds can be heard is reduced. Each outward dome represents a reduction of the listening area by 3 dB.

Source: NPS 2013c.

FIGURE 3-2: REDUCTION IN LISTENING AREA DUE TO INCREASING DECIBEL LEVELS

A one decibel change is not readily perceivable by the human ear, but any addition to this difference could begin to impact listening ability. An increase of 3 dB would reduce the listening area for wildlife and visitors by 50%. An additional 3 dB (for a total of 6 dB) would reduce the listening area by another 50% (for a total of 75% from the original area). For example, if a predator can hear a potential prey animal in an area of 100 square feet in a setting with natural ambient sounds, that animal's ability to hear would be reduced to 50 square feet if the sound levels were increased by 3 dB. If the noise levels were increased by 6 dB over natural ambient levels, the animal's ability to hear would be reduced to 25 square feet. Similar reduction would occur for visitors and their ability to hear natural sounds or interpretive programs.

Sound levels in national parks can vary greatly, depending on location, topography, vegetation, biological activity, weather conditions, and other factors. For example, the din of a typical suburban area fluctuates

between 50 and 60 dBA, while the crater of Haleakala National Park is intensely quiet, with levels around 10 dBA. Table 3-2 presents some examples of SPLs measured in national parks, as well as the SPLs for sounds typical of human soundscapes.

TABLE 3-2: SOUND LEVELS MEASURED IN NATIONAL PARKS

Decibel level (dBA)	Sound Source
10	Volcano crater (Haleakala National Park)
20	Leaves rustling (Canyonlands National Park)
40	Crickets at 16.4 feet (Zion National Park)
50	Moderate rainfall
60	Conversational speech at 3.3 feet (Whitman Mission National Historic Site)
80	Snowcoach at 98.4 feet (Yellowstone National Park)
100	Thunder (Arches National Park)
120	Military jet, 328 feet above ground level (Yukon-Charley Rivers National Park)

Sources: NPS 2012a, n.d.c; PWIA 2011; CHC n.d.

OVERVIEW OF SOUNDSCAPES AND ACOUSTIC ENVIRONMENT AT THE NATIONAL LAKESHORE

Within Pictured Rocks National Lakeshore, the most common natural sounds are the waves of Lake Superior, the wind blowing through the trees, and sounds of insects and birds. Because the national lakeshore is relatively undeveloped and has few roads and visitor amenities, natural sounds are prevalent in many areas (NPS 2002). Human-caused noise is also present at the national lakeshore, including motorized vessels on Lake Superior, snowmobiles, logging activities, aircraft, vehicles, and the public address system on commercial tour boats (NPS 2002, 2004).

During internal scoping for this project, staff noted that Alger County Road Highway 58, the main road through the national lakeshore, had been converted from a dirt road to a paved road. Since the completion of paving and other improvements, staff have observed the road being used more, with users able to drive at faster speeds. Increased usage and higher speeds likely increased noise in the acoustic environment at the national lakeshore. There has been an increase in the use of recreational vehicles and motorcycles in the national lakeshore since the road was improved, which also contribute noise to the environment.

In 2012, the NPS collected baseline acoustic data at Pictured Rocks National Lakeshore during late summer to correspond with the peak visitor and PWC use season (NPS 2013d). Acoustical monitoring systems were deployed in the park to collect sound level data and continuous audio recordings from July 2012 to September 2012. These stations were configured to collect information for approximately thirty days but remained deployed for an additional month due to logistics of retrieval. Three acoustical monitoring systems were deployed at the national lakeshore as depicted in figure 3-3; information on the characteristics of the three sampling locations (Miners Castle, Beaver Basin, and Au Sable Dunes) can be found in the Acoustical Monitoring Report (NPS 2013d). Ambient sound levels were measured continuously every second over the 30-day monitoring period. For calculating audibility of human-caused sounds, eight representative days of data were analyzed by trained acoustic technicians. These measurements characterize the acoustic environment in different areas of the park.

Auditory Analysis

Table 3-3 includes the median existing and median natural sound levels for daytime (7 a.m. – 7 p.m.). The 2012 Acoustical Monitoring Report includes median existing and median natural sound levels for nighttime (7 p.m. – 7 a.m.) as well; however, PWCs are not allowed to operate at the national lakeshore at night. This restriction eliminates PWC noise from affecting nocturnal wildlife or overnight visitors; therefore, only the daytime median ambient metrics would apply to the analysis for PWC use. (See the 2012 *Pictured Rocks National Lakeshore Acoustical Monitoring Report* [NPS 2013d] for more information on methods and protocols of data collection and analysis.)

TABLE 3-3: DAYTIME SOUND LEVELS AT PICTURED ROCKS NATIONAL LAKESHORE

Site	Site Name	Median Existing Ambient (dBA)	Median Natural Ambient (dBA)
PIRO001	Miners Castle	36.3	33.0
PIRO002	Beaver Basin	39.2	38.2

Source: NPS 2013d.

NPS *Management Policies 2006* states that the natural ambient sound level serves as the baseline condition against which all current conditions will be evaluated in national park units (NPS 2006; Section 8.2.3). It demonstrates the environment of sound that exists in the absence of human-caused noise (NPS 2013d). Even in areas where human-caused noise can be heard much of the day, there are still periods when sound levels are near or at the natural level. Results from the Acoustical Monitoring Report indicated that the daytime natural ambient sound levels at the national lakeshore are 33.0 dBA at Miners Castle and 38.2 dBA at Beaver Basin. It is also useful to compare noise levels to existing sound levels – those that include natural and human-caused sounds. The existing daytime sound levels documented during the study period are 36.3 dBA at Miners Castle and 39.2 dBA at Beaver Basin. These levels demonstrate there is currently some impact from human-caused sound at the national lakeshore. Sources of noise (any human-caused sound that masks or degrades natural sounds) detected at Pictured Rocks National Lakeshore include vehicles on nearby roads, PWCs, other watercraft, and aircraft. Table 3-4 displays percent time audible values for common noise sources during the monitoring period.

TABLE 3-4: MEAN PERCENT TIME AUDIBLE FOR COMMON HUMAN-CAUSED SOUNDS: AIRCRAFT, WATERCRAFT, PWCS AND VEHICLES*

Site	Site Name	Mean Percent Time Audible (in 24 Hour Period)				
		All Human-caused Noise	Aircraft	All Watercraft	PWC**	Vehicles
PIRO001	Miners Castle	62.6%	2.7%	42.0%	0.43%	1.4%
PIRO002	Beaver Basin	30.8%	5.4%	12.4%	0.05%	2.02%

* Data based on off-site listening of 8 representative days from the 30-day data set

** PWCs are part of the watercraft total

Source: NPS 2013d.

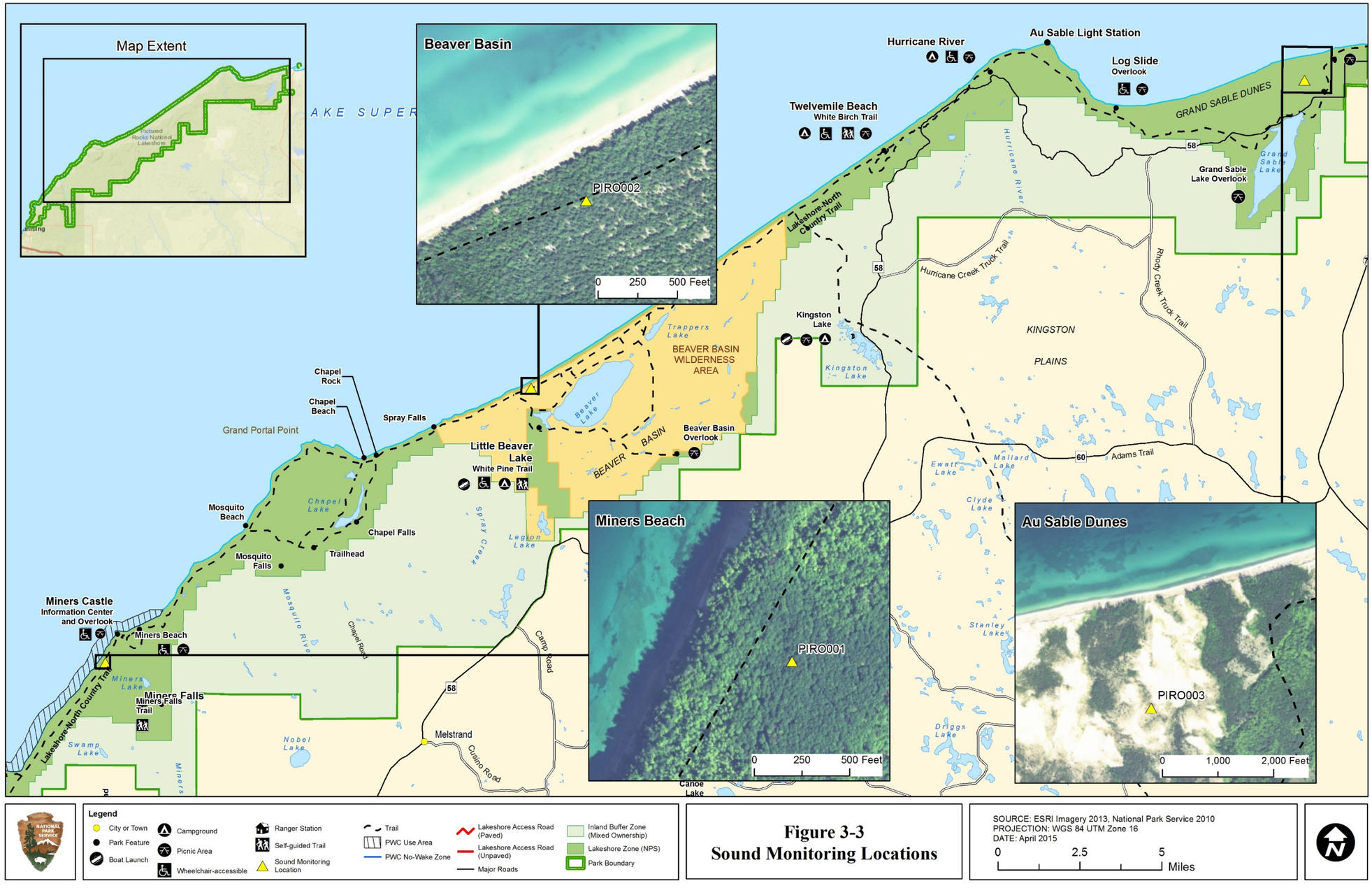


Figure 3-3
Sound Monitoring Locations

SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
0 2.5 5 Miles

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The percent time that noise intensities exceeded other determined values also serves as an important metric analyzed in the 2012 Acoustical Monitoring Report. This allows for a comparison in the variations in sound levels over time or between sites. The values were chosen based on the effect they have on humans:

- 35 dBA – This value is designed to address health effects of sleep interruption; noises at this loudness can have effects on blood pressure while sleeping (Harabaldis et al. 2008).
- 45 dBA – This value represents the recommendation from the World Health Organization that noise levels inside bedrooms and classrooms remain below 45 dBA (Berglund et al. 1999).
- 52 dBA – This value is based on the EPA level for speaking in a raised voice to an audience at 32.8 feet (EPA 1974). This represents the sound level at which an interpretive program in the national lakeshore would be impacted.
- 60 dBA – This value is the sound level where normal communications at individuals standing 3.3 feet (1 meter) apart would be interrupted. This represents the sound level at which recreational visitors conversing would be impacted, including hikers and kayakers.

Table 3-5 provides the time above metrics for these values.

TABLE 3-5: MEAN PERCENT TIME ABOVE METRICS THAT COULD AFFECT HUMAN BEHAVIOR

Site	Frequency* (Hz)	% Time Above Metric - Daytime Hours (7:00 a.m. to 7:00 p.m.)			
		35 dBA	45 dBA	52 dBA	60 dBA
Miners Castle	20–1,250	35.6	0.4	0.0	0.0
	12.5–20,000	62.8	2.9	0.1	0.0
Beaver Basin	20–1,250	70.2	4.0	0.0	0.0
	12.5–20,000	81.1	10.7	1.4	0.0

* 12.5 – 20,000 Hz represents the full range of human hearing.
20-1,250 Hz corresponds with transportation noise.
Source: NPS 2013d.

These values demonstrate that during the period of study for frequencies associated with transportation noise, the two sites monitored did not have sound levels that would interrupt normal speech communication (60 dBA) or interpretative programs at these sites (52 dBA). In addition, sound levels only rarely exceeded the World Health Organization's recommended bedroom noise level (45 dBA). The sound monitoring results indicate that sounds levels at the lower use site (Beaver Basin) exceeded the specified levels more often than at the higher use site (Miners Castle). The monitor at Miners Castle was located on a cliff approximately 0.75 mile west of Miners Beach, a high-use area for visitors, and approximately 164 feet above the water surface. The Beaver Basin monitor was located approximately 0.10 mile from the shoreline in wilderness and only approximately 37 feet above the surface of the water. This could account for the differences in magnitude of sound that was recorded between the two sites. The sounds from Miners Beach, the busier of the two sites, dissipated before reaching the monitor due to the height and distance from the shoreline. Further, wave action likely contributed to the higher sound levels at Beaver Basin; due to the closer placement of the monitor, the sound was not able to dissipate as much before reaching the monitor.

PWCs are not permitted within or directly adjacent to the Beaver Basin Wilderness Area; however, other motorized watercraft are permitted adjacent to the wilderness area and PWCs can be used outside of the national lakeshore's boundary, which is located 0.25-mile from the shoreline of Lake Superior. The data in table 3-4 show that for all types of motorized watercraft, including PWCs, the noise occurrence is higher at Miners Castle than Beaver Basin. The improvements to Alger County Road Highway 58, noted as a potential concern for increased noise, were completed prior to this study. For this study, vehicle noise represented a small portion of the non-natural sounds recorded. Table 3-4 shows that of the three categories of non-natural noise (aircraft, watercraft, and vehicles), vehicle noise is audible for the least amount of time.

NOISE AND PWC USE

PWC noise differs from most other watercraft due to the style in which PWCs are operated. PWCs often leave the water, which amplifies the noise, as the muffling effect of the water ceases, creating louder and more variable noise. When the PWC reenters the water, the hull of the vessel smacks the surface of the water, adding to the noise of the engine. The repetitive noise of PWC hulls hitting the water and the concentration of PWCs in the same location for extended periods exacerbates PWC noise (Komanoff and Shaw 2000). Additionally, the rapid acceleration and deceleration of PWCs result in louder and more salient noise than when PWCs are operated at constant speed.

According to the PWIA, technological advances have substantially reduced PWC noise, resulting in newer, quieter models. Noise reduction has been achieved through the redesign of the intake and exhaust system, the use of noise cancelling devices, better insulation, and additional sound muffling. The PWIA notes that disturbing noise from PWCs is often the result of improper operation such as use too close to the shoreline. While educational efforts have also reduced noise issues (PWIA 2011), the use of PWCs still contributes noise that can affect park resources and the environment.

Details about what human-caused sounds are audible at the national lakeshore, as well as sound levels and the percent time audible during a 24-hour period for each sound, are included in the 2012 Acoustical Monitoring Report (NPS 2013d). To analyze the percent time audible, trained technicians listen to 8 days of audio data. These eight days are a representative sample set from the 30 days of data that were collected. The Acoustical Monitoring Report presents a summary of audibility at both study sites in tables 9 and 10 on pages 16 and 17, respectively. At the Miners Castle site, PWC noise is a small portion of the noise detected at the site. The average percent time that human-caused noise could be heard averaged over a 24-hour period is 62.6% per hour; the average percent time PWCs could be heard was 0.43% per hour (table 3-4). The percent time audible ranged from 0% to 1.9%, with most hours (13 of 24) having no audible PWC noise. For those hours with recorded PWCs, the percent time audible ranged from 0.4% to 1.9% (NPS 2013d). As a comparison, the hour with the highest percent audible for other watercraft was 72% at Miners Castle, meaning that during that hour, watercraft other than PWCs could be heard 72% of the time. Other watercraft could be heard in 23 out of 24 hours at Miners Castle, indicating overnight boat traffic, likely shipping traffic. The average percent time other watercraft could be heard at Miners Castle was 36.5% for an entire day (NPS 2013d). It is important to note that PWCs must operate at a flat-wake speed within 200 feet of the shoreline; other watercraft do not have this same restriction.

At Beaver Basin, the average percent time PWCs could be heard was 0.05% per hour (averaged across 24 hours) (table 3-4). The percent time audible per hour ranged from 0% to 0.7%, with most hours (22 of 24) having no audible PWC noise. As a comparison, the average percent time watercraft other than PWCs could be heard was 12.4% per hour. Further, the percent time audible per hour for watercraft other than PWCs ranged from 0% to 25.2% with only 3 of 24 hours having no audible watercraft noise (NPS 2013d).

Modeling Acoustic Conditions

To compliment and corroborate this ground-based data, the NPS estimated acoustic conditions using predictions from a geospatial sound model. For the model, sound levels for the continental United States were predicted using actual acoustical measurements combined with a multitude of explanatory variables such as location, climate, landcover, hydrology, wind speed, and proximity to noise sources (roads, railroads, and airports). The model predicts daytime sound levels during midsummer (Mennitt, Sherrill, and Fristrup 2014). Figure 3-4 shows the impact of human-caused noise on the natural acoustic conditions. This modeling demonstrates how much the area is influenced by human-caused sounds. Table 3-6 includes the predictions throughout Pictured Rocks National Lakeshore for existing ambient sound levels, natural ambient sound levels and the difference between the two, or impact.

TABLE 3-6 – MODELED AMBIENT SOUND LEVELS, NATURAL AMBIENT SOUND LEVELS, AND THE NOISE IMPACT AT PICTURED ROCKS NATIONAL LAKESHORE

Acoustic Environment	Minimum (dBA)	Median (dBA)	Mean (dBA)	Maximum (dBA)
Existing sound level (human and natural)	33.81	36.55	36.53	42.72
Natural sound level (no human-caused sounds)	33.9	35.5	35.48	36.72
Impact (amount that existing is over natural)	0	1.01	1.05	7.79

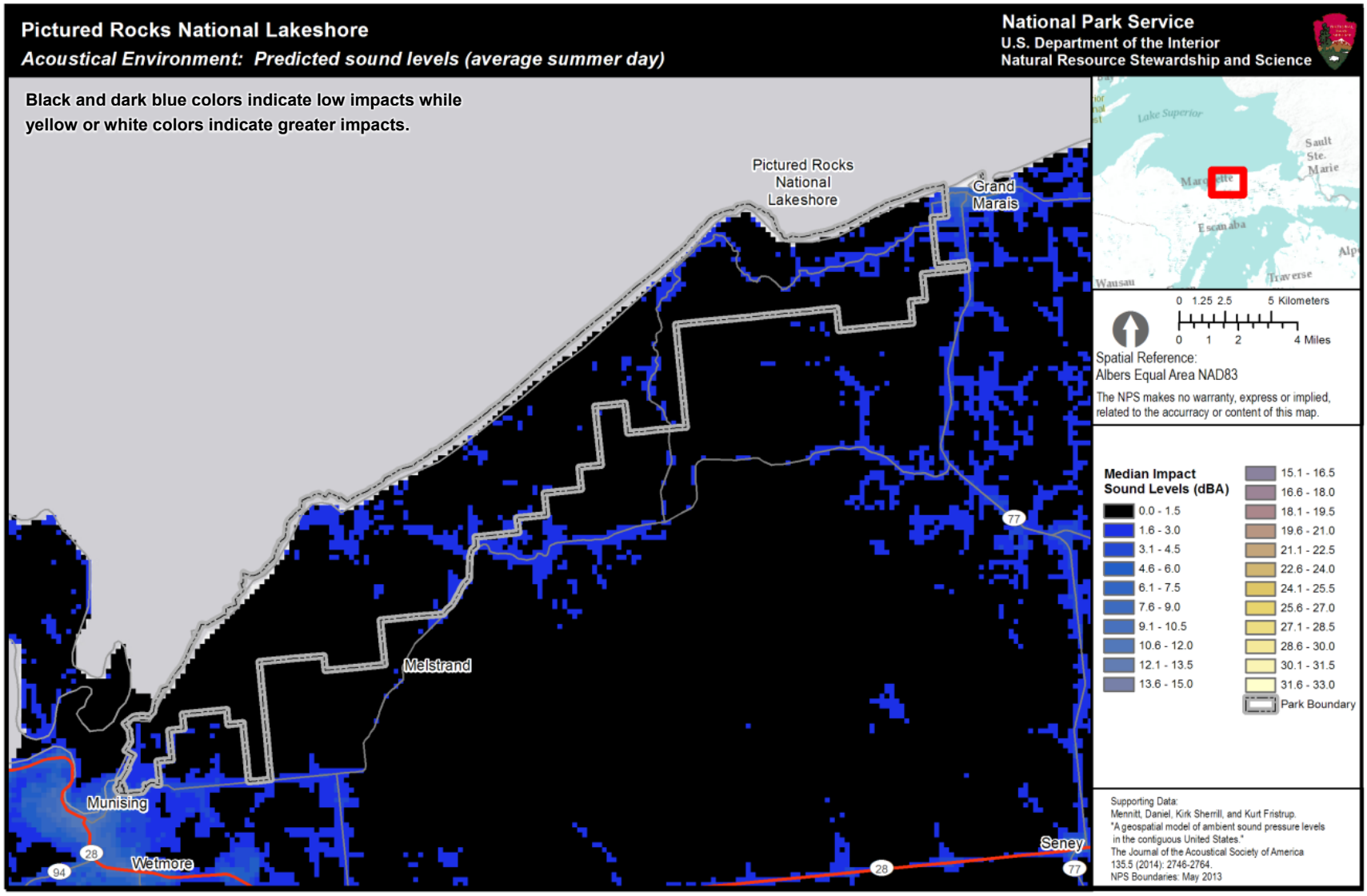
Source: Mennitt, Sherrill, and Fristrup 2014

These results correspond with the ground-based data collected at the park and reported in the 2012 Acoustical Monitoring Report. The predicted existing sound levels at the national lakeshore range from 33.8 dBA to 42.7 dBA, with a median of 36.6 dBA. The ground-based data shows median existing sound levels to be 36.3 dBA at Miners Castle and 39.2 dBA at Beaver Basin, which correspond with the modeled results. The predicted natural sound levels at the national lakeshore range from 33.9 dBA to 36.7 dBA, with a median of 35.5 dBA. The ground-based data shows median natural sound levels to be 33.0 dBA at Miners Castle and 38.2 dBA at Beaver Basin, which correspond with the modeled results.

WILDLIFE AND WILDLIFE HABITAT

Pictured Rocks National Lakeshore contains many varied habitats, including hardwood and coniferous forests, wetlands, sand dunes, cliffs, and shoreline and aquatic habitats. These areas support many wildlife species both seasonally and year-round, including several species of mammals and nesting and migratory birds. As would be anticipated in colder climates, the number of amphibian and reptile species present in the national lakeshore is relatively low.

Overall, wildlife is particularly abundant at the national lakeshore due to the diverse habitats and physiography, the remote setting of the national lakeshore, and the undeveloped areas surrounding the national lakeshore in Alger County. Forested areas within the national lakeshore are predominantly mixed maple/beech hardwood and coniferous forests and cedar swamps. Some forest stands exhibit old-growth characteristics that, in combination with varied physiography, add to the diversity of wildlife in the area. While there are many wildlife species present in the national lakeshore, wildlife species discussed below only includes those that could potentially be impacted by the presence of PWCs.



NPS Natural Sounds & Night Skies Division and NPS Inventory and Monitoring Program MAS Group 20150413

FIGURE 3-4: MEDIAN SOUND LEVEL IMPACT MAP FOR PICTURED ROCKS NATIONAL LAKESHORE

MAMMALS

The national lakeshore is home to a high diversity of mammalian species, with 52 native species estimated to occur in the national lakeshore (NPS 2002). Several larger species of mammals are present at the national lakeshore, including black bear (*Ursus americanus*), coyote (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*) (NPS 2013e). Many smaller mammal species are also abundant at the national lakeshore. Mink (*Mustela vison*), beaver (*Castor canadensis*), skunk (*Mephitis mephitis*), river otter (*Lutra canadensis*), and muskrat (*Ondatra zibethicus*) can be found in the inland aquatic habitats of the national lakeshore (NPS 2013e, 2014a). The fisher (*Martes pennati*) and marten (*Martes americana*) became extinct within Michigan by the early 1940s, but have been re-introduced throughout the Upper Peninsula (NPS 2013e; NPCA n.d.). The habitats of most mammals are located far from the shoreline.

BIRDS

Due to the rich variety of habitats found within the national lakeshore, bird species diversity is high. A total of 182 bird species have been sighted, including full-year resident, summer resident, and migratory species.

Many bird species take advantage of waterbodies found within the national lakeshore for foraging and resting. Because of their high mobility, many waterfowl common to the Mississippi flyway migrate through the national lakeshore region or remain as summer residents. Waterbirds species that nest in the national lakeshore include the common loon, Canada goose (*Branta canadensis*), American black duck (*Anas rubripes*), common merganser (*Mergus merganser*), red-breasted merganser (*Mergus serrator*), sandhill crane (*Grus canadensis*), and herring gull (*Larus argentatus*). Additionally, several shorebirds are known to breed at the national lakeshore, including killdeer (*Charadrius vociferus*) and spotted sandpiper (*Actitis macularius*). Waterfowl are found along the Lake Superior shoreline, but can also be found nesting and feeding around the inland lakes and ponds.

Birds use a range of habitats along the shoreline of the national lakeshore for nesting, including sandbars, rocky or sandy cliffs, and beaches. Species such as herring gulls and ring-billed gulls (*Larus delawarensis*) often use open areas near water, including sand or rocky islands sandbars, and beaches (Sibley 2011). Additionally, bank swallows (*Riparia riparia*) are known to nest in vertical sandbanks, while cliff swallows (*Petrochelidon pyrrhonota*) and peregrine falcons use rocky cliffs or overhangs for nesting (Sibley 2011). Upland nesting raptors, such as bald eagle and merlin use the shoreline for hunting or roosting; bald eagles can also nest along the shoreline.

SPECIAL-STATUS SPECIES

For the purposes of this EA, "special-status species" are defined as those species listed by the USFWS as endangered, threatened, candidate, or special concern; by NOAA National Marine Fisheries Services as endangered or threatened; or by the MDNR as endangered, threatened, candidate, or a species of concern. The terms "threatened" and "endangered" generally describe the official federal status of vulnerable species, as defined by the ESA of 1973. The term "candidate" is used officially by the USFWS when describing those species for which sufficient information on biological vulnerability and threats is available to support issuance of a proposed rule to list, but rule issuance is precluded for some reason. The federal "species of concern" status is applied to those species for which listing may be warranted, but further biological research and field study are needed to clarify their conservation status.

FEDERALLY LISTED SPECIES

The ESA of 1973, as amended, requires impacts on all federally listed threatened or endangered species be considered in planning for federal actions. NPS policy also requires examination of the impacts on federal candidate species, as well as state-listed threatened, endangered candidate, rare, declining, and sensitive species (NPS 2006, section 4.4.2.2). Table 3-7 includes the federally threatened or endangered species identified for Alger County, Michigan and identifies those that are present in the project area as defined in chapter 1.

TABLE 3-7: FEDERALLY LISTED SPECIES IDENTIFIED IN ALGER COUNTY AND PRESENT OR POTENTIALLY PRESENT AT PICTURED ROCKS NATIONAL LAKESHORE

Scientific Name	Common Name	Federal Status	Present in the Project Area
Plants			
Cirsium pitcher	Pitcher's thistle	Threatened	X
Birds			
Calidris canutus rufa	Rufa red knot	Threatened	
Charadrius melodus	Piping plover	Endangered	X
Dendroica kirtlandii	Kirtland's warbler	Endangered	
Mammals			
Canis lupus	Gray wolf	Endangered	X
Lynx canadensis	Canada lynx	Threatened	
Myotis septentrionalis	Northern long-eared bat	Threatened	X

Sources: USFWS 2013a; NPS 2014.

Pitcher's Thistle (*Cirsium pitcheri*): The pitcher's thistle is an endemic native thistle to the Great Lakes that grows along open sand dunes and low open beach ridges along the Great Lakes, most commonly in nearshore plant communities (USFWS 2013b). The species must grow for five to eight years before flowering, and the thistle blooms and sets seeds only once during its lifetime. Blooms are produced between June and September. Pitcher's thistle populations are threatened by shoreline development and road maintenance and construction, which fragment dune habitat and alter dune processes. Shoreline recreation activities, particularly the use of off-road vehicles in dune habitats, also threaten pitcher's thistle (USFWS 2013b). The Grand Sable Dunes support one of the only two US populations of the pitcher's thistle on Lake Superior. The Grand Sable Dunes provide the large, intact, and active dune habitat ideal to support the pitcher's thistle. Although pitcher's thistle is known to grow at the national lakeshore, no impacts to this species are expected from PWC use; therefore, pitcher's thistle will not be carried forward for analysis in the "Environmental Consequences" chapter.

Piping Plover (*Charadrius melodus*): Piping plovers are small shorebirds with a stocky build, sandy colored upper bodies, white undersides, and orange legs. During the breeding season, adults have a single black band around their necks and a black forehead (USFWS 2001). Plovers eat insects, spiders, and crustaceans (USFWS 2001). An analysis of the stomach contents of chicks in the Great Lakes indicated that they consumed insects from 16 different families, including wasps, bees, beetles, and flies (USFWS 2003). Plover feeding is diurnal, meaning that they are active during the day.

The population of plovers found in the Great Lakes was listed as federally endangered in 1986, and critical habitat was established in breeding grounds in 2001 (USFWS 2003). Piping plover critical habitat has been designated on a small portion of land that is managed by the park near the Grand Marais ranger station; this land is not physically connected to the remainder of the park. From 1986 until 2002, populations fluctuated, with a high of 51 breeding pairs; during this time breeding occurred mainly in Michigan breeding areas (USFWS 2003). Historical estimates of breeding pairs in the Great Lakes region estimate 492–682 breeding pairs with approximately 215 of these pairs in Michigan, but these numbers may be high estimates (USFWS 2003).

Plover habitat includes wide, flat, and open sandy beaches for foraging, and nest territories often include wetlands and creeks. In the Great Lakes region, plovers use sparsely vegetated beaches, cobble pans, and sand spits of glacially formed sand dunes (USFWS 2001, 2003). Piping plovers within Michigan are found within coastal emergent wetlands, coastal dune/beaches, the Great Lake islands, and large contiguous natural landscapes (MDNR 2005). Plovers nest on sand spits and sand beaches. In Michigan, plover nesting habitat typically includes large dunes with marram grass (*Ammophila breviligulata*) that are associated with a beach greater than 30 meters wide. These sites are also often adjacent to rivers or ponds (USFWS 2003).

Piping plovers are present in the Great Lakes from mid-April through August, when they return to nest and raise young after spending the winter along the southern Atlantic Coast and Gulf Coast (NPS n.d.d). Nests are usually initiated by May, and plovers in this region typically only produce one brood per year, though some may produce two broods (USFWS 2003). Eggs typically hatch in late May to late July, and chicks in Michigan fledge approximately 21–30 days after hatching (USFWS 2003). Breeding adult plovers typically leave the nesting grounds by mid-August, though some may leave earlier in late July. Juvenile plovers leave nesting sites later than breeding adults and are usually dispersed from nesting areas by the end of August (USFWS 2003).

Major threats to the piping plover include habitat loss and degradation resulting from development and the use of water control structures on lakes and streams. Most breeding pairs in the Great Lakes only will re-nest once if their nest is destroyed, while adult plovers in other areas may nest up to four times if nests are destroyed (USFWS 2003). Nest disturbance by people either driving or walking on the beach can lead piping plovers to abandon their nest. Humans may also accidentally crush nests, and dogs, cats, and other animals may either harass or kill plovers, or their young or eggs (USFWS 2001). Motorized vessels, PWCs, and aircraft may also disturb nesting plovers (USFWS 2003). Non-motorized recreation including beach walking, hiking, kayaking, camping, and close-up photography has also disturbed plovers in the Great Lakes region (USFWS 2003).

Predation of nests in the Great Lakes was responsible for the failure of approximately 14.5% of clutches in Michigan between 1981 and 1999. Predators include herring gulls, ring-billed gulls, American crows (*Corvus brachyrhynchos*), common ravens (*C. corvax*), coyotes, raccoons, and domestic dogs (*Canis familiaris*) and cats (*Felis catus*) (USFWS 2003).

Piping plovers are known to forage on a beach within national lakeshore boundary, near Grand Marais. Additional sightings have been recorded at Sand Point and near the Twelvemile Beach campground. Piping plovers are also known to nest near the national lakeshore boundary, and the NPS assists with monitoring through a cooperative agreement with the USFWS (NPS 2003, n.d.d). Piping plovers have historically nested inside the national lakeshore boundary. According to park staff, nesting plovers have not been observed in the national lakeshore in over a decade; however, the park offers breeding habitat and the population is growing, so there is a chance that breeding range could expand.

A segment of national lakeshore beach in Grand Marais and adjacent private beach are listed as critical habitat for piping plovers. Critical habitat includes areas that provide the primary constituent elements for the Great Lakes plover breeding population. These include sandy areas with island or mainland shorelines that support sparse vegetation and are associated with wide unforested dune systems and inter-dune wetlands (NPS 2004).

Rufa Red Knot (*Calidris canutus rufa*): The rufa red knot is one of six subspecies of red knots. This subspecies winters in the several regions (the southeast United States, the northwest Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America) and breeds in the central Canadian Arctic (USFWS 2014). Migratory habitats generally include large coastal zones, mudflats, and open sandy beaches where they feed on invertebrates such as small mollusks, marine worms, and crustaceans (Audubon n.d.). The rufa red knot resemble other sandpipers with mottled gray plumage; however, during breeding, the rufa red knot develops a rust-colored face, throat, and breast. The largest threats to rufa red knot include climate change, coastal development, and overharvesting of horseshoe crabs.

The rufa red knot was listed as a federally endangered species in December 2014 (USFWS 2014). The rufa red knot may use habitat at the national lakeshore during migration. Although there are no official records of rufa red knot at the national lakeshore, they have been observed to the west in Marquette and to the east at Whitefish Point (Heyd 2017 pers. comm.). While red knots may use habitat within the project area, they are transitory. If PWCs were to be used in areas where red knots occurred, they might affect feeding and cause the birds to avoid certain areas, but these effects would not be significant. When considering the low use of PWCs at the national lakeshore, the low occurrence of red knots in the area and the minimal effect of PWC use on the red knots if PWC use were to occur when red knots were present, it is reasonable to conclude that PWC use may affect but is not likely to adversely affect red knots at the national lakeshore. Therefore, this species will not be carried forward for analysis in the "Environmental Consequences" chapter.

Northern Long-eared Bat (*Myotis septentrionalis*): The northern long-eared bat is found across much of the eastern and north central United States and its range includes 37 states. The northern long-eared bat is known to occur and breed within the national lakeshore. White-nose syndrome, a fungal disease found to affect bats, is currently a threat to this bat, especially throughout the Northeast where the species has declined by up to 99% from pre-white-nose syndrome levels at many hibernation sites (USFWS 2015a). During the summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees; they may also roost in cooler places, like caves and mines (USFWS 2015a). They emerge at dusk to feed on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation and by gleaning motionless insects from vegetation and water surfaces (USFWS 2015a). Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula, and breeding begins in late summer or early fall when males begin swarming near hibernacula (USFWS 2015a). Pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup (USFWS 2015a). Although they are known to use the shoreline within the project area, no impacts to northern long-eared bats are expected from PWC use because bats are most active at night when PWCs are not in use and PWCs are not operated in close proximity to daytime roosting areas; therefore, this species will not be carried forward for analysis in the "Environmental Consequences" chapter.

Gray Wolf (*Canis lupis*): The gray wolf is listed as a federally endangered species. The population of gray wolves in Michigan's Upper Peninsula, Wisconsin, and Minnesota are identified as the Western Great Lakes Distinct Population Segment. Since 2007, several proposals to delist the Western Great Lakes Distinct Population Segment have been issued and overturned in court decisions. Most recently, wolves in the Western Great Lakes Distinct Population Segment were relisted under the ESA due to a

December 2014 federal court decision (USFWS 2015b). Wolves are considered top predators and can occupy a variety of habitats with sufficient prey animals (MDNR 2015). Wolves are not common at the national lakeshore. The low PWC usage combined with the low usage of the area by wolves reduces the potential for impact. Although they are known to use the shoreline within the project area, no impacts on wolves are expected from PWC use; therefore, gray wolves will not be carried forward for analysis in the "Environmental Consequences" chapter.

STATE-LISTED SPECIES

The Michigan Natural Features Inventory, a program of the Michigan State University Extension, manages a list of state and federally listed species by county. While a full list of listed species found in Alger County, Michigan, can be found in appendix C, state-listed species found in the vicinity of the national lakeshore are listed in table 3-8.

TABLE 3-8: STATE LISTED SPECIES FOUND IN THE VICINITY OF PICTURED ROCKS NATIONAL LAKESHORE

Scientific Name	Common Name	State Status	Present in the Project Area
Plants			
Botrychium acuminatum	Moonwort	Endangered	
Botrychium campestre	Prairie moonwort or dunewort	Threatened	
Botrychium hesperium	Western moonwort	Threatened	
Botrychium mormo	Goblin moonwort	Threatened	
Callitriche hermaphroditica	Autumnal water-starwort	Species of Concern	
Calypso bulbosa	Calypso orchid or fairyslipper	Threatened	
*Cirsium pitcheri**	Pitcher's thistle	Threatened	X
Crataegus douglasii	Douglas's hawthorn	Species of Concern	
Cypripedium arietnum	Ram's head lady slipper	Species of Concern	
Elymus glaucus	Blue wild-rye	Species of Concern	
Elymus mollis	American dune wild-rye	Species of Concern	X
Empetrum nigrum	Black crowberry	Threatened	
Listera auriculata	Auricled twayblade	Species of Concern	
Myriophyllum alterniflorum	Alternate-leaved water-milfoil	Species of Concern	
Myriophyllum farwelli	Farwell's watermilfoil	Threatened	
Pinguicula vulgaris	Butterwort	Species of Concern	
Potamogeton confervoides	Alga pondweed	Species of Concern	
Tanacetum huronense	Lake Huron tansy	Threatened	X
Trisetum spicatum	Downy oat-grass	Species of Concern	
Stellaria longipes	Stitchwort	Species of Concern	
Vaccinium cespitosum	Dwarf bilberry	Threatened	
Insects			
Trimertropis huroniana	Lake Huron locust	Threatened	

Scientific Name	Common Name	State Status	Present in the Project Area
Fish			
Acipenser fulvscens	Lake sturgeon	Threatened	
Coregonus artedi	Lake herring	Threatened	
Birds			
Accipiter gentilis	Northern goshawk	Species of Concern	
Buteo lineatus	Red-shouldered hawk	Threatened	
*Charadrius melodus**	Piping plover	Endangered	X
Gavia immer	Common loon	Threatened	X
*Dendroica kirtlandii**	Kirtland's warbler	Endangered	
Falco columbarius	Merlin	Threatened	X
Falco peregrinus	Peregrine falcon	Endangered	X
Haliaeetus leucocephalus	Bald eagle	Species of Concern	X
Pandion haliaetus	Osprey	Species of Concern	X
Mammals			
*Lynx canadensis**	Canada Lynx	Endangered	
*Myotis septentrionalis**	Northern long-eared bat	Species of Concern	X

Source: MSU 2013a, 2013b.

* covered in the "Federally Listed Species" section.

Species known to occur within the project area are described in more detail below.

American Dune Wild-rye (*Elymus mollis*): In Michigan, American dune wild-rye only occurs on the southern shore of Lake Superior. The national lakeshore has known occurrences of this species, which inhabits sandy beaches and dunes of shores. American dune wild-rye is a large, erect grass that grows in clumps. The blades of this grass are thick grayish-green and the stems terminate in a dense spike of numerous flowered spikelets. American dune wild-rye is vulnerable to heavy recreational use (Higman and Penskar 1999). Although American dune wild-rye is known to grow within the project area, no impacts to this species are expected from PWC use; therefore, American dune wild-rye will not be carried forward for analysis in the "Environmental Consequences" chapter.

Lake Huron Tansy (*Tanacetum huronense*): In Michigan, the Lake Huron tansy is found on calcareous dune and beach systems. It has 1-3 main stems with hairy, and deeply twice or more divide leaves. The tansy produces a yellow flower head that is composed of numerous separate small flowers of two shapes. It blooms from late June through August, and is found in active dunes, old stabilized dunes, and sandy or cobble beaches (Choberka et al. 2001). Although Lake Huron tansy is known to grow at the national lakeshore, no impacts to this species are expected from PWC use; therefore, Lake Huron tansy will not be carried forward for analysis in the "Environmental Consequences" chapter.

Common Loon (*Gavia immer*): In Michigan, the common loon breeds in the Upper Peninsula and the Lower Peninsula. In breeding plumage, they have a black back and head, with a "necklace" and "chinstrap" of thin white vertical stripes and a white breast and underside. Common loons also have checkered white spots on the wings, red eyes, and a long thick black bill. They breed in inland lakes of adequate size with stable water levels and areas for nesting such as undeveloped shorelines, small islands,

or bog mats. Younger common loons may also use the Great Lakes for other activities (Gibson 2007). Common loon is a Michigan state threatened species and is analyzed in the "Special-Status Species" section of the "Environmental Consequences" chapter.

Osprey (*Pandion haliaetus*): The osprey is found throughout Michigan but breeding ospreys are concentrated in the upper two-thirds of the state, including the Upper Peninsula (Postupalsky 2011). Ospreys are distinctive with white underparts, black eyestripe, and wingspan of 5-6 feet. Ospreys are unique raptors in that they feed solely on live fish and dive to catch their prey. Ospreys nest in tall trees or atop utility poles, often near open water, and return to the same nest sites (USFWS 2011). Osprey is a state species of concern and is analyzed in the "Special-Status Species" section of the "Environmental Consequences" chapter.

Bald Eagle (*Haliaeetus leucocephalus*): The bald eagle is found in all but 20 counties in Michigan, and is present in all counties in the Upper Peninsula. Bald eagles have a wingspan of 6-7 feet, and are easily recognizable by their white head and white tail that contrasts with the dark brown body and wings, and yellow eyes, beak, and feet. Bald eagles nest in upland areas as well as along shorelines and build large nests at the top of large trees. Bald eagles hunt and roost along the shoreline and are heavily associated with aquatic environments and sheltered forest areas (Gehring 2009). The bald eagle was listed on the federal endangered species list until 2007, when it was removed from the list for the contiguous 48 states due to species recovery. During that time, the bald eagle was listed as federally endangered in all states except Michigan, Minnesota, Wisconsin, and Washington, where it was listed as threatened (Federal Register 2010). Although this species has been delisted, it is still afforded protection under the Bald Eagle and Golden Eagle Protection Act, the Migratory Bird Treaty Act, and the Lacey Act (USFWS 2013c). These federal laws prevent the take, possession, transportation, sale, import, or export of bald eagles and bald eagle products (USFWS 2013c). Bald eagle is a Michigan state species of concern and is analyzed in the "Special-Status Species" section of the "Environmental Consequences" chapter.

Merlin (*Falco columbarius*): In Michigan, the merlin is not a commonly seen species, but can be found breeding in areas in the Upper Peninsula and the northern portion of the Lower Peninsula. The merlin is medium-sized bird with a highly barred tail, light "sideburns," and lightly streaked underparts. They are similar in appearance to the peregrine falcon, but are distinguished by their smaller size and dark tail, which has two to five contrasting light-colored bands of color, or stripes. Merlins commonly nest in boreal forests, particularly near lakeshores or on islands (Cuthrell 2002). A portion of Twelvemile campground was closed in the spring of 2013 for the protection of a nesting pair of merlins. Merlin is a Michigan state threatened species and is analyzed in the "Special-Status Species" section of the "Environmental Consequences" chapter.

Peregrine Falcon (*Falco peregrinus*): In Michigan, the peregrine falcon is not common, and DDT contamination greatly lowered the population. In recent years, efforts have been made for reintroduction, including at the national lakeshore, where some nesting has occurred. The peregrine falcon has bluish-gray upperparts, with a black facial stripe, white or grayish underparts, and spotting and barring under the wings and tail. Nest sites are usually found on cliffs overlooking waterbodies or open areas (Monfils 2007). Peregrine falcon is a Michigan state endangered species and is analyzed in the "Special-Status Species" section of the "Environmental Consequences" chapter.

ETHNOGRAPHIC RESOURCES

Ethnographic resources, as defined by the NPS, are the cultural and natural features of a park that are of significance to peoples traditionally associated with the park lands for two or more generations and whose interest in park resources began prior to establishment of the park unit. Ethnographers identify, research, document, and maintain inventories of park cultural resources with traditional meanings and continuing

use by such peoples. Ethnographic resources can be landscapes, places, objects, and significant natural resources.

Archeological sites identified within the national lakeshore indicate the area was occupied by prehistoric peoples from as early as the Paleoindian period (6,000–5,000 BC), through the Archaic period (5,000–500 BC) and into the Woodland period (200 BC –AD 1650). During the earliest two eras, the land was lightly populated with people seeking the advantages of the land and water by setting up seasonal camps along the national lakeshore. The Woodland period saw a development of some agriculture, along with an increase in population and more settled occupation patterns. This is reflected by the presence of burial mounds and artifacts showing the development of tool technology and the production of ceramic vessels, enabling people to take better advantage of the local resources.

French traders and missionaries made the first European contact of the Upper Peninsula area during the 17th century. At that time, the Chippewa, who had been in the Lake Superior region since approximately AD 1100, populated the land with settlements on Grand Island and near Old Munising. The Chippewa also established a burial ground on Sand Point, held special ceremonies and rituals at the Grand Sable Dunes, and located lodges at Grand Marais. European American settlement in the area did not begin until after the Chippewa ceded their land to the US government in 1836. The US government pushed the Chippewa to reservations located in Minnesota, Wisconsin, and Michigan, although many remained scattered in the national lakeshore area.

The Bureau of Applied Research in Anthropology at the University of Arizona-Tucson conducted an ethnographic resources study of the national lakeshore in 1999 (University of Arizona 2001). This study identified the Chippewa Native American group as possessing a cultural affiliation to the land within the national lakeshore. Although the Federally recognized tribe is known as the Chippewa, the tribe is also known as the Ojibway, and within their tribe, they call themselves the Anishinaabe. The Chippewa occupied the Lake Superior area beginning in the 12th century and remained there until they ceded their lands to the United States for European American settlement in 1836. Six Chippewa bands may rightfully claim cultural affiliation with national lakeshore lands, while five additional bands along the north shore of Lake Superior may also have close ties.

The 1999 ethnographic resources study revealed the national lakeshore contains several hundred ethnographic resources linked to the Chippewa. These include 11 activity complexes, 488 plants, 79 animals, seven minerals, and 16 landform types. The Lake Superior shoreline itself is an important landform linked to the Chippewa way of life, as the group used the waterways for canoe routes and fishing. In addition to using the Lake Superior shoreline, the Chippewa inhabited both seasonal camps and more permanent settlements off the shoreline, in protected areas along river mouths and creeks where they could be sheltered but still easily access the water. The Chippewa consider these areas where the land and water meet to be culturally important as well.

Other landforms that hold religious or cultural significance for the Chippewa include the Grand Sable Dunes on the east end of the national lakeshore, a sacred place the Chippewa used for burials and vision quests, as well as burial grounds at Sand Point and Munising, both located on the west end of the national lakeshore. Physically prominent landforms such as the Pictured Rocks cliffs and Miners Castle were used for ceremonial functions by the Chippewa and are considered culturally significant.

VISITOR USE AND EXPERIENCE

VISITOR USE STATISTICS

Since 1973, the NPS has been recording visitation at the national lakeshore. The statistics indicate that visitation at the national lakeshore has generally been increasing over the last 8 years. Figure 3-5 shows total visitation for the years 1979-2016 and figure 3-6 shows the average visitation per month (2000–2016). In 2016, the total number of visitors to the national lakeshore was 777,428 (NPS 2017a). While visitation has fluctuated over the years, the trend of highest visitation during the months of July and August remains constant. The highest recorded yearly visitation occurred in 2016; the lowest recorded year was 1979 with 270,376 (NPS 2017a).

Visitor satisfaction at the national lakeshore is generally high. The results of a 2009 survey of visitor satisfaction using Visitor Survey Cards indicated that 98% of national lakeshore visitors were satisfied overall with facilities, services, and recreational opportunities at the national lakeshore (NPS n.d.e). Approximately 74% of visitors rated outdoor recreational opportunities as very good, and another 20% rated them as good (NPS n.d.e). The same survey completed in 2013 indicated that 73% of visitors rated outdoor recreational activities as very good, and another 25% as good; overall visitor satisfaction in 2013 was 97% (NPS n.d.e).

VISITOR ACTIVITIES

There are two official visitor centers in the national lakeshore; the Interagency Visitor Center is open year-round and the Grand Sable Visitor Center is open for the summer. There are also three additional visitor contact stations located in the park. These are Munising Falls Visitor Center, Miners Castle Information Station, and the Au Sable Light Station Information Center. Visitor centers provide information on activities and services available at the national lakeshore. Many of the centers also have interpretive exhibits and activities for learning about the natural and cultural resources found at the national lakeshore. Park rangers are available at the visitor centers to assist visitors with planning trips and any needs they may have during their visit.

Typical visitor activities at the national lakeshore include camping, hiking, backpacking, and picnicking. Visitors also participate in water-related activities, including kayaking, canoeing, boating, fishing, swimming, and using PWCs. Winter activities include snowmobiling, cross-country skiing, and snowshoeing. Many visitors to the national lakeshore also visit beach areas for walking or sightseeing. Figure 3-7 presents the locations of popular visitor recreation sites and facilities. After the Alger County Road Highway 58 was upgraded from a dirt road to a paved road, visitors had easier access to the national lakeshore, resulting in increased activity.

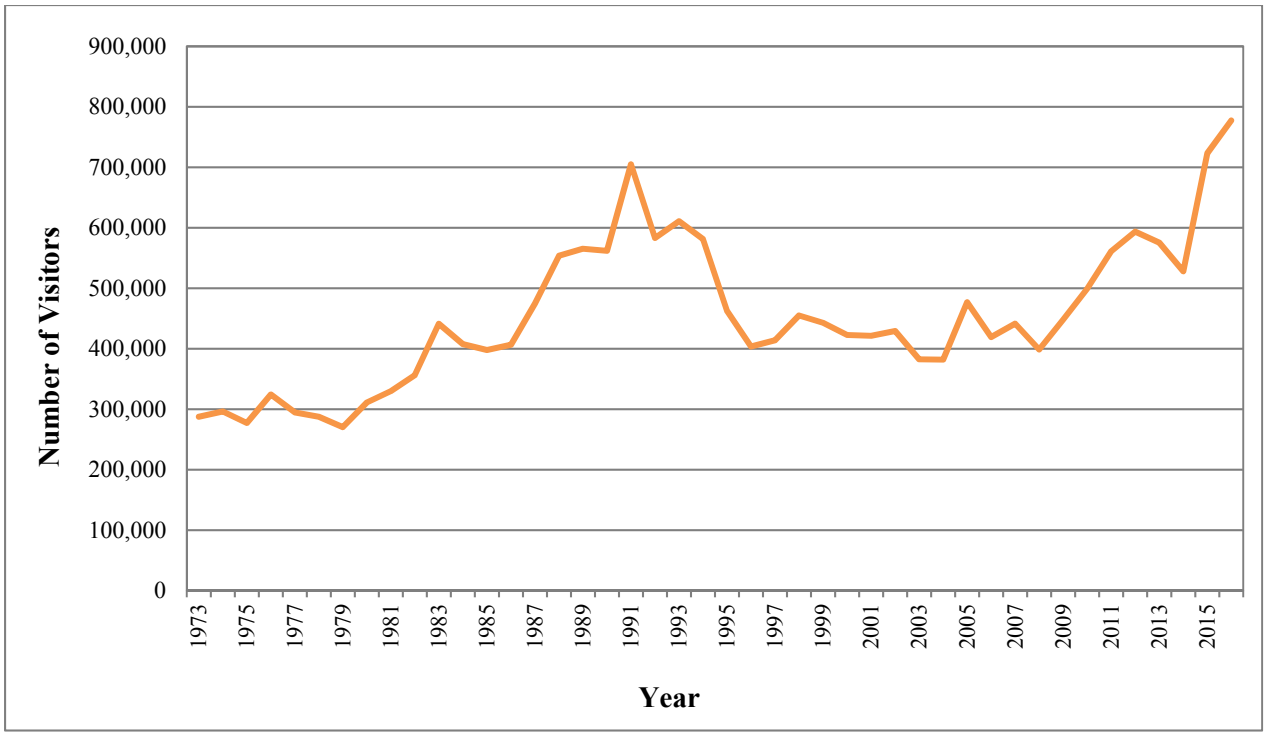


FIGURE 3-5: TOTAL VISITATION AT THE NATIONAL LAKESHORE (1973–2016)

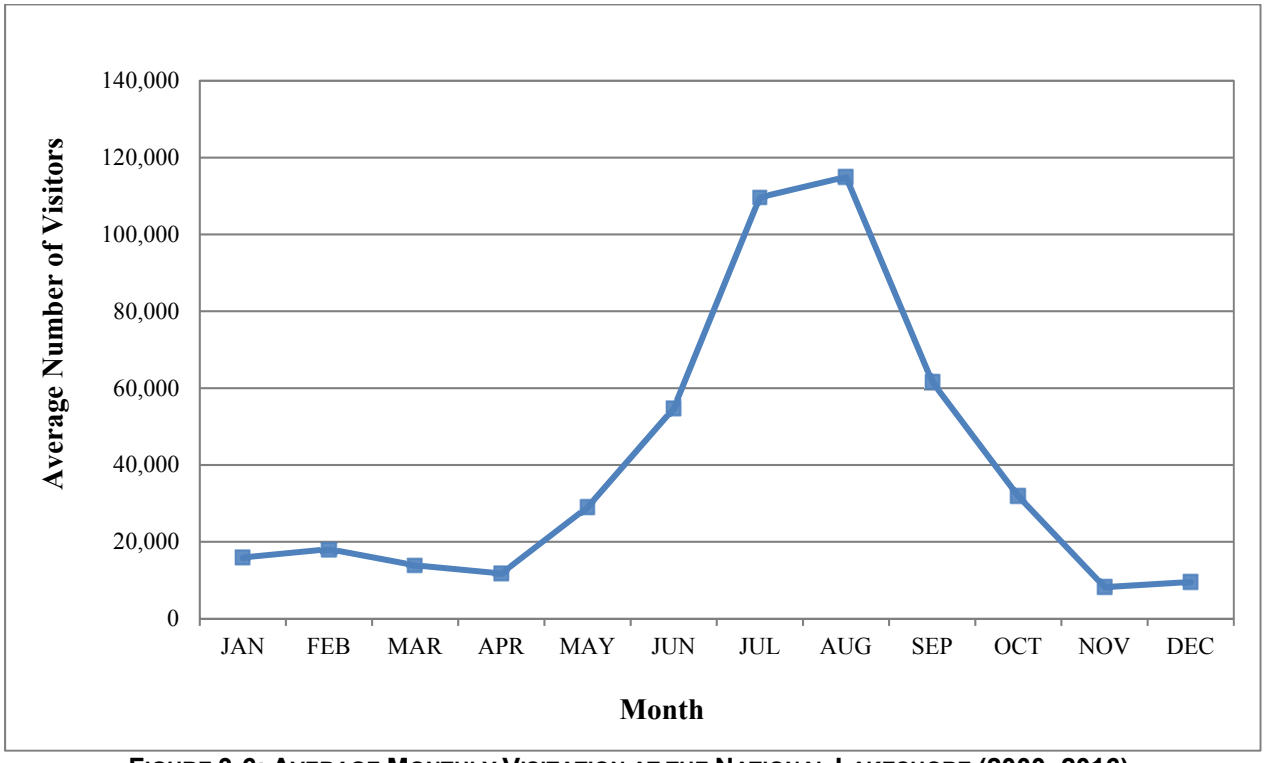


FIGURE 3-6: AVERAGE MONTHLY VISITATION AT THE NATIONAL LAKESHORE (2000–2016)

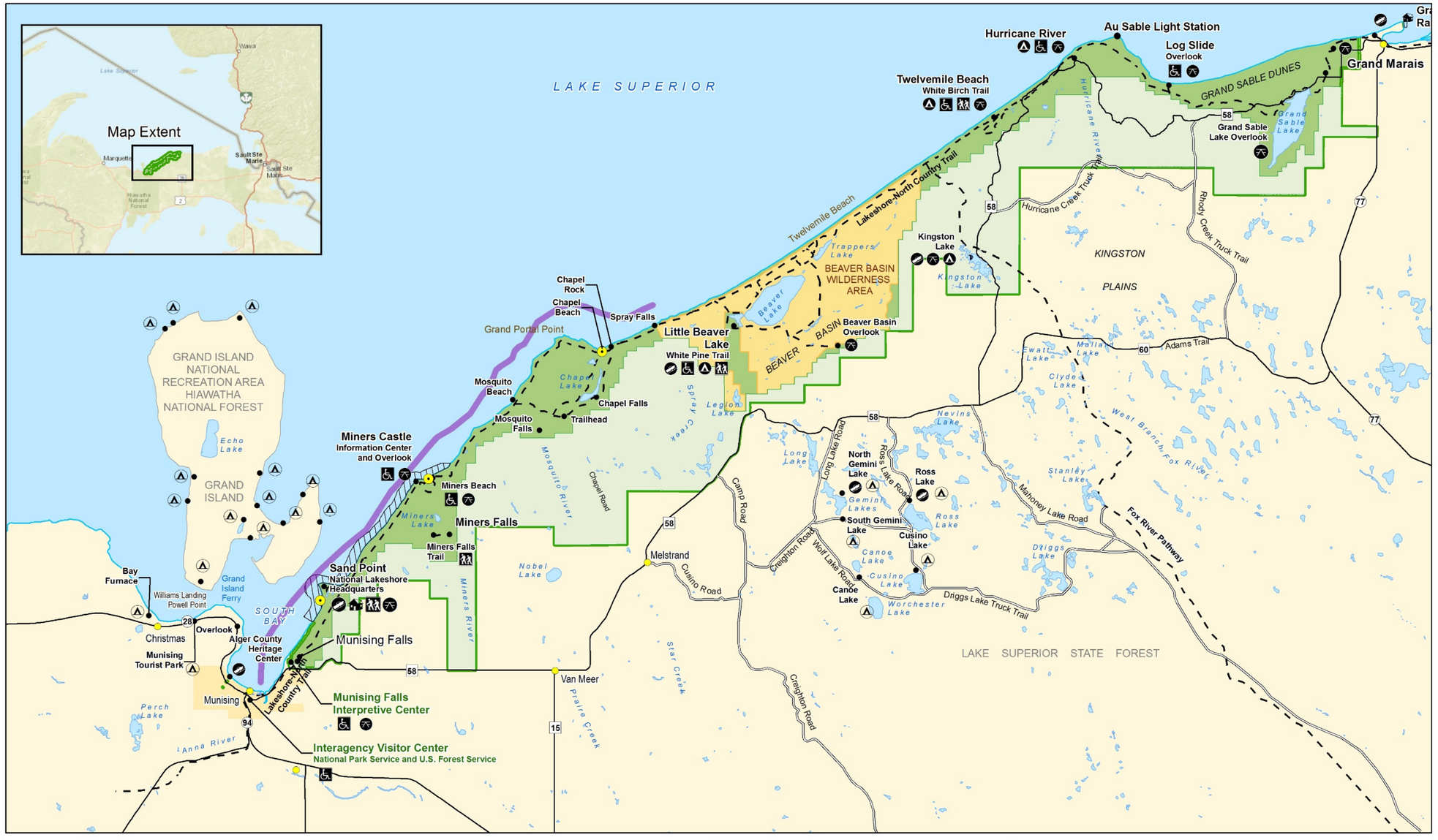


Figure 3-7
Recreation Features and PWC Survey Locations

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Camping

Backcountry camping is available at the national lakeshore (figure 3-7) and campsites are available from distances of approximately 250 feet to 2 miles from the Lake Superior shoreline. Campers must stay in designated backcountry campgrounds; however, camping in the winter is dispersed as campsites are not identifiable under the snowpack. The designated backcountry campgrounds are located at 2-5 mile intervals along the trails, and have site-specific capacity limitations. Individual sites accommodate 1-6 people, and group backcountry campsites are available for groups of 7-20 people. There are 14 individual backcountry campgrounds and eight group campsites, which are largely located along the shoreline. Reservations can be made for backcountry camping. Some sites are accessible from the water for boaters, while other sites can only be reached by hikers. While many boaters can access campsites, these water-accessible sites are most commonly used by kayakers. A visitor survey completed in 2002 indicates that approximately 7% of visitors used the national lakeshore for an overnight backcountry experience. Park visitors interviewed for this survey originated from 37 states and foreign counties. Approximately 58% of the visitors interviewed were from Michigan. Visitors from Illinois, Wisconsin, Ohio, Indiana, and Minnesota made up another 26% of the interviewees. Only 3% of those interviewed were international travelers (Simmons and Gramann 2002). In 2016, the total number of backcountry camper overnights was 21,000, and 22,000 visitors overnighted in drive-in campgrounds (NPS 2017b). Tent and recreational vehicle camping at drive-in campsites is also available at three locations within the national lakeshore: Twelvemile Beach, Hurricane River, and Little Beaver Lake. Little Beaver Lake Campground is located adjacent to the Beaver Creek Wilderness Area along an inland lake; this campground is approximately 1.2 miles from the shoreline of Lake Superior. Hurricane River and Twelvemile Beach campsites are located along the shoreline of Lake Superior. Individual drive-in sites include a picnic table, fire grate, and tent pad. Potable water and vault toilets are also available at the campground. No reservations are accepted at these sites, which are first-come, first-served. Recreational vehicle sites at the national lakeshore do not include electric, water, or sewer hookups. Approximately 18% of visitors to the national lakeshore stay in drive-in campgrounds (Simmons and Gramann 2002).

Hiking/Backpacking

Day hiking and backpacking are both common activities at the national lakeshore. The national lakeshore offers more than 90 miles of trails, including 42 miles of trails along Lake Superior, most of which is within 200 feet of the shore of Lake Superior. Hikers can gain access to the beach from several trails. The Miners Falls Trail is a 1.2-mile hike that ends at a viewing platform at Miners Falls. The Sand Point Marsh Trail is a half-mile fully accessible trail. It traverses a wetland complex with interpretive exhibits. The White Birch Trail is two miles long starting at the Twelvemile Beach Campground, and explores uplands habitats adjacent to Lake Superior. The White Pine Trail is located at Little Beaver Lake Campground and the 0.7-mile loop runs through a stand of white pine. The results of a visitor survey in 2002 indicate that 66% of visitors to the national lakeshore go on a day hike, and 78% of visitors participate in sightseeing activities (Simmons and Gramann 2002). The North Country National Scenic Trail provides access to remote locations at the national lakeshore. The trail provides excellent views, and has backcountry campsites located at 2-5 mile intervals along the trail.

Wilderness Experience

A wilderness experience is available at the national lakeshore within the Beaver Basin Wilderness, which is discussed in the “Wilderness” section of this chapter.

Shoreline/Beach Use

Much of the shoreline at the national lakeshore is accessible from roads and hiking trails. The areas of highest shoreline use at the national lakeshore are at Miners Beach, Sand Point, Hurricane River campground, Chapel Beach, and Sable Falls, where roads allow for easy access of the shoreline. Most of Twelvemile Beach is within wilderness and is accessible only by hiking, while Twelvemile Beach Campground and Day Use area is accessible by a paved road (Country Road Highway 58) and is popular with day hikers and backpackers. Visitor surveys completed at the national lakeshore in 2001 indicate that the most popular activities at the shoreline among visitors include sightseeing, beach activities, day hiking, and enjoying the solitude and quiet. Less common activities included sea kayaking, motorized boating, and fishing (Simmons and Gramann 2002; Mechenich et al. 2006). Roughly a third of visitors surveyed also participated in swimming, though swimming is largely dependent on water temperatures and weather conditions, which can change rapidly and are generally cool (Simmons and Gramann 2002).

Surveyors collected data on PWC and visitor use at three locations (Chapel Beach, Miners Beach, and Sand Point) over the July 4th weekend 2013, which was expected to be a peak weekend for visitation. The highest daily number of visitors observed during this PWC survey over the three days observed was at Miners Beach (approximately 480 visitors), followed by Sand Point (approximately 320 visitors) and then Chapel Beach (approximately 200 visitors) (NPS 2013b). Visitors at these shoreline areas participated in beachcombing, swimming, sunbathing/recreating/relaxing, walking/running dogs, picnicking, and other activities; most visitors were on the beaches in the afternoons (NPS 2013b).

At the time of this EA, the NPS initiated work on the Miners Beach Visitor Use Plan, which will address the recent increase in visitation at Miners Beach. This plan will address land-based activities only.

Commercial Boat Tours

Pictured Rocks Cruises, Inc. operates commercial boat tours along the national lakeshore from mid-May through mid-October, and serves as an authorized NPS concessionaire. Cruises run for 2-3 hours, and tour the national lakeshore shoreline, including the most scenic areas and landmarks. During the tour, the boats move close to the shoreline (at flat-wake speeds), and guides provide short descriptions of the area using a public address system. A regular cruise, Spray Falls cruise, and a sunset cruise are all available (Pictured Rocks Cruises 2014a). The regular cruise runs from mid-morning throughout the afternoon. The spray falls cruise occurs in the later afternoon, and includes an extension of the route to view Spray Falls.

Source: Pictured Rocks Cruises 2014a

The sunset cruise departs as the last tour of the day and provides a sunset viewing of the rock cliffs along the shoreline. The commercial tour ships run from the Munising city dock between the shoreline and Grand Island for views of the East Channel Lighthouse then continue past Miners Castle, Painted Cove, Caves of all Colors, Lovers Leap, Rainbow Cave, Indian Head, Gull Rookery, Grand Portal, Battleship Rock, Flower Vase, Indian Drum, Chapel Cove, and Chapel Rock. The Spray Fall cruise continues for an additional 10-15 minutes to

view the Spray Falls, a large waterfall that shoots 70 feet over a cliff into Lake Superior (Pictured Rocks Cruises 2014a). The path of the boat tours is depicted in figure 3-7.

Information provided by guides over the public address system on all cruises includes a history of the boat, facts about the national lakeshore and surrounding area, and highlights along the tour (Pictured Rocks Cruises 2014a). In July and August, a park ranger narrates the return trip on the 10 am and 2 pm boat cruises. The current boats in the cruise fleet are between 64 and 67 feet in length, and can accommodate 150 passengers. The boats are powered by two diesel engines, and provide stabilizers and high tech navigation equipment. (Pictured Rocks Cruises 2014b). Tour boats operated are approximately 440 horsepower (Mechenich et al. 2006). During the peak of the visitor season up to ten cruises may run each day (Pictured Rocks Cruises 2013; Mechenich et al. 2006). Approximately 29% of visitors take the Pictured Rocks National Lakeshore cruise or a cruise of the shipwrecks (Simmons and Gramann 2002).

PWC Use

Within the national lakeshore, PWCs are only permitted on the waters of Lake Superior and not on inland lakes and rivers. Under the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore, which is currently in effect, PWCs are allowed from the western boundary of the national lakeshore to the east end of Miners Beach (figure 2-1). Within the national lakeshore boundary, PWCs can only be launched at the Sand Point boat ramp. Visitors may also launch their PWCs from the Munising Municipal boat ramp (or other areas outside the national lakeshore) and ride their PWCs into the national lakeshore. PWC rentals are not available at the national lakeshore or in nearby Munising. However, PWCs are available for rent at locations within an hour of the national lakeshore, including in Michigamme, which is approximately 75 miles west of Munising and from the Forest Glen Store, located about 15 miles south of Munising along Forest Highway 13.

PWC use has been historically low at the national lakeshore, which is largely due to the cold water temperature, cool ambient air temperature, quickly changing weather conditions, and heavy winds and wave action. A survey of PWC use was completed in 2001 over the July 4th weekend at the Sand Point launch. PWC use during the 2001 survey ranged from 8 to 13 PWCs each day, with an average of 6.6 PWCs in the national lakeshore per day (NPS 2002). To document more recent PWC use at the national lakeshore, the NPS conducted a survey over the 2013 July 4th weekend, a peak holiday weekend (July 4–6, 2013). During the three-day survey at the national lakeshore, data collectors observed a total of 551 watercraft, including 25 PWCs, at the three counting sites, Sand Point, Miners Beach, and Chapel Beach. Any PWCs observed within Chapel Beach during the survey period were not in compliance as this area is closed to PWCs. The survey indicated that the level of PWC use remains low and that PWCs only comprised about 5% of watercraft use and approximately 7% of all motorized watercraft use (excluding commercial tour boats). PWC use was greatest at Sand Point, where a total of 16 PWCs were observed representing approximately 12% of all the watercrafts observed at this site during the three-day survey period. The average of 5.3 PWCs per day at Sand Point is slightly lower than during the 2001 survey. The numbers of PWCs at Chapel Beach (one PWC) and Miners Beach (eight PWCs) were much lower, with PWCs representing approximately 1% and 2% of the watercraft at these sites, respectfully. Sand Point provides the only boat launch within the national lakeshore boundaries, which most likely explains the higher use at this site. The maximum daily number of PWCs observed in the park during the survey period was nine (NPS 2013b).

According to the July 2013 study (NPS 2013b), a majority of PWCs observed were used for short periods. Only 6 of the 25 PWCs were used for all-day recreation. These PWCs were located at Sand Point and Miners Beach and stayed an average of 5 hours at these beaches between the hours of noon and 6:00 p.m. Visitors that used PWCs at the sites for shorter trips visited during approximately the same time period as visitors who used PWCs for all-day recreation (11:00 a.m. to 6:00 p.m.); however, the heaviest PWC use

occurred between the hours of noon and 2:00 p.m. This survey was conducted over the July 4th weekend, a weekend that typically has heavy PWC use, and PWC use ranged between 2 and 14 PWCs per day with an average of 8 PWCs per day (NPS 2013b).

Data collectors also recorded the duration of each PWC trip and noted how users operated the PWC (i.e., travel between two points or recreational use and play). Data collectors observed that in many cases, a single PWC was used for several short trips over a longer time period, often by multiple users. In these cases, a group of visitors would beach and launch the PWC several times throughout their stay at a site. These rides were an average of 13 minutes in duration. It should be noted that several trips that lasted for more than 60 minutes were not included in this total because the PWCs left the site, and it is unknown if the PWCs were in use for the entire survey period or if the users beached the PWCs in other locations (NPS 2013b). It is possible that these PWC users were traveling between two points, transiting more than others are, leave the jurisdictional boundary of the national lakeshore, or even entering areas that are closed to PWCS. It is because of this uncertainty that these PWC observations were not included in the totals for the survey. The main use of the PWCs during the survey at all sites was for recreational purposes rather than for travel between two points. Users operated PWCs predominantly in circles. PWC users observed during the 2013 study were generally respectful of other national lakeshore users, with only one recorded observation of a PWC operating close to swimmers (NPS 2013b).

As requested by the NPS, the captains of Pictured Rocks Cruises, Inc. collected PWC data from March to October of 2012. These tours operate from Sand Point to Spray Falls multiple times a day from mid-March through mid-October. Data collected included the date, time, and location that the PWC was observed; the number of PWCs within a group; a description of the PWC; and the number of passengers riding on the PWC (NPS 2012b). These data are presented as a supplement to 2013 PWC count data to help determine the level of PWC use. PWC numbers could include double-counts of PWCs by commercial tour boat captains who may have seen a PWC two times during one trip but counted the PWC twice. Additional details on data collected during this survey period are in appendix D, and include temperature data, and PWC observation locations. Below is a summary of the data collected by captains of the commercial tour boats between March and October 2012:

- The first PWC observed within national lakeshore boundaries after the count began in March was on June 28, 2012.
- The last PWC observed within national lakeshore boundaries was recorded on September 3, 2012.
- PWCs were observed on 23 of the 68 days between June 28 and September 3, 2012.
- A total of 82 PWCs were recorded.
- The maximum number of PWCs observed on any one day was 10.
- The daily average number of PWCs each day for the 23 days when PWCs were observed was 3.5.
- PWCs were only seen on days when the maximum air temperature was 67 degrees or higher, based on temperature data acquired for the days of the surveys. The temperature data are also included in appendix D.

PWC Registration Data

As of June 2014, a total of 97,242 PWCs were registered in Michigan (PWIA 2014). PWC model years range from 1985 through 2014. Prior to 2000, only carbureted two-stroke engines were being manufactured. Beginning in 2000 and continuing through 2010, carbureted two-stroke and direct injection two-stroke and four-stroke engines were manufactured. The newer direct injection two-stroke and four-

stroke PWC engines are quieter than the older carbureted two-stroke engines and do not discharge fuel directly into the water (PWIA 2006). From 2011 through present day, only direct injection two-stroke and four-stroke engines are being manufactured. The PWC registration data do not indicate which type of engine each PWC has; therefore, it is unclear as to how many PWCs have two-stroke engines and how many have four-stroke engines. There is no way of knowing exactly what types of PWCs are being operated in the park due to the lack of permit requirements or a controlled entry point. Of the PWCs registered in Michigan, 61% were manufactured prior to 2000, indicating two-stroke engines, and 7% were manufactured after 2011, indicating four-stroke engines. The remaining 32% of PWCs are likely a mixture of both two-stroke and four-stroke engines manufactured between 2000 and 2010. Table 3-9 presents PWC registration data for Alger County where the national lakeshore is located, as well as the four surrounding counties (Marquette, Luce, Schoolcraft, and Delta), and the 15 counties of the Upper Peninsula.

TABLE 3-9: PWC REGISTRATION DATA FOR ALGER COUNTY, SURROUNDING COUNTIES, AND COUNTIES OF THE UPPER PENINSULA

Counties	Total Number of PWCs Registered	PWC Engines*		
		Number of PWCs Manufactured before 2000	Number of PWCs Manufactured between 2000 and 2011	Number of PWCs Manufactured after 2011
PWCs Registered in Alger County	87	59 (68%)	28 (32%)	0 (0%)
PWCs Registered in Marquette, Luce, Schoolcraft and Delta Counties	1,218	739 (61%)	421 (34%)	58 (5%)
PWCs Registered in 15 Counties of the Upper Peninsula	3,071	1,965 (64%)	980 (32%)	126 (4%)

* PWCs manufactured before 2000 are considered to have two-stroke engines, between 2000 and 2011 are considered to have a combination of two-stroke and four-stroke engines, and after 2011 are considered to have four-stroke engines.

Other Watercraft Use (Motorboats, Canoes, and Kayaks)

Both motorized and non-motorized boating occurs in the national lakeshore. A visitor study in 2002 indicated that 7% of visitors participate in non-motorized boating activities, and 3% of visitors participate in a motorized boating activity (Simmons and Gramann 2002). Data on the numbers and types of motorized and non-motorized vessels were collected over the July 4th holiday weekend in 2013. During the survey period (July 4–6), surveyors counted all vessels at three locations in the national lakeshore, Chapel Beach, Miners Beach, and Sand Point (figure 3-7). All vessels at each location were counted once per survey day; however, it is possible that boats could be double-counted if they moved up the shoreline (i.e., a single boat could be counted at both Sand Point and Miners Beach if it visited both locations in a single day). Table 3-10 presents the numbers of motorized and non-motorized vessels counted at the three locations during the survey. A total of 353 motorized watercraft, 25 PWCs, and 173 non-motorized vessels were observed over the holiday weekend (NPS 2013b). Motorized watercraft are commonly used in the national lakeshore, and motorboats greatly outnumber PWCs at the national lakeshore (Mechenich et al. 2006; NPS 2013b).

TABLE 3-10: MOTORIZED AND NON-MOTORIZED VESSELS COUNTED DURING THE JULY 2013 PWC SURVEY

Vessel type	Chapel Beach	Miners Beach	Sand Point	Total
Motorized Boats				
Pontoon Boat	40	76	43	**159**
Fishing Boat	26	67	42	**135**
Personal Watercraft	1	8	16	**25**
Tour Boat	13	27	11	**51**
Jon Boat	2	1	4	**7**
Coast Guard Boat	0	0	1	**1**
Total Motorized Boats	**82**	**179**	**117**	**378**
Non-Motorized Boats				
Kayak	10	144	14	**168**
Stand Up Paddleboard	0	3	0	**3**
Sail Boat	0	1	1	**2**
Total Non-Motorized Boats	**10**	**148**	**15**	**173**

Kayaking offers a popular way for visitors to explore the shoreline and sandstone cliffs of the national lakeshore. According to recent estimates, the 250 percent surge in kayaking usage between 2013 and 2015 has caused congestion at park facilities (Jarvi 2016). Several backcountry camping sites are accessible from the water, though backcountry permits are needed for camping at these sites (see the "Camping" section above). Kayaks can be rented in Munising from outfitters and rental shops, and roughly 3,100 kayaks were rented in the 2013 season (Colyer 2013). Although kayaks can be rented by the hour, guided trips are also available, including half-day, full-day, and multi-day trips. During the three-day survey period in 2013, several large groups of kayaks of 11 or more vessels were launched for guided kayak tours from Miners Beach (NPS 2013b). Kayakers at Chapel Beach and Sand Point were generally boating unaccompanied or in small groups or 2 or 3 kayaks (NPS 2013b). Canoeing is also a common visitor activity at the national lakeshore; however, data collectors did not observe canoes on Lake Superior over the 2013 July 4th weekend.

Motorized and non-motorized boats may be launched in Lake Superior at the Munising Municipal boat ramp, the Grand Marais harbor, and a small boat ramp at Sand Point. Additional put-in points for Lake Superior for non-motorized boats are located at Sand Point, Miners Beach, Twelvemile Beach, and Hurricane River, as well as local sites outside the national lakeshore boundary. The inland lakes at the park also provide recreational opportunities for boaters. PWC use is not permitted on the inland lakes. Grand Sable Lake is the only inland lake that allows motorboats. Additionally, Beaver Lake and Little Beaver Lake allow electric motor boats. These three lakes are the only inland water bodies accessible by boat ramp. Non-motorized boats are permitted on all inland lakes, and many of the smaller inland lakes are ideal for canoeing. Lake Superior may not provide ideal conditions for canoes and small boats, as conditions can be rough and small craft are easily swamped.

VISITOR SAFETY

Many of the recreational activities undertaken by visitors at the national lakeshore are highly compatible, such as picnicking, hiking, swimming, and kayaking. These activities can occur simultaneously with few conflicts between user groups. The use of motorized vessels, such as PWCs, in close proximity to other visitors could present safety issues.

Incidents between PWC users have occurred at the national lakeshore and have been recorded through incident reports and visitor surveys. PWC incidents include operating within 150 feet of another vessel, traveling above a flat-wake speed, and operating too close to swimmers. A large wake from a PWC could endanger swimmers or kayakers, especially those that are young or inexperienced. Flat-wake zone provisions and other safety measures are discussed further in chapter 2 in the "Elements Common to the Action Alternatives" section. From 2009 through 2016, there were approximately 12 incidents for violating the state law requiring a flat-wake speed and perpendicular travel to and from the shore for 200 feet (Colyer 2012; Leutscher 2014 pers. comm., Patmore 2015 pers. comm.; Leutscher 2017). Law enforcement reported approximately 42 incidents involving PWCs between 2009 and 2016 for operating a PWC in a closed area. There were 5 additional incidents of PWCs in closed areas that were called in by other visitors; however, these incidents did not result in citations or warnings because the PWC users had vacated the area prior to arrival of law enforcement. Additionally, there was one incident recorded for a PWC operator stranded on a beach due to the PWC drifting away in the rough surf (Colyer 2012; Leutscher 2014 pers. comm., Patmore 2015 pers. comm.; Leutscher 2017). These data were collected by national lakeshore law enforcement personnel and should be considered an estimate of the PWC violations that have occurred, as the park does not retain an official record of violations. Despite these citations, no documented accidents have occurred at the national lakeshore from PWC operation. In addition, operating small craft on the open waters of Lake Superior also presents some safety considerations for park visitors. Quick moving storms and rapidly building waves can create dangerous conditions for small craft operating in areas where no shelter is available.

WILDERNESS

In 2009, the 11,740-acre Beaver Basin Wilderness was designated at the national lakeshore. It includes 13 miles of Lake Superior shoreline from Spray Falls to Sevenmile Creek (figure 3-7; NPS 2013f). The boundary of the wilderness area is located at the shoreline of Lake Superior, with the waters of the lake outside the designated wilderness area. The wilderness area includes Beaver Lake, Trappers Lake, and Legion Lake, as well as five coldwater streams, extensive wetland complexes, old-growth cedar swamps, hardwood forests, and unique geologic features. The wilderness area provides important habitat for both aquatic and terrestrial wildlife, such as brook trout, largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieu*), black bear, grey wolf, fish and American marten, migratory bird species, waterfowl, and game birds (NPS 2013f).

The wilderness area also provides opportunities for solitude and quiet, wilderness recreation, and spiritual renewal (NPS 2013f). Prior to being listed as wilderness, the Beaver Basin was noted for its untrammeled nature, primeval character and influence, largely unnoticeable human imprint, protection of natural conditions, and its ability to provide opportunities for solitude and primitive recreation (NPS 2004). Although the wilderness still shows some traces of historic logging and other uses, the imprint of these uses is largely unnoticeable (NPS 2004). Approximately 8.4 miles of the North Country National Scenic Trail and 8.5 miles of other national lakeshore trails run through the wilderness. Recreational activities available within the Beaver Basin Wilderness include small group recreation along the North Country National Scenic Trail, along several connector trails, and at six campsites. Traditional uses in the wilderness are still permitted, such as hunting, fishing, day hiking, overnight backpacking, canoeing,

kayaking, cross-country skiing, and snowshoeing (NPS 2013f). Motorized vessels may beach along the shoreline of Lake Superior adjacent to the wilderness. Electric boats are still allowed to operate on Little Beaver and Beaver Lakes, but no other motorized vehicles are allowed in wilderness, providing the opportunity for visitors to enjoy quiet and solitude. Upgrades to the Alger County Road Highway 58 have allowed for easier access to the national lakeshore which has resulted in an increase in visitation. Since being paved, visitors are also able to drive at a faster speed. This increases noise in the national lakeshore and wilderness areas.

Under the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore, PWC use is currently permitted from the western boundary of the national lakeshore to the east end of Miners Beach and is not allowed in park waters adjacent to the designated wilderness area; however, PWCs are permitted outside of national lakeshore boundary, which extends to ¼ mile from the shoreline. Other motorized vessels, including commercial tour boats, are allowed to operate within park waters along the wilderness shoreline and are not subject to the flat-wake provisions that apply to PWC use.

The 2004 General Management Plan also outlined several management prescription zones, including primitive and pristine zones. Beaver Basin Wilderness is included in the primitive zone, which was designated to provide a sense of remoteness and immersion in nature. The pristine zone, which provides for an independent, wild experience with full immersion in the natural environment, includes the Grand Sable Dunes Research Natural Area.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This "Environmental Consequences" chapter analyzes beneficial and adverse impacts that would result from implementing any of the alternatives considered in this EA. This chapter includes descriptions of the methods used to analyze direct, indirect, and cumulative impacts. The resource topics presented in this chapter and the organization of the topics correspond to the resource discussions in "Chapter 3: Affected Environment."

GENERAL METHODOLOGY FOR DETERMINING IMPACTS

The analysis of impacts follows CEQ guidelines and the NPS NEPA Handbook (NPS 2015a) and incorporates the best available scientific literature and data. Overall, the NPS based the impact analyses and conclusions on the review of existing literature, park studies, information provided by experts within the park and other NPS personnel, other agencies, professional judgment, and public input. For each resource topic addressed in this chapter, the applicable analysis methods are discussed.

CEQ regulations that implement NEPA require the assessment of three categories of effects in the decision-making process for federal projects: direct, indirect, and cumulative. Direct impacts are those impacts that happen in the same place and at the same time as the federal action; indirect impacts are those that happen later in time or farther removed from the area of the federal action. Impacts are described as being beneficial or adverse. A beneficial impact is an impact that would result in a positive change in the condition or appearance of the resource. An adverse impact is an impact that causes an unfavorable result to the resource when compared with the existing conditions.

The impacts of the alternatives are assessed using the CEQ definition of "significantly" (40 CFR § 1508.27), which requires consideration of both context and intensity.

> *Context* is the setting, situation, or circumstances surrounding a particular resource (40 CFR § 1508.27(a)). Context provides a backdrop against which the intensity of impacts can be compared to understand their relative importance. Context is also resource-specific, in many cases involving things such as laws directed at the preservation of a resource, NPS policies regarding preservation or management of specific resources, whether the resource is fundamental to the park, etc. Context also includes duration.
>
> *Intensity* is the severity or magnitude of the impact. Considering intensity means looking at different aspects of the affected resource that might make an impact more or less important (40 CFR § 1508.27(b)). For example, if the affected resource is rare or unique, an adverse impact might be considered more severe than if the resource is common and widespread; if the alternative has elements that have never been implemented before or whose impacts cannot be reasonably predicted, then the impacts of the alternative might be of greater magnitude than if the alternative consists of routine actions whose impacts are well-understood.

In determining impacts of the alternatives for this analysis, impacts are compared to the current condition of each resource, as described in chapter 3. Current conditions reflect ongoing PWC use, as defined under the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore (36 CFR § 7.32(d)(1)). PWCs are currently permitted from the western boundary of the national lakeshore to the east end of Miners Beach (alternative 1).

ASSUMPTIONS USED IN DETERMINING IMPACTS

In determining impacts to resources for each alternative, assumptions were developed concerning the level of PWC use, the types of PWCs in use, and level of compliance.

Level of PWC Use: To properly evaluate potential impacts to resources, the NPS estimated the current level of PWC use at the national lakeshore. Although the NPS does not routinely collect data on PWC use, two studies were completed during the preparation of this EA to better understand PWC use at the national lakeshore:

- commercial tour boat captains with Pictured Rocks Cruises, Inc. noted the number of PWCs observed from March to October 2012 (NPS 2012b)
- NPS conducted a PWC survey on July 4–6, 2013, at Miners Beach, Sand Point, and Chapel Beach (NPS 2013b)

Chapter 3 and appendix D contain details of these surveys. Table 4-1 presents observational data compiled based on the 2012 and 2013 PWC surveys.

TABLE 4-1: OBSERVATIONAL DATA ON PWC USE AT PICTURED ROCKS NATIONAL LAKESHORE BASED ON 2012 AND 2013 SURVEYS

Parameter	Observations	Source
First PWC observed in 2012	June 28	NPS 2012b
Last PWC observed in 2012	September 3	NPS 2012b
Maximum daily number of PWCs observed (2012)	10	NPS 2012b
Maximum daily number of PWCs observed (2013)	14	NPS 2013b
Average number of PWCs observed each day[1]	3.5	NPS 2012b
Average number of PWCs observed each day- July 4th holiday weekend (2013)	7.6	NPS 2013b
Time of day of peak PWC use observed	12 p.m. – 2 p.m.	NPS 2012b, NPS 2013b

Notes:

1 Based on days when PWCs were observed, observations were not recorded every day throughout the summer

Using the data collected during the 2012 and 2013 surveys and park staff experience, NPS created assumptions to aid in the evaluation of PWC use at the national lakeshore under the three alternatives. These assumptions are presented in table 4-2.

Trends in PWC Use and Analysis Period for this EA: As explained in detail in "Chapter 3: Affected Environment" of this document, the 2002 Personal Watercraft Use EA estimated peak PWC usage at 13 per day (NPS 2002) based on PWC counts over the July 4th weekend in 2001. To document more recent PWC use at the national lakeshore, the NPS conducted a survey over the 2013 July 4th weekend, a peak holiday weekend (July 4–6, 2013). The results of the 2013 PWC use study (NPS 2013b) indicate that the current level of PWC use is similar to the level of PWC use that was estimated in 2001. Additionally, there are no known businesses renting PWCs in the area of the national lakeshore; local rental opportunities could lead to an increase in use. This information suggests that there would not likely be an increase in PWC use at the national lakeshore in the foreseeable future. Therefore, for the impacts analysis in this chapter, it is assumed that PWC use would remain at the current level, with a maximum of 14 PWCs per day (holidays/weekends) and 4 PWCs on an average day (weekday). As stated in chapter 1,

PWC use likely remains low at the national lakeshore due to the remoteness of the park and distance from large population centers, cold water temperature, cool ambient air temperature, sudden changes in weather conditions, and heavy winds and wave action on Lake Superior.

TABLE 4-2: ASSUMPTIONS ON PWC USE AT PICTURED ROCKS NATIONAL LAKESHORE BASED ON 2012 AND 2013 SURVEYS AND STAFF EXPERIENCE

Parameter	Assumption	Assumption Based on
Months of most PWC use	July and August (8 weeks)	Data
Peak use day (holiday/weekends)	14 PWCs/day	Data
Average use day (weekday)	4 PWCs/day	Data
Number of peak use days per season	16 days[a]	Staff Experience
Number of average use days per season	24 days[b]	Staff Experience
Number of days with no PWC use	16 days[c]	Staff Experience

Notes:
a 16 peak days out of 56 total days (Friday and Saturday each week for 8-week period)
b 24 days with average use out of 56 total days
c 16 days with no use out of 56 total days (at least 2 days per week with no PWC use, including good weather days)

Duration of PWC Use: For analyzing impacts to air quality, water quality, soundscapes, and other park resources, it was necessary to estimate how long PWCs would be operated each day. As the July 2013 PWC survey shows, duration of use can be highly variable by user. Some users were on a PWC for short durations (less than 30 minutes), while others appeared to use the PWCs for transit and may have used them for longer periods. The maximum period of PWC operation observed was approximately 5 hours (NPS 2013b); however, the average time of individual PWC use at the national lakeshore is probably lower than 5 hours, based on the observations of park staff. Therefore, the NPS assumed 3 hours as the average duration of PWC use per day.

Two Stages of PWC Engines:

***During the Phase-Out**: The two-year period following implementation of the new PWC regulations when carbureted two-stroke engines would be allowed within the national lakeshore.*

***Post Phase-Out**: Two years after the implementation of the new PWC regulations, carbureted two-stroke engines would no longer be permitted at the national lakeshore. PWC use would be limited to direct injection two-stroke and four-stroke PWCs.*

PWC Engine Type: The type of PWC used (carbureted two-stroke engine versus direct injection two-stroke or four-stroke engines) was estimated using Michigan PWC registration data (PWIA 2014). Michigan registration data are used because it is assumed the majority of PWC visitors come from within the state. While the park does not continuously track whether PWC users are local or travel from out of state, a 2002 study indicated that approximately 60% of the US visitors to the national lakeshore were from Michigan (Simmons and Gramann 2002). Most of the PWC users in the national lakeshore are believed to be local residents or owners of summer homes in the area who are using their personal machines. According to the Michigan registration data, 93% of PWCs registered as of June 2014 were manufactured before 2011 and 7% were manufactured since 2011; however, these data do not indicate what type of engine the PWC contains. PWC manufacturers started using direct injection and catalytic converters in every model year since 1999 in response to regulations set forth by EPA in 1996 (PWIA 2011). For models produced after 2000 and before 2011, when production of carbureted two-stroke

engines stopped, there is no way to know if the PWCs are carbureted two-stroke or direct injection two-stroke or four-stroke engines. Because of this uncertainty, this EA assumes that PWCs during the phase-out are carbureted two-stroke engines and PWCs after the phase-out are direct injection engines.

This EA assumes that PWCs during the phase-out are carbureted two-stroke engines and PWCs after the phase-out are direct injection engines.

The action alternatives (alternatives 1 and 2) include a phase-out of the use of carbureted two-stroke engines at the national lakeshore, accomplished through compliance with the 2010 EPA air quality emissions standards. As stated in chapter 2, the phase-out would be conducted in two stages. From implementation of this PWC management plan, carbureted two-stroke engines would be allowed within national lakeshore boundaries for the first two years (*during the phase-out*). After two years, PWCs containing carbureted two-stroke engines would no longer be permitted within the national lakeshore (*post phase-out*). For some resource topics in this EA (such as air quality and water resources), the analysis includes an evaluation of the impacts associated with the use of carbureted two-stroke PWC engines during the phase-out period and with the use of direct injection two-stroke and four-stroke PWCs post phase-out.

Compliance with Regulations: Detailed impact analysis assumes PWC users will comply with park regulations. While individual acts of non-compliance could occur, they are not analyzed in the alternatives. Between 2009 and 2016, law enforcement recorded 54 incidents with PWC users, which included 42 cases of PWCs in closed areas and 12 violations of the requirements for flat-wake speed and perpendicular travel within 200 feet of the shoreline. Although 54 incidents over 8 years is a relatively low number, these incidents only represent those that were recorded by law enforcement. Because PWC users have been documented violating regulations, the NPS must assume that instances of noncompliance could continue after implementation of the new PWC management plan at the national lakeshore. Noncompliant behavior could include operating PWCs in areas where they are prohibited, operating above flat-wake speeds within 200 feet of the shoreline, and operating too closely to swimmers or other boaters.

CUMULATIVE IMPACTS ANALYSIS METHOD

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other ongoing or reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR § 1508.7). As stated in the CEQ handbook, "Considering Cumulative Effects under the National Environmental Policy Act" (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on impacts that are truly meaningful. Cumulative impacts are considered for all alternatives, including alternative 3, the no-action alternative.

Cumulative impacts were determined for each affected resource by combining the incremental impacts of the alternatives analyzed with other ongoing and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future actions and plans at the national lakeshore and, if applicable, in the surrounding region (Alger County). Table 4-3 summarizes the ongoing and reasonably foreseeable actions that could affect the various resources of the national lakeshore.

TABLE 4-3: CUMULATIVE IMPACT SCENARIO

Project	Brief Description	Affected Impact Topics
Other Watercraft Use	Watercraft including commercial tour boats and other motorboats are commonly used in the national lakeshore. Visitors use private boats, motorized and non-motorized, and commercial tour boats to access these areas. Use of boats within the national lakeshore can both enhance and detract from visitor experience, depending on the preferred experience of the visitor. This activity can also cause potential impacts to natural and ethnographic resources, and to visitor safety.	• water resources • air quality • acoustic environment and soundscapes • wildlife and wildlife habitat • special-status species • ethnographic resources • visitor use and experience • visitor safety • wilderness
Expansion of Munising City Dock	This project would be completed in five phases including dredging, construction of floatation docks, shore side work, the extension of an existing dock, and the possible construction of an east breakwall. The first phase included the dredging of Lake Superior within the Munising city dock area, completed in 2013. Construction began in July 2017 to expand the Bayshore Marina and add floatation docks to the harbor. The increase in boat traffic could result in additional noise disturbance to visitors and wildlife.	• acoustic environment and soundscapes • wildlife and wildlife habitat • visitor use and experience
Beech Bark Disease Tree Removal	Beech bark disease symptoms were first identified at the national lakeshore in 2001. The NPS is planning and effectively removing hazard trees from developed areas (facilities, picnic areas, parking lots, etc.) by using chainsaws. The disease is now quickly spreading from east to west through the national lakeshore, resulting in a high mortality rate for beech trees. Removal of hazard trees that have succumbed to beech bark disease is an ongoing project at the national lakeshore.	• acoustic environment and soundscapes • wildlife and wildlife habitat • special-status species • visitor use and experience • wilderness
Sand Point Revetment	Sand Point, the most popular beach at the park, was modified in the early 1990s with the installation of a 650-foot long rock revetment to control erosion. Over the years, portions of the revetment have failed, resulting in changes to the end of Sand Point. The NPS is currently preparing an EA to analyze possible alternatives to remove the revetment at Sand Point. This would allow natural processes to occur, such as the littoral drift of sediments, along the shoreline, which is an important landform linked to the Chippewa way of life.	• water resources • wildlife and wildlife habitat • special-status species • ethnographic resources • visitor use and experience
New Seasonal Kayak Launch	The City of Munising proposes to install a seasonal floating kayak launch in the Anna River and renovate an existing crib pier in South Bay. These actions will provide navigational access and recreational improvements with handicap-accessible features at the Munising Bay Universal Access Site.	• visitor use and experience

WATER RESOURCES

This section addresses potential impacts on water quality. All motorized boating activity within the national lakeshore (e.g., commercial tour boats, fishing boats, speedboats, and PWCs) contributes some petroleum-related pollutants of concern to the waters of the national lakeshore including benzene, toluene, ethylbenzene, xylenes, and other hydrocarbons, MTBE, and PAHs (VanMouwerik and Hagemann 1999). These pollutants can cause potential health concerns for aquatic life and humans if they persist in high enough concentrations.

GUIDING REGULATIONS AND POLICIES

Clean Water Act: Under the Clean Water Act, EPA develops ambient water quality criteria for the protection of human health and aquatic life. Similarly, MDEQ has developed their own human health criteria for certain pollutants. In general terms, these federal and state ambient water quality criteria represent concentrations that are believed to be safe for humans and aquatic life in waters of the United States. When federal or state ambient water quality criteria are not available, published toxicological benchmark values can be used to analyze impacts on water quality.

The portion of Lake Superior that is within the national lakeshore is designated as an outstanding state resource water, as discussed in "Chapter 3: Affected Environment." The outstanding state resource water designation mandates that the current water quality of the national lakeshore be maintained, and any action that would decrease the water quality is prohibited. While the NPS is required to continue to meet EPA and MDEQ water quality standards, the NPS must also maintain Lake Superior's outstanding state resource water designation. This designation is more protective than state and federal water quality standards, as there are additional regulatory antidegradation requirements to protect existing water quality.

STUDY AREA

The study area for analyzing impacts to water quality consists of the 0.25-mile jurisdictional boundary of the national lakeshore extending into Lake Superior. For analysis of water quality, the shoreline of the national lakeshore was separated into four segments: Sand Point (segment 1), Cliffs (segment 2), Beaver Basin (segment 3), and Grand Sable (segment 4); these segments are shown in figure 4-1.

Alternative 1 only examines impacts to water quality in the Sand Point segment because PWCs would be prohibited from the other three segments. Alternatives 2 and 3 encompass all four segments.

METHODOLOGY AND ASSUMPTIONS

The water quality impact assessment methodology used in this EA is the same basic approach presented in the 2002 EA with adjusted segments to correspond with the current PWC use area, updates to the human health criteria, and different PWC use assumptions within areas of the national lakeshore, which are outlined above in the "Assumptions Used in Determining Impacts" section at the beginning of this chapter. The Water Quality Assessment and Calculations discussed below can be found in Appendix A.

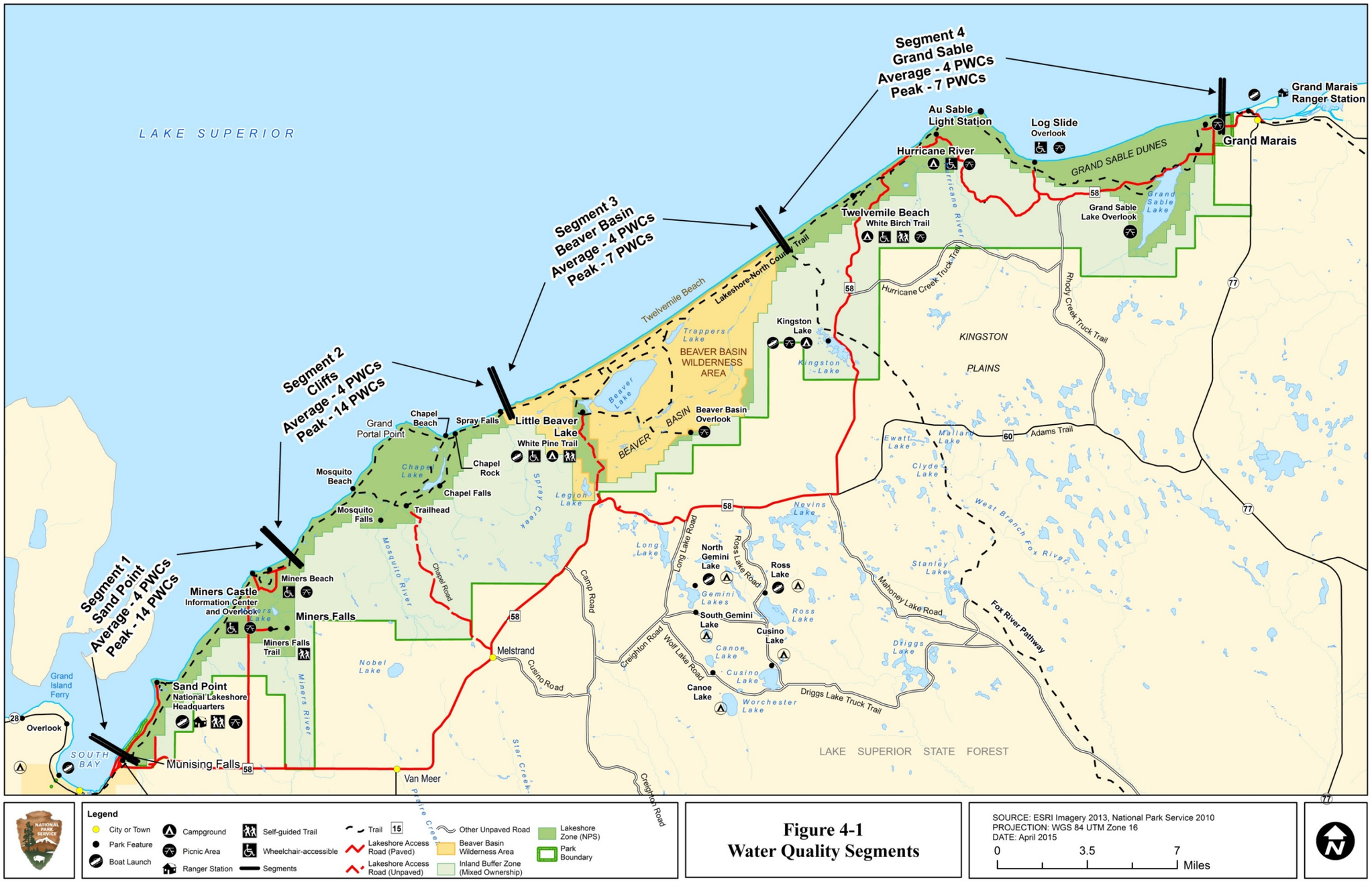

Figure 4-1
Water Quality Segments

SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
0 3.5 7 Miles

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Level of PWC Use: To estimate the impacts to water quality from PWC use, the national lakeshore was divided into four segments, as stated above in the "Study Area" section. Additionally, two scenarios were modeled for daily use of PWCs – average and peak daily use. Table 4-4 presents the segments, the length of the segments, and the number of PWCs and PWC-hours modeled for average and peak days under alternatives 1 and 2. The level of PWC use is based on staff observations and PWC surveys from 2012 and 2013.

TABLE 4-4: CALCULATION OF AVERAGE AND PEAK PWC-HOURS FOR EACH SEGMENT OF PICTURED ROCKS NATIONAL LAKESHORE

Segment	Length (miles)	Alternative 1: Current Regulations under the 2005 Special Regulation for PWC Use				Alternative 2: Entire Shoreline Open to PWC Use			
		Average Use		Peak Use		Average Use		Peak Use	
		# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours
1. Sand Point	9.2	4	12	14	42	4	12	14	42
2. Cliffs	6.0	0	0	0	0	4	12	14	42
3. Beaver Basin	10.2	0	0	0	0	4	12	7	21
4. Grand Sable	14.3	0	0	0	0	4	12	7	21

Pollutants Analyzed: Four pollutants associated with the petroleum-based fuel used by PWCs were analyzed: benzene, benzo(a)pyrene, naphthalene, and 1-methylnaphthalene. The analysis follows the procedure in the 2002 EA. Further information regarding the pollutants analyzed and those dismissed from analysis can be found in appendix A.

Toxicity Benchmarks and Criteria: Pictured Rocks National Lakeshore does not have site-specific water quality standards; therefore, national standards were used in this analysis to evaluate the potential impacts to water quality at the national lakeshore from PWC use. EPA water quality criteria protective of aquatic life for the pollutants of concern are not available; therefore, ecotoxicological screening benchmarks were acquired from scientific literature. These benchmarks represent a threshold for effects to ecological receptors, which are used to determine if chemicals present in or potentially released to the environment pose an ecological threat. Human health criteria are extraordinarily conservative values used to determine the highest concentrations of pollutants in water that are not expected to pose significant risks to human health (EPA 2014). Development of the ecotoxicological screening benchmarks and human health criteria are discussed further in appendix A; the benchmarks and criteria used in this analysis are presented in table A-2 in appendix A.

Daily Pollutant Loadings: The amount of each pollutant (benzene, benzo(a)pyrene, naphthalene, and 1-methylnaphthalene) that would be released to the surface water of Lake Superior during daily PWC use was estimated. The pollutant loading estimates apply only to PWC use during the two-year phase-out period of PWCs with carbureted two-stroke engines. The alternative approaches make the assumption that all PWCs at the national lakeshore will be those with carbureted two-stroke engines that discharge unburned gasoline and gasoline additives directly into the water. Post phase-out, all PWCs would have direct injection engines, which do not discharge fuel directly into the water (PWIA 2006), essentially eliminating pollutant loading to the surface water. There could be incidental releases of fuel to Lake Superior from fuel leaks or fuel spills by PWC users; however, spills and leaks are expected to be

infrequent and would not create appreciable impacts on water quality. Pollutant loading calculations and daily pollutant loadings results are presented in detail in appendix A (tables A-3, A-4, and A-5).

Threshold Volumes: Threshold volumes are defined as the volume of water needed to dilute the calculated pollutant loads to the concentrations of water quality criteria or benchmark. Threshold volume calculations and results are presented in detail in appendix A (tables A-3, A-4, and A-5).

Analysis: The threshold volumes for each pollutant of concern were compared to the volume of water available within each segment of the shoreline. The volumes of each segment were calculated by multiplying the area of each segment by the general depth. These volumes are presented in tables A-3, A-4, and A-5 of appendix A. The following analysis identifies the percent of the volume of water needed in each segment to dilute the pollutant load to the concentrations of ecotoxicological screening benchmarks or human health criteria.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Under alternative 1, all PWC use (4 PWC on an average day, 14 PWC on a peak day) would occur in segment 1, which spans 9.2 miles from the western boundary of Pictured Rocks National Lakeshore to the eastern end of Miners Beach (See figure 4-1, segment 1). This alternative would implement a phasing-out of PWCs containing carbureted two-stroke engines. After this two-year phase-out period, carbureted two-stroke engines would no longer be permitted within the national lakeshore resulting in the elimination of PWC-related pollutant discharges to park waters.

During the Phase-Out: During the phase-out, it is assumed that 100% of the PWC use at the national lakeshore would be those that contain the older, carbureted two-stroke engines, which discharge unburned gasoline and gasoline additives directly into the water. This likely overestimates the level of pollution as it is reasonable to expect some of the PWCs currently in use at the lakeshore would use the newer technology. This approach is a conservative estimate since data on the actual machines in use at the national lakeshore is not available. The projected discharge into the water column from PWC use under alternative 1 was compared to ecological toxicology benchmarks and human health criteria for the pollutants, as explained in appendix A. Table 4-5 presents the daily pollutant loadings to the national lakeshore based on PWC use estimates and the volume of water needed to dilute each pollutant. This "threshold volume" is translated into the percentage of water in the Sand Point segment needed to dilute each pollutant to meet ecological benchmarks and human health criteria. The water quality assessment and calculations are explained in appendix A.

The calculations (table 4-5) demonstrate that pollutants generated by PWC use under alternative 1 are so low that none would be present in sufficient quantity to come close to the human health criteria or ecological benchmark levels, allowing the water quality of the national lakeshore to remain high. The water volumes needed to dilute PWC-related pollutants to meet the benchmarks and criteria are extremely low in relation to the volume of water available in the segment. The very low levels of pollutants generated by PWCs would not affect human health or aquatic organisms.

TABLE 4-5: DAILY POLLUTANT LOADINGS AND THRESHOLD WATER VOLUMES FOR AVERAGE AND PEAK CONDITIONS IN SEGMENT 1 (SAND POINT) DURING PHASE OUT– ALTERNATIVE 1

Parameter	Pollutant	Average PWC Use per Day			Peak PWC Use per Day		
		Daily Loading to Water (mg)	Threshold Water Volume Needed*		Daily Loading to Water (mg)	Threshold Water Volume Needed*	
			Acre-Feet	Percent		Acre-Feet	Percent
Volume of Water Available		**31,557 acre-feet**			**31, 557 acre-feet**		
Ecological Benchmark	Benzo(a)pyrene	282	16.31	0.05	986	57.09	0.18
	Naphthalene	502,816	33.97	0.11	1,759,855	118.89	0.38
	1-Methylnapthalene	783,821	302.60	0.96	2,743,373	1,059.09	3.36
	Benzene	1,307,321	8.15	0.03	4,575,622	28.53	0.09
Human Health Criteria	Benzo(a)pyrene	282	1,903.05	6.03	986	6,660.68	21.11
	Benzene (MDEQ)	1,307,321	88.32	0.28	4,575,622	309.13	0.98
	Benzene (EPA)	1,307,321	504.70	1.60	4,575,622	1,766.44	5.60

Mg = milligram

* The threshold water volume is the amount of water needed or percent of volume of water available to dilute the pollutant to the benchmark or criterion value.

Threshold volumes required to meet human health regulations are generally larger than those for ecological health, as is the case for this analysis (table 4-5). It is important to consider that the human health criteria are based upon *daily lifetime* exposure to these concentrations, which is not consistent with the expected visitor exposures at the park. More specifically, these human health criteria assume 176 pounds (80 kilograms) body size, daily lifetime consumption of 10 cups (2.4 liters) of contaminated water, and daily lifetime consumption of 0.8 ounce (22 grams) of contaminated fish from the site. These criteria are developed for chronic exposure scenarios whereas exposure to visitors will be acute, thus this is a conservative approach. Typical park visitors that recreate in Lake Superior engage in activities such as swimming, boating, and fishing. It is anticipated that these recreational users would only incidentally ingest small quantities of lake water while swimming, and would have skin contact with surface water. For these reasons, the criteria used for human health are conservative and protective when applied to exposures scenario for park visitors. Even given these conservative measures for human health, the volume of water required to dilute the range of average to peak pollutant emissions is 0.28% to 21.11% of the water available in the Sand Point Segment (31,557 acre-feet).

In addition to the threshold volume information presented in table 4-5, water samples were collected at the national lakeshore in 2012, as described in the "Water Resources" section of chapter 3. The results of these samples indicated that pollutant loadings attributed to PWC use were largely undetectable. PWC use under alternative 1 would result in continued adverse impacts on water quality at the national lakeshore, localized in the Sand Point segment. However, due to the low level of PWC use at the park, the relatively short PWC use season, and the large volume of water in the system, impacts on water quality would be minimal during the first two years of plan implementation.

Post Phase-Out: After the phase-out of carbureted two-stroke PWCs, all PWCs would have direct injection two-stroke or four-stroke engines, which do not discharge fuel directly into the water (PWIA 2006). Therefore, there would be no PWC-related pollutant discharges related to normal operation to park waters after the two-year phase out. Incidental releases from small leaks or spills would be possible, but would be expected to be infrequent and minor, resulting in no detectable impact. Specifically, PWCs

would no longer contribute the daily pollutant loadings presented in table 4-5 post phase-out, and the pollutant loads from benzene and other pollutants associated with gasoline in the national lakeshore would be reduced overall from current conditions, which would be beneficial to water quality.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Under alternative 2, the entire 42-mile shoreline would be open to PWC use; however, PWC use is expected to remain concentrated near Sand Point, the location of the only boat launch in the national lakeshore, and Miners Beach. These two locations are popular beaches within the national lakeshore and experience high levels of visitation from beach users, picnickers, and other boaters using both motorized and non-motorized vessels. Visitors wanting to use PWCs often combine PWC use with these same activities. Visitors would be able to launch PWCs at Sand Point and travel east to newly opened areas, but this analysis assumes most PWC use would remain between Sand Point and Miners Beach. The majority of PWC users may not choose to travel long distances to access newly opened areas under alternative 2. Use near Grand Marais within the national lakeshore could increase because there is a boat launch in Grand Marais outside of the NPS boundaries; however, boating conditions there are less hospitable for PWCs compared to Munising and Sand Point. Grand Marais is fully exposed to Lake Superior conditions, whereas Munising and Sand Point are protected by Grand Island, making the waters there slightly calmer and less susceptible to large waves. Lake Superior can be a challenging environment for PWCs with weather changing quickly, making it dangerous to be too far from a safe landing area. Although PWC use could increase in areas currently closed to PWCs, it is expected that use in newly opened areas would be lower than PWC use on the western side of the park due to lack of access and the distance from the Sand Point boat launch.

This alternative would implement a phase-out of PWCs containing carbureted two-stroke engines. After this two-year phase-out period, carbureted two-stroke engines would no longer be permitted within the national lakeshore, resulting in the elimination of PWC-related pollutant discharges to park waters.

During the Phase-Out: During the phase-out, it is assumed that 100% of the PWC use at the national lakeshore would be PWCs with older, carbureted two-stroke engines, which discharge unburned gasoline and gasoline additives directly into the water. The projected emissions discharged into the water column from PWC use under alternative 2 were compared to ecological benchmarks and human health criteria for the pollutants analyzed in this EA. Tables 4-6 and 4-7 present the daily pollutant loadings to the national lakeshore based on PWC use estimates, as well as the volume of water needed to dilute each pollutant for alternative 2. This threshold volume is translated into the percentage of water in each segment needed to dilute each pollutant to meet ecological benchmarks and human health criteria.

All segments were modeled using an estimate of 4 PWCs per day for average use (see assumptions in table 4-1). To conservatively estimate water quality impacts under alternative 2, the analysis assumes a certain level of use within each segment for periods of peak use. It was assumed that peak PWC use in the Beaver Basin and Grand Sable segments would be lower than the use in the Sand Point and Cliffs segments, due to the distance between the segments, the PWC launch area in Sand Point, and the conditions of Lake Superior. For peak use, Sand Point and Cliffs segments were modeled using an estimate of 14 PWCs per day, while Beaver Basin and Grand Sable segments were modeled using an estimate of 7 PWCs per day. Pollutant loadings and threshold volumes for the Sand Point and Cliffs segments are presented in table 4-6; the Beaver Basin and Grand Sable segments are presented in table 4-7.

TABLE 4-6: DAILY POLLUTANT LOADINGS AND THRESHOLD WATER VOLUMES FOR AVERAGE AND PEAK PWC USE CONDITIONS IN SEGMENTS 1 AND 2 (SAND POINT AND CLIFFS) – ALTERNATIVE 2

Parameter	Pollutant	Average PWC Use				Peak PWC Use			
		Daily Loading to Water (mg)	Threshold Water Volume Needed*			Daily Loading to Water (mg)	Threshold Water Volume Needed*		
			Acre-Feet	Sand Point Percent	Cliffs Percent		Acre-Feet	Sand Point Percent	Cliffs Percent
Volume of Water Available		**31,557 acre-feet (Sand Point) 20,467 (Cliffs)**				**31,557 acre-feet (Sand Point) 20,467 (Cliffs)**			
Ecological Benchmark	Benzo(a)pyrene	282	16.31	0.05	0.08	986	57.09	0.18	0.28
	Naphthalene	502,816	33.97	0.11	0.17	1,759,855	118.89	0.38	0.58
	1-Methylnapthalene	783,821	302.60	0.96	1.48	2,743,373	1,059.09	3.36	5.17
	Benzene	1,307,321	8.15	0.03	0.04	4,575,622	28.53	0.09	0.14
Human Health Criteria	Benzo(a)pyrene	282	1,903.05	6.03	9.30	986	6,660.68	21.11	32.54
	Benzene (MDEQ)	1,307,321	88.32	0.28	0.43	4,575,622	309.13	0.98	1.51
	Benzene (EPA)	1,307,321	504.70	1.60	2.47	4,575,622	1,766.44	5.60	8.63

* The threshold water volume is the amount of water needed to dilute the pollutant to the benchmark or criterion value.

TABLE 4-7: DAILY POLLUTANT LOADINGS AND THRESHOLD WATER VOLUMES FOR AVERAGE AND PEAK USE CONDITIONS IN SEGMENTS 3 AND 4 (BEAVER BASIN AND GRAND SABLE) – ALTERNATIVE 2

Parameter	Pollutant	Average PWC Use				Peak PWC Use			
		Daily Loading to Water (mg)	Threshold Water Volume Needed*			Daily Loading to Water (mg)	Threshold Water Volume Needed*		
			Acre-Feet	Beaver Basin Percent	Grand Sable Percent		Acre-Feet	Beaver Basin Percent	Grand Sable Percent
Volume of Water Available		**29,716 (Beaver Basin) 21,354 (Grand Sable)**				**29,716 (Beaver Basin) 21,354 (Grand Sable)**			
Ecological Benchmark	Benzo(a)pyrene	282	16.31	0.05	0.08	493	28.55	0.10	0.13
	Naphthalene	502,816	33.97	0.11	0.17	879,927	59.45	0.20	0.28
	1-Methylnapthalene	783,821	302.60	0.96	1.48	1,371,686	529.54	1.78	2.48
	Benzene	1,307,321	8.15	0.03	0.04	2,287,811	14.28	0.05	0.07
Human Health Criteria	Benzo(a)pyrene	282	1 903.05	6.40	9.30	493	3,330.34	11.21	15.60
	Benzene (MDEQ)	1,307,321	88.32	0.30	0.41	2,287,811	154.56	0.52	0.72
	Benzene (EPA)	1,307,321	504.70	1.70	2.36	2,287,811	883.22	2.97	4.14

* The threshold water volume is the amount of water needed to dilute the pollutant to the benchmark or criterion value.

In the Sand Point segment, PWCs are currently permitted. As a result, during the phase-out period, impacts in this segment are expected to be the same as those described for alternative 1. Daily pollutant loadings in the Cliffs segment would be the same as those in the Sand Point segment, as the PWC use assumptions would be the same (4 average, 14 peak). However, the total water volume for the Cliffs segment is approximately one-third less than the Sand Point segment, meaning that a greater percentage of the total water volume would be needed to dilute each pollutant to meet the ecological benchmarks and human health criteria. For example, considering human health under peak PWC use, benzo(a)pyrene would require approximately 21% of the volume of Sand Point for dilution but approximately 33% of the water in the Cliffs segment (table 4-6).

Despite the larger percent of the total volume of the Cliffs segment needed for dilution of PWC-based pollutants, all of the pollutants would be diluted to levels protective of human health and aquatic life. This analysis assumes that remote segments of the park, such as Beaver Basin and Grand Sable, would be used less by visitors. These segments contain smaller volumes of water than the Sand Point segment; however, given the expected lower use in these segments, the Beaver Basin and Grand Sable segments contain sufficient volumes of water to dilute pollutant loadings from PWCs to levels protective of aquatic life and human health under both average and peak PWC use conditions.

As stated previously, the human health criteria are based upon *daily lifetime* exposure to the concentrations of gasoline-related pollutants. The criteria used for human health are conservative and protective and likely overstate the risk to the typical visitor to the national lakeshore. However, even with the conservative values, the volume of water needed to dilute each pollutant to a level protective of human health would range from approximately 0.3% to 33% for all segments under both average and peak PWC use conditions. This is an indication that the very low levels of pollutants generated by PWCs would not result in a change to water quality that could affect human health or aquatic organisms.

Under alternative 2, the entire shoreline would be open to PWC use and subject to the deposition of pollutants in the water column during the phase-out of carbureted two-stroke PWCs. The impacts from PWC use in the Sand Point segment would be the same as current conditions, as described for alternative 1. The other three segments would experience adverse effects from pollutant loading from PWC use when compared to current conditions. However, due to the low level of PWC use at the park, the relatively short PWC use season, and the volume of water in the lake system, adverse impacts on water quality would be minimal during the first two years of plan implementation, but would not be detectable.

Post Phase-Out: After the phase-out of carbureted two-stroke PWCs, it is assumed that the level of PWC use at the national lakeshore would remain the same; however, all PWCs would have direct injection two-stroke or four-stroke engines, which do not discharge fuel directly into the water (PWIA 2006). The elimination of discharges from carbureted two-stroke engines into the national lakeshore would have a beneficial impact to water quality under alternative 2 by preventing the pollutant loadings presented in tables 4-6 and 4-7. The Sand Point segment would experience beneficial effects when compared to current conditions. Water quality conditions in the Cliffs, Beaver Basin, and Grand Sable segments are expected to be very similar to current conditions, though adverse impacts could occur due to the addition of PWCs in these areas from potential gasoline spills or leaks.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Under alternative 3, PWCs would be prohibited from operating within all four segments of the national lakeshore. In the Sand Point segment where PWCs are currently allowed to operate, this would eliminate PWCs as a source of pollutants, resulting in a small but beneficial effect on water quality. However, the beneficial effects would be limited as the current pollutant loadings from PWC use are so small, especially with the large volume of water available for dilution. In the long term, the impacts on water

quality under alternative 3 would be similar as those described under alternative 1 post phase-out. The elimination of PWC use would result in beneficial impacts, because it eliminates the potential for PWC discharges from the entire lakeshore.

CUMULATIVE IMPACTS

Other ongoing and reasonably foreseeable future actions within and around the national lakeshore have the potential to impact water quality. The continued use of other motorized watercraft contributes to water quality impacts at the national lakeshore. Based on the PWC survey during the July 4th weekend in 2013 (NPS 2013b), the ratio of other motorized boats to PWCs is approximately 14 to 1. Similar to PWCs, motorized boats can contribute to water pollution by generating contaminant loadings, which degrade the water quality of the national lakeshore and result in adverse impacts. While other motorized watercraft are expected to produce the same gasoline-related pollutants as PWCs, data on the sizes and types of other motorboat engines are not available; therefore, the amount of pollutants discharged by other motorized vessels cannot be accurately calculated. However, due to the level of motorboat use observed in the park, it can be assumed that they contribute a much greater volume of pollutants to park waters compared to PWCs.

The future Sand Point revetment project would remove or replace the failing revetment. This project would consider a range of alternatives, from allowing retaining the current revetment without improvements to replacing the revetment. The alternatives would be developed, to the extent possible, to allow natural shoreline processes to occur while restoring or preserving the natural and cultural resources. This project could create short-term adverse impacts due to turbidity from construction activities; however, over the long term, this project would be beneficial to water quality, as it would allow natural processes to occur.

These ongoing and reasonably foreseeable future actions would have adverse impacts on water quality at the national lakeshore from increased pollutants and beneficial impacts from allowing natural shoreline processes to occur. When compared to existing conditions, PWC use under alternative 1 would result in adverse effects during the two-year phase-out period and beneficial impacts after two years from the elimination of pollutants to surface waters from carbureted two-stroke PWC engines. Impacts from alternative 2 would be similar to impacts for alternative 1 in the Sand Point segment, where PWC use currently occurs. Impacts in other segments would be short-term adverse during the two-year phase-out period. Following the phase-out, impacts for alternative 2 would be reduced but would still be slightly adverse, as PWCs would operate in areas where currently PWCs are not permitted. Alternative 3 would also result in beneficial effects from eliminating PWC use at the national lakeshore. The beneficial and adverse impacts on water quality from PWC use under each of the alternatives would be slight and would not result in appreciable effects; the water quality of the national lakeshore would remain high under each of these alternatives. Therefore, when considered with the other ongoing and future actions described above, the three alternatives would not contribute noticeably to the cumulative adverse and beneficial impacts.

CONCLUSION

Under alternatives 1 and 2, the use of older, more polluting PWCs would continue during the first two years of plan implementation. Impacts to water quality would be localized in the Sand Point segment and would be adverse in the short term, but would remain at or near current levels of impact from PWC use. Under alternative 1, there would be no PWC-caused water quality impacts in other areas of the national lakeshore outside of the Sand Point segment. Alternative 2 would result in adverse impacts to water quality in the Cliffs, Beaver Basin, and Grand Sable segments compared to the existing conditions because PWC use is not currently authorized in these areas. Though the entirety of the shoreline would be

open to PWCs under alternative 2, the amount of PWC recreation is not expected to increase and the majority of use would continue to take place in the Sand Point Segment. The estimated pollutant loading from PWC use under alternatives 1 and 2 would not be high enough to adversely affect aquatic life or human health, based on literature-derived benchmarks and federal and state criteria. After the first two years of implementation, only direct injection two-stroke and four-stroke engines would be permitted, which would eliminate PWC-related discharges to the surface water. Leaks or spills could occur but would be expected to be infrequent and small (PWIA 2006). In the long term, the impacts to water quality in the Sand Point segment would be beneficial compared to current conditions under alternatives 1 and 2. Under alternative 2 in the long term, the water quality of the other three segments would be reduced compared to the phase-out period, but would still be adverse, as PWCs would operate in areas where currently PWCs are not permitted. When compared with current conditions at the national lakeshore, alternative 3 would result in slight beneficial impacts on the water quality in the Sand Point segment from the elimination of PWC pollutants. Water quality in the segments of the national lakeshore east of Miners Beach would not change under alternative 3, as PWC use is currently prohibited in those segments. Although the three alternatives are expected to create slight adverse or beneficial impacts on water quality, the exceptional water quality of the national lakeshore would not be noticeably altered; it would remain high. The three alternatives would not contribute appreciably to the cumulative adverse and beneficial impacts of the other ongoing and future actions on water quality.

Climate change could also have impacts on the water resources at Pictured Rocks National Lakeshore. Research shows that declines in ice around Lake Superior and tributary streams, as well as earlier melting, is taking place (Robertson et al. 1992, Anderson et al. 1996, Magnuson et al. 2000, Austin and Colman 2007). As the timing of Lake Superior's summer continues to advance by a half day each year (Austin and Colman 2007), evaporation could continue to affect lake level changes. Overall the climate in the Great Lakes region is expected to become drier. Lake levels are expected to decrease, resulting in increased concentrations of pollutants as the available water for dilution also decreases (UCS 2003).

AIR QUALITY

PERSONAL WATERCRAFT EMISSIONS

PWCs burn fuel and generate air emissions, including carbon monoxide (CO), nitrogen oxide (NO_X), particulate pollution, unburned hydrocarbons (HC), a form of volatile organic compound (VOC), trace amounts of organic hazardous air pollutants, and carbon dioxide (CO_2). These emissions can contribute to air pollution and may cause adverse effects to human health and welfare, including impacts to visibility and climate change. The extent to which air pollution affects human health and welfare depends on the magnitude of the emissions and the existing air quality.

- CO is a primary pollutant, meaning it is emitted directly into the atmosphere. At sufficient concentrations, CO has adverse human health effects, including toxic effects on blood and tissues, and has been linked to increased risk for people with heart disease, reduced visual perception, impaired cognitive functions, impaired aerobic capacity, and possible fetal effects.
- NO_X is a primary and secondary pollutant. Secondary pollutants are not directly emitted, but form when primary pollutants react in the atmosphere. NOx has potential direct public health effects and the potential to form particle pollution in the atmosphere, which can degrade visibility and impact vistas in protected areas. Nitrogen deposition in excessive amounts from NO_X emissions can also cause acidification of soils, which can adversely affect vegetation and surface water.
- NO_X and VOCs combine chemically in the presence of heat and sunlight to form ozone, a lung irritant.

- Particle pollution is both a primary and secondary pollutant with potential adverse public health effects related to respiratory function.
- HC may also include trace amounts of organic hazardous air pollutants such as formaldehyde, a confirmed human carcinogen.
- Ozone-related health effects include impairment of lung function and other respiratory symptoms, aggravation of asthma, and increased hospital and emergency room visits for respiratory problems.
- CO_2 and other greenhouse gases are believed to contribute to a gradual increase in global temperatures and changes to climate patterns.

Prior to 2006, PWC engines were generally carbureted two-stroke engines. In these engines, the cylinders are flushed after each combustion cycle and are refilled with a mixture of air and fuel, leading to lower fuel efficiency and higher emissions (NMMA 2013). Regulations that went into effect in 2006 required two-stroke engines to be fuel injected to reduce air pollutant emissions. Direct injection two-stroke engines purge the cylinders with clean air that contains no fuel. The fuel is then directly injected into the cylinder after the exhaust port has closed, greatly reducing emissions (NMMA 2013). Four-stroke engines complete four strokes of the piston during each cycle (intake, compression, expansion, and exhaust) (Roth et al. 2012). This design results in lower emissions and higher fuel efficiency (MECA 2009).

GUIDING REGULATIONS AND POLICIES

Clean Air Act: The Clean Air Act established National Ambient Air Quality Standards (NAAQS) to protect public health and welfare from air pollution. Under provisions of the 1990 Clean Air Act amendments, federal actions may not cause or contribute to violations of the NAAQS and are required to "conform" to applicable state implementation plans in non-attainment areas (40 CFR Part 93 Subpart B – Determining General Conformity of Federal Actions). Pictured Rocks National Lakeshore is in an area designated as Class II and is in attainment for all of the NAAQS. Consequently, the airshed is not as highly protected as federal mandatory Class I areas, has some capacity to absorb additional air pollution, and is not subject to the requirements of the General Conformity Regulations (40 CFR Part 93).

Applicable PWC Emission Standards: Under the Clean Air Act amendments, the EPA is required to evaluate emissions from nonroad engines and vehicles and to set standards to control and reduce emissions. These standards are applicable to the manufacturers of PWCs. There are currently no emission standards in place for PWC use in the park. However, PWC users would be required to abide by the 2010 EPA emissions standards under the action alternatives in this EA. A full discussion of the progression of EPA standards and milestones is presented in "Appendix B: Air Quality Standards and Analysis Methodology."

STUDY AREA

The study area for air quality includes the immediate locations designated for PWC use under each of the alternatives and the surrounding nearshore areas where air emissions may produce impacts. For purposes of this analysis, the study area is the 0.25-mile NPS jurisdictional boundary in Lake Superior plus a 10,000-meter wide strip inland, which covers most of the land within the park boundaries.

METHODOLOGY AND ASSUMPTIONS

To assess air quality impacts resulting from the proposed alternatives, the following assumptions were used:

- Typical use patterns for PWCs at the national lakeshore were identified. Peak hours of use were estimated, assuming that on a high-use day, all PWC would operate at the same time. Daily maximum usage rate is assumed to be 14 PWCs/day and 3 hours/PWC/day, or 42 hours of PWC use per day. PWC usage at the national lakeshore for other resources was assumed to occur on 56 days per year (8 weeks during July/August: 16 peak days per season, 24 average days per season, and 16 days with no PWC use per season) for a total of 960 hours. For the air quality analysis, the team decided to examine the impacts of peak usage for the 56 days per year that PWCs are assumed to operate, resulting in an estimate of 2,352 hours of annual PWC operation. While this overestimates annual usage, and therefore annual emissions, the team determined this was the most conservative analysis and would be most protective in analyzing the potential for impacts to air quality at the national lakeshore.
- The air emissions model assumes that during the phase-out period (first two years of plan implementation) all PWCs are carbureted two-stroke models. This assumption likely overestimates the impacts from PWC air emissions during the phase-out. While 93% of the PWCs registered in Michigan were manufactured prior to 2011 (when PWC manufacturers stopped producing carbureted two-stroke PWCs), it is unknown how many of these PWCs are carbureted two-stroke or direct injection two-stroke or four-stroke engines. The future condition (post phase-out of carbureted two-stroke PWCs) calculations assume that all PWCs are the less-polluting direct injection two-stroke or four-stroke models.
- The air emissions modeling was only conducted for alternative 1. Under this alternative, PWCs would be permitted to operate between Sand Point and Miners Beach, which incorporates 9.2-miles of the national lakeshore shoreline; the model estimates emissions from PWC use, based on the assumptions above, for a 10-mile segment. The 10-mile segment approximates the area of alternative 1. Alternative 2 assumes that PWC use would not increase, although the entire shoreline would be open to PWC use. Under alternative 2, the same amount of air pollutants from PWC use would be produced, but the pollutants would be spread out over the entire 42 miles of shoreline. In this manner, the modeling results for alternative 1 produce a worst-case scenario for effects on air quality at the national lakeshore.

Impacts of PWC use on air quality were examined using two EPA models: one that examined air emission rates and a second that examined the worst-case concentrations for emissions produced by PWCs. The modeling results were compared to national standards, as well as national and NPS-specific screening thresholds to characterize the potential for impacts from air emissions. Below are the steps taken in this analysis; full descriptions of the modeling, standards, and screening thresholds are available in appendix B.

1. Air quality designations for the areas surrounding the study area were identified to ensure that the project emissions would not affect NAAQS compliance in neighboring areas. The study area is located in Alger County, Michigan, which is a Class II area designated as attainment for all NAAQS. Existing sources of air emissions in Alger and the adjacent counties are identified in table 3-1 in the "Air Quality" section of chapter 3.
2. Air emissions rates from PWC use under the proposed alternatives were estimated using the EPA National Mobile Inventory Model (NMIM) software package, as described in appendix B. The National Mobile Inventory Model estimates the annual emissions produced by PWC use and the results are provided in tons of pollutant emitted per year. The NMIM modeling was performed for criteria pollutants (CO, NO_x, PM_{10} [particulate matter less than 10 micrometers in diameter], $PM_{2.5}$ [particulate matter less than 2.5 micrometers in diameter], and SO_2), as well as for VOCs and CO_2. The modeled air emissions rates were compared to screening thresholds presented in

Technical Guidance to Assessing Impacts to Air Quality in NEPA and Planning Documents (NPS 2011b) to determine the need for further modeling.

3. The potential air quality impacts from PWC use were determined using the EPA AERSCREEN dispersion model (screening-level air quality model). Dispersion modeling is used to characterize the atmospheric processes that disperse a pollutant emitted by a source, such as a PWC, using mathematical formulations (EPA 2016). AERSCREEN is described fully in appendix B. The model assumes that the current designated PWC use area at the national lakeshore is a source of emissions, or a source of pollution that emits a substance or radiation from a specified area. AERSCREEN dispersion modeling was only performed for CO; no dispersion modeling was performed for other criteria pollutants because their estimated emissions fell below screening thresholds, as described further in the analysis below.
4. The NAAQS, ambient air (prevention of significant deterioration) increments, and prevention of significant deterioration significant impact levels (SILs) were reviewed for each pollutant. Where applicable, impacts from PWC emissions were compared with the SILs, which are the most protective screening criteria for human health and air quality values (more background information on SILs and how they are used to understand impacts to air quality is provided below and in appendix B). SILs are available for NO_2, $PM_{2.5}$, PM_{10}, SO_2, and CO. Significant deterioration SILs for pollutants are provided in appendix B (tables B-2 and B-3).
5. Background air pollutant concentrations from the nearest monitoring location to the national lakeshore (Duluth, Minnesota – approximately 273 miles) were reviewed for comparison to the modeled pollutant concentrations for the national lakeshore.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Current levels of PWC use would continue under alternative 1. Airborne pollutants related to PWC use that could affect human health include CO, PM_{10}, $PM_{2.5}$, and ozone; air quality related values, including visibility and biological resources, could be affected by ozone, NO_x, and $PM_{2.5}$. NO_x and VOCs are precursors to ozone and are evaluated separately in lieu of ozone. Additionally, the emission rate of CO_2 was examined to determine the level of greenhouse gas emissions from the use of PWCs. The annual emissions of these criteria pollutants and greenhouse gases associated with alternative 1 were estimated using the EPA NMIM software and are presented in table 4-8.

TABLE 4-8: ANNUAL PWC EMISSIONS UNDER ALTERNATIVE 1

Phase	Estimated Annual Emissions (tons/year)						
	Criteria Pollutants						
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2
During the phase-out	9.56	0.172	0.101	0.093	0.001	5.25	64.2
Post phase-out	7.51	0.397	0.004	0.003	0.001	0.497	58.1

The *Technical Guidance to Assessing Impacts to Air Quality in NEPA and Planning Documents* (NPS 2011b) provides direction on the level of air quality analyses that should be included in a NEPA document such as this one. Annual emission rates for all pollutants below 5 tons per year are considered *very small*, and rates below 50 tons per year are regarded as *small*. These rates are screening thresholds for attainment areas, such as Alger County, and are protective of NPS resources. Screening thresholds help determine if an emissions source would cause or contribute to the degradation of these resources. Based on the assumption of 2,352 hours of annual PWC operation at the national lakeshore, the estimated annual emission rates fall within the *very small* category except for VOC emissions during the phase-out

period and CO emissions during and after the phase-out (table 4-8). VOCs during the phase out period (5.25 tons/year) are just above the *very small* category (less than 5 tons per year), and well within the *small* category (less than 50 tons/year). CO emissions for both phases are in the *small* category.

Under alternative 1, CO_2 emissions are estimated to be approximately 64.2 tons per year during the phase-out and 58.1 tons per year post phase-out (table 4-8). Although these annual emission rates are higher than those of the criteria pollutants, emissions of CO_2 from PWC use would be minimal. The annual emission rate for CO_2 under alternative 1 is orders of magnitude lower than the stationary source significance emission rate level, which is 75,000 tons per year indicating that the amount of CO_2 contributed to the environment by annual PWC use would be minimal and would not affect the regional air quality.

Table 4-8 shows the estimated NO_X emissions increase following the phase-out period. The reason for this increase is because new engine technologies provide more efficient combustion, resulting in more complete oxidation of CO to CO_2. Lower levels of CO increase O_2 concentrations in the air, resulting in higher NO_X production. The estimated amounts of criteria pollutants NO_x, $PM_{2.5}$, PM_{10}, and SO_2 emitted by PWCs would be *very small* both during and after the phase-out of carbureted two-stroke PWC engines, according to the thresholds provided in NPS guidance on air quality impacts (NPS 2011b).

NPS air quality guidance (NPS 2011b) does not recommend additional modeling if annual emissions are small. Although annual emissions of CO were estimated to be well below 50 tons per year, AERSCREEN dispersion modeling was performed for CO to further assess ambient impacts. No further modeling was performed on other criteria pollutants since their emissions were estimated to be less than 5 tons per year.

Table 4-9 presents the maximum modeled ambient impacts (concentrations) for CO with respect to SILs, as well as NAAQS. The NAAQS were developed to protect public health and welfare from the effects of air pollution. These standards apply to the six criteria pollutants and are presented in table B-1 in appendix B. Michigan has adopted the federal NAAQS for use in managing ambient air quality. EPA uses SILs as a screening tool to determine if the emissions from a stationary source (in this case, PWCs) would have a "significant" impact on air quality in the area; these values are presented in table B-3 in appendix B. This number is the most conservative threshold and represents the minimum level of CO that is considered to have an impact. Under prevention of significant deterioration rules, further impact analysis is not required on new sources of emissions with modeled impacts are below the SIL. This includes air quality related values, such as visibility, plants, animals, soils, and water. SILs are more protective of air quality values and human health than NAAQS, which represent the maximum level of CO permitted under the Clean Air Act. The prevention of significant deterioration program is described in detail in appendix B.

TABLE 4-9: PREDICTED MAXIMUM CARBON MONOXIDE IMPACTS VERSUS SIGNIFICANT IMPACT LEVELS

Phase	Averaging Period	Maximum Modeled Concentration (ppm)	NAAQS (ppm)	Significant Impact Level (ppm)
During phase-out	1-hour	2.51	35	2.22
	8-hour	0.94	9	1.75
Post phase-out	1-hour	1.97	35	2.22
	8-hour	0.74	9	1.75

ppm = parts per million

As shown in table 4-9, the modeled impacts (ambient concentration increases) under alternative 1 for CO are well below the NAAQS.

The maximum CO emissions may be 13% above the SIL for the 1-hour averaging period during the phase out. As noted above, the SIL is a screening tool for stationary sources of air emissions. If the SIL is exceeded, the next step would be to model all point sources in the area to determine if the point source of interest (in this case PWCs), in combination with other point sources, causes NAAQs criteria in the area to be exceeded. After review of the data, the team determined the potential for impact to CO levels was minimal and additional analysis was not needed for the following reasons:

- There are no stationary point sources within the project area. The other primary sources would be other motorized boats.
- The modeled analysis assumes that 14 PWCs would be operating in the same area for 1 full hour and that all of these PWCs have carbureted two-stroke engines. These assumptions overestimate the actual PWC emissions produced. The maximum number of PWCs observed over the course of one day at the national lakeshore was 14, which were at different locations and not operating simultaneously. According to observations at the park, typical operation of a given PWC lasts 20 to 30 minutes (NPS 2013b). This may occur multiple times over the course of a day, but observations of operation for one hour without stopping was rare (NPS 2013b).
- The SIL is for emissions from a stationary source over one hour. As noted, PWCs would be operating across a 9.2 mi area of the national lakeshore. Therefore, PWC emissions would not be stationary.
- Once the phase out is complete, the modeled CO levels would be below the SIL.

To further analyze the levels of CO from PWC use, table 4-10 presents the historical background levels of CO from the closest ambient monitoring station in Duluth, Minnesota, which would include the impacts of all existing sources of CO emissions, including PWCs at the national lakeshore.

TABLE 4-10: HISTORICAL CARBON MONOXIDE BACKGROUND DATA FROM THE DULUTH, MINNESOTA AMBIENT MONITORING STATION

Year	Maximum Concentration (ppm)		Year	Maximum Concentration (ppm)	
	1-hour	8-hour		1-hour	8-hour
2000	4.2	2.1	2007	4	3.1
2001	4.6	2.9	2008	4.1	1.8
2002	3.4	2.1	2009	3.5	1.5
2003	4.7	1.9	2010	3	1.9
2004	3.1	1.5	2011	2.7	1.6
2005	4.6	1.6	2012	1.9	1
2006	2.8	1.4	2013	8.7	3
NAAQS	35	9	NAAQS	35	9

Historical levels of CO recorded at the Duluth station are well below the NAAQS for 1-hour (35 ppm) and 8-hour (9 ppm) averaging times. The estimated concentration of CO from PWC emissions at the national lakeshore fell within or below the range recorded at this station (table 4-10), and continued use of PWCs at the national lakeshore would be expected to remain below the NAAQS for CO. The estimated

air pollution associated with PWC use under alternative 1 indicates low annual emission rates for criteria pollutants, ozone precursors, and the greenhouse gas CO_2. Actual emission rates would be expected to be lower than those modeled because the models used peak conditions (14 PWCs per day for the entire 56-day PWC season) to analyze a highest pollutant concentration scenario Emission rates are likely to be considerably lower because PWC use is much lower on average days and some days there is no PWC use at the national lakeshore. During the phase-out, there would be minimal adverse impact on air quality. There would be a long-term improvement in air quality after the phase-out compared to current conditions due to the reduced emissions produced by newer PWC engines. Although PWC use would have some minimal impact on air quality, the impact would not be measurable and air quality at the national lakeshore and in the region would remain high.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Under alternative 2, the entire 42-mile shoreline would be open to PWC use; however, PWC use is expected to remain concentrated near Sand Point and Miners Beach due to the location of the only boat launch in the national lakeshore and the more suitable conditions for PWC use. These two locations are popular beaches within the national lakeshore and experience high levels of visitation from beach users, picnickers, and other boaters using both motorized and non-motorized vessels. Visitors wanting to use PWCs often combine PWC use with these same activities. Under alternative 2, PWCs could launch at Sand Point and travel east to newly opened areas, but most PWC users may not travel long distances to access new areas. PWC use near Grand Marais could increase because there is a boat launch in Grand Marais; however, boating conditions there are less hospitable for PWCs then in Munising and Sand Point.

Under this alternative, the number of PWCs used daily in the national lakeshore would be the same as under alternative 1. Because air quality is measured on a regional level, the estimated annual emission rates presented in table 4-8 for alternative 1 would apply under alternative 2, as the aggregate emissions (annual tons) from PWC use under alternative 2 would be same as under alternative 1. The estimated amounts of criteria pollutants NO_x, $PM_{2.5}$, PM_{10}, and SO_2 emitted by PWCs would be *very small*, both during and after the phase-out of carbureted two-stroke PWC engines, according to the thresholds provided in NPS guidance on air quality impacts (NPS 2011b). As presented in table 4-8, the emission rate for CO would be higher than other criteria pollutants; however, concentrations of CO would fall below the prevention of significant deterioration significant impact levels with the exception of 1-hour impact during the phase-out of carbureted two-stroke engines, which exceeds the SIL by approximately 13%. The estimated emission rates for the precursors for ozone (NO_x and VOCs) and the greenhouse gas CO_2 (table 4-8) are low enough that further modeling is not needed under the 2011 NPS air quality guidance; these pollutants would not be expected to create a measurable impact on air quality. As stated for alternative 1, the air pollutants released from PWC use would not create a perceptible adverse impact on air quality at the national lakeshore. During the phase-out, the impact on air quality would be the same as current conditions. After the phase-out, air quality would improve, due to the reduced emissions produced by newer PWC engines. Although PWC use would have some minimal impact on air quality, the impact would not be measurable and air quality at the national lakeshore and in the region would remain high.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Under alternative 3, PWC use would not be allowed at Pictured Rocks National Lakeshore, resulting in beneficial effects on the airshed of the national lakeshore, when compared to existing conditions. By prohibiting PWC use, the NPS would eliminate the concentrations of criteria pollutants, greenhouse gases, and ozone precursor pollutants released by PWC engines. This beneficial effect would be minimal, as the estimated annual emission rates from PWC use are considered to be *very small* to *small* (table 4-8).

The elimination of these pollutants would result in beneficial effects when compared to current conditions but would not result in measurable changes to air quality at the national lakeshore.

CUMULATIVE IMPACTS

Sources of air pollutants near the national lakeshore, other than motorized watercraft, include motorized vehicles, residential homes, and industrial complexes such as power plants, as described in the "Air Quality" section of chapter 3. These sources contribute to the adverse effects on air quality at the national lakeshore; however, low numbers of vehicles and the distance from residences and businesses limit the adverse impacts on air quality at the park. The effects of these sources are also captured in chapter 3. The only other ongoing or reasonably foreseeable future action within and around the national lakeshore that has the potential to impact air quality at Pictured Rocks National Lakeshore would be the use of other motorized watercraft.

Based on the 2013 PWC survey (NPS 2013b), the ratio of other motorized boats to PWCs is approximately 14 to 1. This count includes pontoon boats, fishing boats, Jon boats, and commercial tour boats. Data on the types of engines in the motorized watercraft used at the national lakeshore is not currently available. However, using the average and peak PWC numbers and the ratio of other motorized watercraft to PWCs, the number of motorized watercraft per day at the national lakeshore could range from 56 to 196 vessels. The operation of this number of other motorized watercraft would result in adverse impacts to air quality that would surpass those modeled for PWCs under the alternatives.

The ongoing use of other motorized watercraft at the national lakeshore would continue to produce adverse impacts on air quality. PWC use under alternative 1 would result in slight adverse impacts on air quality during the two-year phase-out period and improved, yet still adverse, impacts after two years from the elimination of older more polluting PWC engines. Impacts from alternative 2 would be similar to impacts for alternative 1 in the area between Sand Point and Miners Beach, where PWC use currently occurs. Impacts on air quality east of Miners Beach would be adverse during the two-year phase-out period. Following the phase-out, impacts for alternative 2 would be reduced but would still be slightly adverse, as PWCs would operate in areas where currently PWCs are not permitted. Alternative 3 would result in beneficial effects to air quality from the elimination of air pollutants associated with PWC use.

The adverse impacts on air quality from PWC use under alternatives 1 and 2 and the beneficial impacts from alternative 3 would be slight and would not result in appreciable effects. Therefore, when considered with the other ongoing and future actions described above, the three alternatives would not contribute noticeably to the cumulative adverse and beneficial impacts on air quality at the national lakeshore.

CONCLUSION

Impacts on air quality under alternative 1 would be adverse; however, the release of air pollutants from PWC use would not create a distinguishable effect on air quality at the park. The annual emission rates of criteria air pollutants are expected to be comparable to current conditions with continued slight adverse impacts for 2 years during the phase-out of older, more polluting PWCs. Compared to current conditions, air quality under alternative 1 would improve post phase-out, due to the elimination of the older, more polluting PWCs. Estimated concentrations of greenhouse gases and ozone precursor pollutants would remain very low. Impacts under alternative 2 would be the same as alternative 1, except that since PWCs would be permitted along the entire national lakeshore, new areas would be impacted by PWC use. While the entire national lakeshore would be open to PWC use under alternative 2, as documented before, it is expected most PWC use would remain in the western areas near Sand Point and Miners Beach. As with alternative 1, air quality impacts under alternative 2 would only be slight, and would be reduced after the phase-out. Alternative 3 would result in beneficial impacts to air quality compared to current conditions,

as PWCs would be banned from the national lakeshore, eliminating the air pollutants released by PWCs in the park. However, due to the low level of current PWC use at the national lakeshore, the beneficial effects would not be measurable. Although the three alternatives are expected to create slight adverse or beneficial impacts on air quality, the air quality of the national lakeshore would not be noticeably altered. The three alternatives would not contribute appreciably to the cumulative adverse impacts of other watercraft use on air quality at the national lakeshore.

ACOUSTIC ENVIRONMENT AND SOUNDSCAPES

PWC use at the national lakeshore has an impact on the soundscape and acoustic environment. The natural soundscape in this area includes the sounds of waves on the lake, birds chirping, and wind in the trees. PWC noise and other non-natural sound sources, such as watercraft and automobiles, affect this soundscape; in this discussion, these non-natural sounds are described as noise. Natural sounds are important to wildlife and to visitors seeking a quiet visit to the national lakeshore. PWCs can disrupt the natural soundscape and prevent other visitors from experiencing the sounds of the natural environment. PWCs are often cited as being particularly disruptive when they engage in rapid maneuvers because of the variable noise levels they produce. PWC use in a concentrated area for an extended period also worsens the effects of PWC noise (Komanoff and Shaw 2000). The PWC industry has worked to decrease the noise generated by newer PWC models. Improvements include a redesign of the intake and exhaust structures, noise cancelling devices, and better noise muffling and insulation. Additionally, educational efforts have been used to reduce the disruptive noise from PWCs (PWIA 2011).

The purpose of this section is to describe the impacts to the acoustic environment from PWC use under the project alternatives. Noise impacts to wildlife, special-status species, wilderness, and visitor experience are described in those respective sections later in this chapter.

GUIDING REGULATIONS AND POLICIES

Director's Order 47: ***Soundscape Preservation and Noise Management***: Director's Order 47 requires park managers to measure baseline acoustic conditions; determine which existing or proposed human-caused sounds are consistent with park purposes; set acoustic management goals and objectives based on those purposes; and determine which noise sources impact the park and need to be addressed by management. This directive serves to aid superintendents in eliminating, mitigating, or minimizing inappropriate noise sources.

Federal and State Regulations: Federal regulations for noise abatement (36 CFR § 3.15) prohibit operating a vessel at sounds above 75 dB measured using test procedures applicable to vessels underway (Society of Automotive Engineers SAE—J1970).

Michigan state regulations also provide some measures that may mitigate the impacts of PWC noise. Michigan regulations require PWCs to operate at a flat-wake speed perpendicular to the shoreline when within 200 feet of any Great Lakes shoreline.

STUDY AREA

The study area for analyzing impacts to soundscapes consists of the allotted shoreline for the specific alternatives (Sand Point to Miners Beach for alternative 1 and the entire shoreline of the national lakeshore for alternatives 2 and 3).

METHODOLOGY AND ASSUMPTIONS

Baseline Data: Soundscape data were collected at the national lakeshore in an Acoustical Monitoring study completed in 2012 (NPS 2013d), as discussed in the "Acoustic Environment and Soundscapes" section of chapter 3. The data collected from two sites (Miners Castle and Beaver Basin) during the survey were used as the baseline acoustical data for the national lakeshore in this analysis.

The Acoustical Monitoring Report (NPS 2013d) determined the existing ambient sound levels (including both natural and human-caused sounds) and the natural ambient sound levels (excluding human-caused sound) at the national lakeshore. These sound levels were recorded as median values, meaning that the actual sound levels at the national lakeshore are louder than the median ambient sound metric 50% of the time, and softer than the median ambient sound metric 50% of the time for both the natural and existing ambient metrics. The Acoustical Monitoring Report (NPS 2013d) identified sound levels for both daytime and nighttime; however, because PWC use is not permitted at the national lakeshore at night, only the daytime values are discussed.

Noise Experienced by Visitors

Noise generated by PWCs can affect other visitors at the national lakeshore, as well as wildlife. The noise levels presented in this section represent the noise generated by PWCs that is experienced by other visitors during the daily length of stay at the national lakeshore. The length of stay for shoreline visitors and other watercraft users is assumed to be 4 hours for all scenarios presented in this analysis.

The daytime median existing ambient sound level is the baseline condition used for this impact analysis. These median values (including human-caused and natural sounds) were determined to be 36.3 dBA at Miners Castle and 39.2 dBA at Beaver Basin (NPS 2013d). This range of median existing ambient sound levels for the two monitoring locations (36.3 to 39.2 dBA) is considered the baseline condition and will be referred to as such for the remainder of the document.

The sound levels described in the 2012 Acoustical Monitoring Report may be lower than actual soundscape conditions at the national lakeshore due to the locations of the acoustical monitoring equipment used during the study. Features such as elevation and topography could interfere with the amount of sound reaching the receivers. The Beaver Basin monitor was located approximately 0.10 mile from the shoreline in wilderness and approximately 37 feet above the surface of the water, while the monitor at Miners Castle was located on a cliff approximately 0.75 mile west of Miners Beach (a high-use area for visitors) and approximately 164 feet above the water surface. This could account for the differences in magnitude of sound that was recorded between the two sites. The sounds from Miners Beach, the busier of the two sites, dissipated before reaching the monitor due to the height and distance from the shoreline. Further, wave action likely contributed to the higher sound levels at Beaver Basin. Due to the closer placement of the monitor to the shoreline, the sound of wave action was not able to dissipate as much before reaching the monitor.

In contrast, in the sound attenuation modeling used to supplement the Acoustical Monitoring Report (discussed fully in the next section), the visitor and the noise source (PWC) are on the same topographical plane, with the visitor located 150 to 320 feet from the noise source. Specifically, for popular beach locations, such as Sand Point and Miners Beach, the results obtained from the sound recorders are not directly comparable to this sound attenuation modeling, as the results do not incorporate the noise associated with crowded beaches. During the July 2013 PWC survey (NPS 2013b), visitor numbers were noted at intervals throughout each day. The highest number of visitors recorded during these intervals was

120 at Sand Point and 200 at Miners Beach. In addition, park personnel have reported that the parking areas for these locations are often full during busy summer weekends.

Sound Attenuation Modeling: To supplement the data in the Acoustical Monitoring Report (NPS 2013d), sound attenuation modeling was conducted to determine the level of noise produced by PWCs and how that noise affects the soundscape at the national lakeshore.

PWIA presents data indicating that the shift from carbureted two-stroke engines to direct injection two-stroke or four-stroke engines has resulted in reduced PWC engine noise (PWIA 2011). Sound reduction has been accomplished in part by lowering the noise levels produced by PWCs, but also by lowering the pitch of the engine (PWIA 2006).

Harris, Miller, Miller, and Hanson, Inc. recorded the noise level of three different 2001 two-stroke PWC engines when operated approximately 82 feet (25 meters) from a visitor (Menge et al. 2002). Fristrup and Joyce (2014) determined the reduction in noise of the three PWC engines when upgraded to four-stroke engines. These data were used to estimate PWC noise post phase-out of carbureted two-stroke PWCs. Table 4-11 presents the peak noise from three different two-stroke and four-stroke PWC engines measured from an 82-foot distance at full throttle. Peak noise levels are the highest instantaneous sound level produced by a noise source.

TABLE 4-11: PEAK A-WEIGHTED NOISE FROM THREE DIFFERENT TWO-STROKE AND FOUR-STROKE PWC ENGINES

PWC Model	Peak Noise of Two-Stroke Engines[a] (dBA)	Reduction of Noise from Four-Stroke Engines[b] (dBA)	Peak Noise of Four-Stroke Engines (dBA)
Kawasaki 1100 STX DI (direct injection)	75.5	9.0	66.5
SeaDoo GTX DI (direct injection)	75.8	9.2	66.6
SeaDoo GTS (carbureted)	72.3	5.8	66.5

a Menge et al. 2002; measured from a distance of 82 feet at full throttle.

b Fristrup and Joyce 2014; estimated based on Menge et al. 2002.

For the sound attenuation modeling, seven locations within the national lakeshore were chosen to measure the noise a visitor would experience as a result of PWC use under both of the action alternatives. These locations are Sand Point, Miners Beach, the North Country National Scenic Trail at Grand Portal, Chapel Beach, the North Country National Scenic Trail at Spray Falls, Twelvemile Beach at Beaver Creek (within the Beaver Basin Wilderness Area), and the North Country National Scenic Trail north of Hurricane River. For each of these locations, the source of the noise (the PWC) was positioned approximately 200 feet from the shoreline; this distance was chosen as it marks the point where PWCs are permitted to operate freely and travel at speeds faster than those required in the flat-wake zone. An additional receiver (visitor) point was positioned on the water at Miners Beach, 50 feet from the shore, to demonstrate the noise a kayaker on the water would experience from PWCs (150 feet from the PWC). Appendix E presents these eight sound modeling locations, the types of visitor activities that could be interrupted, the type of PWC use expected, and a map of the locations. The sound attenuation modeling applies to alternatives 1 and 2 only, because alternative 3 would prohibit the use of PWCs at the national lakeshore. Alternative 1 examines the noise a visitor would experience at Sand Point and Miners Beach from a PWC 200 feet offshore, as well as the noise a kayaker would experience on the water from a PWC 200 feet offshore at Miners Beach. Alternative 2 includes all eight locations in the analysis of effects on the natural soundscape as the entire lakeshore would be open to PWC use under this alternative. The

model accounts for the effects of decreasing sound with distance from the source, as well as atmospheric conditions and ground absorption.

Sound attenuation modeling was completed for all of these locations for carbureted two-stroke PWC engines and direct injection two- or four-stroke PWC engines, as well as for all PWC activity types (point source, transiting, and play), as described in the following section. Although the locations of the receptors varied to include different national lakeshore habitats (beaches and cliffs), distances from the PWC (301 to 363 feet), and elevation above the PWC (1 to 197 feet), the noise experienced by receptors on the shore, as provided by the modeling results, were relatively the same. For each scenario, the noise experienced by a receptor (potential visitor) on the shore differed by only 1.6 to 1.8 dBA. For this reason and to simplify the discussion, this analysis uses an average of the noise levels experienced at the terrestrial locations for visitors on the shore. The distance of the shoreline visitor to the PWC is also presented as an average (320 feet) based on the modeling locations; for each location, the PWC location was 200 feet from the shoreline, but the location of the visitor from the shoreline varied based on the terrain and activity (see appendix E for this information). The kayaking scenario is presented separately because this receptor is on the same plane as the PWC and much closer to the PWC, resulting in higher sound levels. The noise experienced by a visitor is dependent on the visitor's location relative to the PWC; this is also true for wildlife, including special-status species.

The full results of the sound attenuation modeling for each of the terrestrial receptor locations are presented in appendix E.

PWC Activities Modeled: Several PWC scenarios were modeled, including stationary position (point source), transiting, and circling (play).

- *Point source* – Stationary PWCs emit noise that changes the soundscape. PWCs are rarely stationary; however, point source positions were modeled, as they provide the basis for other PWC behavior.
- *Transiting* – Transiting PWCs at the national lakeshore are those traveling from one site to another. Transiting is movement, usually at higher speeds, parallel to the shoreline outside of the flat-wake zone.
- *Play* – PWC play behavior is described as circling, usually at higher or varying speeds. The modeling does not account for speed variation, and the resulting noise levels are to be considered the lower limit of the noise heard by a visitor during play behavior.

Components of PWC Use: Several factors are direct consequences of PWC use. These factors were not modeled but are discussed in the analysis.

- *PWC Speed* – Higher speeds produce louder noise; integrated exposure increases with increasing speed. Noise source levels decline by 0.1707 dB per mile per hour (Menge et al. 2002). The model assumed a speed of 50 mph.
- *Number of PWCs* – Doubling the number of PWCs equates to the doubling of the sound source, which causes a 3-dB increase (e.g., the noise from 2 PWCs would be 3 dB louder than the noise heard from 1 PWC; an increase from 1 PWC to 4 PWCs would result in a 6-dB increase).
- *Duration of PWC Use* – Doubling the duration of PWC use increases the average noise exposure by 3 dB (e.g., the noise from 30 minutes of play behavior is 3 dB lower than the noise from 60 minutes of play behavior with the same speed and number of PWCs).

- *Length of Visitor Stay* – Doubling the duration of a visitor's stay decreases the average noise exposure by 3 dB (e.g., the noise from PWCs transiting together during a 4-hour visit is 3 dB louder than the same number of PWCs at the same speeds during an 8-hour visit because the same amount of noise is spread out over a longer period)

PWC Use: To estimate the impacts from PWC use, assumptions were made to determine the level of PWC use at the national lakeshore. On an average PWC-use day, 4 PWCs are expected to use the waters of the national lakeshore; on a peak day, there would be 14 PWCs parkwide. The PWC behaviors for this analysis were modeled for a single PWC; however, given the components explained above, scenarios involving more than one PWC were analyzed quantitatively. For transiting, it is assumed that 4 PWCs would be the largest number of PWCs transiting together on an average day and 8 PWCs for a peak day. For play behavior, it was assumed that the duration of play would be 15–30 minutes with as many as six sessions per day and that no more than 4 PWCs would be at play at one time in one location. For all scenarios, the length of stay for a visitor would be 4 hours; this represents the amount of time the affected visitor is at the national lakeshore, not the duration of PWC use. This visitor represents any receiver of sound in the national lakeshore and correlates to what wildlife may experience as well as humans.

Factors that Influence Sound Travel: Several factors may influence the distance sounds travel including the topography, the atmospheric conditions, and the vegetation in an area, as described in the "Acoustic Environment and Soundscapes" section of chapter 3. Water and rock tend to reflect sounds well, while softer surfaces such as leaf litter generally absorb sound. Atmospheric temperature profiles cause sound to refract, which can enhance or decrease the transmission of sound. These factors may influence the impact of PWC noise on the natural soundscape in the national lakeshore. A full description of the factors accounted for and the limitations of the sound attenuation modeling are included in appendix E.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Peak noise *is the instantaneous noise level generated by a source.*

Average noise *levels represent the average noise experienced by the visitor for the duration of the visitor's stay.*

During the Phase-Out: During the phase-out period, alternative 1 would represent a continuation of current PWC management at the national lakeshore. Table 4-12 presents the peak and average noise levels that would occur at locations under alternative 1 during the phase-out of carbureted two-stroke PWCs. The peak numbers are the point source generated from the sound attenuation modeling, as described above in the "Methodology and Assumptions" section. The peak noise is the highest instantaneous noise level generated by a carbureted two-stroke PWC; the peak noise levels experienced by visitors for the selected visitor scenarios at the national lakeshore range from 61.3 to 72.8 dBA, depending on their location in reference to the PWC. The average noise levels represent the average noise experienced by the visitor for the duration of the visitor's stay (assumed to average four hours for the model); the average noise levels range from 51.0 to 59.3 dBA. The scenarios modeled included visitors at Sand Point and Miners Beach, two popular beach sites for visitors within the current PWC use area where PWC use would continue under alternative 1. Visitors often rent kayaks and launch from Miners Beach on solo or guided kayak rides; therefore, one of the visitor scenarios modeled included a kayak on the water, approximately 150 feet from a PWC.

TABLE 4-12: PEAK AND AVERAGE NOISE LEVELS FROM PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Carbureted Two-Stroke PWC		Direct Injection Two-stroke or Four-stroke PWC	
	Peak Noise Levels (dBA)	Average Noise Levels (dBA)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
320 feet from visitor on shore	61.3	51.0	55.6	45.2
150 feet from kayaker	72.8	59.3	67.1	53.6

PWC type = Sea-Doo GTS; Number of PWCs = 1; Speed = 50 mph; Duration of visitor's stay = 4 hours

These scenarios show that both the peak and the average noise levels from PWC noise would be higher than the baseline sound levels recorded at the national lakeshore in 2012 (36.3 to 39.2 dBA) (NPS 2013d).

The sound attenuation modeling results displayed in Table 4-12 demonstrate the noise generated by one PWC at certain sampling points; however, PWCs are rarely stationary while on the water. More realistic PWC use includes traveling from one site to another parallel to the shoreline and play behavior, which consists of maneuvering in circles, often at high speeds with rapid acceleration and deceleration. These behaviors were observed during the 2013 PWC survey (NPS 2013b). Additional modeling was conducted using the peak noise levels generated from the sound attenuation modeling to estimate the noise levels visitors at the national lakeshore would experience during these types of PWC use.

During transit, PWCs users have been observed traveling in pairs. During the 3-day 2013 PWC survey, pairs of PWCs were launched at the same time at Sand Point and Miners Beach, and these PWCs traveled together while on the water (NPS 2013b). Table 4-13 presents the noise levels generated by carbureted two-stroke PWCs during transit (as experienced over a four-hour visitor stay). The noise levels from 1 PWC range from 30.9 to 39.3 dBA. As discussed in the "Methodology and Assumptions" section, noise levels increase by 3 dB when the number of PWCs is doubled. Table 4-13 includes the daily noise levels for 4 PWCs and for 8 PWCs, which would be the maximum number of vessels expected to travel together on average and peak use days, respectively. The noise experienced by visitors from transiting PWCs is less than that presented in Table 4-12 for one PWC. The reason is the analysis for Table 4-11 assumes the PWC remains in essentially the same location, whereas the transiting analysis assumes the PWC is moving through the area. At a speed of 50 mph, PWCs would quickly enter and exit the area where noise is heard by visitors, and the visitor onshore or in a kayak would experience the noise for a very brief period. The noise levels from 1 PWC transiting alone and 4 PWCs traveling together fall within the baseline sound levels (36.3 to 39.2 dBA) at the national lakeshore (NPS 2013d). The noise levels of 8 PWCs transiting together exceed the baseline sound levels. Although this scenario is feasible and falls within the assumptions for a peak PWC use day, the probability of 8 PWCs traveling together is small based on observations of PWC use at the national lakeshore. The largest group of PWCs recorded during in 2012 by the captains of the Pictured Rocks Cruises and the NPS during the July 2013 PWC survey consisted of 5 PWCs (NPS 2012b, 2013b). As seen in Table 4-13, the noise a kayaker would experience from any number of PWCs transiting at a distance of 150 feet from the kayak would exceed the baseline sound levels (36.3 – 39.2 dBA). The only exception is the scenario with one PWC after the phase-out (33.6 dBA; Table 4-13). For one PWC during the phase-out, the difference between noise from the PWC and baseline is minimal. For the other scenarios, the increased noise level could affect the kayaker's ability to communicate. As described in chapter 3, for every 3 dB increase in noise, the listening area decreases by half. The listening area for kayakers is essentially unchanged with one PWC operating, but

is decreased with multiple PWCs. Impacts to visitors from PWC operation is discussed in more detail in the "Visitor Use and Experience" section of this chapter.

TABLE 4-13: DAILY NOISE LEVELS FROM PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Carbureted Two-Stroke PWC Noise Levels (dBA)			Direct Injection Two-stroke or Four-stroke PWC Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs	1 PWC	4 PWCs	8 PWCs
320 feet from visitor on shore	30.9	36.9	39.9	25.0	31.2	33.9
150 feet from kayaker	39.3	45.3	48.3	33.6	39.6	42.6

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours

Based on data collected during the 2013 PWC survey, play behavior is expected to occur at Sand Point and Miners Beach, as PWCs in these locations were observed circling the majority of the time PWCs were in use (NPS 2013b). Table 4-14 presents noise experienced by visitors (onshore or kayakers) from a carbureted two-stroke PWC engine during play behavior under alternative 1. The duration of PWC use is expected to vary, so table 4-14 presents the noise from 30, 60, and 90 minutes of cumulative use over a 4-hour visitor stay. These numbers represent the noise experienced by other visitors when PWCs are operating in play mode over the course of the 4-hour day. The noise generated by PWC play behavior and experienced by visitors (60.8 to 68.9 dBA) would exceed baseline sound levels (36.3 to 39.2 dBA) at the national lakeshore (NPS 2013d). Speed varies during circling maneuvers on a PWC; this variation in speed, and therefore noise, can be more disruptive than constant noise such as that of a transiting PWC. For routine maneuvers, there would be brief increases of 5 dB and increases of up to 10 dB for rapid 180-degree turns (Fristrup and Joyce 2014). Additionally, the data presented in table 4-14 represent the noise from 1 PWC exhibiting play behavior. Doubling the number of PWCs to 2 vessels would increase the noise by 3 dB; increasing the number to 4 PWCs circling at one time would increase the values in table 4-14 by 6 dB.

TABLE 4-14: DAILY NOISE LEVELS FROM PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Carbureted Two-Stroke PWC Noise Levels (dBA)			Direct Injection Two-stroke or Four-stroke PWC Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes	30 minutes	60 minutes	90 minutes
320 feet from visitor on shore	60.8	63.8	65.6	55.1	58.1	59.9
150 feet from kayaker	68.9	71.9	73.7	63.2	66.2	68.0

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

The modeling results in tables 4-13 and 4-14 estimate the sound that would impact a receptor, representative of the sound that visitors, wildlife, and special status species would experience from PWC use during the phase-out period under alternative 1. The impacts on visitor experience, wilderness character, wildlife, and special-status species are discussed further in those sections of this chapter.

During the phase-out period, carbureted two-stroke PWC use would have the same effect on the soundscape as is currently occurring, and adverse impacts to the natural soundscape of the national lakeshore are anticipated to continue during the phase-out period under alternative 1.

Post Phase-Out: After the phase-out period, it is expected that PWC use at Pictured Rocks National Lakeshore would remain at about the same level; however, all PWCs would have direct injection two-stroke or four-stroke engines. These PWC engines include features to reduce noise, such as hull insulation, exhaust system sophistication, materials selection, and other muffling technology. The peak and average noise levels for the direct injection PWCs (55.6 to 67.1 dBA), presented in table 4-12, are lower than those for the PWCs with carbureted engines (61.3 to 72.8 dBA). Similarly, the average noise levels for the direct injection PWC engines (45.2 to 53.6 dBA) are lower than those for the PWCs with carbureted engines (51.0 to 59.3 dBA). These scenarios show that both the peak and the average noise levels from PWC use would be higher than the baseline sound levels recorded at the national lakeshore in 2012 (36.3 to 39.2 dBA) (NPS 2013d). Table 4-13 presents the daily noise levels for direct injection two-stroke and four-stroke PWCs traveling parallel to the shoreline. Noise levels were modeled for a single PWC traveling alone, a group of 4 PWCs, and a group of 8 PWCs. For visitors on the beach, the results for direct injection engines were similar to those observed for carbureted engines; however, the modeled noise results for direct injection engines are slightly lower than for the carbureted engines. The sound levels experienced by visitors on the beach for all three groups of PWC users (25.0 to 33.9 dBA) fall below the baseline sound levels (36.3 to 39.2 dBA) recorded during the 2012 acoustical monitoring study (NPS 2013d). During the phase-out, only PWCs traveling alone and in groups of four were below or within the range of baseline sound levels. For kayakers, noise levels experienced from PWCs would be reduced with use of direct injection engines. During the phase-out, all scenarios modeled exceeded the baseline noise levels (see table 4-13). For direct injection engines post phase-out, the noise experienced by a kayaker from a single PWC traveling alone would fall within the baseline sound levels and the noise from a group of 4 PWCs traveling together (39.6 dBA) would just barely exceed the upper range of the baseline sound levels (39.2 dBA). The noise experienced by a kayaker from a group of 8 PWCs traveling together with direct injection engines (42.6 dBA) would exceed the baseline sound levels, but would be lower than that caused by a similar group of PWCs with carbureted engines (48.3 dBA).

As noted above, the predominant PWC behavior expected to occur at Sand Point and Miners Beach is play behavior. Table 4-14 presents noise experienced by visitors (onshore or from a kayak) from a direct injection two-stroke or four-stroke PWC engine during play behavior under alternative 1 (duration of play modeled for 30, 60, and 90 minutes of cumulative use over a 4-hour stay). These numbers represent the noise experienced by other visitors when PWCs are operating in play mode over the course of the 4-hour visitor stay. As described for the modeled results for carbureted engines using similar scenarios, the noise generated by PWC play behavior and experienced by visitors (55.1 to 68.0 dBA) would exceed baseline sound levels for visitors on the shore and kayakers on the water. While all scenarios resulted in noise levels that exceed the baseline sound levels, these results represent a reduction in noise experienced by the visitors when compared to modeled results for carbureted engines (60.8 to 73.7 dBA). The use of direct injection two-stroke or four-stroke PWCs would result in less noise generated during PWC operation at the national lakeshore; therefore, the phase-out of carbureted two-stroke PWCs would have beneficial impacts on the soundscape and acoustic environment when compared to current conditions. Post phase-out, the quieter PWC engines would also have less of an impact on wildlife, wilderness character, special status species, and visitors; these impacts are discussed in their respective sections.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

The entire shoreline (approximately 42 miles) of the national lakeshore would be open to PWC use under alternative 2.

During the Phase-Out: Table 4-15 presents the peak and average noise levels for carbureted two-stroke PWC use that visitors would experience along the shoreline of the national lakeshore.

TABLE 4-15: PEAK AND AVERAGE NOISE LEVELS FROM PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Carbureted Two-Stroke PWC		Direct Injection Two-stroke or Four-stroke PWC	
	Peak Noise Levels (dBA)	Average Noise Levels (dBA)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
320 feet from visitor on shore	61.3	51.1	55.5	45.3
150 feet from kayaker	72.8	59.3	67.1	53.6

PWC type = Sea-Doo GTS; Number of PWCs = 1; Speed = 50 mph; Duration of visitor's stay = 4 hours

In addition to the scenarios modeled for alternative 1, additional scenarios between Miners Beach and the eastern edge of the national lakeshore were modeled to understand the impact of PWC use to soundscapes and other resources throughout the expanded PWC use area for alternative 2. For these scenarios, the peak noise levels for the selected visitor scenarios at the national lakeshore range from 61.3 to 72.8 dBA. The average noise levels represent the average noise experienced by the visitor for the duration of the visitor's stay; the average noise levels range from 51.1 to 59.3 dBA. These scenarios show that both the peak and the average noise levels from PWC noise would be higher than the baseline sound levels recorded at the national lakeshore in 2012 (36.3 to 39.2 dBA) (NPS 2013d).

As described for alternative 1, PWCs were also modeled when transiting and in circling play behavior. Table 4-16 presents the noise levels generated by carbureted two-stroke PWCs during transit. The noise levels from 1 PWC transiting alone and 4 PWCs traveling together fall within the baseline sound levels (36.3 to 39.2 dBA) recorded during the 2012 acoustical monitoring study (NPS 2013d) for visitors on the shoreline; however, a kayaker on the water would experience noise levels above the baseline sound levels. The noise level of 8 PWCs transiting together exceeds the baseline sound levels for both shoreline visitors and kayakers. As noted for alternative 1, while it is feasible that 8 PWCs could travel together and this scenario falls within the assumptions for a peak PWC use day, the probability of 8 PWCs traveling together is small based on observations of PWC use during the 2013 PWC survey (NPS 2013b). Similarly, the noise a kayaker would hear from any number of PWCs transiting at a distance of 150 feet exceeds the baseline sound levels.

TABLE 4-16: DAILY NOISE LEVELS FROM PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Carbureted Two-Stroke PWC Noise Levels (dBA)			Direct Injection Two-stroke or Four-stroke PWC Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs	1 PWC	4 PWCs	8 PWCs
320 feet from visitor on shore	31.0	37.0	40.0	25.3	31.3	34.3
150 feet from kayaker	39.3	45.3	48.3	33.6	39.6	42.6

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours

Alternative 2 would permit the use of PWCs in waters of the national lakeshore adjacent to the wilderness area, a use previously not permitted in this area. The noise levels experienced by a shoreline visitor in Beaver Basin is consistent with the results presented in table 4-16; the noise levels for PWCs during transit would fall within the baseline sound levels in this area from 1 PWC transiting alone and 4 PWCs traveling together and the noise levels from 8 PWCs traveling together would exceed the baseline sound

levels slightly (30.5 to 39.5 dBA, appendix E, table E-9). However, it is a new noise source in a sensitive area of the national lakeshore.

Table 4-17 presents noise experienced by visitors (onshore or kayakers) from a carbureted two-stroke PWC engine during play behavior under alternative 2. As described for alternative 1, 30, 60, and 90 minutes of cumulative use over a 4-hour stay were modeled, presented in table 4-17. These numbers represent the noise experienced by other visitors when PWCs are operating in play mode for the noted cumulative time over the course of the 4-hour day. Similar to alternative 1, the noise generated by PWC play behavior and experienced by visitors would exceed baseline sound levels of 36.3 to 39.2 dBA for all visitor locations modeled. Speed varies during circling maneuvers on a PWC; this variation in speed, and therefore noise, can be more disruptive than constant sound such as that of a transiting PWC. For routine maneuvers, there would be brief increases of 5 dB and increases of up to 10 dB for rapid 180-degree turns (Fristrup and Joyce 2014). Additionally, the data presented in table 4-17 represent the noise from 1 PWC. Doubling the number of PWCs would increase the noise by 3 dB; increasing the number to 4 PWCs circling at one time would increase the values in table 4-17 by 6 dB.

TABLE 4-17: DAILY NOISE LEVELS FROM PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Carbureted Two-Stroke PWC Noise Levels (dBA)			Direct Injection Two-stroke or Four-stroke PWC Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes	30 minutes	60 minutes	90 minutes
320 feet from visitor on shore	61.0	64.0	65.7	55.2	58.2	60.0
150 feet from kayaker	68.9	71.9	73.7	63.2	66.2	68.0

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

The modeling results in tables 4-16 and 4-17 estimate the sound that would impact a receptor, representative of the sound that visitors, wildlife, and special status species would experience from PWC use during the phase-out period under alternative 2. The impacts on visitor experience, wilderness character, wildlife, and special-status species are discussed further in those sections of this chapter.

During the phase-out period, carbureted two-stroke PWC use would have the same effect on the soundscape as is currently occurring between Sand Point and Miners Beach, and the adverse impacts to the natural soundscape of the national lakeshore are anticipated to continue during the phase-out period under alternative 2. Because alternative 2 would allow PWC use along the entire shoreline, it would adversely impact the soundscape and acoustic environment, as PWC use would add a new human-caused noise source. These impacts would be limited to the period of PWC use (summer months, weekends, daylight hours).

Post Phase-Out: After the phase-out period, the use of PWCs would remain the same as current conditions, with 4 PWCs on average days and 14 PWCs on peak days; however, all PWCs would have direct injection two-stroke or four-stroke engines. These PWC engines include features to reduce noise, such as hull insulation, exhaust system sophistication, materials selection, and other muffling technology. The peak and average noise levels for the direct injection PWCs, presented in table 4-15, are lower than those for the PWCs with carbureted engines. The peak noise levels for the PWC engine modeled range from 55.5 to 67.1 dBA, and the average noise levels range from 45.3 to 53.6 dBA, depending on the visitor use scenario. Table 4-16 presents the noise levels for direct injection two-stroke and four-stroke PWCs traveling parallel to the shoreline. As described for alternative 1, noise levels were modeled for a

single PWC traveling alone, a group of 4 PWCs, and a group of 8 PWCs. For visitors onshore, the results for direct injection engines were similar to those observed for carbureted engines, with modeled results for direct injection engines (25.3 to 34.3 dBA) being lower than for the carbureted engines (31.0 to 40.0 dBA). The noise levels experienced by visitors onshore for all three groups of PWC users fall within the baseline sound levels (36.3 to 39.2 dBA) recorded during the 2012 acoustical monitoring study (NPS 2013d). Only PWCs traveling alone and in groups of four met these criteria for carbureted engines. Kayakers were modeled at one location, off shore of Miners Beach with the PWCs at a distance of 150 feet, so the modeling results are the same as described for alternative 1. Kayakers would experience a reduction in noise heard with the use of direct injection engines. For carbureted engines, all scenarios modeled exceeded the baseline sound levels (see table 4-16). For direct injection engines, the noise experienced by a kayaker from a single PWC traveling alone would fall within the baseline sound levels and the noise from a group of 4 PWCs traveling together (39.6 dBA) would just barely exceed the upper range of the baseline level (39.2 dBA). The noise experienced by a kayaker from a group of 8 PWCs traveling together with direct injection engines (42.6 dBA) would exceed the baseline sound level, but would be lower than the noise level caused by a similar group of PWCs with carbureted engines (48.3 dBA). Alternative 2 would allow PWC use along the entire lakeshore, exposing more kayakers to PWC noise when compared to alternative 1 and current use.

Table 4-17 presents noise experienced by visitors (onshore or from a kayak) from direct injection two-stroke or four-stroke PWC engines during play behavior under alternative 2; modeling results of 30, 60, and 90 minutes of cumulative use over a 4-hour stay are presented. These numbers represent the noise experienced by other visitors when PWCs are operating in play mode for the noted cumulative time over the course of the 4-hour day. As described for the modeled results for carbureted engines using similar scenarios, the noise generated by PWC play behavior and experienced by visitors (55.2 to 68.0 dBA) would exceed baseline sound levels (36.3 to 39.2 dBA) at all locations modeled. However, these results represent a reduction in noise experienced by the visitors when compared to modeled results for carbureted engines (61.0 to 73.7 dBA). The noise of PWCs exhibiting play behavior, whether operating alone or in small groups, would disrupt the natural soundscape and acoustic environment of the national lakeshore and impact visitor experience, wildlife, special-status species, and wilderness. Impacts associated with noise from PWC operation to resources other than soundscape and acoustic environment are discussed in each of those respective sections. The noise of PWCs exhibiting play behavior, whether operating alone or in small groups, would disrupt the natural soundscape and acoustic environment of the national lakeshore and impact visitor experience, wildlife, special-status species, and wilderness. Impacts associated with noise from PWC operation to resources other than soundscape and acoustic environment are discussed in each of those respective sections. As described for alternative 1, the use of direct injection two-stroke or four-stroke PWCs would result in less noise generated as a result of PWC operation at the national lakeshore. However, the expansion of PWC use to the entire length of the national lakeshore would expand the area of impact greatly, including the wilderness area. Even with the opening of the entire shoreline to PWC use, levels of use would be expected to remain higher at the western end due to the presence of the boat launch and its proximity to the town of Munising. Alternative 2 could result in slightly lower levels of PWC noise in areas currently open to PWC use if users spread out along the shoreline east of the current PWC use area, as opposed to concentrated between Sand Point and Miners Beach. Under alternative 3, new sources of noise would be present in areas not previously open to PWCs, including the portion of Lake Superior adjacent to the Beaver Basin Wilderness Area. These impacts would coincide with PWC use patterns at the national lakeshore and would occur primarily during the summer months and only during daylight hours.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Under alternative 3, PWCs would be prohibited from operating within the 0.25-mile jurisdictional boundary of the national lakeshore. This alternative would eliminate PWCs as a noise source at the

national lakeshore, resulting in beneficial effects from the removal of PWC noise in the soundscape and acoustic environment; however, other motorized watercraft would continue to operate and generate noise along the entire shoreline, so the benefits would be slight. The effects of the elimination of PWC noise on wildlife, special-status species, wilderness character, and visitor use and experience is discussed in the respective sections in this chapter.

CUMULATIVE IMPACTS

Other ongoing and reasonably foreseeable future actions within and around the national lakeshore have the potential to impact the soundscape and the acoustic environment. Other motorized watercraft use is the activity that contributes the most to noise during daytime hours within the national lakeshore where PWCs operate (NPS 2013d). The 2012 Acoustical Monitoring Report showed that the mean percentage of time that other watercraft were audible was greater than that of any other noise source for both sampling locations (NPS 2013d). Based on the PWC survey during the July 4th weekend in 2013 (NPS 2013b), the ratio of other motorized boats to PWCs is approximately 14 to 1. These motorized boats generate noise, which interrupts the soundscape and acoustic environment of the national lakeshore and results in adverse impacts. In addition to the noise generated by engines, the commercial tour boats use a public address system that can be heard on the beaches in some locations of the national lakeshore.

Future and ongoing actions would also have adverse impacts on soundscapes. Expansion of the Munising city dock will result in additional temporary noise impacts from future seawall construction. Due to an increased demand, the city of Munising will be adding approximately 28 boat slips, which could result in an increase in boat traffic, and therefore, long-term impacts on the soundscape from engine sound. An additional proposed project at the Munising marina could result in future short and long term adverse impacts on the soundscape from a proposed seawall, backfill, riprap, boat well and hoist, and dredging in Munising Bay. The beech bark disease tree removal project includes the removal of hazard trees from areas targeted for the management of beech bark disease in the national lakeshore (NPS 2012d). The noise from the use of chainsaws to remove hazard trees disrupts the soundscape and acoustic environment in the surrounding areas of the national lakeshore.

Alternatives 1 and 2, the action alternatives, would continue to allow adverse impacts on the soundscape and acoustic environment of the national lakeshore through the use of PWCs. The ongoing and reasonably foreseeable future actions described above would have adverse impacts on the soundscape and acoustic environment at the national lakeshore from the contribution of noise. Impacts from alternative 1 would affect only the Sand Point to Miners Beach area of the national lakeshore, whereas the impacts from alternative 2 would have the potential to impact the soundscape along the entire national lakeshore. The incremental adverse impact of the action alternatives would not alter the intensity of adverse impacts on soundscapes from the other ongoing and future actions described above.

Alternative 3 would result in beneficial impacts as PWCs would be banned from the national lakeshore, reducing the noise added to the soundscape and acoustic environment and experienced by visitors and wildlife from the operation of PWCs. Although alternative 3 would provide beneficial effects on the soundscape and acoustic environment, the effects would be slight and would not alter the intensity of adverse impacts on soundscapes and acoustic environment from other ongoing and future actions.

CONCLUSION

The modeled PWC noise levels in this analysis were compared to the baseline sound levels recorded at the national lakeshore in 2012 (NPS 2013d). The baseline noise levels of 36.3 dBA and 39.2 dBA are the median daytime existing ambient sound levels at Miners Castle and Beaver Basin, respectively. As discussed in “Chapter 3: Affected Environment,” the results of the 2012 Acoustical Monitoring Report

indicate that noise resulting from PWC use between Sand Point and Miners Beach does not dominate the soundscape at the national lakeshore, particularly when compared with other sources of noise, such as other watercraft (NPS 2013d). Based on the estimated ratio of 1 PWC for every 14 motorized watercraft (NPS 2013b), PWC use would contribute a small portion of the noise that interferes with the natural soundscape; this is supported by the 2012 Acoustical Monitoring Report (NPS 2013d). Although PWCs represent a small portion of the noise at the national lakeshore, PWC noise differs from most other watercraft due to the style in which PWCs are operated, which results in a higher level of impact, especially for PWCs operated in play mode.

Alternative 1 would continue to allow PWC use only between Sand Point and Miners Beach. During the phase-out period, the use of carbureted two-stroke PWCs would continue to adversely impact the soundscape and acoustic environment but only to the extent of current impacts. This means that the baseline sound level of 36.3 dBA recorded at Miners Castle in the 2012 Acoustical Monitoring Report (NPS 2013d) incorporated the noise generated from carbureted two-stroke PWCs. After the phase-out period, the removal of the louder, carbureted two-stroke engines would have slight beneficial impacts to the soundscape and acoustic environment of the national lakeshore. However, noise from PWC use, although it would be reduced, would continue to impact the national lakeshore, as the PWCs would be audible above the existing ambient sound, particularly when larger numbers of PWCs travel together or during play behavior. Additionally, the analysis models specific use scenarios – transiting or playing. Actual PWC use varies and includes transiting, playing, idling, acceleration, and deceleration. It is not possible to model all the various combinations, but these different behaviors could cause additional impacts to the soundscapes. Ultimately, because of the low level of PWC use, combined with the infrequency of use (summer months, weekends, daylight hours), impacts under alternative 1 would be minimal as high visitor use areas are already being impacted by multiple recreational uses, no new impacts from PWC use would occur, and the switch to direct injection two-stroke or four-stroke PWC engines would reduce the levels of noise contributed by PWC use. Although the impacts on soundscapes and acoustic environment under alternative 1 would be reduced post phase-out, this alternative would continue to contribute slightly to the adverse impacts from other ongoing and reasonably foreseeable future actions.

Under alternative 2, the impacts of PWC use on the soundscape and acoustic environment would be similar to those described for alternative 1; however, the areas of the soundscape and acoustic environment impacted by PWC noise under alternative 2 would include the entire shoreline of the national lakeshore. Although it is anticipated that PWC use would remain concentrated in the western portion of the national lakeshore, areas that do not currently allow PWC use under the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore would be subject to PWC noise under alternative 2. The Beaver Basin Wilderness Area, which is managed in part to provide opportunities for solitude and naturalness, is located adjacent to the shoreline and would be adversely affected by PWC use under alternative 2. The modeling described in this analysis shows that PWCs can be heard above the baseline sound levels of 36.6 and 39.2 dBA recorded at Miners Castle and Beaver Basin, respectively, in the 2012 Acoustical Monitoring Report (NPS 2013d), especially when traveling together in larger numbers and during play. Given the low levels of PWC use and the infrequency of use (summer months, weekends, daylight hours), impacts from PWCs under alternative 2 would not be significant, but the impacts from PWC use under alternative 2 would be greater than those under alternative 1 due to new areas of the lakeshore being exposed to PWC noise. The impacts on soundscape and acoustic environment would be reduced post phase-out.

Alternative 3 would result in slight beneficial impacts on the acoustic environment and soundscapes of the national lakeshore from the elimination of PWC noise. Although the no-action alternative would provide beneficial effects on soundscape and acoustic environment, the effects would be slight and would not counteract the adverse impacts from other ongoing or future actions.

WILDLIFE AND WILDLIFE HABITAT

In this section, the impacts on wildlife and wildlife habitat from PWC use are analyzed. The noise, speed, and ability of PWCs to access shallow water can interrupt wildlife behaviors and can cause disruption of natural behaviors, flight from and avoidance of habitat, degradation of habitat, and a reduction in fitness. These effects can alter diversity and density on a regional or landscape scale (Cole and Knight 1990; Boyle and Samson 1985). The analysis in this section includes the potential impacts on wildlife and wildlife habitat from PWC use and from PWC users beaching their vessels and disembarking on the shoreline and upland areas.

STUDY AREA

The study area for analyzing impacts to wildlife and wildlife habitat consists of the allotted shoreline for the specific alternatives (Sand Point to Miners Beach for alternative 1 and the shoreline of the entire national lakeshore for alternatives 2 and 3). Approximately 15 miles of the 42-mile shoreline would be inaccessible for landing PWCs because the sandstone cliff faces are directly adjacent to Lake Superior; however, noise from PWC operating on the water could still affect wildlife in these areas. Impacts to wildlife from PWC noise could occur along any areas of the shoreline open to PWC use under a particular alternative. In areas where PWC users are able to beach their vessels and recreate on land, a 100-foot area inland from the shoreline was analyzed for impacts on wildlife and wildlife habitat.

METHODOLOGY AND ASSUMPTIONS

Types of Impacts: Information on wildlife at the national lakeshore was gathered from existing NPS data, including species lists and GIS information. The analysis includes the direct and indirect effects of PWC use on wildlife and wildlife habitat. Wildlife impacts were determined by examining the potential effects of PWC use and terrestrial recreation by PWC users on native wildlife species, their habitats, or the natural processes sustaining them. The greatest impacts on wildlife would be the noise generated by PWCs and the types of movement associated with PWC operation, which is intrinsically different than that of other motorized watercraft.

Acoustic resources are integral to wildlife communication, behavior, and many other ecological processes. Anthropogenic, or human-caused, noise can adversely affect wildlife in various ways. Exposure to relatively high noise levels that typically occur close to a source can produce potentially harmful physiological responses in animals, including hearing loss, elevated stress hormone levels, and hypertension. Even low levels of noise can interfere with ecological processes in surprising and complex ways. Some groups of animals (especially in social species) benefit by producing alarm calls to warn of approaching predators and contact calls to maintain group cohesion. A reduction in communication distance created by noise might decrease the effectiveness of these social networks. Furthermore, many animals are known to eavesdrop on vocalizations from different species. For example, gray squirrels, listen in on the communication calls of blue jays to assess site-specific risks of cache pilfering; and nocturnally migrating songbirds and newts use the richness and complexity of biological sounds produced in local environments to make habitat decisions. Animals also use accidental sounds produced by potential prey to locate their next meal; other animals use sound to avoid predation. It is likely that other ecological sounds are similarly important to animals. Animal communication and the interaction between wildlife and the acoustic environment is an interconnected landscape of information networks based on intentional and accidental sounds.

While studies on the effects of noise on wildlife are not plentiful, available literature shows that noise can greatly influence behavior, which can affect fitness. Most behavioral changes fall into one of these four categories:

- changes in temporal patterns—animals can change their movement, feeding, and mate attraction behaviors to avoid anthropogenic noise
- alteration in movement—animals may avoid or abandon sites due to noise
- decrease in foraging and increased vigilance—noise can interfere with foraging behavior or elicit anti-predator behavior, which could reduce foraging success
- changes in mate attraction—noise can reduce success of an animal's acoustic signals in trying to attract a mate (Francis and Barber 2013)

All of these behavioral responses to noise can directly affect the survival and fitness of an animal or indirectly affect the animal through physiological stress (Francis and Barber 2013). The characteristics of the anthropogenic noise can affect animals differently. Loud noises are successful in masking important biological sounds while fluctuating noise can elicit a response similar to predation, which would likely result in a flight response (Francis and Barber 2013). Anthropogenic noise can alter bird populations and communities (Francis, Ortega, and Cruz 2009). Noise can deter birds from using certain otherwise suitable habitats for breeding and nesting, and can also reduce reproductive success by increasing the chances of predation due to masking of important biological sounds (Francis, Ortega, and Cruz 2009).

It has been estimated that other motorized watercraft at the national lakeshore outnumber PWCs at a ratio of 14 to 1; however, PWCs operate differently than other motorized watercraft and could affect wildlife differently. PWC operation for this analysis is characterized as either transiting or play. Transiting is defined as operating a PWC at a constant speed while moving in one direction, with the aim of traveling from one location to another; this is similar to motorboat operation. When PWCs are operated in play mode, they change direction and speed frequently, accelerating and decelerating rapidly. This change in speed and direction can cause the PWC to leave and re-enter the water, which results in the hull slapping the water. Noise generated by PWCs during play behavior, either directly from operation or from the hull slapping the water, is louder than when transiting. The frequent changes are more disruptive than the constant noise generated during transit behavior. Both the noise and the erratic movement exhibited by PWCs during play behavior can scare and harass wildlife. PWCs moving rapidly and at varying speeds with frequent changes in direction are actions that can disrupt wildlife and cause stress, as discussed in the previous paragraph. The analysis incorporates the sound attenuation modeling to describe the changes to the acoustic environment during PWC play behavior. Although the sound attenuation modeling uses a human receptor (shoreline visitor or kayaker), these values can be compared to the background noise levels recorded at the national lakeshore in the 2012 acoustical monitoring study (NPS 2013d). As stated in chapter 3, an increase of 3 dB would reduce the listening area for wildlife by 50%. An additional 3 dB (for a total of 6 dB) would reduce the listening area by another 50% (for a total of 75% from the original area) (NPS 2013c).

Affected Wildlife: The wildlife groups that were identified to be most at risk from impacts of PWC use are waterbirds, including wading birds, gulls, and waterfowl; cliff-nesting birds; and small mammals. The national lakeshore has an abundance of wildlife; however, PWC use is unlikely to affect most species. The areas along the shoreline are not regularly used by larger mammals because the available habitat is limited and human use is higher. Aquatic mammals such as beavers and river otters are present at the national lakeshore, but as described in chapter 3, these species can be found in the inland aquatic habitats of the national lakeshore where PWCs are prohibited. Amphibians and reptiles are not abundant in the national lakeshore, as discussed in "Chapter 3: Affected Environment" and are not analyzed in this

section. It should be noted that park staff has observed snapping turtles swimming in Lake Superior in the Sand Point area. Snapping turtles and their nests could be disturbed by PWC use at Sand Point, including launching; however, because the likelihood is low, snapping turtles are not discussed further in this analysis. Wetland areas and inland lakes would not be directly affected by PWC use because PWC use is restricted to Lake Superior. However, PWC users who disembark from their PWCs could venture into wetland habitats near the shoreline of Lake Superior, which may have indirect effects on these habitats.

PWC Engine Types: The noise generated by PWCs could disrupt wildlife both during and after the phase-out period; therefore, the impact analysis does not include separate discussions of the periods during and after the phase-out of carbureted two-stroke engines. Although there would be a reduction in noise after the phase-out the nature of the noise and its disruption of wildlife behavior would not be markedly different. Any differences that would occur from the phase-out of carbureted two-stroke engines are discussed within the analysis.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Birds: Under alternative 1, the noise and presence of PWCs and their users could affect birds through alarming, flushing, disturbing nesting behaviors, disrupting or changing habitat, or causing physical harm.

Birds that are alarmed by PWCs may alter their behavior in ways such as increased calling, increased vigilance, flushing, and changes in typical behavior. Based on a review of literature examining the effects of human disturbance on waterbirds, Borgmann (2011) concluded that motorized boats operating at high speeds is one of the types of disturbances that cause birds to flush the quickest when compared with other anthropogenic disturbances, such as kayaking or walking. Flushing can change the feeding habits of birds by reducing the amount of time a bird spends foraging, forcing them into other habitats, or causing them to avoid favored feeding spots (Hamann et al. 1999; Kaiser and Fritzell 1984; Tuite et al. 1983). Birds that are flushed may or may not return to their original locations following disturbance. This is true for birds foraging along the shoreline, flying over the water, or resting on the water. Birds that are flushed due to disturbance expend extra energy, which can negatively affect reproductive success. Flight is a costly activity for energy reserves of waterbirds, requiring flushed birds to increase their food intake to account for the energy loss (Ward and Andrews 1993). Birds that are not able to increase foraging may experience poorer body condition, which could translate into reduced reproductive success. Ultimately, frequent flushing could result in population-level impacts (Borgmann 2011).

Flushing from motorboats has been determined to affect courting behavior, nesting behavior, and egg and young survival (Galicia and Baldassarre 1997; Åhlund and Götmark 1989; Bouffard 1982). Flushing can be caused by the noise or the presence of PWCs. Impacts from transiting PWCs would be expected to be similar to those of other motorized watercraft, since the PWCs are traveling at a relatively constant speed and direction. PWCs in play mode would be more disruptive and cause birds to flush more frequently. The rapid changes in speed and direction that characterize play are responsible for this effect.

Birds on the open water, such as gulls or mergansers, could be affected by both the noise and the physical disruption associated with PWCs use, especially PWCs operating in play mode when erratic movement and frequent changes in speed and direction occur. PWCs could strike waterbirds, causing injury. However, waterbirds would likely flee an area being used by PWCs; therefore, physical contact would be expected to occur infrequently. Waterbirds disturbed by the presence and noise of PWCs would likely move to a quieter area of the lake. As described above, this disturbance could interrupt feeding and other behaviors, all of which could alter the fitness of individual birds. While some disturbance, and therefore some level of impact, would be expected, the low level of PWC use at the national lakeshore means disturbances would be rare. Because PWC use at the national lakeshore is low, local and regional population-level effects would not be expected from flushing due to disturbance.

Wading and shorebirds using the shoreline for foraging, loafing, and nesting could also be affected by the use of PWCs and other watercraft. In a comparison of the effects of PWCs operating in a transiting mode and outboard-powered boats on birds, Rodgers and Schwikert found that larger birds, such as great blue herons (*Ardea herodias*), exhibited a significantly greater average flushing distance than smaller birds. A majority of the species studied did not show a significant difference in flushing distance between PWCs and outboard-powered boats (Rodgers and Schwikert 2002). Because these birds use the shoreline habitat, PWCs transiting to and from the beach or boat launch would potentially have direct interactions with the birds. The required low speeds within 200 feet of the shoreline would minimize direct interactions between the birds and PWCs; however, shorebirds could be disrupted from foraging in the surf and would likely flee to another part of the shoreline. Under alternative 1, the only sandy areas where PWCs could beach are Sand Point and Miners Beach. Because these beaches are popular visitor locations and shorebirds are unlikely to nest in these areas, impacts would be limited to feeding and resting behaviors. Similar to waterbirds, shorebirds would be expected to experience some disturbances from the use of PWCs in play mode. However, play behavior would at least 200 feet offshore, providing space to reduce noise impacts and removing the impacts associated with operating PWCs in close proximity to the birds. Similar to waterbirds, PWC operation could disturb wading and shorebirds when the birds are flying over the water. As noted above, the low level of PWC use at the national lakeshore means actual disturbances to birds along the shoreline or flying over the water would be infrequent.

Similar to wading and shorebirds, impacts to cliff dwelling birds (songbirds, raptors, crows, and gulls) from PWC use would be mostly related to noise as most operation would occur outside the 200-foot flat-wake zone. The noise from PWCs could impact cliff dwelling birds, such as cliff swallows at the national lakeshore. These species are not common but are known to breed at the national lakeshore. Although no nest areas have been documented for cliff nesting birds in the area open to PWC use under alternative 1, suitable habitat is present in this area and could be occupied in the future. Noise impacts from PWCs could affect cliff dwelling birds during nesting, roosting, or loafing, including flushing from nesting or roosting areas, interruption of incubation, and nest abandonment. The nesting and young rearing periods overlap with the peak PWC use period between Memorial Day and Labor Day.

In conclusion, birds are susceptible to impacts from PWC use, especially from PWCs operating in play mode. Direct physical impacts, such as strikes from collisions with PWCs could occur, but would be expected to be rare because most birds would flee prior to a collision. As discussed above, impacts such as flushing and harassment associated with the operation of PWCs in close proximity to birds would be expected to have a greater impact than direct collisions with PWCs. Waterbirds, which rest and forage on and in the water, would be expected to be most impacted by PWC operation because they use areas open to PWC play behavior.

Waterbirds, shorebirds, wading birds, and cliff dwelling birds would experience impacts from the noise of PWCs. For example, the sound attenuation modeling for alternative 1 determined that a single carbureted two-stroke PWC during circling play behavior would generate noise levels between 60.8 and 73.7 dBA (table 4-14) and a single direct injection two-stroke or four-stroke PWC during circling play behavior would generate noise levels between 55.1 and 68.0 dBA (table 4-14), depending on the location of the receptor and the length of time the PWC is at play. Wading and shorebirds that would likely be foraging along the shoreline would experience sound levels similar to a visitor on the beach (60.8 to 65.6 dBA during the phase-out period and 55.1 to 59.9 dBA post phase-out, according to the modeling); birds loafing or foraging on the open water would experience higher sound levels similar to the modeled kayaker (68.9 to 73.7 dBA during the phase-out period and 63.2 to 68.0 dBA post phase-out). These noise levels are representative of one PWC at play. Doubling the number of PWCs to 2 vessels would increase the noise by 3 dB; increasing the number to 3 PWCs circling at one time would increase the values by 6 dB. These noise levels exceed the baseline sound levels (36.3 to 39.2 dBA) that were recorded at the national lakeshore during the 2012 acoustical monitoring study (NPS 2013d). Shannon et al 2015

examined two decades of research documenting the effects of noise on wildlife and determined the noise levels that could disrupt biological responses. For birds, changes in the frequencies and durations of calls were observed at 60 dBA. Further, a decline in reproductive success was seen at 58 dBA. These noise levels indicate that the natural behaviors of birds could be affected by PWC use at national lakeshore. Under alternative 1, birds would continue to be affected by PWC use at the national lakeshore at the same level as they are currently; however, given the low levels of PWC use, the short period of peak use (daytime during summer months), the limited area of the lakeshore open to PWC use under alternative 1, and the high level of other recreation uses at these beaches on the national lakeshore, the impacts from PWCs would be minimal.

Mammals: No aquatic mammals would be affected by PWC use. Impacts to terrestrial mammals would occur from PWC noise and from PWC users that beach their vessels and recreate on land. Use of the shoreline habitat by larger mammals is limited due to human activity and anthropogenic noise. Smaller mammals could be affected by PWC users that beach their vessels and disembark to recreate in the terrestrial habitat. While the amount of suitable habitat is limited in the area of analysis (100-foot area from the shoreline), foraging and mate attraction activities could be disrupted for small mammals, such as mice, voles, chipmunks, and squirrels. Sand Point and Miners Beach are popular visitor destinations where visitors commonly use motorized watercraft and explore terrestrial habitats; therefore, mammals that use the shoreline habitats between Sand Point and Miners Beach are likely to be habituated to the noise associated with these activities. Mammals would likely flee in the presence of PWC users who recreate on land, but the mammals would be expected to return to the area once the disturbance has passed. Mammals would also be affected by the noise generated by PWCs, particularly during play activity, which is more disruptive than transit. The sound attenuation modeling estimates that a visitor on the shoreline would experience sound levels of approximately 60.8 to 65.6 dBA during the phase-out period and 55.1 to 59.9 dBA post phase-out when one PWC is exhibiting play behavior (table 4-14); doubling the number of PWCs would add 3 dBA to these estimates. Mammals using habitats beyond the shoreline would experience lower sound levels due greater distance from the PWCs and vegetative cover, which dissipates and absorbs sound. Although there are no available studies that examine the effects of noise on small mammals, PWC noise would be expected to interrupt communication between and among species, as demonstrated in the Shannon et al 2015 synthesis. However, given the small number of PWCs expected (4 on an average day and 14 on a peak day), the short period of peak use (Memorial Day to Labor Day), and the use of other motorized watercraft at the national lakeshore, impacts on mammals from PWC use are expected to be minimal.

Invasive Species: The use of PWCs could contribute to the spread of invasive species to the national lakeshore. Watercraft and boat trailers that are used on multiple waterbodies could transport organisms such as the zebra mussel and the quagga mussel. Currently there are no nonnative aquatic species identified within the waters of Lake Superior at the national lakeshore, however, they could easily be established through transport on a contaminated vessel. This potential impact is mitigated by requiring PWC users to decontaminate their PWCs and all associated equipment between uses at different water bodies so they are free of any vegetation, animals, mud, and any other organic material; this is required by the 2016 Superintendent's Compendium (NPS 2016). The benefits of decontaminating PWCs prior to use in the national lakeshore would be discussed with visitors according to the improved education and outreach program.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Under alternative 2, the entire 42-mile shoreline would be open to PWC use. PWC use is expected to remain concentrated near Sand Point, the location of the only boat launch in the national lakeshore, and Miners Beach. These two locations are popular beaches within the national lakeshore and experience high levels of visitation from beach users, picnickers, and other boaters—using both motorized and non-

motorized vessels. Visitors wanting to use PWCs often combine PWC use with these same activities. PWCs would be able to launch at Sand Point and transit east to newly opened areas. Use near Grand Marais could increase because there is a boat launch in Grand Marais; however, boating conditions there are less hospitable for PWCs then in Munising and Sand Point. Grand Marais is fully exposed to Lake Superior conditions, whereas Munising and Sand Point are protected by Grand Isle, making the waters there slightly calmer and less susceptible to the large waves typical in Lake Superior. Lake Superior can be a challenging environment for PWCs with weather changing quickly, making it dangerous to be too far from a safe landing area. While PWC use could increase in areas currently closed to PWCs, it is expected that use in newly opened areas would be lower than the area between Sand Point and Miners Beach due to lack of access and the distance from the Sand Point boat launch. However, alternative 2 would introduce new impacts to areas of the national lakeshore currently devoid of PWC use.

Birds: Impacts from PWC use under alternative 2 would be the same types of impacts described above for alternative 1, with the primary difference in impacts being the areas of the national lakeshore potentially affected. Under alternative 1, use would be confined to the area currently open to PWC use, approximately 9.2 miles from the western end of the national lakeshore to Miners Beach. Under alternative 2, the area open to PWC use would expand to the entire national lakeshore, resulting in 42 miles of lakeshore available for PWC use. With these new areas open to use, new habitats and the birds that use them could potentially be impacted, including the national lakeshore adjacent to the Beaver Basin Wilderness Area.

In evaluating the impacts to birds under this alternative, the low level and frequency of PWC use means that while birds would be impacted from both transiting and play behavior by PWC users, the impacts would be uncommon. In spite of the low use level anticipated, the presence of PWCs in the newly opened areas would represent an increased impact to birds in these areas; therefore, while the frequency of impact would be low, the use of PWCs would affect birds in these areas in the same manner as discussed for alternative 1.

Under alternative 2, PWCs would be able to beach on any appropriate sandy section of the shoreline, including along the Beaver Basin Wilderness Area. This means several beaches not currently available for PWC users would be open and birds in these areas potentially impacted by the use and presence of PWCs and PWC users. The greatest impact in these areas would be the addition of noise generated from PWCs during play behavior. This would be a new type of anthropogenic noise experienced by wildlife, a noise that is more disruptive than other watercraft due to the frequent changes in loudness and pitch. To a lesser degree, the presence and movement of PWCs could also create impacts in these areas where PWCs are currently prohibited. The presence and movement of PWCs and their users could cause birds to flush. Under alternative 1, the beaches open to PWC access are heavily used by many visitors. Under alternative 2, beaches that currently experience much less use would be open to PWCs. Alternative 2 would represent a new impact but the number of PWCs expected is expected to remain low and the period of use is expected to remain short. The impacts on birds are expected to be minimal; however, these adverse impacts would affect birds in areas that are currently devoid of interruptions in behavior from PWC presence, movement, and noise.

Mammals: The impacts on mammals from PWC users beaching their vessels and recreating on land would be the same as described for alternative 1; however, the impacts would occur over a larger area of the national lakeshore. Mammals would be temporarily disturbed by the addition of a new and potentially disruptive noise source, and by the presence of visitors that disembark from their PWCs. These visitors could also trample terrestrial habitat and burrows of small mammals. The terrestrial habitats adjacent to the beaches are more diverse under alternative 2, which could allow impacts to a greater variety of small mammals. Impacts on mammals are expected to be minimal under alternative 2 due to the low levels of PWC use and the limited period of PWC use (summer months, daylight hours); however, these adverse

impacts would affect mammals in areas that are currently devoid of interruptions in behavior from PWC noise and disturbance and trampling from PWC users.

Invasive Species: The impacts on native wildlife and wildlife habitat from invasive species transported to the national lakeshore from PWC use would be the same as described for alternative 1.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Under alternative 3, PWC use on Lake Superior within the national lakeshore boundary would not be allowed, resulting in beneficial effects on wildlife and wildlife habitat. The absence of PWCs on the water would eliminate wildlife disturbance related to PWC use. Wildlife on shore and in terrestrial habitats would no longer be disturbed by users beaching PWCs and recreating in terrestrial habitats. The no-action alternative would result in beneficial effects on wildlife and wildlife habitat between Sand Point and Miners Beach; however, the removal of PWC use would not result in substantial beneficial effects due to the low level of PWC use at the national lakeshore.

CUMULATIVE IMPACTS

Four ongoing and future actions could contribute additional noise impacts at the national lakeshore, which could disrupt wildlife behaviors. The use of other watercraft is ongoing and could impact wildlife through disturbance, primarily from noise. Additional impacts on wildlife from changes to air and water quality due to PWC use are possible, but as described previously in this chapter, changes in air and water quality would be minimal. Use of other motorized watercraft is the activity that contributes the most to persistent impacts on wildlife and wildlife habitat within the national lakeshore. Other motorized watercraft at the national lakeshore outnumber PWCs at a ratio of 14 to 1 and they are allowed to operate along the entire length of the national lakeshore. The presence of these watercraft and the noise they generate affect wildlife by disrupting natural behaviors.

The Munising city dock expansion is a five-phase project that includes the following activities: dredging, construction of new docking, shoreside work, the extension of an existing dock (L Dock), and the possible construction of an east breakwall. The dredging was completed in 2013. At the time this EA was prepared, the work on expanding the Bayshore Marina and adding floatation docks to the harbor was in process. The construction portions of this project will result in temporary adverse impacts on wildlife due to construction noise. The expansion of the marina and additional docking could result in an increase in boat traffic, and therefore, long-term impacts on wildlife at the national lakeshore from engine noise. Operations at the marina could also result in additional noise that could adversely affect wildlife over the long term.

The future Sand Point revetment project would remove or replace the failing revetment. This project would consider a range of alternatives, from retaining the current revetment without improvements to replacing the revetment. The alternatives would be developed, to the extent possible, to allow natural shoreline processes to occur while restoring or preserving the natural and cultural resources. The revetment project could have temporary adverse impacts on wildlife from in-water construction and construction noise, but overall the impacts would be beneficial, as natural shoreline processes would be allowed to occur.

One ongoing project within the national lakeshore is resulting in a loss of wildlife habitat. Beech bark disease at the national lakeshore has been spreading from east to west since it was identified in 2001. The beech bark disease tree removal project includes the removal of hazard trees from areas targeted for the management of beech bark disease in the national lakeshore. (NPS 2012d). This program is ongoing and

could impact wildlife through disturbance from noise and removal of potential wildlife habitat, which could ultimately change vegetation composition, adversely affecting native wildlife.

Overall these ongoing and future actions would produce adverse impacts on wildlife and wildlife habitat at the national lakeshore. When compared to existing conditions, PWC use under alternative 1 would result in minimal adverse effects to wildlife and wildlife habitat from the presence, movement, and noise of PWCs. The slight adverse impacts from alternative 1 would not contribute appreciably to the cumulative adverse impacts from the other actions described above. Impacts from alternative 2 would be similar to impacts for alternative 1 in the portion of the park between Sand Point and Miners Beach. Similar types of impacts would occur along the rest of the shoreline under alternative 2; however, although these impacts would be minimal, these adverse impacts would affect birds in areas that are currently devoid of interruptions in behavior from PWC presence, movement, and noise. Taken into context with the other ongoing and future actions, the adverse impacts of alternative 2 would not contribute appreciably to the cumulative adverse impacts, mostly due to impacts associated with existing motorized watercraft use throughout the national lakeshore. The no-action alternative, alternative 3, would result in beneficial effects from the elimination of PWCs and PWC users who could impact wildlife and wildlife habitat; however, the beneficial effects of alternative 3 would be slight and would not offset the adverse impacts on wildlife and wildlife habitat from other actions, such as continued use of motorized vessels throughout the national lakeshore.

CONCLUSION

Under alternative 1, PWC use would not change from current conditions; PWCs would be allowed to operate between Sand Point and Miners Beach and use would be limited to daytime hours and would be concentrated during the summer months. PWCs operated in transit mode would impact wildlife, but these impacts would be very similar to impacts from other motorized watercraft. The greatest impact of PWC use is the disruptive noise generated during play behavior, which could cause flushing and would greatly reduce wildlife listening area while the PWCs are in use. Wildlife that inhabit the areas adjacent to the shoreline would be affected by the PWC users who beach their vessels on the beach and recreate in these areas. The impacts on wildlife currently caused by PWC use would continue under this alternative during the phase-out period and would be slightly reduced post phase-out due to lower noise levels generated by direct injection PWC engines. Play behavior, even with the quieter engines after the phase-out, could reach noise levels that have been found to disrupt natural behaviors in birds (Shannon et al 2015). PWC use would continue to be low under alternative 1 (an estimated 4 PWCs per day for average days and 14 PWCs on peak days), and the impacts are not expected to result in measurable effects on wildlife. When considered with other ongoing and future actions, alternative 1 would not contribute appreciably to the cumulative adverse impacts on wildlife and wildlife habitat in the vicinity of the national lakeshore.

Alternative 2 would result in adverse impacts to wildlife along the entire shoreline (42 miles) of the national lakeshore. Though the entirety of the shoreline would be open to PWCs under alternative 2, the amount of PWC recreation is not expected to increase, and the majority of use would continue to take place between Sand Point and Miners Beach. The impacts in this area would be the same as those described for alternative 1. However, alternative 2 would introduce a new and disruptive noise source to areas that do not currently experience this type of noise, including the Beaver Basin Wilderness Area. Similar to alternative 1, PWC play activities could reach noise levels that affect natural wildlife behaviors both during the phase-out and post phase-out. Although greater impacts are expected under alternative 2 when compared to alternative 1 and current conditions, this alternative would not result in local or regional population-level effects on wildlife due to the low level of PWC use. Alternative 2 would not contribute appreciably to the cumulative adverse impacts on wildlife and wildlife habitat from ongoing and future actions in the vicinity of the national lakeshore.

Under alternative 3, PWCs would not be permitted at the national lakeshore, resulting in slight beneficial impacts to wildlife and wildlife habitat in the area between Sand Point and Miners Beach from the reduction in noise and disturbance. Although alternative 3 would provide beneficial effects on wildlife and wildlife habitat, the effects would not counteract the adverse impacts from other ongoing or future actions.

Climate change could also have adverse impacts on wildlife at Pictured Rocks National Lakeshore. Research shows changes in climate can have adverse effects on breeding and winter distribution of birds in North America (Watson et al. 1997). Wildlife species often rely on certain habitats and other conditions, such as temperature, presence of wetlands, or interior habitat. Wildlife species could be directly affected by changes in temperature and precipitation rates depending on their sensitivity to environmental changes (Olson 2013). Observed changes in some wildlife species due at least in part to climate change include a shift of activity ranges north as temperatures change, a shift in the timing of annual life stages (e.g., migration, breeding), spread of invasive species, and extinction (Aldred 2014).

SPECIAL-STATUS SPECIES

As stated in "Chapter 3: Affected Environment," special-status species are plants and animals are defined as those species listed by the USFWS as endangered, threatened, candidate, or special concern; by NOAA National Marine Fisheries Services as endangered or threatened; or by the MDEQ as endangered, threatened, candidate, or a species of concern. Federally and state-listed threatened and endangered species as well as candidate species are given equal consideration for analysis in this EA. Although there are other habitats at the national lakeshore that support many special-status species, only those species potentially affected by the proposed action of this EA are discussed in this section.

This section describes the study area and details the assessment methodology and assumptions. This section then provides a detailed, species-specific impact analysis for each alternative. It is important to note that only those federally and state-listed species that are present and affected by this project are included in the discussions of this section.

STUDY AREA

The study area for analyzing impacts to special-status species consists of the allotted shoreline for the specific alternatives (Sand Point to Miners Beach for alternative 1 and the shoreline of the entire national lakeshore for alternatives 2 and 3). Approximately 15 miles of the 42-mile shoreline would be inaccessible for landing PWCs because the sandstone cliff faces are directly adjacent to Lake Superior; however, noise from PWC operating on the water could still affect special-status wildlife species in these areas. Impacts to special-status species from PWC noise could occur along any areas of the shoreline open to PWC use under a particular alternative. In areas where PWC users are able to beach their vessels and recreate on land, a 100-foot area inland from the shoreline was analyzed for impacts on special-status species.

METHODOLOGY AND ASSUMPTIONS

Protected Species: Special-status wildlife species at the national lakeshore that have the potential to be affected and are analyzed in this chapter include the federally listed piping plover and the state-listed common loon, osprey, bald eagle, merlin, and peregrine falcon.

Types of Impacts: Existing data and GIS maps were used to determine existing conditions and analyze impacts for the three alternatives. The types of impacts would be similar to those described in the "Wildlife and Wildlife Habitat" section of this chapter.

PWC Engine Types: The noise generated by PWCs could disrupt special-status wildlife species both during and after the phase-out period; therefore, the impact analysis does not include separate discussions of the periods during and after the phase-out of carbureted two-stroke engines. Any differences that would occur from the phase-out of carbureted two-stroke engines are discussed within the analysis.

USFWS DETERMINATION OF IMPACT

The terminology below is used in the ESA to assess impacts to federally listed species and is used in this section to be consistent with federal regulations.

No effect: When a proposed action would not affect a listed species or designated critical habitat.

May affect / not likely to adversely affect: Effects on special-status species are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or are completely beneficial.

May affect / likely to adversely affect: When an adverse effect to a listed species may occur as a direct or indirect result of proposed actions and the effect either is not discountable or is completely beneficial.

Is likely to jeopardize proposed species / adversely modify proposed critical habitat (impairment): The appropriate conclusion when the NPS or the USFWS identifies situations in which PWC use could jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside park boundaries.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Under alternative 1, the PWC use area (the 9 miles between Sand Point and Miners Beach) and levels of use would remain the same as current conditions; therefore, impacts are expected to remain consistent with those that are currently occurring. However, after the phase-out of older PWCs, noise impacts would be expected to diminish, albeit only slightly.

Federally Listed Species

Piping Plover (Federally and State Endangered): Piping plovers forage on various beaches throughout the national lakeshore, including Sand Point, Twelvemile Beach, and the eastern shoreline of the park. Piping plovers are known to nest near, but not within, the national lakeshore boundary on the small peninsula near Grand Marais. There is designated piping plover critical habitat on a small portion of land that is managed by the park near the Grand Marais ranger station; this land is not physically connected to the remainder of the park. Piping plovers have historically nested inside the national lakeshore boundary; however, nesting plovers have not been observed in the national lakeshore in over a decade. Breeding habitat is present in the park and the population is growing, so the breeding range could expand in the future (Heyd 2017 pers. comm.).

In the national lakeshore, the shallow habitats along the shoreline where piping plovers may forage are located within and adjacent to the existing 200-foot flat-wake zone. Impacts to plovers from the movement of PWCs operating outside the flat-wake zone are expected to be minimal, but PWC users that beach their vessels and recreate on foot could disturb foraging piping plovers. Disturbance to piping plovers would be the same as those described for other birds in the "Wildlife and Wildlife Habitat" section of this chapter and could include increased vigilance, altering foraging behavior, and flushing.

Motorized and non-motorized recreation has been shown to disturb plovers in the Great Lakes, and PWCs in particular may disturb nesting plovers (USFWS 2003). Non-motorized recreation including beach walking, hiking, kayaking, camping, and close-up photography have also disturbed plovers in the Great Lakes region. These activities can cause plovers to flush their nests (USFWS 2003). The beaches within the PWC use area open under alternative 1 are considered marginal piping plover habitat. Under alternative 1, PWC noise could disturb foraging piping plovers along the shoreline. Piping plovers would be expected to be most impacted by the noise generated during PWC play behavior, as the loudness and pitch of this behavior changes frequently and can be disruptive to wildlife. Piping plovers have been observed foraging at Sand Point, which is within the area of PWC under alternative 1. Piping plovers foraging along the shoreline would experience sound levels similar to a visitor on the beach (60.8 to 65.6 dBA during the phase-out period and 55.1 to 59.9 dBA post phase-out for one PWC, according to the sound attenuation modeling). These noise levels exceed the baseline sound levels of the national lakeshore. Further, as described in the "Wildlife and Wildlife Habitat" section, changes in the frequencies and durations of calls and declines in reproductive success have been observed with noise levels between 58 and 60 dBA (Shannon et al 2015). These noise levels indicate that the natural behaviors of piping plovers could be affected by PWC use at national lakeshore. Under alternative 1, piping plovers would continue to be affected by PWC use at the national lakeshore at the same level as they are currently. The amount of PWC noise experienced by plovers under alternative 1 during the phase-out period would be consistent with that which is currently occurring at the national lakeshore, and would be slightly reduced after the phase-out period. The number of PWC users who beach their vessels and recreate on foot would also remain constant. Given the low PWC use of the park, the short period of peak PWC use (daytime hours during summer months), the marginal plover habitat adjacent to the PWC use area, and the limited number of shoreline miles open to PWC use under alternative 1, adverse impacts on individual piping plovers may occur due to the sensitive nature of this listed species, but the impacts would be infrequent and minimal.

Section 7 Conclusions: Although disturbance of piping plovers during PWC use and onshore recreation by PWC users would be incidental, harassment of federally listed species is considered a take and prohibited under the ESA. Overall, this alternative *may affect, but is not likely to adversely affect* the piping plover. If the plover becomes established at the national lakeshore in the future, mitigating actions could be required to minimize adverse effects from PWC use.

State-Listed Species

Common Loon (State Threatened): The common loon is a primarily aquatic waterfowl species that breeds on inland lakes of adequate size with stable water levels and undeveloped shorelines. Loons use shallow water for foraging, nurseries, and shelter, and deep water for diving and social interaction. The loon spends the majority of time in water swimming and diving for prey (Cornell n.d.).

Direct interactions, or collisions, between PWCs and loons could occur but would be considered uncommon. Loons are agile birds and have the ability to move quickly (Cornell n.d.) if disturbed by PWC noise or movement. However, as stated in the "Wildlife and Wildlife Habitat" section in chapter 4, flushing can have adverse effects on birds, causing them to expend excess energy. This could lead to a decline in body condition, altered behavioral patterns, and lowered reproductive success. PWCs would be allowed to travel at flat-wake speeds, perpendicular to the shoreline within 200 feet of the shoreline or cliffs. This restriction would minimize potential direct interactions and disruptions to loon behavior.

Loon nesting habitat does not exist within the study area for alternative 1. PWC users recreating on land would not affect loons; however, foraging and swimming loons could be affected by the presence and noise of PWCs on the water. Impacts from transiting PWCs would be expected to be similar to those of other motorized watercraft, since the PWCs are traveling at a relatively constant speed and direction.

PWCs in play mode would be more disruptive and cause birds to flush more frequently. The rapid changes in speed and direction that characterize play are responsible for this effect. Loons loafing or foraging on the open water would experience sound levels from PWC play behavior similar to those modeled for a kayaker in the sound attenuation modeling (68.9 to 73.7 dBA during the phase-out period and 63.2 to 68.0 dBA post phase-out for one PWC); these noise levels exceed the baseline sound levels of the national lakeshore. Shannon et al 2015 reported changes in the frequencies and durations of calls and declines in reproductive success have been observed in birds in areas with noise levels between 58 and 60 dBA. These noise levels indicate that the natural behaviors of common loons could be affected by PWC use at national lakeshore. Under alternative 1, PWC use would remain low because it is not expected to increase from current use levels, which would limit potential impacts on the common loon. Impacts from noise would be slightly lower following the phase-out period. Slight adverse impacts would continue to occur on individual common loons, primarily from noise or movement associated with PWC use on the open water beyond the 200-foot flat-wake zone.

Bald Eagle (State Species of Concern) and Osprey (State Species of Concern): Bald eagle and osprey are two species identified by MDEQ as species of concern that could be affected by PWC use at the national lakeshore. The birds could be affected in the same manner described for wading birds, shorebirds, and cliff dwelling birds in the "Wildlife and Wildlife Habitat" section of this chapter. Bald eagle and osprey could use the areas along the shoreline for foraging and resting, and bald eagles also may nest along forested areas of the shoreline. These birds are mobile and agile in flight and would be expected to avoid collisions with PWCs; however, the noise from PWCs could have an effect on bald eagles or osprey using the 9 miles of shoreline open to PWC use under alternative 1. Bald eagle and osprey nest and use habitat above the cliffs and therefore would likely experience noise levels similar to those modeled for a hiker on a trail (also located above the water set back from the cliff faces). During PWC play behavior, bald eagles and osprey could experience noise levels of 60.8 to 65.6 dBA during the phase-out period and 55.1 to 59.9 dBA post phase-out; these noise levels exceed the baseline sound levels of the national lakeshore. These noise levels could cause eagles and osprey to flush from nests and roost sites, expending unnecessary energy and potentially exposing eggs and nestlings to environmental dangers. Additionally, the noise and presence of PWCs could alter these birds' normal foraging or resting behaviors. Shannon et al 2015 reported behavioral changes related to communication and reproduction in birds in areas with noise levels between 58 and 60 dBA. These noise levels indicate that the natural behaviors of bald eagles and osprey could be affected by PWC use at national lakeshore. Under alternative 1, PWC users that beach their vessels and disembark to recreate in forested areas could disrupt nesting and resting eagles and osprey. PWC users along the shoreline could encounter bald eagles feeding on carrion. These birds are slower to react to disturbance, as birds with full crops can have difficulty taking flight, increasing the potential for harassment from visitors (the crop is the inner organ within the esophagus that stores and softens food for digestion.) The 200-foot flat-wake zone would protect eagles and osprey from most impacts other than noise (such as harassment and flushing due to changes in speed and direction), except when the birds are flying over the water.

Under alternative 1, bald eagles and osprey would continue to be affected by PWC in the same manner as is currently occurring at the national lakeshore. Impacts would decrease slightly after the phase out of older-model PWCs from a reduction in noise levels. PWC play behavior and presence of PWC users along the shoreline would impact these raptor species; however, the impacts would be minimal due to the low levels of PWC use and the limited use period per year (daytime hours during summer months). The 200-foot flat-wake zone would limit adverse impacts to eagles and osprey by reducing PWC speeds and noise along the shoreline. Further, alternative 1 limits PWC use to a 9-mile segment between Sand Point and Miners Beach, which is heavily used for recreation purposes. The national lakeshore contains many remote places with potential habitat for bald eagles and ospreys where PWC impacts would not occur.

Peregrine Falcon (State Endangered) and Merlin (State Threatened): Because the falcons (peregrine and merlin) use open water for hunting prey, collisions or direct interactions with PWCs would be extremely unlikely. These birds are highly mobile and agile in flight and would be expected to avoid any contact with PWCs. These falcons are state-listed and no critical habitat is mapped within the study area; however, falcon nests are found along the shorelines of the national lakeshore.

Peregrine falcon nest sites are usually found on cliffs overlooking waterbodies or open areas (Monfils 2007), whereas merlins build nests at the top of large trees along the shoreline. It is possible that PWC users on foot could encounter forested areas that may be used by merlins for nesting. However, these encounters are expected to occur to individuals so infrequently that impacts would not be measurable and would be unlikely to cause any changes at the population level. Although PWCs are primarily used outside of the 200-foot flat-wake zone, the noise from PWCs could have an effect on cliff-nesting peregrines or merlins nesting close to the shoreline, and operation inside the flat-wake zone could also cause a sight disturbance. Nesting peregrine falcons could be disturbed by engine noise because the nesting season in Michigan is between April and late September (MDNR 2014b). Peregrine falcons use the cliff faces for roosting and could be disturbed during roosting. The nesting period for merlins also extends into the peak PWC season. These falcons would experience noise levels similar to those modeled for a visitor on the beach. As described for the bald eagle and osprey, PWC play behavior would have the greatest effect on bird behavior and the modeled noise levels exceed the existing noise levels in the national lakeshore. Noise from play behavior also exceeds the noise levels found to disrupt communication and reproduction behaviors in birds (Shannon et al 2015). Noise and sight disturbance from PWC use could cause falcons to flush from nests and roost sites, expending unnecessary energy and exposing eggs and nestlings to environmental dangers. However, alternative 1 limits PWC use to a 9-mile segment between Sand Point and Miners Beach, which is heavily used for recreation purposes. Speed restrictions associated with the 200-foot flat-wake zone would limit noise and motion impacts from PWC use. The national lakeshore contains ample areas with potential habitat for peregrine falcons and merlins throughout the park where PWC impacts would not occur. With the spatial limitation of alternative 1, combined with the low numbers of PWCs at the national lakeshore, disturbance to peregrine falcons and merlins would not be expected to cause measurable effects to these species.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Alternative 2 would allow PWC use along the entire shoreline of the national lakeshore. PWC users would be able to land their vessels on any sandy beach and use the shoreline and upland areas for recreation purposes. The shoreline of the national lakeshore offers a variety of habitats. Under alternative 2, PWC use would affect areas with lower visitor use than the current PWC use area, which could translate into new impacts for some special-status species.

Federally Listed Species

Piping Plover (Federally and State Endangered): Foraging piping plovers could be disturbed, as discussed under alternative 1, by the noise and presence of PWCs and the presence of PWC users that disembark from beached vessels to recreate on land. Under alternative 2, the entire shoreline would be open to PWC use; therefore, the potential for impacts on piping plovers would be greater than under alternative 1 (current conditions).

Under alternative 2, it is expected that visitation to the portion of the national lakeshore currently open to PWC use (Sand Point to Miners Beach) would remain constant. PWC use could expand in new areas open to PWCs under alternative 2. However, due to the unpredictable wind and wave conditions along the remaining shoreline, PWC use is expected to be low on the eastern side of the park. Use near Grand Marais within the national lakeshore would likely increase because there is a boat launch in Grand Marais

outside of the park boundaries; however, PWC use is expected to be lower at Grand Marais than in Sand Point and Munising due to the difference in boating conditions.

PWC users on the waters of the eastern park boundary could disturb foraging piping plovers along the shoreline, as well as nesting plovers adjacent to the park because of the noise generated by PWC engines. The portion of the national lakeshore that contains piping plover critical habitat would not experience direct impacts from PWCs or PWC users because this small portion of the national lakeshore would not be open to PWC use.

Under alternative 2, PWC users could beach PWCs at any appropriate sandy location along the 42 miles of shoreline. PWC users on foot would be able to access piping plover habitat and potentially disturb plovers foraging within the national lakeshore boundary. Non-motorized recreation has been shown to cause disturbance, including flushing from nests (USFWS 2003). Although PWC use is expected to remain low, PWC users would be able to access areas under this alternative that are currently closed to PWC use. These areas are open to other forms of recreation, but PWC users could be an added stressor.

As discussed for alternative 1, the greatest impact on piping plovers from PWC use would be disturbance from noise. In previous studies, motorized recreation has been shown to disturb plovers in the Great Lakes, and PWCs in particular may disturb nesting plovers (USFWS 2003). Piping plovers are known to forage on the beach at Sand Point, but this is considered marginal habitat. Plovers also forage within national lakeshore boundary near Grand Marais and near the Twelvemile Beach campground. Piping plovers are also known to nest near the national lakeshore boundary (NPS 2003, n.d.d). Nesting plovers have not been observed in the national lakeshore in over a decade; however, the park offers breeding habitat and the population is growing, so there is a chance that breeding range could expand. Under alternative 2, piping plovers using these habitats could be disturbed by PWC noise, especially when PWCs are operating in play mode. Piping plovers foraging along the shoreline would experience noise levels similar to a visitor on the beach (61.0 to 65.7 dBA during the phase-out period and 55.2 to 60.0 dBA post phase-out for one PWC, according to the sound attenuation modeling). These noise levels exceed the baseline sound levels of the national lakeshore as well as thresholds that have been found to affect communication and reproductive behavior of birds (Shannon et al 2015). Based on this information, the natural behaviors of piping plovers could be affected by PWC use at the national lakeshore.

Under alternative 2, the plovers that forage at Sand Point would experience impacts that are the same as those described under alternative 1 because the level of PWC use is not expected to change. Piping plovers that forage near Twelvemile Beach and those that forage and nest near? Grand Marais would experience impacts from PWC use that do not currently occur. PWC use in areas east of Sand Point is expected to be very low due to unpredictable wind and wave conditions, but impacts on piping plover cannot be discounted. Given the low levels and the short period of PWC use (daytime hours during the summer months), indirect effects on individual piping plovers may occur due to the sensitive nature of this listed species, but the impacts are expected to be small. However, because the noise and presence of PWCs could affect piping plovers in areas where PWCs are currently absent, impacts from alternative 2 would be greater than those expected under alternative 1.

Section 7 Conclusions: Although disturbance of piping plovers during PWC use and onshore recreation by PWC users would be incidental, harassment of federally listed species is considered a take and prohibited under the ESA. Overall, this alternative *may affect, but is not likely to adversely affect* the piping plover. If the piping plover becomes established at the national lakeshore in the future, mitigating actions could be required to minimize any adverse effect from PWC use.

State-Listed Species

Common Loon (State Threatened): Under alternative 2, PWC users could beach PWCs at any appropriate sandy location along the 42 miles of shoreline. Loon nesting habitat does not exist within the study area for alternative 2; however, PWC presence and noise on the water could affect foraging or swimming loons, as described under alternative 1. PWC use levels are not expected to increase under alternative 2, but the area of impact would increase, thus increasing the potential for impacts on loons. Adverse impacts on loons are expected to be infrequent and temporary under alternative 2; however, opening the entire shoreline to PWC use creates potential impacts on common loons that do not currently exist. As explained for piping plover, due to the low level of PWC use and the short season in which PWCs are used, impacts on loons would be small, but the impacts under alternative 2 would be greater than those expected under alternative 1.

Bald Eagle (Species of Concern) and Osprey (Species of Concern): Bald eagles and osprey could be affected by PWC use under alternative 2. As stated under alternative 1, the species use the areas along the shoreline for nesting, foraging, and resting and could be affected by PWC noise while on the water and disturbance from PWC users in terrestrial habitats, but these impacts are expected to be minimal due to the low levels of PWC use and the limited use period per year (daytime hours during summer months). Under alternative 2, the entire shoreline would be open to PWC use, including more secluded, less popular recreation areas and the Beaver Basin Wilderness Area. These areas are likely to contain more suitable habitat than that which exists in the PWC use area for alternative 1. Although PWC use will remain low under alternative 2, this alternative presents the potential for PWC use to adversely affect bald eagles and osprey over a greater area where they are more likely to occur. The adverse impacts from alternative 2 would be greater than those expected for alternative 1. However, impacts to these species would remain low due to the small amount of PWC use expected at the lakeshore.

Peregrine Falcon (State Endangered) and Merlin (State Threatened): Under alternative 2, the type of impacts on peregrine falcons and merlins would be the same as described for alternative 1, but the area of impact would increase because the entire shoreline would be open to PWC use. The greatest impacts on peregrine falcons would be from PWC presence and noise in close proximity to their nests on cliffs; these nests would be considered inaccessible to PWC users on foot. It is possible that PWC users on foot could encounter forested areas that merlins may be using for nesting. Alternative 2 would allow PWC use where higher quality peregrine falcon and merlin habitat occurs. Peregrine falcons and merlins have both successfully fledged young in the park over recent years (NPS 2015b). Under alternative 2, PWC use and period of activity (daytime during summer months) would remain low, but this alternative would introduce a new stressor to peregrine falcons and merlins that does not exist under current conditions. The adverse impacts would be small but would be greater than those expected under alternative 1. The 200-foot flat-wake zone would help lessen impacts to nesting and foraging birds.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Under alternative 3, there would be beneficial impacts on special-status species. The current PWC use on Lake Superior within the national lakeshore boundary would not be allowed, thus eliminating potential impacts on the federally listed species (piping plover) or state listed species (piping plover, common loon, bald eagle, osprey, peregrine falcon, and merlin). The no-action alternative would also reduce the potential for trampling effects on the grassland/herbaceous habitat that may support nesting habitat for merlin. Because PWC users would no longer have access to the national lakeshore, there would be beneficial effects on federal and state-listed species from the elimination of noise and the presence of PWCs.

CUMULATIVE IMPACTS

Other ongoing and future planned actions within and around the national lakeshore have the potential to impact special-status species. Based on the PWC survey during the July 4th weekend in 2013 (NPS 2013b), the ratio of other motorized boats to PWCs is approximately 14 to 1. On the water, the presence and noise of motorized boats could disrupt piping plovers, common loons, bald eagles, osprey, peregrine falcons, and merlins along the entire length of the lakeshore. Visitors on foot could disturb nesting and resting bald eagles, osprey, and merlins. From the Grand Marais boat launch location, visitors would have to navigate around a peninsula to access the open shoreline of Lake Superior and the national lakeshore. This peninsula is mapped as critical habitat for nesting piping plovers, and motorized watercraft and visitors that beach their boats to disembark on land could potentially disturb nesting plovers. The use of other watercraft could affect special-status species in the same ways as PWCs.

Another ongoing project within the national lakeshore is causing a loss of wildlife habitat. Beech bark disease at the national lakeshore has been spreading from east to west since it was identified in 2001. The beech bark disease tree removal project includes the removal of hazard trees from areas targeted for the management of beech bark disease in the national lakeshore. (NPS 2012d). This program is ongoing and could impact the special-status species through disturbance from noise and removal of and changes to potential habitat.

The future Sand Point revetment project would remove or replace the failing revetment. This project would consider a range of alternatives, from retaining the current revetment without improvements to replacing the revetment. The alternatives would be developed, to the extent possible, to allow natural shoreline processes to occur while restoring or preserving the natural and cultural resources. The revetment project could have temporary adverse impacts on special-status species from in-water construction and construction noise, but overall the impacts would be beneficial, as natural shoreline processes would be allowed to occur.

Overall these ongoing and future actions would produce adverse impacts on special-status species at the national lakeshore. When compared to existing conditions, PWC use under alternative 1 would result in continued minimal adverse effects to special-status species from the presence, movement, and noise of PWCs. The slight adverse impacts from alternative 1 would not contribute appreciably to the cumulative adverse impact from the other ongoing and future actions described above. Impacts from alternative 2 would be similar to impacts for alternative 1 in the portion of the park between Sand Point and Miners Beach. Similar types of impacts would occur along the rest of the shoreline under alternative 2. Although these impacts would be minimal, these adverse impacts would affect the special-status bird species in areas that are currently devoid of interruptions in behavior from PWC presence, movement, and noise. Taken into context with the other ongoing and future actions, the adverse impacts of alternative 2 would not contribute appreciably to the cumulative adverse impacts. Alternative 3 would result in beneficial effects from the elimination of PWCs and PWC users who could impact special-status species; however, the beneficial effects of the no-action alternative would be slight and would not offset the adverse impacts on special-status species from other ongoing and future actions, such as continued use of motorized vessels throughout the national lakeshore.

CONCLUSION

Alternatives 1 and 2 *may affect, but are not likely to adversely affect* the federally listed species found within the study area (piping plover). The state-listed species (common loon, bald eagle, osprey, peregrine falcon, and merlin) would experience adverse impacts from PWC use from PWC users that beach their vessels and recreate on land, from the presence of PWCs in the water, and from the noise generated by PWC use.

Under alternative 1, PWC use would not change from current conditions; PWCs would be allowed to operate between Sand Point and Miners Beach and use would be limited to daytime hours and would be concentrated during the summer months. Special-status species that inhabit the areas adjacent to the shoreline would be affected by the PWC users who beach their vessels on the beach and recreate in these areas. PWCs operated in transit mode would impact special-status species, but these impacts would be very similar to impacts from other motorized watercraft. The greatest impact of PWC use is the disruptive noise generated during play behavior, which could cause flushing and would greatly reduce listening area for the species while the PWCs are in use. The impacts on special-status species currently caused by PWC use would continue under this alternative during the phase-out period and would be slightly reduced post phase-out due to lower noise levels generated by direct injection PWC engines. Play behavior, even with the quieter engines after the phase-out, could reach noise levels that have been found to disrupt natural behaviors in birds (Shannon et al 2015). PWC use would continue to be low under alternative 1 and the season short (daytime during summer months), and the impacts are not expected to result in measurable effects on special-status species. When considered with other ongoing and future actions, alternative 1 would not contribute appreciably to the cumulative adverse impacts on special-status species.

Alternative 2 would allow PWC use along 42 miles of the national lakeshore. The types of impacts would be the same as those described for alternative 1 and although the amount of PWC recreation is not expected to increase, this alternative would affect special-status species in areas that are not currently impacted by PWC use. Under alternative 2, the majority of use would continue to take place between Sand Point and Miners Beach. Similar to alternative 1, PWC play activities could reach noise levels that affect natural behaviors both during the phase-out and post phase-out. Although alternative 2 would produce greater adverse impacts on special-status species when compared to alternative 1, this alternative would not result in local or regional population-level effects on special-status species due to the low level of PWC use that occurs at the lakeshore. Alternative 2 would not contribute appreciably to the cumulative adverse impacts on special-status species from ongoing and future actions in the vicinity of the national lakeshore.

Under alternative 3, PWCs would not be permitted at the national lakeshore, resulting in slight beneficial impacts to special-status species in the area between Sand Point and Miners Beach from the reduction in noise and disturbance. Although alternative 3 would provide beneficial effects on special-status species, the effects would not counteract the adverse impacts from other ongoing or future actions.

Climate change may also have adverse impacts on special-status species at Pictured Rocks National Lakeshore. Changes in climate may result in migratory bird species arriving earlier in the spring (Watson et al. 1997). This could impact special status species that rely heavily on specific vegetation or prey species. If these resources do not respond to climatic changes, they may not be available when the birds arrive (USGCRP 1996).

ETHNOGRAPHIC RESOURCES

This analysis includes an evaluation of the potential for impact to ethnographic resources at the national lakeshore as a result of PWC use, mainly in the forms of noise and visual intrusions to ceremonial events. Ethnographic resources are the cultural and natural features of a park that are of cultural significance to peoples traditionally associated with it. Ethnographic resources have not yet been formally evaluated for their status as traditional cultural properties/sacred sites at Pictured Rocks National Lakeshore; however, the 1999 University of Arizona ethnographic resources study revealed the national lakeshore contains several hundred ethnographic resources linked to the Chippewa. Traditional uses of cliffs, beaches, dunes, coves, river mouths, and the shoreline indicate the need for visitors to show reverence and respect. PWC noise level and pitch changes, caused by rapid acceleration, deceleration, and change of direction, can be disturbing to the traditional users of these areas and detract from the enjoyment and use of these areas. In

addition, the often brightly colored PWCs and flotation devices may constitute a visual intrusion to traditional users, who have expressed concern about the disruption that crowds, trash, and frequently used trails already have on their use of these resources.

GUIDING REGULATIONS AND POLICIES

NPS Management Policy 2006 - 5.3.5.3 Ethnographic Resources: The NPS must consider the effects of park actions on "the cultural and natural features of a park that are of traditional significance to traditionally associated peoples." This includes "ethnic or occupational communities that have been associated with the park for two or more generations (40 years), and whose interests in the park's resources began before the park's establishment."

Executive Order 13007, "Sacred Indian Sites": Executive Order 13007 was designed to protect and preserve Indian religious practices. The NPS has a responsibility to (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners; and (2) avoid adversely affecting the physical integrity of such sacred sites.

STUDY AREA

The study area for analyzing impacts to ethnographic resources consists of the allotted shoreline open to PWC use under the specific alternatives (Sand Point to Miners Beach for alternative 1, and the entire shoreline of the national lakeshore for alternatives 2 and 3). Ethnographic resources include plants, animals, minerals, landforms, and structures found throughout the national lakeshore.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

PWC use would continue to have adverse impacts on ethnographic resources from the western boundary of the park to Miners Beach due to disturbance from the presence and noise of the vessels. Significant ethnographic resources include natural and cultural materials, features, and places (Stoffle et al. 1994: 9). The 1999 ethnographic resources study identified significant Chippewa resources in the South Bay area (including Munising Falls and the Sand Point Marsh), and Miners Beach and Miners Castle for ceremonies, spiritual cleansing, and food gathering (University of Arizona 2001). Boat patrols would be conducted during the use of ethnographic resources, such as ceremonies, to monitor and restrict PWC use near ceremonies. The implementation of boat patrols would limit potential PWC-related intrusions, mitigating the effects of the adverse impacts from PWCs; however, the boat patrols themselves would be an intrusion upon ethnographic resource use. PWC users could directly impact natural resources used for ethnographic reasons. PWC users that beach their vessels and disembark to recreate on the shoreline and upland areas could damage plants and disturb wildlife that are considered important to the Chippewa. Overall, adverse impacts from PWC use are anticipated to be minimal because PWC use is low at the national lakeshore and expected to remain at current levels and would be limited to the portion of the park shoreline west of Miners Beach.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

This alternative would have impacts on ethnographic resources similar to those discussed under alternative 1; however, under alternative 2, ethnographic resources along the entire national lakeshore could be affected by the presence and noise of PWCs. In addition to the South Bay area, Miners Beach, and Miners Castle, PWCs would have access to Beaver Basin, Sable Falls, and Hurricane River, areas identified in the 1999 ethnographic resources study as significant resources of the national lakeshore for ceremonies, spiritual cleansing, and food and medicine gathering (University of Arizona 2001).

Ethnographic resources could be affected from noise, visual intrusion, and direct and indirect effects on natural resources. This alternative would have adverse impacts during Chippewa ceremonies within the park. The impacts would tend to be indirect, infrequent, and of short duration due to the low number of PWC users operating in the national lakeshore and the dispersed nature of use under alternative 2. Boat patrols would mitigate the impacts from PWC use by monitoring and restricting use near ceremonies; however, the boat patrols themselves would be an intrusion upon ethnographic resource use. As stated for alternative 1, PWC users could adversely affect natural resources that are considered important to the Chippewa by trampling vegetation and disturbing wildlife when recreating in shoreline and upland habitats. This impact would be minimal due to the low level of PWC use at the national lakeshore; however, alternative 2 would introduce PWC-related impacts to ethnographic resources east of Miners Beach, where PWCs are currently prohibited, resulting in a greater adverse impact than expected for alternative 1.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Discontinuing PWC use under alternative 3 would have beneficial effects on ethnographic resources for the Chippewa. The no-action alternative would eliminate the number of possible incidents of noise and visual intrusion attributable to PWC use, as well as damage or disturbance to the natural resources from PWC users who beach their vessels and disembark on the shoreline and upland areas. PWC use would not interfere with Chippewa ceremonies, spiritual cleansing, or food gathering in the South Bay area, Miners Beach, and Miners Castle; however, the benefits of the no-action alternative would be slight due to the low levels of PWC use at the national lakeshore.

CUMULATIVE IMPACTS

Other ongoing and future planned actions within and around the national lakeshore have the potential to impact ethnographic resources. The use of other watercraft is an activity that could cause visual and auditory disturbance during the use of ethnographic resources. Based on the PWC survey during the July 4th weekend in 2013 (NPS 2013b), the ratio of other motorized boats to PWCs is approximately 14 to 1. This count includes pontoon boats, fishing boats, Jon boats, and commercial tour boats. These motorized boats generate noise from engines and from the public address systems in the commercial tour boats, which could interrupt the use of ethnographic resources of the national lakeshore and result in adverse impacts.

The future Sand Point revetment project would remove or replace the failing revetment. This project would consider a range of alternatives, from retaining the current revetment without improvements to replacing the revetment. The alternatives would be developed, to the extent possible, to allow natural shoreline processes to occur while restoring or preserving the natural and cultural resources. The revetment project could have temporary adverse impacts on ethnographic resources from in-water construction and construction noise and long-term adverse impacts if the shoreline is altered, as the shoreline is an important landform linked to the Chippewa way of life.

These ongoing and future actions would have adverse impacts on the ethnographic resources at the national lakeshore from the contribution of noise, visual disturbance, and possible alteration of ethnographic resources. When compared to existing conditions, PWC use under alternative 1 would result in minimal adverse effects to ethnographic resources from the presence and noise of PWCs and potential for PWC users to harm natural resources that are considered important to the Chippewa by trampling vegetation and disturbing wildlife when recreating on land. The slight adverse impacts from alternative 1 would not contribute appreciably to the cumulative adverse impact from the other ongoing and future actions described above. Impacts from alternative 2 would be similar to impacts for alternative 1 in the portion of the park between Sand Point and Miners Beach. Similar types of impacts would occur along

the rest of the shoreline under alternative 2. Although these impacts would be minimal, these adverse impacts would affect the ethnographic resources in areas that are currently devoid of PWC presence and noise. Taken into context with the other ongoing and future actions, the adverse impacts of alternative 2 would not contribute appreciably to the cumulative adverse impacts. Alternative 3 would result in beneficial effects from the elimination of PWCs and PWC users who could impact ethnographic resources; however, the beneficial effects of the no-action alternative would be slight and would not offset the adverse impacts on ethnographic resources from other ongoing and future actions, such as continued use of motorized vessels throughout the national lakeshore.

CONCLUSION

PWC use under alternative 1 would result in continued adverse impacts on ethnographic resources between Sand Point and Miners Beach. PWCs could have noise and visual intrusion effects under alternative 1, which could interrupt use of Miners Beach, Miners Castle, and the South Bay for ethnographic reasons. During ceremonies, the NPS would run boat patrols, which could have similar adverse effects, though to a lesser degree. In addition, PWC users that beach their vessels and disembark on the shoreline and upland areas for recreation could damage natural resources that are used by the Chippewa as ethnographic resources. PWC use would continue to be low under alternative 1 and the season short (daytime during summer months), and the impacts are expected to result in slight adverse impacts on ethnographic resources. When considered with other ongoing and future actions, alternative 1 would not contribute appreciably to the cumulative adverse impacts on ethnographic resources.

Under alternative 2, PWC use could adversely affect the use of Miners Beach, Miners Castle, and the South Bay for ethnographic reasons, as described for alternative 1. However, with 42 miles of shoreline open to PWC use under this alternative, PWC use could also interrupt ethnographic uses of Beaver Basin, Sable Falls, and Hurricane River. The types of impacts would be the same as those described for alternative 1: visual intrusion and noise from PWCs and boat patrols and potential indirect impacts on natural resources regarded and used by the Chippewa by PWC users that beach their vessels and disembark into terrestrial areas. Adverse impacts on ethnographic resources under alternative 2 would be minimal but the impacts would be greater than those expected under alternative 1 due to the larger area open to PWCs and the greater number of ethnographic resources linked to the Chippewa that could be affected. Alternative 2 would not contribute appreciably to the cumulative adverse impacts on ethnographic resources from ongoing and future actions in the vicinity of the national lakeshore.

Alternative 3 would result in slight beneficial impacts on the ethnographic resources of the national lakeshore from the elimination of PWCs. Despite these beneficial impacts from alternative 3, overall cumulative impacts from ongoing and future project and actions on ethnographic resources are anticipated to be adverse.

VISITOR USE AND EXPERIENCE

Impacts on visitor use and experience are assessed in this section. The analysis includes an evaluation of the potential for changes to recreational opportunities and the quality of the visitor experience at the national lakeshore related to PWC management under the alternatives.

GUIDING REGULATIONS AND POLICIES

Pictured Rocks National Lakeshore General Management Plan: Part of the purpose of the national lakeshore is to provide opportunities for public benefit in recreation, education, enjoyment, and inspiration (NPS 2004). Its significance lies in the spectacular and diverse shoreline of Lake Superior that visitors enjoy. The mission of the national lakeshore is to conserve the ecosystem integrity of the national

lakeshore, a mosaic of geologic, biologic, scenic, and historic features, offering opportunities for recreation, education, inspiration, and enjoyment forever (NPS 2004). The enabling legislation for the national lakeshore identifies preservation, inspiration, education, recreation, and enjoyment as important elements of the visitor experience.

STUDY AREA

The study area for analyzing impacts to visitor use and experience consists of the allotted shoreline for the specific alternatives (Sand Point to Miners Beach for alternative 1 and the entire shoreline of the national lakeshore for alternatives 2 and 3).

METHODOLOGY AND ASSUMPTIONS

The purpose of this analysis is to assess the impacts of PWC use on visitors at the national lakeshore. During the peak visitation season in 2016 (June, July, and August), a total of 95,414, 184,081, and 193,349 visitors, respectively, were estimated to visit the national lakeshore. Assuming 4 PWCs were used each average day and 14 PWCs were used each peak day, PWC users accounted for less than 1% of use throughout the season.

Based on the July 2013 PWC survey (NPS 2013b), other motorized watercraft outnumber PWCs at the national lakeshore at a ratio of 14 to 1. Motorized watercraft considered in this count include pontoon boats, fishing boats, Jon boats, and commercial tour boats.

Other recreational activities and visitor experiences at the national lakeshore were identified and taken into account while determining impacts to visitor use and experience. Other user groups include campers, hikers/backpackers, beach users, swimmers, other motorized boat users, canoers/kayakers, and picnickers. Visitor attitudes and satisfaction in areas where PWCs are used were evaluated based on public comments received during the public scoping process for this project (NPS 2013g). In order to simplify the assessment of visitor experience impacts, the types of affected visitors are divided into three groups: PWC users, other watercraft users, and shoreline users. Other watercraft users include visitors using tour boats, motorboats, and non-motorized boats (canoes and kayaks) within the national lakeshore. Shoreline users include visitors who engage in hiking, swimming, picnicking, and other visitors using the shoreline areas of the national lakeshore.

As discussed in the "Acoustic Environment and Soundscapes" section of this chapter, PWC use at the national lakeshore impacts the acoustic environment. One of the values of the national lakeshore is the ability to enjoy the natural environment and noise generated by PWCs can impact this experience. A system-wide survey of park visitors revealed that nearly 91% of visitors come to national parks to enjoy the natural sounds (NPS 1994). Noise can distract visitors from the resources and purposes of cultural areas, the tranquility of historic settings, and the solemnity of memorials and sacred sites. In 2008 and 2009, the NPS conducted a telephone survey with over 4,000 respondents in the United States to obtain information on public attitudes and behaviors related to programs and services provided by the NPS. Respondents were asked their opinion of the statement "I should be able to go to a national park and not hear mechanized sounds like engine noise and cell phones when I am in wild or undeveloped areas." Among visitors, 78% agreed or strongly agreed, as did 74% of non-visitors (Taylor et al. 2011).

The noise levels associated with PWC use that would be experienced by visitors was modeled for the two action alternatives; full modeling results are presented in the "Acoustic Environment and Soundscapes" section and appendix E.

The potential for change in visitor experience was evaluated by identifying projected increases or decreases in both PWC and other visitor uses, and determining whether these projected changes would affect the desired visitor experience.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Impact to PWC Users: During the phase-out of carbureted two-stroke engines, alternative 1 would continue to be beneficial to the visitor experience of PWC users. PWC users would continue to be allowed to operate their vessels within the same area as currently allowed under the 2005 regulations (36 CFR § 7.32(d)(1)). Launch sites and PWC landing sites would remain the same. PWC users would be expected to continue to comply with current Michigan state law and NPS regulations concerning PWC operation.

After the first two years of implementing this PWC management plan, carbureted two-stroke engines would no longer be permitted within the national lakeshore. A portion of PWC users would be adversely impacted by the phase-out of carbureted two-stroke PWC engines. Many of the PWCs registered in the counties surrounding the national lakeshore and in all of Michigan were manufactured prior to the production of direct injection two-stroke or four-stroke engines, based on PWC registration data. This information indicates that many of the PWCs likely to be used at the national lakeshore have carbureted two-stroke engines. The experience of visitors that use carbureted two-stroke PWCs as a primary vessel and consider PWCs to be of central importance to their visit would be adversely impacted because this recreation opportunity would no longer be available. However, these PWC users could continue to experience the national lakeshore if they are able to purchase direct injection two-stroke or four-stroke PWCs or if they chose other recreational activities. There would be no impact to PWC users with direct injection two-stroke or four-stroke engines after the phase-out of carbureted two-stroke engines.

Impact to Other Watercraft Users: Other watercraft users include those that use motorized and non-motorized watercraft. As previously stated, other motorized watercraft users greatly outnumber PWC users at the national lakeshore. Under alternative 1, adverse impacts would continue to occur between Sand Point and Miners Beach to other watercraft users who find that PWC use distracts from their experience. The greatest distraction from PWC use is noise. Visitors may have difficulty hearing and communicating with others aboard their vessel due to noise associated with PWCs (NPS 2013g). During the public scoping period for this project, one visitor that kayaks at the national lakeshore stated that the smells emitted from PWCs diminish the national lakeshore experience (NPS 2013g). Impacts from PWCs circling, or playing, within the same area would be greater than those impacts associated with PWCs traveling at a high speed from one location to another parallel to the shoreline (see the "Acoustic Environment and Soundscapes" section and appendix E). Noise and smells associated with PWCs would be continuous and last longer periods if PWCs circle within the same area.

Kayakers and canoers typically recreate closer to the shoreline, making interaction between PWC users and kayakers or canoers more likely within the 200-foot flat-wake zone than outside this area. PWC use inside the 200-foot flat-wake zone would be restricted (see chapter 2 for details), which would reduce the impacts to kayakers and canoers from direct interaction. Even so, some visitors on kayaks or canoes may find the noise, sight, and smell of PWCs within these areas take away from the solitude of their national lakeshore experience. Kayakers on the water experience a higher level of noise from PWCs operating outside the 200-foot flat-wake zone than shoreline users because there is less space separating the visitor and the PWC and no terrain to buffer the noise. PWC noise for a kayaker is approximately 8 dB higher than that which a shoreline user would experience during average PWC use. As discussed in the "Acoustic Environment and Soundscapes" section of this chapter, a kayaker on the water at a distance of 150 feet from a PWC participating in play behavior would experience sound levels of 68.9 to 73.7 dBA during the phase-out period and 63.2 to 68.0 dBA post phase-out (table 4-14). The noise levels generated

during play activity are dependent on the PWC speed and behavior; these estimates are based on a PWC traveling at 50 mph between 30 and 90 minutes. PWCs rapidly accelerate and decelerate during play behavior, and this type of variable noise has been found to be more disturbing than constant noise (Leventhall 2003). Doubling the number of PWCs involved in circling play behavior would increase the noise level of by 3 dB. The estimated noise levels of PWCs at play greatly exceed the baseline sound levels (36.3 to 39.2 dBA) of the national lakeshore. As discussed in the "Acoustic Environment and Soundscapes" section of chapter 3, for every 3 dB increase in noise levels, the listening area is reduced by 50%, so that an increase of 6 dB reduces the listening area by 75%, and an increase of 15 dB reduces the listening area by almost 97%. For kayakers, the increase in noise level from PWC operation would range from approximately 30 to 35 dB during the phase-out, and from approximately 27 to 30 dB after the phase-out. This increase in noise level could reduce the listening area almost completely when PWCs are used this way in close proximity to kayakers and canoers. However, this type of PWC operating behavior is not allowed within 200 feet of the shoreline, where most kayakers and canoers recreate.

Although these adverse impacts to visitor experience of other boaters would continue under alternative 1, interactions between PWC users and other boaters would be infrequent due to the low numbers of PWCs at the park and because other boaters can use the entire lakeshore, including areas where PWCs are not allowed. In addition, the improved visitor education component of alternative 1 would provide information that may change the behavior of some PWC users, who might otherwise act in a manner that would detract from the experience of others. Impacts to visitor experience associated with noise and smells would decrease after the phase-out of the carbureted two-stroke engines because the newer PWC engines operate more cleanly and quietly. (PWIA 2006). Emissions were generally lower when modeled for direct injection engines, as described in the "Air Quality" section.

Impact to Shoreline Users: Hikers, picnickers, and beach users between the western boundary of the national lakeshore and the east end of Miners Beach would continue to be adversely impacted by the use of PWCs. PWCs would be limited to the 9.2-mile long area between Sand Point and Miners Beach, and the use of PWCs would continue to be more concentrated in that area. During peak PWC use days, visitors in that area would continue to experience adverse impacts from the presence and noise of PWC use.

The impact of the noise associated with PWC use on visitor experience was modeled for two PWC use behaviors: transiting and play. Transiting is when PWCs are moving parallel to the shoreline at a constant speed. Play behavior is when PWCs are circling in a smaller area, characterized by rapid acceleration and deceleration. For both behaviors, it was assumed the PWCs were at least 200 feet offshore, in compliance with existing regulations; in these scenarios, the shoreline visitor was positioned approximately 320 feet from the PWC. The modeling estimated the noise levels that would be generated by 1 PWC transiting alone and 4 and 8 PWCs traveling together. During the phase-out period, noise levels experienced by shoreline users would range from 30.9 to 39.9 dBA and after the phase-out period, noise levels would be 25.0 to 33.9 dBA. In these scenarios, only 8 carbureted two-stroke PWCs traveling together exceeded the baseline sound levels (36.3 to 39.2 dBA) of the national lakeshore. The noise of transiting PWCs would likely not be noticeable to most onshore visitors at Sand Point or Miners Beach or to visitors at inshore areas of the park.

PWC users operating their watercraft using a circling behavior would impact visitors on the beaches, as the noise fluctuates during rapid acceleration and deceleration, causing a greater disturbance. The sound attenuation modeling estimated the noise that would be generated by play behavior that lasted 30, 60, and 90 minutes. During the phase-out period, noise levels would range from 60.8 to 65.6 dBA and after the phase-out period, noise levels would be 55.1 to 59.9 dBA. Doubling the number of PWCs involved in circling play behavior would increase the noise level by 3 dB. All of these scenarios exceeded the baseline sound levels (36.3 to 39.2 dBA) of the national lakeshore. Furthermore, these noise levels are

high enough that conversations between visitors onshore could be disrupted, as noise above 60 dBA is expected to disrupt conversation. Impacts from circling play behavior would be periodic and short term because PWCs typically operate in this manner for very short time periods. During the July 2013 PWC survey, observed instances of play behavior typically lasted 10 to 20 minutes (NPS 2013b).

As PWCs are typically only operated 2 to 3 months of the year due to the air temperature, water temperature, and water conditions, no impact of PWC noise would be expected outside of this period. There would also be no impact from PWC noise at night when PWCs are not allowed. During the time when PWCs are beached at Sand Point or Miners Beach, no impacts to the visitor experience of shoreline users would be expected from PWC noise. Impacts would be greater during the phase-out of carbureted two-stroke engines, as these engines are typically louder when operated. After the phase-out period, impacts from the use of PWCs would still occur; however, the adverse impacts would be lower, as direct injection two-stroke or four-stroke PWCs operate more quietly. Impacts to users outside of the PWC use area would be minimal or non-existent, depending on the distance of the visitor from the PWC use area. Since sound is often amplified and carries over water, some noise distraction may exist; however, the adverse impacts would be relatively low compared to impacts within the PWC use area.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Impact to PWC Users: Impacts to PWC users at the park would be beneficial under alternative 2 because the PWC use area would be expanded by more than 30 miles. In addition, more beach areas would be available for PWCs to use as landing sites to access more areas of the park. Expanding the PWC use area would allow more opportunities for PWC users to explore the national lakeshore and to enhance the experience of these visitors.

Impacts associated with the phase-out of carbureted two-stroke engines would be the same as those discussed under alternative 1. PWC users who currently operate machines with carbureted two-stroke engines would be adversely impacted after the two-year phase-out period, as they would have to purchase a newer model PWC in order to use it at the national lakeshore.

Impact to Other Watercraft Users: Impacts to other watercraft users within the national lakeshore would be similar to those discussed under alternative 1, except that these impacts could occur along the entire length of the lakeshore. Both motorized and non-motorized watercraft users would experience adverse impacts due to the presence of PWCs; however, noise would be the greatest impact, especially when PWCs are operating in the circling behavior. The noise levels from PWC use for alternative 2 would be the same as those described for alternative 1. The types of impacts would be similar in that visitors aboard a motorized watercraft could have trouble hearing and communicating with each other. These impacts would negatively impact the national lakeshore experience for users of both motorized and non-motorized watercraft. The presence of PWCs on the waters of the national lakeshore could also detract from the experience of kayakers and canoers.

The impacts in the area between the western boundary of the park and Miners Beach would be essentially the same as alternative 1. Although PWCs can use the entire national lakeshore under alternative 2, the expectation is that most use would remain in the current PWC use area. If opening the entire shoreline to PWC use were to cause a slight decrease in PWC in the western area, it would be expected to be too small a change for other visitors to notice. Other watercraft users that typically recreate in areas east of Miners Beach (outside the current PWC use area) would be more adversely impacted than those that recreate inside the current PWC use area since this area would be newly opened to PWC use under alternative 2. Kayakers and canoers using the water adjacent to the Beaver Basin Wilderness Area could be particularly affected since they could be anticipating a different experience so close to the wilderness area. Although this area is currently open to motorized boats, PWC play behavior could be more disturbing to these

visitors. Similar to alternative 1, impacts to other watercraft users would decrease following the phase-out of carbureted two-stroke engines due to the decrease in engine noise; however, even the quieter PWCs would be a new impact on watercraft users east of Miners Beach to the eastern end of the park. For this reason, the overall impacts on other watercraft users under alternative 2 would be more adverse than those under alternative 1.

Impact to Shoreline Users: The types of impacts to shoreline users would be similar to those described under alternative 1. Impacts to visitors recreating within the current PWC use area would be essentially the same as alternative 1. Although PWCs can use the entire national lakeshore under alternative 2, the expectation is that most use would remain in the current PWC use area. If PWC use in eastern areas caused a slight decrease in PWC in the western area, it would be expected to be too small a change to notice. Impacts to shoreline users outside the current PWC use area would occur, since PWCs would have the opportunity to use the entire length of the national lakeshore. Because additional beach areas would be available for PWC landing sites, beach users and swimmers outside the current PWC area would be affected from having PWCs within 200 feet of the shoreline. Impacts on visitors to the Beaver Basin Wilderness Area would likely be greater than in other areas of the shoreline because the PWC noise would interrupt the solitude and quiet that is expected in wilderness. Other motorized watercraft are currently permitted along the entire length of the national shoreline; however, PWC noise would add to the current noise levels under this alternative. Impacts to wilderness character are further discussed in the "Wilderness" section of this chapter.

Sound attenuation modeling for transiting and play behavior were described under alternative 1. The only transiting scenario modeled that exceeded the baseline sound levels of the national lakeshore was the scenario with 8 carbureted two-stroke PWCs traveling together. The impact of transiting PWCs would likely not be noticeable to most onshore visitors, since motorized boats are permitted along the entire shoreline of the national lakeshore and produce similar noise. However, PWC play behavior would create distinctive sounds that are currently absent from areas east of Miners Beach, as the noise fluctuates during rapid acceleration and deceleration, causing a greater disturbance. All scenarios for PWC play behavior exceeded the baseline sound levels of the national lakeshore. Noise levels above 60 dBA would be expected to disrupt conversation; therefore, the modeling demonstrates that play behavior using a carbureted two-stroke PWC would be loud enough to disrupt conversation among visitors on the shoreline. PWC users typically engage in play behavior for very short time periods; therefore, impacts from play behavior would be periodic and short term. The majority of impacts would be expected to occur during the summer months, and there would be no impacts between sunset and sunrise, as PWC use would not be allowed during that time. Following the phase-out of carbureted two-stroke engines, impacts associated with noise are expected to decrease for users in the current PWC area; however, even the quieter direct injection two-stroke and four-stroke PWCs would be a new impact on shoreline users east of Miners Beach. The impacts to shoreline users under alternative 2 would be more adverse than those under alternative 1.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Impact to PWC Users: National lakeshore visitors who use PWCs as a primary vessel or who consider PWCs to be of central importance to their visit would experience a substantial adverse impact under the no-action alternative because PWC use would be prohibited. During the public scoping period for this project, one commenter stated that "Pictured Rocks are best seen and enjoyed from the water and these machines [PWCs] are a great way to allow people to make to most of their experience at the park" (NPS 2013g). Although PWC users comprise less than 1% of the total users at the national lakeshore during the peak use season, these visitors' choice of recreation would be eliminated. Visitors desiring to use PWCs would have to launch and recreate in areas outside of the national lakeshore's boundary. However, PWC users would continue to have the opportunity to experience the entire length of the national lakeshore

through other recreational activities, including the use of conventional motorized and non-motorized watercraft. Alternative 3 would result in adverse impacts to visitors who use PWCs at the national lakeshore.

Impact to Other Watercraft Users: Other watercraft users, including motorboat users, canoers, and kayakers would possibly benefit from the ban of PWCs throughout the national lakeshore, depending on how they view PWC use. Some watercraft users find the operation of PWCs a nuisance while operating their watercraft (NPS 2013g). During the public scoping period for this project, one commenter stated that when canoeing or kayaking, PWCs disturb the solitude of the national lakeshore. Banning PWCs throughout the national lakeshore would eliminate interactions between PWC users and other boaters, resulting in beneficial impacts to these visitors.

Impact to Shoreline Users: Visitors at the national lakeshore include campers, hikers, picnickers, and beach users, in addition to PWC users. Many visitors seek a sense of solitude while visiting a national park unit, such as Pictured Rocks National Lakeshore. Visitors enjoy the peaceful atmosphere of the natural environment offered by the national lakeshore. The ban of PWCs within the national lakeshore would benefit these users, particularly in the area from Sand Point to Miners Beach where PWCs are currently allowed to operate, by allowing greater periods of natural quiet and solitude. Beneficial impacts to shoreline users under alternative 3 would be less noticeable in areas of concentrated visitor use (e.g. Miners Beach) due to the level of activity and noise that is commonly associated with recreational beach use.

CUMULATIVE IMPACTS

Ongoing and future planned actions within and around the national lakeshore have the potential to impact visitor experience. The use of other motorized watercraft is an ongoing activity at the national lakeshore that can adversely impact some visitors, such as canoers and kayakers, and shoreline users, throughout the park. Based on the PWC survey during the July 4th weekend in 2013 (NPS 2013b), the ratio of other motorized boats to PWCs is approximately 14 to 1. This count includes pontoon boats, fishing boats, Jon boats, and commercial tour boats. These motorized boats generate noise, which interrupts the soundscape and the solitude of the national lakeshore and results in adverse impacts to some park users. The continued use of other motorized watercraft benefits those visitors who prefer to experience the national lakeshore using motorized watercraft.

The Munising city dock expansion is another project with ongoing and future activities that would produce beneficial impacts at the national lakeshore due to increased recreational activities. The Munising city dock expansion is a five-phase project that would increase operations, provide additional boat slips, and allow for increased boating opportunities. At the time this EA was prepared, the work on expanding the Bayshore Marina and adding floatation docks to the harbor was in process. The construction portions of this project will result in temporary adverse impacts on visitor use and experience due to construction noise. The expansion of the marina and additional docking would result in long-term adverse impacts on visitor experience at the national lakeshore from engine noise and increased boat traffic. However, it would also expand boating opportunities for visitors, resulting in beneficial impacts for visitors wanting access to the national lakeshore using motorized watercraft. The new seasonal floating kayak launch in the Anna River is also located at the Munising city dock. The kayak launch would provide another put-in spot for kayakers and canoers, resulting in beneficial impacts for non-motorized watercraft users.

The future Sand Point revetment project would remove or replace the failing revetment. This project would consider a range of alternatives, from retaining the current revetment without improvements to replacing the revetment. The alternatives would be developed, to the extent possible, to allow natural shoreline processes to occur while restoring or preserving the natural and cultural resources. The

revetment project could have temporary adverse impacts on visitor use and experience during construction. Visitors to this popular swimming beach would be temporarily impacted by closures and noise during construction; however, the revetment would protect natural and cultural resources, which would benefit the visitor experience after construction.

The beech bark disease tree removal project is an ongoing project to remove hazard trees from areas targeted for the management of beech bark disease in the national lakeshore. The beech bark disease tree removal has the potential to alter vegetation communities, which could degrade visitor experience for those people that enjoy the natural environment of the national lakeshore. Chainsaw noise associated with tree removal could also negatively impact visitor experience.

Overall, these ongoing and future actions would produce beneficial impacts on visitor use and experience at the national lakeshore due to continued and new opportunities for recreation. When compared to existing conditions, PWC use under alternative 1 would result in continued adverse effects to other watercraft and shoreline users from the presence, odors, and noise of PWCs; alternative 1 would continue to provide beneficial impacts on PWC users, as they could continue their preferred recreational activity at the park. These impacts from alternative 1 would not contribute appreciably to the cumulative beneficial impacts from the other actions described above.

The types of impacts from alternative 2 would be similar to impacts for alternative 1 in that PWC users would be beneficially impacted and other watercraft and shoreline users would be adversely affected from allowing PWC use along the entire shoreline of the national lakeshore. However, alternative 2 would result in greater beneficial and adverse impacts, respectively, due to PWC use in areas that are currently off-limits to PWCs. Taken into context with the other ongoing and future actions, the impacts of alternative 2 would contribute appreciably to the cumulative beneficial impacts for PWC users; however, the adverse impacts of alternative 2 to other watercraft and shoreline users would not diminish the cumulative beneficial impacts from the other actions described above.

When the adverse impacts to PWC users under alternative 3, the no-action alternative, are combined with the beneficial impacts resulting from other current and future actions, cumulative impacts are expected to be adverse for PWC users because they would no longer be able to recreate on PWCs within the park. When the beneficial impacts to other national lakeshore users under the no-action alternative are combined with the beneficial and adverse impacts from the cumulative actions, impacts would be overall beneficial due to the increased opportunities for recreation. Taken into context with the other ongoing and future actions, the impacts of alternative 3 would contribute appreciably to the cumulative beneficial impacts for other watercraft and shoreline users. For PWC users, however, the adverse impacts of removing PWC use from the national lakeshore under alternative 3 would cause the cumulative impacts to be adverse..

CONCLUSION

During the phase-out of carbureted two-stroke engines, there would continue to be beneficial impacts to PWC users under alternative 1, as PWC use would continue as currently managed. Under alternative 2, there would be beneficial impacts to PWC users, who would be allowed to recreate along the entire shoreline in the park. Post phase-out of carbureted two-stroke engines, adverse impacts to PWC users with carbureted two-stroke engines would occur under both alternatives 1 and 2, as these visitors would no longer be able to operate their current PWCs within the national lakeshore.

Under alternatives 1 and 2, the presence of PWCs within the national lakeshore boundary would continue to adversely affect the visitor experience of other watercraft users and shoreline visitors in the national lakeshore from the noise associated with PWCs. Impacts would be greater under alternative 2, since

PWCs would have the opportunity to use the entire length of the shoreline, causing impacts from PWC use in areas where they are currently not allowed. Impacts under both alternatives would be greater during the first two years of implementation of the plan as carbureted two-stroke engines would continue to be allowed within the national lakeshore. Post phase-out, adverse impacts to visitor experience would decrease when carbureted two-stroke engines are eliminated due to the decrease in noise and emissions. Although adverse impacts to other users would occur under alternative 1, impacts are not expected to be appreciable due to the low level of PWC use in the park, the short period of peak use (daytime hours during summer months), and the limited number of shoreline miles open to PWC use. Under alternative 2, impacts on other watercraft users and shoreline visitors would be greater because PWC use would negatively affect these visitors in areas where the presence, noise, and odors of PWCs are currently absent. For other visitors to the national lakeshore, alternatives 1 and 2 would not contribute to the cumulative beneficial effects from other ongoing and future actions in the vicinity of the national lakeshore.

For PWC users, alternatives 1 and 2 would be overall beneficial. Under alternative 1, PWC use would remain the same as currently managed during the phase-out of carbureted two-stroke engines. PWC users with carbureted two-stroke PWC engines would experience adverse impacts after the phase-out, as they would be prohibited from using these vessels at the park. These PWC users would be required to purchase or rent PWCs with direct injection two-stroke or four-stroke engines for use at the national lakeshore. Under alternative 2, PWCs would be permitted along the entire shoreline, resulting in beneficial impacts to PWC users. Similar to alternative 1, a portion of PWC users could experience adverse impacts after the phase-out, as PWCs with carbureted two-stroke engines would be prohibited at the national lakeshore. For PWC users at the national lakeshore, alternative 1 would not contribute to the cumulative beneficial effects from other ongoing and future actions in the vicinity of the national lakeshore, but alternative 2 would contribute appreciably.

Under alternative 3, banning PWC use from the national lakeshore would have substantial adverse impacts on PWC users, as this form of recreation would be eliminated. However, these visitors would still have the opportunity to experience the national lakeshore through different recreational opportunities, including conventional motorized and non-motorized recreation. This alternative would have beneficial impacts on the visitor experience of other watercraft users and shoreline users, such as hikers, picnickers, and beach users, at the national lakeshore from the elimination of PWC noise. However, removing PWCs from Pictured Rocks National Lakeshore would only provide minimal benefits to the experience of other visitors due to the current low usage of PWCs at the national lakeshore. Alternative 3 would result in cumulative adverse effects for visitors who use PWCs. Cumulative impacts to other visitors would still be beneficial due to other ongoing and future actions in the vicinity of the national lakeshore.

VISITOR SAFETY

Impacts on visitor safety associated with the use of PWCs are assessed in this section.

GUIDING REGULATIONS AND POLICIES

Michigan State Regulations: Michigan state PWC restrictions and NPS PWC regulations (36 CFR § 3.8 and 3.9) are enforced at the national lakeshore to promote the safe use of PWCs. These rules are enforced by the NPS, MDNR, and the USCG. The Michigan Personal Watercraft Safety Act of 1998 (Public Act 116) states the following restrictions for PWC users:

- No operating within 150 feet of another vessel unless at flat-wake speed (MCL 324 § 80205(6)).

- No operating within 100 feet of a dock, swim area, a person in the water, an anchored or drifting vessel (MCL 324 § 80209(2)).
- No operating within 200 feet of a diver, a dive boat, or a PFD with a diving flag (MCL 324 § 80209(3)).
- No operating in less than 2 feet of water unless either at a flat-wake speed or launching/landing (MCL 324 § 80205(7)(a)(b)).
- No weaving in heavy traffic (MCL 324 § 80205(9)(a)).
- No waiting until the last possible minute before swerving to avoid a collision (MCL 324 § 80205(9)(c)).
- No operating PWC at a speed that endangers people or property (MCL 324 § 80205(9)).
- No operating PWC within 200 feet of the shoreline unless travelling perpendicular to the shoreline at a flat-wake speed (MCL 324 § 80209(1)).

STUDY AREA

The study area for analyzing impacts to visitor safety consists of the allotted shoreline for the specific alternatives (Sand Point to Miners Beach for alternative 1 and the entire shoreline of the national lakeshore for alternatives 2 and 3).

METHODOLOGY AND ASSUMPTIONS

The methodology and assumptions for visitor safety are similar to those used for visitor use and experience. The purpose of this impact analysis is to assess the impacts of PWC use on the safety of visitors. The potential visitor-related impacts attributable to PWCs include a higher rate of accidents than from other watercraft, conflicts with other park users, and safety situations associated with operating PWCs in open waters in a quickly-changing environment. Potential impacts were identified based on the number and activities of PWCs operating within particular areas, the number and activities of other visitors in an area, and the proximity of these user groups.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Safety concerns for PWC operators include the potential for collisions with other PWCs or other water craft (motorized or not), loss of control of the PWC, and rapidly changing weather and water conditions on Lake Superior. Alternative 1 includes safety provisions (e.g., speed limits, required training, behavior limits, etc.) specifically designed to reduce the likelihood of these impacts. Assuming PWC operators comply with these requirements, the potential for impacts would be minimal. Rapid changes in weather conditions on Lake Superior are common. These weather changes can include increased wind and wave action which can make PWC operation unsafe. The area near Sand Point is somewhat buffered by the presence of Grand Island, but PWC operators must be aware of the dangers of operating a watercraft on Lake Superior.

Assuming compliance, impacts on visitor safety under alternative 1 would be minimal and include potential collisions with swimmers or other boaters, similar to current conditions. Sand Point is a popular area for swimming. There is a small boat ramp at Sand Point that can accommodate kayaks, canoes, and PWCs. It is the only area where PWCs can be launched in the national lakeshore. Although there are no documented cases of accidents occurring between PWC users and swimmers, there is potential for accidents if PWC users are not aware of all the swimmers in the area. During the July 2013 PWC survey

(NPS 2013b), a total of 16 PWCs were observed over the three-day period at Sand Point and swimming did occur within this area. There would continue to be the potential for adverse impacts to visitor safety as a result of PWC use in this area. The water at Miners Beach is colder than at Sand Point, resulting in fewer swimmers at this beach. Although the risk for conflict between PWCs and swimmers is lower at Miners Beach, the potential for risk does exist.

Kayaks are used and can land at both Sand Point and Miners Beach. Under alternative 1, PWCs would continue to be allowed to operate and beach in each of these areas. During the July 2013 PWC survey (NPS 2013b), a total of 16 PWCs were observed at Sand Point, and 8 PWCs were observed at Miners Beach. Only 14 kayaks were observed at Sand Point; however, 144 kayaks were observed at Miners Beach. Conflicts and safety concerns between kayakers and PWC users include collision or a kayak capsizing due to inappropriate behavior of a PWC user; however, there are no documented cases of such accidents. The improved visitor education component of alternative 1 would provide information that may change the behavior of some PWC users who might otherwise act in a manner that would create unsafe situations, thus reducing the potential for impacts.

The greatest safety concern related to PWC use and other visitors is collision; however, as previously stated, no documented accidents have been recorded within the national lakeshore. The potential for impacts to visitor safety is minimal for alternative 1 due to the low usage of PWCs (both in numbers observed and days of usage) at the national lakeshore and the limited area in which PWCs can operate.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Under alternative 2, the entire 42-mile shoreline of the national lakeshore would be open to PWC use. Safety concerns under alternative 2 for PWC operators would be similar to those described for alternative 1. The primary difference between the two alternatives would be safety concerns with PWC operations over a larger area, most of which is remote and subject to rapid changes in weather and boating conditions that could make PWC operation difficult or unsafe. The shoreline east of Miners Beach is used by other visitors, but usage is generally lower than the more heavily used Sand Point and Miners Beach. Because the shoreline is not protected, the potential for changes in weather and boating conditions is greater. If conditions become difficult or dangerous, a PWC operator may have to travel farther to get to safety. Alternative 2 includes provisions, including increased visitor education and outreach, that would reduce the potential for these impacts, but the safety of the PWC operator would be largely dependent on the individual operator's compliance with these provisions.

Impacts to visitor safety for other visitors would be adverse, similar to those discussed under alternative 1, because kayakers, swimmers, and other boaters may feel uneasy recreating in areas where PWC use occurs. Operation of PWCs at high speeds in areas used by swimmers and kayakers may cause potential safety risks (including collisions) and would create impacts on other visitors. Although the potential for accidents involving PWCs exists, there are no documented PWC-related accidents at the national lakeshore, indicating that the potential for such an accident is low. Opening the entire shoreline to PWC use would introduce safety concerns to those users who typically recreate in areas where PWCs are currently not allowed and also to PWC operators. These users would no longer have an area that is PWC-free to swim, kayak, or boat. However, the 200-foot flat-wake zone would reduce the potential for conflicts between PWC users and other visitors.

Similar to alternative 1, the greatest safety concern related to PWC use for PWC operators and other visitors is collision; however, as previously stated, no documented accidents have been recorded within the national lakeshore. The potential for PWC users to encounter dangerous environmental conditions under alternative 2 is greater due to the large expanse of shoreline that would be available for PWC use. The potential for impacts to visitor safety is higher for alternative 2 when compared with current

conditions, but is still minimal due to the low usage of PWCs (both in numbers observed and days of usage) at the national lakeshore.

ALTERNATIVE 3: NO ACTION / NO PWC USE

Under alternative 3, the no-action alternative, PWC use would not be allowed within the national lakeshore boundary. This would eliminate safety concerns for PWC operators. Prohibiting PWCs within the national lakeshore would result in beneficial impacts on the safety of swimmers, kayakers, and canoers. Under the no-action alternative, these safety concerns would no longer exist because PWCs would not be permitted at the national lakeshore.

CUMULATIVE IMPACTS

One ongoing action within and around the national lakeshore has the potential to impact visitor safety. The use of other watercraft is an ongoing activity that can impact some visitors, such as canoers, kayakers, swimmers, and PWC users. Based on the PWC survey during the July 4th weekend in 2013 (NPS 2013b), the ratio of other motorized boats to PWCs is approximately 14 to 1. These motorized boats could cause adverse impacts on visitor safety because accidents could occur from different user groups using the same waters.

Under alternative 1, the incremental adverse impacts of PWC use on visitor safety of both PWC operators and other visitors would contribute a small amount to the overall cumulative impacts. When the adverse impacts to other national lakeshore users including other boaters, swimmers, and kayakers under alternative 1 are combined with the adverse impacts from other ongoing and future actions, cumulative impacts are expected to be adverse.

Under alternative 2, the potential for impacts to visitor safety is similar to alternative 1 in the area between Sand Point and Miners Beach. In the area east of Miners Beach the potential for impacts to visitor safety for PWC operators and other visitors is higher than alternative 1. This is due to the potential for boating conditions to change and become hazardous with little or no warning, the remoteness of much of the national lakeshore, and because other visitors in these areas currently do not experience safety concerns associated with PWC use.

Alternative 3 would eliminate PWC use at the national lakeshore, resulting in beneficial impacts on the safety of PWC operators and other visitors. The beneficial impacts to visitor safety under alternative 3 would not contribute appreciably to the cumulative impacts from ongoing and future actions; overall cumulative impacts are still expected to be adverse. Although eliminating PWC use would be beneficial on visitor safety, this would only cause a slight decrease in the adverse impacts on visitor safety that could occur from use of other motorized watercraft at the national lakeshore.

CONCLUSION

Under alternative 1, PWC use would continue in the current PWC use area and would continue to cause potential adverse impacts on visitor safety for PWC operators and other visitors, especially with other boaters, swimmers, and kayakers. Alternative 2 would open the entire length of the national lakeshore to PWC use. This would open 42 miles of shoreline to potential impacts (e.g., collision and capsizing) for PWC operators and other visitors and would not provide any PWC-free areas for visitors. Concerns for visitor safety are justifiable; however, no accidents between PWCs and other boaters, swimmers or kayakers have been documented to date. Based on this information and the low levels of PWC use, the probability of accidents involving PWCs is low under both alternatives. The impacts from alternative 1 would not contribute appreciably to the cumulative adverse impacts on visitor safety from use of other

motorized watercraft at the national lakeshore. Although alternative 2 would result in greater adverse impacts than alternative 1, opening the entire shoreline to PWC use would not increase the intensity of the cumulative adverse impacts on visitor safety. Other motorized watercraft also use the entire shoreline and create the potential for adverse impacts on the safety of other boaters, kayakers, and swimmers. The small number of PWCs that would be expected to use the shoreline east of Miners Beach would not add appreciably to this danger.

Under alternative 3, PWCs would be banned at the national lakeshore, resulting in beneficial impacts on visitor safety, as concerns for PWC operators and for other boaters, swimmers, and kayakers due to PWC speeds and operation in a circling behavior would be eliminated. These beneficial impacts would not contribute appreciably to the cumulative impacts of other ongoing and future actions, and cumulative impacts on visitor safety would remain adverse. The beneficial impacts of eliminating PWC use would cause a slight decrease in the adverse impacts on visitor safety.

WILDERNESS

This section analyzes the impacts on the Beaver Basin Wilderness Area. The analysis includes the potential effects of the noise and presence of PWCs on wilderness character and values. Preserving the acoustic environment and natural sounds of such areas are critical to effective wilderness management and can have important effects on wilderness character. Natural soundscapes and the absence of anthropogenic noise are crucial components of the wilderness qualities of solitude, unconfined recreation, and naturalness. Human-caused noise is often one of the most common and pervasive human influence on the primeval character of wilderness. Human caused noise, especially low frequency sound from sources such as vehicles and machinery, can travel for miles and can affect the quality and character of wilderness.

GUIDING REGULATIONS AND POLICIES

NPS *Management Policy 2006,* 6.3 Wilderness Resource Management: NPS policy is to manage wilderness areas for the "preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved."

STUDY AREA

The study area for analyzing impacts to wilderness includes the Beaver Basin Wilderness Area, which is approximately 11,740 acres along 13 miles of the shoreline of the national lakeshore. Lake Superior waters are not designated as part of the wilderness area, but there is the potential for noise intrusion into wilderness from PWC use on adjacent waters. The use of PWCs is not currently authorized adjacent to the Beaver Basin Wilderness.

METHODOLOGY AND ASSUMPTIONS

Information about the impacts of PWCs on the wilderness characteristics and values was determined by examining existing NPS data, including information on the impacts of PWCs on soundscapes and visitor experience. PWC use would not be allowed on waters adjacent to the Beaver Basin Wilderness Area under alternatives 1 and 3; however, impacts were assessed for use of PWCs in areas on Lake Superior adjacent to wilderness under alternative 2.

When evaluating impacts to wilderness from PWC use, the park considered wilderness characteristics and values, the preservation of the natural conditions, and opportunities for solitude and a primitive and unconfined type of recreational experience for park visitors.

ALTERNATIVE 1: PWC USE FROM WESTERN BOUNDARY TO MINERS BEACH

Under alternative 1, PWC use would not be allowed within the national lakeshore boundary adjacent to the Beaver Basin Wilderness Area. The eastern boundary of the PWC use area and the western boundary of the Beaver Basin Wilderness Area are separated by approximately 8 miles of shoreline. Given the distance, it can be assumed that wilderness visitors would not be able to hear PWCs operating in the current PWC use area. PWCs operated on Lake Superior outside of the boundary of the national lakeshore could be seen and heard by visitors, but the distance of these PWCs would be at least 0.25-mile from the shoreline of the wilderness area, which is the jurisdictional boundary of the park. PWCs operated outside of the national lakeshore boundary would not be managed under this plan, and therefore, impacts from these PWCs are not analyzed in this document.

Alternative 1 would represent a continuation of current conditions, and assuming compliance, there would not be an impact on wilderness character from PWC use within the boundary of the national lakeshore. PWCs operated between Sand Point and Miners Beach would not be heard inside the wilderness area. Visitors to the Beaver Basin Wilderness Area would have opportunities for solitude and quiet, and a wilderness experience would be possible; however, it is important to note that other motorized watercraft are currently permitted to use the shoreline adjacent to the wilderness area and contribute anthropogenic noise to the soundscape.

ALTERNATIVE 2: ENTIRE SHORELINE OPEN TO PWC USE

Under alternative 2, the entire 42-mile shoreline of the national lakeshore would be open to PWC use, and PWCs would be permitted to beach at the Beaver Basin Wilderness Area. PWC use at and adjacent to the Beaver Basin Wilderness Area would produce adverse impacts on the natural, untrammeled, and opportunities for solitude or a primitive and unconfined type of recreation qualities of wilderness through PWC presence and noise.

The noise from and presence of PWC use under alternative 2 would affect wilderness character. Table 4-18 presents the noise levels a visitor in the wilderness area would experience from a PWC operating in the water adjacent to the wilderness area. This table presents the peak (highest instantaneous) noise and average noise of a stationary PWC experienced by the visitor for the duration of the visitor's stay. The transit and play scenarios also represented in table 4-18 are more representative of actual PWC use at the national lakeshore and what visitors to the wilderness area would experience, as explained in the "Acoustic Environment and Soundscapes" section. The transit scenario assumes that the PWC (traveling at a speed of 50 mph) would quickly enter and exit the area where noise is heard by visitors and the visitor would experience the noise for a brief period. In the play scenario, the results of the sound modeling present the noise generated from a PWC going at a constant speed in a rectangular box. In reality, PWCs will rapidly accelerate and decelerate during play behavior; this type of variable noise has been found to be more disturbing than constant noise (Leventhall 2003).

TABLE 4-18: NOISE LEVELS GENERATED BY PWC USE ADJACENT TO THE BEAVER BASIN WILDERNESS AREA

PWC Engine Type	Noise Levels (dBA)							
			Transit			Play		
	Peak	Average	1 PWC	4 PWCs	8 PWCs	30 minutes	60 minutes	90 minutes
During the phase-out	61.0	50.5	30.5	36.5	39.5	60.4	63.4	65.2
Post phase-out	55.3	44.8	24.8	30.8	33.8	54.7	57.7	59.5

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours

The noise generated by PWCs transiting together parallel to the shoreline would be similar to the type of noise generated by motorized boats participating in the same behavior. With the exception of the scenario that includes a group of 8 carbureted two-stroke PWCs transiting together (39.5 dBA), the average noise generated by transiting PWCs and experienced by visitors would be below the baseline noise level for Beaver Basin. While 8 PWCs transiting together falls within the assumptions for a peak PWC use day, given the low PWC use at the national lakeshore and the distance from the nearest PWC launch point, it is extremely unlikely that 8 PWCs would be transiting together in the waters adjacent to Beaver Basin Wilderness Area. PWC play behavior, as modeled for during and after the phase-out, would exceed the baseline noise level, and the noise experienced by visitors from play behavior during the phase-out would be at levels that would interrupt conversational speech (60 dBA). Doubling the number of PWCs involved in circling play behavior would increase the noise level by 3 dB. PWCs were observed operating in groups of two or more during the 2013 PWC survey (NPS 2013b); therefore, it would be safe to assume that play behavior would exceed 60 dBA after the phase-out as well. While this level of noise may be appropriate for more developed areas of the lakeshore, it would detract from the wilderness character of Beaver Basin.

PWC noise is different than that of other motorized watercraft because PWCs often accelerate and decelerate rapidly during play behavior, which is more disruptive than constant noise. Although motorized watercraft currently operate along the entire shoreline of the national lakeshore, PWC noise would be added to the existing soundscape and could be more prevalent, limiting the opportunities for solitude, and adversely affecting the natural and untrammeled quality of wilderness. Visitors seeking a wilderness experience along the shoreline of the Beaver Basin Wilderness Area would hear PWCs, which would adversely impact their experience. Further, the presence of PWCs adjacent to the Beaver Basin Wilderness Area would be an added visual intrusion on the wilderness experience when compared to current conditions. Some wilderness visitors may choose to avoid recreating at Beaver Basin Wilderness Area during peak PWC use periods due to the intrusion on the soundscape and viewscape. PWC use under alternative 2 would represent a new disturbance within the wilderness area of the park. Although PWC use would remain low and the season short under alternative 2, the added presence and noise of the PWCs would be noticeable to visitors of the Beaver Basin Wilderness Area during times of PWC use, resulting in adverse impacts on wilderness character. Wilderness areas are some of the most protected areas within a national park, characterized 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" (NPS 2006). As such, any new source of noise is an adverse impact to the wilderness area. The low level of PWC use in the national lakeshore means that instances of noise in waters adjacent to the wilderness would be infrequent. Even so, it would represent an intrusion for visitors seeking a wilderness experience, where noise associated with human activity is deemed undesirable. It should be noted that these adverse impacts would be absent during evening hours and during the off-season for PWCs (Labor Day through Memorial Day).

ALTERNATIVE 3: NO ACTION / NO PWC USE

Under the no-action alternative, PWC use would not be allowed in the national lakeshore. Assuming compliance, the absence of PWCs within the national lakeshore would not have an impact on wilderness characteristics and values because PWCs are currently prohibited from operating in waters adjacent to the Beaver Basin Wilderness Area. Impacts under the no-action alternative would be the same as under alternative 1.

CUMULATIVE IMPACTS

Ongoing and future actions within and around the national lakeshore have the potential to impact wilderness. The beech bark disease tree removal project includes the removal of hazard trees from areas targeted for the management of beech bark disease in the national lakeshore. The use of chainsaws to remove hazard trees would disrupt the natural soundscape in the surrounding areas of the national lakeshore, which may impact the Beaver Basin Wilderness Area. Additionally, the removal of the trees could ultimately change vegetation composition and alter the natural quality of the wilderness area. Use of other motorized watercraft in the park would have adverse impacts on wilderness character, as motorized watercraft introduce disruptive noise in areas with a natural soundscape. The impacts of PWC use under alternative 2 would contribute noticeably to the adverse cumulative impacts associated with the above actions on wilderness, as the presence and noise of PWCs would have an adverse impact on wilderness character. This adverse impact would be lessened somewhat after the phase-out of carbureted two-stroke engines, as the newer PWCs would produce less noise. However, PWC noise under alternative 2 would represent a new impact to wilderness character that currently does not exist. Alternatives 1 and 3 would not contribute to the cumulative impacts from ongoing and future actions; overall cumulative impacts on wilderness are expected to be adverse, with alternative 2 contributing noticeable adverse impacts.

CONCLUSION

Under alternative 2, PWC use would be allowed along the entire shoreline of national lakeshore and PWCs would be allowed to beach in areas adjacent to the Beaver Basin Wilderness Area. There would be adverse impacts to wilderness character from the presence and noise related to PWC use. PWC use would remain low under alternative 2; however, during the daylight hours of the summer months, PWC use would have a noticeable adverse impact on the wilderness character. Although motorized watercraft currently use the waters adjacent to the wilderness area, PWC presence and use (especially play behavior, which can be particularly disruptive) would represent a new intrusion on the viewscape and soundscape of the wilderness area. Alternative 2 would contribute appreciably to the adverse cumulative impacts resulting from other ongoing and future actions in the vicinity of the national lakeshore.

Under alternative 1, PWC use would be allowed at the national lakeshore from the western boundary of the national lakeshore to the east end of Miners Beach, which would be the same as currently allowed under the 2005 Special Regulation for PWC Use at Pictured Rocks National Lakeshore. PWC use would be prohibited at the national lakeshore under alternative 3, and visitors within wilderness areas would have the same opportunities to experience solitude and quiet as under current conditions. Alternatives 1 and 3 would not have impacts on wilderness.

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CHAPTER 5: CONSULTATION AND COORDINATION

Scoping is the effort to involve agencies and the general public in determining the scope of issues to be addressed in the environmental document. Among other tasks, scoping determines important issues and eliminates issues determined to be not important, allocates assignments among the interdisciplinary team members and participating agencies, identifies related projects and associated documents, identifies other permits, surveys, consultations, etc. required by other agencies, and creates a schedule that allows adequate time to prepare and distribute the environmental document for public review and comment before a final decision is made. Scoping includes consultation with any interested agency, or any agency with jurisdiction by law or expertise to obtain early input and permits needed for implementation. Scoping also includes coordination with the public regarding the proposed project.

SECTION 7 CONSULTATION

In accordance with Section 7 of the ESA of 1973, the NPS sent a letter on December 6, 2012 to the USFWS, NOAA National Marine Protected Areas Center, and MDNR to solicit comments regarding the existence of threatened or endangered species within the national lakeshore. No response was received from these agencies regarding consultation on special-status species. The NPS sent an additional letter on June 24, 2013, to these agencies again requesting comments and input on the December 6, 2012, letter. A response was received on July 26, 2013, from the USFWS noting concurrence with the listed species identified by the NPS as occurring in the region of the national lakeshore. The USFWS also expressed concern about PWC use in nearshore waters potentially disturbing nesting piping plovers, and concerns that PWC use could allow visitors to access beaches where they could disturb listed species.

This EA evaluates the potential impacts to federally protected species as required by the ESA. This document serves as the biological assessment and will be sent to USFWS for their review and concurrence.

SECTION 106 CONSULTATION

Consultations with the Michigan State Historic Preservation Office (SHPO), as mandated by the implementing regulations (36 CFR 800) for section 106 of the National Historic Preservation Act of 1966, as amended, are ongoing. Informal Consultation was initiated on December 6, 2012, when the NPS sent a letter to the Michigan SHPO about the PWC EA, and requesting comments and information. No response was received from the Michigan SHPO. A follow-up letter was sent on June 24, 2013, requesting a response concurrence and additional information from the Michigan SHPO. No response was received.

The NPS initiated tribal consultation by sending informal consultation letters to the seven tribal groups on December 7, 2012, requesting comments and concurrence on the proposed PWC EA. No responses were received from tribal groups. A second letter was sent to tribal groups on June 24, 2013, as a follow-up to the December consultation letter, and requesting a response to the NPS request for concurrence. No responses were received from tribal groups. This EA is being sent to the Michigan SHPO for their review.

PUBLIC INVOLVEMENT

External scoping is the process used to gather public input. For this project, a scoping brochure was mailed to numerous individuals, organizations, stakeholders, and agencies in order to notify the public of the PWC EA project. The brochure provided a background of the project, including the project history and purpose and need for action, as well as project issues and objectives. The brochure also outlined the

preliminary alternative concepts and provided information on how the public could participate in public scoping. The public was encouraged to use the NPS PEPC website to submit comments on the project. The brochure was available for comment for a total of 32 days between October 9, 2012 and November 9, 2012.

Public scoping meetings were held to obtain public feedback on the purpose and need for the project, the issues associated with PWC use, and preliminary alternatives for managing PWCs at the national lakeshore. Public scoping meetings were held in Munising (October 23, 2012); Marquette (October 24, 2014); and Grand Marais (October 25, 2012). Meetings were held in an open house format in order to provide the public with opportunities to discuss interests and concerns with NPS staff. A total of 33 individuals attended the public scoping meetings. The number of attendees at each of the meetings was as follows:

- Munising – 22 attendees
- Marquette – 7 attendees
- Grand Marais – 4 attendees

A total of 193 correspondences were received during the public comment period from 20 states and two countries, with a majority of letters submitted by individuals living in Michigan. Topics that received a majority of the comments were related to the impact of PWC use on the visitor experience at the national lakeshore, and comments either supporting or prohibiting the use of PWCs at the national lakeshore (NPS 2013g). The NPS considered these comments while preparing this EA.

LIST OF PREPARERS

US DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE

- Jim Northup, Superintendent (former), Pictured Rocks National Lakeshore
- Bruce Leutscher, Chief of Science and Natural Resources, Pictured Rocks National Lakeshore
- Gregg Bruff, Chief of Heritage, Education and Cultural Resources (former), Pictured Rocks National Lakeshore
- Tim Colyer, Chief Ranger (former), Pictured Rocks National Lakeshore
- Clifton Edwards, Seasonal Protection Specialist, Pictured Rocks National Lakeshore
- Lora Loope, Aquatic Ecologist (former), Pictured Rocks National Lakeshore
- Cindy Heyd, Wildlife Biologist, Pictured Rocks National Lakeshore
- Chris Case, Facility Manager (former), Pictured Rocks National Lakeshore
- Bill Smith, Ranger, Pictured Rocks National Lakeshore
- Nick Chevance, Regional Environmental Coordinator (former), Midwest Regional Office
- Doug Wetmore, Project Manager, Environmental Quality Division

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC., PBC

- Suzanne Boltz, Project Manager
- Kathryn Cerny-Chipman, Environmental Scientist
- Mark Dhruv, GIS
- Emily Harakal, (former) Environmental Scientist
- Sarah Koser, Wetland Scientist/Botanist
- John Kumm, Air Quality
- Jeannette Matkowski, Environmental Scientist
- Katie Minczuk, Environmental Scientist
- Sunhee Park, Air Quality
- Bill Rue, Water Quality
- Anita Struzinski, Environmental Scientist
- Eric Yan, GIS

NEW SOUTH ASSOCIATES, INC.

- Brad Botwick, Cultural Resource Specialist

THE FINAL WORD

- Juanita Barboa, Technical Editor
- Sherrie Bell, Technical Editor

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GLOSSARY AND TERMS

A-weighted decibels (dBA)—Weighted or adjusted dB are adjusted to account for the hearing abilities of normal human hearing. Sound levels are often weighted or adjusted to match the hearing abilities of humans, as the way the acoustic environment is experienced depends on the interactions of the frequencies and amplitudes of several sounds. A weighted decibel discounts sounds below 1,000 Hz and above 6,000 Hz, which is approximate to the variation in human hearing sensitivity.

Affected environment—The existing environment to be affected by a proposed action and alternatives.

Alkalinity—A measure of the capacity of water to neutralize acids.

Amplitude—Amplitude, or loudness, refers to the relative strength of sound waves (transmitted vibrations), which are perceived as loudness, or volume. Amplitude is measured in dB, which refer to the noise level or the intensity of the sound (NPS 2012b). Humans with normal hearing can hear amplitude as low as 0 dB, a quiet library is about 30 dB, a vacuum cleaner is roughly 70 dB, hearing loss may begin to occur with sustained exposure to 90 dB, and 125 dB pushes the threshold for human pain

Archeological resources—Any material remnants or physical evidence of past human life or activities of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research. Any material remnants of human life or activities at least 100 years of age, and of archeological interest (32 CFR 229.3(a)).

Attainment—A term used to describe Air Quality Control Regions when the air quality within the Air Quality Control Region is better than the NAAQS standards.

Best management practices—Methods that have been determined to be the most effective, practical means of preventing or reducing pollution or other adverse environmental impacts.

Carbureted two-stroke engine—An earlier PWC engine design that requires two piston movements, or strokes, to complete the engine cycle; as a result, engine cylinders are flushed or scavenged and refilled with and refilled with a mixture of air and fuel after each combustion. This leads to higher emissions and lower fuel efficiency.

Clean Air Act—Established in 1970, the Clean Air Act establishes regulatory standards for air emissions from stationary and mobile sources. The Clean Air Act also authorizes EPA to establish air quality standards (NAAQS) to regulate hazardous air pollutants.

Clean Water Act—Established in 1972, the Clean Water Act determined the regulatory structure for regulating discharges of pollutants into Waters of the United States. The Clean Water Act also determined the structure for regulating water quality standards in surface waters.

Climate change—Any significant change in average climatic conditions (including mean temperature, precipitation, wind patterns, etc.) or variability (such as seasonality or storm frequency) lasting for an extended period (decades or longer).

Context—The significance of an action that must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole.

Council on Environmental Quality (CEQ)—Established by Congress within the Executive Office of the President with passage of the NEPA. The CEQ coordinates federal environmental efforts and works closely with agencies and other White House offices in the development of environmental policies and initiatives.

Critical habitat—"(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance within the provisions of section 4 of this [Endangered Species] Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations and protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this [Endangered Species] Act, upon a determination by the Secretary that such areas are essential for the conservation of the species (ESA, Section 3(5)(a))."

Cultural landscape—A geographic area associated with historic events, activities, or people that reflect the history, development patterns, and relationship between people and the park unit.

Cultural resources—Historic districts, sites, buildings, objects, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reasons.

Cumulative impacts—"the impact on the environment which results from the incremental impact of the action when added to other ongoing or reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7).

Decibel (dB)—Decibels are a unit of measurement that refers to the loudness, or amplitude. Decibels are on a logarithmic scale, which means that an increase of 10 dB represents an increase in magnitude of ten times, or a ten-fold increase in sound energy. Thus, 20 dBA would be perceived as twice as loud as 10 dBA, 30 dBA would be perceived as 4 times louder than 10 dBA, 40 dBA would be perceived as 8 times louder than 10 dBA, etc. In addition, as sound levels increase, so does the distance at which they can be heard. For example, a 6 dBA increase in sound doubles the distance at which the sound can be heard and quadruples the area of audibility.

Direct impacts—Impacts that happen in the same place and at the same time as the federal action.

Direct injection two-stroke engine—A more recent PWC engine design, which still requires two piston movements, or strokes, to complete the engine cycle, but where the cylinders are cleared using only pure air, and fuel is directly injected into the cylinder when the exhaust port has closed, eliminating discharge to the water and reducing air emissions.

Director's Order—Proclamation or order issued by the director of the NPS that may set forth policy or direction or establish specific duties in connection with the execution of federal laws and programs or NPS regulations and programs.

Endangered species—"…any species (including subspecies or qualifying distinct population segment) that is in danger of extinction throughout all or a significant portion of its range (ESA, Section 3(6))." The lead federal agency, USFWS, for the listing of a species as endangered is responsible for reviewing the status of the species on a five-year basis.

Endangered Species Act (ESA) (16 USC 1531 -1544, 87 Stat 884), as amended—An act to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be

conserved and to provide a program for the conservation of such endangered species and threatened species.

Environmental assessment (EA)—An EA is prepared pursuant to the NEPA to determine whether a federal action would significantly affect the environment and thus require a more detailed environmental impact statement.

Ethnographic resources— Ethnographic resources, as defined by the NPS, are the cultural and natural features of a park that are of significance to peoples traditionally associated with the park lands for two or more generations and whose interest in the park resources began prior to establishment of the park unit.

Executive Order—Official proclamation issued by the President that may set forth policy or direction or establish specific duties in connection with the execution of federal laws and programs.

Finding of No Significant Impact (FONSI)—A document prepared by a federal agency showing why a proposed action would not have a significant impact on the environment and thus would not require preparation of an environmental impact statement. It is based on the results of an EA.

Flat-wake speed—A speed of motorized vessel operation when the vessel is operated at an idling speed; this slow speed creates no appreciable wake.

Floodplain—The flat or nearly flat land along a river or stream or in a tidal area that is covered by water during a flood.

Four-stroke engine—A more recent PWC engine design which requires four movements, or strokes, of the pistons to complete the engine cycle. This design results in lower emissions and higher fuel efficiency.

Frequency—The frequency or pitch of a sound is the number of times a sound pressure wave repeats itself per second, or the rate at which an object vibrates. Frequency is measured in units called Hz. Generally, human-caused sounds are lower in frequency and pitch, while natural sounds tend to be higher in frequency and pitch.

Hertz (Hz)—Hertz is a measurement unit used to measure the frequency of a sound. Normal human hearing includes frequencies between 20 Hz and 20,000 Hz, and humans are most sensitive to frequencies between 1,000 Hz and 6,000 Hz.

Historic structures—A district, site, structure, or landscape significant in American history, architecture, engineering, archeology, or culture that meets NRHP significance criteria.

Indirect impacts—Impacts that happen later in time or farther removed from the area of federal action.

Intensity—The severity of an impact.

Is likely to jeopardize proposed species / adversely modify proposed or critical habitat (impairment)—Under the ESA this terminology to assess impacts is used to describe situations in which a proposed action could jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside park boundaries.

May affect / likely to adversely affect—Under the ESA this terminology to assess impacts is used to describe when an adverse effect to a listed species may occur as a direct or indirect result of proposed actions and the effect either is not discountable or is completely beneficial.

May affect / not likely to adversely affect—Under the ESA this terminology to assess impacts is used to describe when effects on special-status species are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or are completely beneficial.

Median existing ambient noise—The median SPL that is exceeded 50% of the time in sound monitoring data. This value represents the value that noises heard in the environment were louder than 50% of the time.

Median natural ambient noise—A calculated estimate of what the ambient noise level would be in an area if all anthropogenic noise sources were removed from the data. This is used as a baseline condition against which current conditions can be measured.

Migratory Bird Treaty Act—Established in 1918, the Migratory Bird Treaty Act implements a series of treaties between the United States, Britain (on behalf of Canada), Mexico, Japan, and Russia to provide standards for the protection of international migratory birds.

National Ambient Air Quality Standards (NAAQS)—Standards set by EPA under the Clean Air Act to regulate pollutants considered harmful to human health or to the environment. Standards have been established for six pollutants (CO, lead, NO_X, ozone, particle pollution, and SO_2). Two types of standards are set; primary standards are set limits to protect public health, while secondary standards are set to protect public welfare, including protecting visibility, crops, and damage to buildings, vegetation, and animals.

National Environmental Policy Act of 1969 (USC 432 1-4347) (NEPA)—The act as amended articulates the federal law that mandates protecting the quality of the human environment. It requires federal agencies to systematically assess the environmental impacts of their proposed activities, programs, and projects including the "no action" alternative of not pursuing the proposed action. NEPA requires agencies to consider alternative ways of accomplishing their missions in ways which are less damaging to the environment.

National Historic Preservation Act of 1966 (16 USC 470 et seq.)—An act to establish a program for the preservation of historic properties throughout the nation, and for other purposes, approved October 15, 1966 [Public Law 89-665; 80 STAT.915; 16 USC 470 as amended by Public Law 91-243, Public Law 93-54, Public Law 94-422, Public Law 94-458, Public Law 96-199, Public Law 96-244, Public Law 96-515, Public Law 98-483, Public Law 99-514, Public Law 100-127, and Public Law 102-575].

No effect—Under the ESA this terminology to assess impacts is used to describe when a proposed action would not affect a listed species or designated critical habitat.

Noise—Noise is defined as a sound that is either unwanted or inappropriate in a particular environment. Noise is considered to be a function of the loudness of the sound, the pitch, and the temporal variability, which is the changing nature or fluctuation of the sound.

Noise-free interval—The length of time between human-caused noise events during sound monitoring.

Nonattainment-- A term used to describe Air Quality Control Regions when the air quality within the Air Quality Control Region exceeds the NAAQS standards for the six criteria pollutants.

Non-point source pollution—A source of water pollution that does not come from a defined point. Non-point source pollution includes pollution from land runoff, precipitation, atmospheric deposition, drainage, and other sources.

Oligotrophic—A type of lake that has relatively low nutrient availability in relation to the size of the lake and volume of water.

Organic Act—Enacted in 1916, this act commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

Particulate matter (PM)—A mixture of small particles and liquid droplets that includes a number of components, including acids, organic chemicals, and dust particles.

Personal watercraft (PWC)—Personal watercraft, as defined in 36 CFR 1.4(a), refers to a vessel, usually 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. Personal Watercraft are commonly referred to as "jet-skis".

Planning, Environment, and Public Comment (PEPC)—The NPS website for public involvement on NPS planning documents. Users of the site can review and submit comments on NPS documents available for public review.

Polycyclic aromatic hydrocarbons (PAHs)—Chemicals that are formed during the incomplete burning of organic substances, including gas, oil, and coal. They are usually found as a mixture.

Scoping—Scoping is done during the initial phase of project planning to seek input from a variety of sources. This input is used to identify issues, areas requiring additional study, alternative methods and locations, and topics to be analyzed in the NEPA document. Scoping is done internally with National Park Service staff and externally with the interested public, other agencies, and stakeholders.

Section l06—Refers to section l06 of the National Historic Preservation Act of l966, which requires federal agencies to take into account the effects of their proposed undertakings on properties included or eligible for inclusion in the NRHP and give the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed undertakings.

Sound—Sound is defined as a pressure wave as it moves through a medium, such as water or air. Sound is measured in terms of frequency and amplitude.

Soundscape—The human perception of acoustic resources in the environment of a park unit.

Submerged aquatic vegetation (SAV)—Plants that have adapted to living in or on aquatic environments. Because living on or under the water surface requires numerous special adaptations, aquatic plants can only grow in water or permanently saturated soil.

Submerged cultural resources—Historic objects, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reasons that is submerged underwater.

Threatened—"…Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (ESA, section 3(19))."

Turbidity—A measure of water clarity and the amount of suspended material in the water.

Unclassified—When used in relation to air quality, a term used to describe Air Quality Control Regions when there is not enough information to appropriately classify the Air Quality Control Region. Areas that are unclassified are considered to be in attainment.

Volatile organic compounds (VOCs)—VOCs include a number of chemicals that are emitted as gases from certain solids or liquids.

Wetlands—The US Army Corps of Engineers (Federal Register 1982) and EPA (Federal Register 1980) jointly define wetlands as: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wilderness area—Wilderness is defined under the Wilderness Act as an area that "has outstanding opportunities for solitude or a primitive and unconfined type of recreation."

Wilderness Act of 1964—Established in 1964, the Wilderness Act enables Congress to set aside, preserve, and protect areas of pristine wilderness for the public to enjoy.

ACRONYMS AND ABBREVIATIONS

CARB	California Air Resources Board
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
dB	decibel
dBA	A-weighted decibel
DDT	Dichlorodiphenyltrichloroethane
EA	environmental assessment
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FR	Federal Register
GMP	general management plan
HC	hydrocarbons
Hz	Hertz
MCL	Michigan Compiled Law
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg	milligram
mph	miles per hour
MTBE	methyl tertiary butyl ether
NAAQS	National Ambient Air Quality Standards
national lakeshore	Pictured Rocks National Lakeshore
NEPA	National Environmental Policy Act
NMIM	National Mobile Inventory Model
NO_X	nitrogen oxide
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
PAH	polycyclic aromatic hydrocarbon
park	Pictured Rocks National Lakeshore
PCB	polychlorinated biphenyl
PEPC	Planning, Environment and Public Comment (website)
PFD	personal flotation device
PL	Public Law
PM	particulate matter
$PM_{2.5}$	particulate matter (2.5 micrometers or less)
PM_{10}	particulate matter (10 micrometers or less)
ppm	parts per million

PWC	personal watercraft
PWIA	Personal Watercraft Industry Association
SHPO	State Historic Preservation Office
SIL	significant impact level
SO_2	sulfur dioxide
SPL	sound pressure level
USCG	US Coast Guard
USFWS	US Fish and Wildlife Service
VOC	volatile organic compound

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APPENDIX A:
WATER QUALITY ASSESSMENT AND CALCULATIONS

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METHODOLOGY

To address potential impacts on water quality at the national lakeshore from personal watercraft (PWC) use, similar methods to the 2002 Pictured Rocks National Lakeshore (national lakeshore) Personal Watercraft Environmental Assessment (EA) were used to evaluate contaminant loadings. The four segments of the lakeshore examined for PWC use were Sand Point (segment 1), Cliffs (segment 2), Beaver Basin (segment 3), and Grand Sable (segment 4) which are depicted in figure A-1. The approaches used to determine impacts to water quality are (Alternative 1) PWC use in Sand Point segment only, (Alternative 2) PWC use in all four segments and, (Alternative 3) prohibited PWC use in all four segments.

The overall approach to evaluate the potential impact of PWC use on the water quality of the national lakeshore was as follows:

- Determine average daily number of PWCs at each of the four segments monitored, as well as hourly usage for each PWC.
- Ascertain ecological and human health toxicity benchmarks for polycyclic aromatic hydrocarbons (PAHs) and benzene based on US Environmental Protection Agency (EPA) and Michigan Department of Environmental Quality (MDEQ) criteria.
- Estimate the loadings to the water column of PAHs (including benzo(a)pyrene, naphthalene, and 1-methylnapthalene) and benzene based on the concentrations of these contaminants in gasoline and PWC-hours.
- Determine waterbody "threshold volumes," defined as the minimum water volume needed to reduce contaminant concentrations at or below federal and state criteria or benchmark toxicity concentrations.

PWC USE

Two scenarios were modeled for daily use of PWCs – average and peak. Table A-1 presents the length of the segments and the number of PWCs modeled for average and peak days under alternatives 1 and 2. PWC use is prohibited in alternative 3 and therefore not included in table A-1.

For alternative 1, Sand Point is the only segment open for PWC use; for alternative 2, PWC use would be allowed across all four segments. Based on PWC studies, the National Park Service estimated the current level of PWC use, as detailed in the "Assumptions Used in Determining Impacts" section of chapter 4. The National Park Service assigned Sand Point and Cliffs an average of 14 PWCs each per day during peak days because they have heavier visitor use. Beaver Basin and Grand Sable are expected to have lower PWC use; therefore, these segments were each assigned 7 PWCs per day. Each PWC is used for 3 hours daily.

TABLE A-1: CALCULATION OF AVERAGE AND PEAK PWC-HOURS FOR EACH SEGMENT OF PICTURED ROCKS NATIONAL LAKESHORE

Segment	Length (miles)	Alternative 1: Current Regulations under the 2005 Special Regulation for PWC Use				Alternative 2: Entire Shoreline Open to PWC Use			
		Average Use		Peak Use		Average Use		Peak Use	
		# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours
1. Sand Point	9.2	4	12	14	42	4	12	14	42
2. Cliffs	6.0	0	0	0	0	4	12	14	42
3. Beaver Basin	10.2	0	0	0	0	4	12	7	21
4. Grand Sable	14.3	0	0	0	0	4	12	7	21

POLLUTANTS ANALYZED

Petroleum-related pollutants of concern related to fuel combustion include methyl tertiary butyl ether (MTBE), PAHs, benzene, toluene, ethylbenzene, xylenes and other hydrocarbons, (VanMouwerik and Hagemann 1999). Benzene, toluene, ethylbenzene, xylenes, and lower weight PAHs evaporate relatively quickly and do not stay in the water column for long periods (EPA 2013). Because of this, toluene, ethylbenzene, and xylenes were not carried forward in the analysis. Benzene was retained and fully analyzed because it is a recognized human carcinogen (EPA 2013). MTBE and higher weight PAHs may remain in the water column for longer periods, which could ultimately affect aquatic wildlife. In Michigan, the use of MTBE in gasoline was phased out in 2003 (EPA 2004); therefore, MTBE is no longer expected to be a concern in the surface waters of the national lakeshore. Following the procedure in the 2002 EA, in addition to benzene, several PAHs were analyzed for impacts on water quality: two lower-weight PAHs, naphthalene and 1-methylnaphthalene, and one higher weight PAH, benzo(a)pyrene.

TOXICITY BENCHMARKS AND CRITERIA

Pictured Rocks National Lakeshore does not have site-specific water quality standards; therefore, national standards were used in this analysis to evaluate the potential impacts to water quality at the national lakeshore from PWC use.

Ecotoxicological Benchmarks: EPA water quality criteria protective of aquatic life for the chemicals analyzed are not available; therefore, ecotoxicological screening benchmarks were acquired from scientific literature. Ecological screening benchmarks represent a threshold for effects to ecological receptors, which are used to determine if chemicals present in or potentially released to the environment pose an ecological threat. For this analysis, the media is the Lake Superior surface water at the national lakeshore.

The ecological toxicity values were sourced from Suter and Tsao's 1996 report. Suter and Tsao (1996) is a widely-used report for assessing chemical specific screening-level risks to aquatic organisms. This report derives toxicity benchmarks from available ecotoxicity data in the primary literature. Furthermore, data are only incorporated into the benchmarks following evaluation of quality as defined by guidelines used to develop the National Ambient Water Quality Criteria. The benchmarks were based on acute toxicity tests. The species used in the tests are invertebrates (*D. pulex*, *D. magna*, *A. aquaticus*, and *C. thummi*) and fish (*C. auratus*, *C. cognatus*, *G. aculeatus*, *P. promelas*, *O. mykiss*, *O. nerka*, *O.*

tshawytscha, *O. kisutch*, *O. gorbuscha*, *L.macrochirus*, *I. punctatus*, *P. reticulate*, *S. malma* and *T. arcticus*). The acute tests had a duration of 48 to 96 hours and used juvenile and/or adult individuals. The endpoint for the test was the median lethal/effective concentration or L/EC_{50}, resulting in death or immobilization of 50% of test population. Benchmarks were calculated by initially determining the Genus Mean Acute Value; next, the chemical specific Final Acute Value Factor is calculated. The next calculation is the Secondary Acute Value, which is required when there are few toxicity data available, as is the case for these chemicals. This is done by dividing the lowest Genus Mean Acute Value for that chemical by the Final Acute Value Factor. Next, the Secondary Acute Value needs to be extrapolated to a chronic value, as aquatic organisms are assumed to be exposed daily. The Secondary Acute–Chronic Ratio is calculated by either taking the geometric mean of the Secondary Acute Value (if there are 3 or more, which is the case with naphthalene but not with the other three chemicals) or using a default value of 17.9 from the EPA (1991). Finally, the toxicity benchmark is calculated by dividing the Secondary Acute Value by the Secondary Acute–Chronic Ratio (calculated or default 17.9).

Human Health Criteria: Human health criteria are used to determine the highest concentrations of pollutants in water that are not expected to pose significant risks to human health (EPA 2014). It is important to recognize that human health criteria are extraordinarily conservative when applied to the human exposures being addressed in this EA. Conservative benchmarks are protective and take into account possible ways a visitor could be exposed to a contaminant. This type of benchmark is appropriate because it is protective of the visitor, as it creates a worst-case scenario. Therefore, if the concentration of a chemical in the water does not exceed a very conservative and protective benchmark for any reasonable period of exposure, there is greater confidence that humans and aquatic resources are not at risk.

EPA compiles national recommended water quality criteria protective of aquatic life and human heath in surface water. These criteria are published pursuant to Section 304(a) of the Clean Water Act and provide guidance for states and tribes to use in adopting water quality standards (EPA 2015). Of the pollutants evaluated in this analysis, EPA water quality criteria are available for benzo(a)pyrene and benzene for human health. The state of Michigan also has a human health water quality criterion for benzene under MDEQ Rule 57. While the EPA criterion for benzene is more conservative, both criteria were used in the analysis for water quality.

The EPA human health Water Quality Criteria values were derived by using available toxicity data and applying exposure assumptions to calculate a chemical specific environmental concentration protective of human health. The assumptions made are a human being exposed weighs 80kg, they directly drink 2.4 L of the 'contaminated' water daily and they consume 22 g. of fish from the 'contaminated' waterbody on a daily basis.

Table A-2 presents the ecological benchmarks, human health criteria and their sources.

TABLE A-2: ECOLOGICAL AND HUMAN HEALTH TOXICITY BENCHMARKS FOR SELECTED POLLUTANTS

Pollutant	Ecological Toxicity Benchmarks			Human Health Toxicity Benchmarks		
	µg/L	mg/L	Source	µg/L	mg/L	Source
benzo(a)pyrene	0.014	1.4×10^{-5}	Suter and Tsao 1996	0.00012	1.2×10^{-7}	EPA 2015
naphthalene	12	0.012	Suter and Tsao 1996	-	-	-
1-methylnaphthalene	2.1	0.0021	Suter and Tsao 1996	-	-	-
benzene	130	0.130	Suter and Tsao 1996	12 2.1	0.012 0.0021	MDEQ 2014 EPA 2015

µg/L = microgram per liter
mg/L = milligram per liter

DAILY POLLUTANT LOADINGS

The amount of each pollutant (benzene, benzo(a)pyrene, naphthalene, and 1-methylnaphthalene) that would be released to the surface water of Lake Superior during daily PWC use was estimated; this is the daily pollutant loading. The analysis used the concentrations of components in gasoline, the rate of discharge of a two-stroke carbureted engine (11.34 liters per hour), and the running time of the PWCs (based on the use assumptions outlined in table A-1) to calculate potential pollutant loading to the lake. The objective of the lake-loading analysis was to determine if the national lakeshore would receive concentrations of selected compounds from gasoline or its combustion products from PWCs that would cause pollutant levels to approach or exceed water quality standards.

The pollutant loading estimates apply only to PWC use during the two-year phase-out period of PWCs with carbureted two-stroke engines. The alternative approaches make the assumption that all PWCs at the national lakeshore will be those with carbureted two-stroke engines that discharge unburned gasoline and gasoline additives directly into the water. Post phase-out, all PWCs would have direct injection engines, which do not discharge fuel directly into the water (PWIA 2006), essentially eliminating pollutant loading to the surface water. There could be incidental releases of fuel to Lake Superior from fuel leaks or fuel spills by PWC users; however, spills and leaks are expected to be infrequent and would not create appreciable impacts on water quality.

This analysis presents total daily pollutant loadings that would be delivered to the surface water instantaneously; these loadings are assumed to dissipate via dilution and volatilization prior to the next boating day. However, in reality, pollutants are deposited throughout the day and some pollutants may persist in the water column. Of the pollutants analyzed, benzo(a)pyrene is the most likely to remain in the environment, as higher weight PAHs are more resistant to oxidation and reduction, but will be emitted in such small amounts that impacts would be undetectable (EPA 2013). Pollutant loading results are presented in tables A-3, A-4, and A-5.

THRESHOLD VOLUMES

Threshold volumes are defined as the volume of water needed to dilute the calculated pollutant loads to the concentrations of water quality criteria or benchmark. The threshold volumes are calculated by dividing the estimated daily pollutant loadings by the ecological benchmark or human health criteria. An advantage of this approach is that it provides a mechanism to estimate pollution levels, even in the absence of baseline water quality data. A limitation is that the calculations yield a total daily load from PWCs that would be instantaneously delivered to the lake, and is assumed to be reduced to zero by the start of the next boating day. In reality, the pollutant load is added in conjunction with all other boating activities throughout the day, and small residual concentrations of some compounds may carry over from one day to the next.

Lake Superior is defined as a dimictic lake (Minnesota Sea Grant 2009), meaning that it mixes twice a year, in the spring and in the fall. With warmer summer temperatures, lakes can stratify into bands of warmer and cooler water. The upper layer, which goes from the surface to about 50 feet in depth, is the warmest layer and is mixed by wind action. In the summer, the upper layer does not mix with the lower, colder layer (Mazumder and Taylor 1994). The depth of Lake Superior in the 0.25-mile area from the shoreline varies but generally reaches depths less than 40 feet; therefore, the analysis for threshold volumes assumes that all water within the segments is readily mixed by wind action and is available for dilution of pollutants from all sources. Threshold volume results are presented in tables A-3, A-4, and A-5.

CALCULATIONS

Below are example loading and threshold volume calculations for a location with 4 PWCs per day that are used for 3 hours each, for a total of 12 PWC-hours per day (such as the average use in the Sand Point location under alternative 2). The daily loading amount (in milligrams) of each pollutant that is discharged to the water is determined. Next, the "threshold volume" of water needed to dilute the concentration of the pollutant to its criterion or toxicity benchmark "safe concentration" is calculated. For complete results, see tables A-3 through A-5.

CONSTANTS

Gasoline emission rate for two-stroke PWC:	11.34 L/hour
Concentration of benzo(a)pyrene in gasoline:	2.07 mg/L (Gustafson et al. 1997)
Concentration of naphthalene in gasoline:	3,695 mg/L (Gustafson et al. 1997)
Concentration of 1-methylnapthalene in gasoline:	5,760 mg/L (estimated from Gustafson et al. 1997)
Concentration of benzene in gasoline:	9,607 mg/L (Hamilton 1996)
Number of liters in 1 acre-foot:	1,233,481.87 L

POLLUTANT LOADING CALCULATIONS TO WATER

PWC-hours (hr)	×	Gasoline Emission per Hour (L/hr)	×	Concentration of Pollutant in Gasoline (mg/L)	=	Pollutant Loading in Water (mg)

Benzo(a)pyrene: 12 PWC-hours × 11.34 L gasoline/hr × 2.07 mg/L = 282 mg

Naphthalene: 12 PWC-hours × 11.34 L gasoline/hr × 3,695 mg/L = 502,816 mg

1-methylnapthalene: 12 PWC-hours × 11.34 L gasoline/hr × 5,760 mg/L = 783,821 mg

Benzene: 12 PWC-hours × 11.34 L gasoline/hr × 9,607 mg/L = 1,307,321 mg

THRESHOLD VOLUMES BASED ON ECOLOGICAL TOXICITY BENCHMARKS

Pollutant Loading in Water (mg)	/	Ecological Benchmark (mg/L)	=	Threshold Volume (L)	=	Threshold Volume (acre-feet)

Benzo(a)pyrene: 282 mg / 1.4×10^{-5} mg/L = 20,120,400 L or 16.31 acre-feet

Naphthalene: 502,816 mg / 0.012 mg/L = 41,901,300 L or 33.97 acre-feet

1-methylnapthalene: 783,821 mg / 0.0021 mg/L = 373,248,000 L or 302.60 acre-feet

Benzene: 1,307,321 mg / 0.130 mg/L = 10,056,315 L or 8.15 acre-feet

THRESHOLD VOLUMES BASED ON HUMAN HEALTH TOXICITY BENCHMARKS

Pollutant Loading in Water (mg)	/	Human Health Benchmark (mg/L)	=	Threshold Volume (L)	=	Threshold Volume (acre-feet)

Benzo(a)pyrene: 282 mg / 1.2×10^{-7} mg/L = 2,347,380,000 L or 1,903.05 acre-feet

Benzene (MDEQ): 1,307,321 mg / 0.012 mg/L = 108,943,416 L or 88.32 acre-feet

Benzene (EPA): 1,307,321 mg / 0.0021 mg/L = 622,533,809 L or 504.70 acre-feet

Tables A-3 through A-5 present the results of calculations for alternatives 1 and 2 under average and peak conditions for all applicable segments. Only Sand Point calculations apply to alternative 1, as PWCs are prohibited in the remaining three segments (table A-3). The numbers of PWCs and PWC-hours for alternative 2 are the same for Sand Point and Cliffs segments under average and peak PWC use; therefore, this scenario is combined and presented in table A-4. The same applies to Beaver Basin and Grand Sable segments; this scenario is presented in table A-5.

VOLUME OF WATER AVAILABLE

Tables A-3, A-4, and A-5 also include the volume of water available within the areas where PWC use occurs (defined as the area between 200 feet of the shoreline and the edge of the national lakeshore or 0.25 mile into Lake Superior), and the threshold water volumes needed to dilute the PWC loadings to criteria or benchmark values. The volume of water in each segment was calculated by multiplying the area of the segment by the general depth.

These comparisons indicate that there is sufficient water available to dilute these loadings to safe concentrations under average use and high traffic use scenarios. Using benzo(a)pyrene at Sand Point under alternative 1 as an example, this assessment shows that 16 acre-feet of water are required to dilute the average daily loading to the benchmark aquatic life protection concentration (0.014 µg/L), and there are 31,551 acre-feet of water within the defined mixing zone area where PWC use occurs. Similarly, for comparison to the EPA human health criterion for benzo(a)pyrene (0.00012 µg/L), 6,661 acre-feet of water are required to dilute the PWC loading to the benchmark under the peak use scenario.

In summary, there is sufficient dilution within area where PWCs are being used within each of the four park segments under each alternative. It is recognized that excursions above these benchmark values will occur for short periods (and small volumes of water) as turbulent mixing and dilution occurs within the wake of the PWC.

TABLE A-3: CALCULATIONS OF DAILY POLLUTANT LOADINGS, VOLUME OF WATER AVAILABLE, AND THRESHOLD WATER VOLUMES NEEDED (IN ACRE-FEET) TO DILUTE PWC EMISSIONS TO BENCHMARK VALUES FOR AVERAGE AND PEAK CONDITIONS FOR ALTERNATIVE 1 – SEGMENT 1 (SAND POINT)

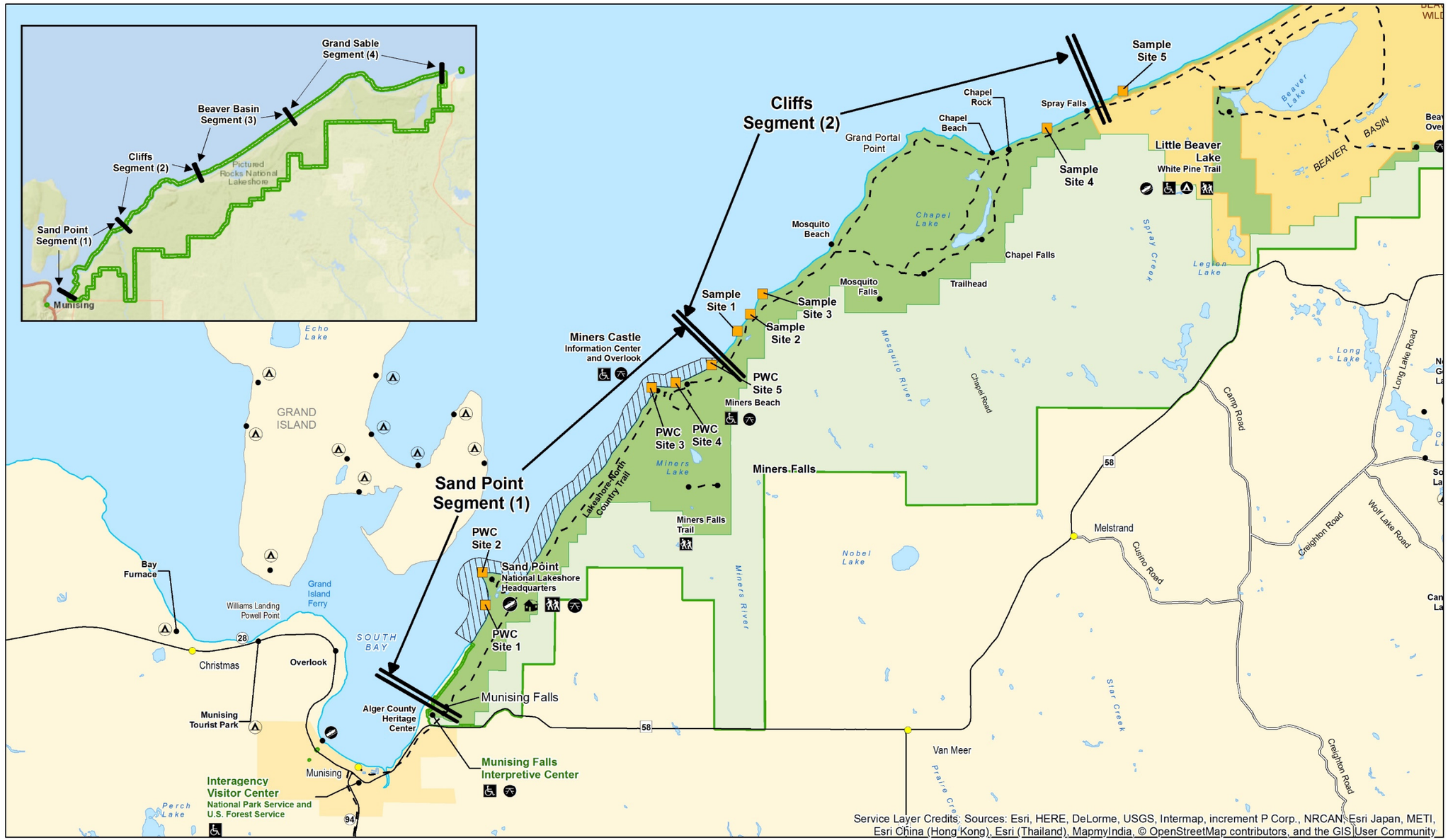
Pollutant	Average PWC Use			Peak PWC Use		
	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)
Volume of Water Available	**31,551 acre-feet**			**31,551 acre-feet**		
benzo(a)pyrene	282	16.31	1, 903.05	986	57.09	6,660.68
napthalene	502,816	33.97	-	1,759,855	118.89	-
1-methyl napthalene	783,821	302.60	-	2,743,373	1,059.09	-
benzene	1,307,321	8.15	88.32 (MDEQ) 504.70 (EPA)	4,575,622	28.53	309.13 (MDEQ) 1,766.44 (EPA)

TABLE A-4: CALCULATIONS OF DAILY POLLUTANT LOADINGS, VOLUME OF WATER AVAILABLE, AND THRESHOLD WATER VOLUMES NEEDED (IN ACRE-FEET) TO DILUTE PWC EMISSIONS TO BENCHMARK VALUES FOR AVERAGE AND PEAK CONDITIONS FOR ALTERNATIVE 2 – SEGMENT 1 (SAND POINT) AND SEGMENT 2 (CLIFFS)

Pollutant	Average PWC Use			Peak PWC Use		
	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)
Volume of Water Available	**31,551 acre-feet (Sand Point) 20,467 acre-feet (Cliffs)**			**31,551 acre-feet (Sand Point) 20,467 acre-feet (Cliffs)**		
benzo(a)pyrene	282	16.31	1, 903.05	986	57.09	6,660.68
napthalene	502,816	33.97	-	1,759,855	118.89	-
1-methyl napthalene	783,821	302.60	-	2,743,373	1,059.09	-
benzene	1,307,321	8.15	88.32 (MDEQ) 504.70 (EPA)	4,575,622	28.53	309.13 (MDEQ) 1,766.44 (EPA)

TABLE A-5: CALCULATIONS OF DAILY POLLUTANT LOADINGS, VOLUME OF WATER AVAILABLE, AND THRESHOLD WATER VOLUMES NEEDED (IN ACRE-FEET) TO DILUTE PWC EMISSIONS TO BENCHMARK VALUES FOR AVERAGE AND PEAK CONDITIONS FOR ALTERNATIVE 2 – SEGMENT 3 (BEAVER BASIN) AND SEGMENT 4 (GRAND SABLE)

Pollutant	Average PWC Use			Peak PWC Use		
	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)
Volume of Water Available	**29,716 acre-feet (Beaver Basin) 21,354 acre-feet (Grand Sable)**			**29,716 acre-feet (Beaver Basin) 21,354 acre-feet (Grand Sable)**		
benzo(a)pyrene	282	16.31	1, 903.05	493	28.55	3,330.34
napthalene	502,816	33.97	-	879,927	59.45	-
1-methyl napthalene	783,821	302.60	-	1,371,686	529.54	-
benzene	1,307,321	8.15	88.32 (MDEQ) 504.70 (EPA)	2,287,811	14.27	154.56 (MDEQ) 883.22 (EPA)


Grand Sable Segment (4)
Beaver Basin Segment (3)
Cliffs Segment (2)
Sand Point Segment (1)
Pictured Rocks National Lakeshore
Munising
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Sand Point Segment (1)
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PWC Site 5
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Miners Beach
Grand Portal Point
Chapel Rock
Chapel Beach
Spray Falls
Mosquito Beach
Mosquito Falls
Chapel Falls
Trailhead
Little Beaver Lake
White Pine Trail
BEAVER BASIN
Beaver Lake
Chapel Lake
Spray Creek
Legion Lake
Mosquito River
Chapel Road
Miners Falls
Miners Falls Trail
Miners Lake
Nobel Lake
Miners River
Lakeshore North Country Trail
Sand Point National Lakeshore Headquarters
Melstrand
Cusino Road
Camp Road
Long Lake
Long Lake Road
Creighton Road
Wolf Lake Road
Star Creek
Prairie Creek
Van Meer
Echo Lake
GRAND ISLAND
Bay Furnace
Grand Island Ferry
Williams Landing
Powell Point
SOUTH BAY
Christmas
Overlook
Munising Tourist Park
Alger County Heritage Center
Munising
Munising Falls
Munising Falls Interpretive Center
Interagency Visitor Center
National Park Service and U.S. Forest Service
Perch Lake
28
58
94
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Legend
City or Town
Park Feature
Boat Launch
Campground
Picnic Area
Ranger Station
Self-guided Trail
Wheelchair-accessible
Segments
Water Quality Sampling Location
Proposed PWC Use Area
Trail
Lakeshore Access Road (Paved)
Lakeshore Access Road (Unpaved)
Other Unpaved Road
Beaver Basin Wilderness Area
Inland Buffer Zone (Mixed Ownership)
Lakeshore Zone (NPS)
Park Boundary
Figure A-1
Water Quality
Sampling Locations
SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
0 2 4
Miles

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APPENDIX B:
AIR QUALITY STANDARDS AND ANALYSIS METHODOLOGY

NATIONAL AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT STATUS, PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY, MARINE SPARK-IGNITION ENGINE EMISSION STANDARDS

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NATIONAL AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT STATUS

The Clean Air Act (CAA) of 1970 and its subsequent amendments in 1977 and 1990 established and provided for periodic update of the National Ambient Air Quality Standards (NAAQS) to protect public health and welfare from the effects of air pollution. The NAAQS apply to six *criteria* pollutants: (1) carbon monoxide, (2) lead, (3) nitrogen dioxide, (4) ozone, (5) particle pollution, and (6) sulfur dioxide. *Primary standards* have been established to protect public health, including sensitive populations such as asthmatics, young children and the elderly. *Secondary standards* are established to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation and buildings. The current NAAQS are summarized in table B-1.

TABLE B-1: NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead		primary and secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide		primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	Annual	53 ppb	Annual mean
Ozone		primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution	$PM_{2.5}$	primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years
		secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years
		primary and secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Notes:
ppm = parts per million
µg/m^3 = micrograms per cubic meter
ppb = parts per billion
PM = particulate matter
Ozone is controlled by regulating emissions of nitrogen oxides and volatile organic compounds.

States and other local jurisdictions with responsibility for managing ambient air quality have the authority under the CAA to either adopt the NAAQS or to adopt more stringent air quality standards. The State of Michigan has adopted the federal NAAQS without change. Alger County, in the Upper Peninsula of Michigan, where Pictured Rocks National Lakeshore is located, and essentially the rest of the state, with small isolated exceptions, are designated as attainment for all of the NAAQS.

PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY

The CAA established the prevention of significant deterioration (PSD) program to protect the air in attainment areas from excessive degradation resulting from new sources of air emissions. Attainment areas may be designated as Class I, Class II, or Class III. Air quality planning areas designated as mandatory Class I under the 1977 CAA, which include 156 national parks larger than 6,000 acres and national wilderness areas and national memorial parks larger than 5,000 acres, are afforded the greatest protection from air quality deterioration. There are two mandatory Class I areas in Michigan – Seney National Wildlife Refuge in Schoolcraft County, approximately 45 kilometers from Pictured Rocks National Lakeshore and Isle Royale National Park, near the northwest shore of Lake Superior, approximately 250 kilometers from the national lakeshore. Other attainment areas are currently designated as Class II, where moderate deterioration of air quality is permitted, except in specified cases. Class III areas are planning areas set aside for industrial growth. There are currently no designated Class III areas. Violations of the NAAQS are not permitted in Class I, Class II, or Class III areas. Deterioration of air quality in attainment areas is limited by controlling the consumption of "ambient air increments" or "PSD increments." Increments are fractions of the difference between the baseline concentration in an area and the NAAQS concentration, and have been established for three of the criteria pollutants: sulfur dioxide, nitrogen dioxide, and particle pollution. An increment constitutes the maximum allowable increase in pollutant concentration above baseline in the area. The increments are smallest in Class I areas, and larger in Class II and Class III areas. Pictured Rocks National Lakeshore is located in an area designated as Class II. The ambient air increments are shown in table B-2.

Emissions of criteria pollutants and the resultant increases in ambient concentration from major new and modified sources subject to PSD are not permitted to consume more than 80% of the available increment in Michigan.

TABLE B-2: AMBIENT AIR (PREVENTION SIGNIFICANT DETERIORATION) INCREMENTS

Pollutant			Class II Areas ($\mu g/m^3$)
Nitrogen Dioxide		Annual arithmetic mean	25
Particle Pollution	$PM_{2.5}$	Annual arithmetic mean	4
		24-hr maximum	9
	PM_{10}	Annual arithmetic mean	17
		24-hr maximum	30
Sulfur Dioxide		Annual arithmetic mean	20
		24-hr maximum	91
		3-hr maximum	512

Abbreviations: PM = particulate matter

As a means of enabling screening assessments to determine the potential for new sources of criteria pollutants to result in ambient concentration impacts that would cause or contribute to a violation of the NAAQS or the PSD increments, US Environmental Protection Agency (EPA) established significant impact levels (SILs). SILs are numerical concentration values that represent thresholds of insignificant (*de minimis*) modeled source impacts. The Class II area SILs are shown in table B-3.

TABLE B-3: CLASS II AREA SIGNIFICANT IMPACT LEVELS

Pollutant		Averaging Period	Significant Impact Level ($\mu g/m^3$)
Nitrogen Dioxide		Annual	1
Particle Pollution	$PM_{2.5}$	Annual	(0.3) [a]
		24-hour	(1.2) [a]
	PM_{10}	Annual	1
		24-hour	5
Sulfur Dioxide		Annual	1
		24-hour	5
		3-hour	25
Carbon Monoxide		8-hour	500
		1-hour	2000

Abbreviations: PM = particulate matter

Notes:

a EPA rescinded its previously promulgated $PM_{2.5}$ SILs in 2013 pursuant to a 2012 Court of Appeals vacatur and remand.

SILs are used for determining if projects subject to PSD (major stationary sources) must conduct comprehensive (multi-source) modeling before construction. If modeled impacts (ambient concentration increases) from new sources of criteria pollutants are below the SILs, the new source is considered insignificant and not to have the potential to cause or contribute to violations of the NAAQS or the PSD increments.

MARINE SPARK-IGNITION ENGINE EMISSION STANDARDS

EPA is required to evaluate air emissions from nonroad engines and vehicles to set standards to control and reduce air emissions. The most significant pollutants associated with nonroad sources are nitrogen oxides (NO_X), volatile organic compounds (VOCs), and carbon monoxide (CO), which contribute to levels of ozone and CO that exceed nonattainment levels under NAAQS in certain areas of the country (EPA 2008a, 2008b). EPA completed the Nonroad Engine and Vehicle Emission Study in 1991, and in 1994 determined that these sources contribute significantly to ozone and CO nonattainment[1]. EPA determined that gasoline marine engines are one of the largest contributors of VOC emissions from the nonroad source category (EPA 2008a).

Working cooperatively with the marine industry and personal watercraft (PWC) manufacturers, EPA finalized Emission Standards for New Gasoline Marine Engines (40 CFR § 91(104)) on October 4, 1996, which established limits and standards for new gasoline spark-ignition marine engines. For gasoline spark-ignition marine engines, the primary pollutants affected by this rule are hydrocarbons (HC), of which VOCs are a component. The rule, which took effect in 1998, affects manufacturers of new outboard engines and the type of inboard engines used in PWCs (EPA 1996). The agency adopted a

[1] As of September 27, 2010, all areas formerly designated non-attainment for CO attained the CO NAAQS and were redesignated as maintenance areas.

9-year phase-in approach to reduce emissions. By the end of the phase-in period (2006), PWC manufacturers were required to meet a combined HC and NO_X emission standard on a corporate average basis that was equivalent to a 75% reduction in HC emissions compared to unregulated levels. The corporate average standard allowed manufacturers to produce some engines that performed at levels lower than the standard and some engines that performed at levels higher than the standard, and to employ a mix of technology types, as long as the overall corporate average was at or below the standard. The emissions control technologies applied include four-stroke engines, direct injection two-stroke engines, and post-combustion catalysts.

On October 8, 2008, EPA finalized and adopted new regulations (40 CFR § 1045(a)(103)) for air quality emissions standards for nonroad spark-ignition marine engines including PWCs (EPA 2008b). EPA also adopted new standards in 2008 to control evaporative emissions for all vessels using spark-ignition marine engines, including provisions for cold weather evaporative emissions standards reflective of fuel line capabilities, and a phase-in for marine diurnal standards to enhance safety of the new regulations (EPA 2008a). EPA estimates that by 2030, these standards would result in a 60% reduction in HC and NO_X emissions from outboard and PWC engines and a 20% reduction in CO emissions from new marine spark ignition engine exhaust (EPA 2008b). These standards will also reduce evaporative emissions by about 70% (EPA 2008b). These regulations only apply to newly manufactured products starting with the 2010 model year, and are consistent with the air emissions standard requirements of the California Air Resources Board (CARB) for models produced starting in model year 2008 (EPA 2008c). EPA indicated the combined HC and NO_X and CO emissions standards can be achieved by phasing out conventional carbureted two-stroke engines and replacing them with direct injection two-stroke or four-stroke engines. This has also been the market-driven trend over the past several years and is widely used technology (EPA 2008a). All PWCs manufactured today use four-stroke direct injection engines or two-stroke direct injection technology, which reduce air emissions up to 90% from models produced in 1998 (NMMA 2013; PWIA 2006). The 2006 and 2010 EPA air quality emissions standards are outlined in tables B-4 and B-5.

TABLE B-4: MARINE SPARK-IGNITION ENGINES AND VESSELS – EXHAUST EMISSION STANDARDS

Regulation	Model Year	HC + NO_x[a] (g/kW-hr)		CO[b] (g/kW-hr)		Useful Life (hours/years)[c]	Warranty Period (hours/years)[c]
		P ≤ 4.3 kW	P > 4.3 kW	P ≤ 4.3 kW	P > 4.3 kW		
2006 Standards	1998	278	(0.917 x (151 + 557/$P^{0.9}$ + 2.44)	-	-	350 / 5	All Emission-related Components: 1 year[d]
	1999	253	(0.833 x (151 + 557/$P^{0.9}$ + 2.89)	-	-		
	2000	228	(0.750 x (151 + 557/$P^{0.9}$) + 3.33	-	-		
	2001	204	(0.667 x (151 + 557/$P^{0.9}$) + 3.78	-	-		All Emission-related Components: 1 year Specified Major Emission Control Components: 200 / 3
	2002	179	(0.583 x (151 + 557/$P^{0.9}$) + 4.22	-	-		
	2003	155	(0.500 x (151 + 557/$P^{0.9}$) + 4.67	-	-		
	2004	130	(0.417 x (151 + 557/$P^{0.9}$) + 5.11	-	-		All Emission-related Components: 200 / 2 Specified Major Emission Control Components: 200 / 3
	2005	105	(0.333 x (151 + 557/$P^{0.9}$) + 5.56	-	-		
	2006-2009	81	(0.250 x (151 + 557/$P^{0.9}$) + 6.00	-	-		
2010 Standards	2010 +[e]	30.0	2.1 + 0.09 x (151 + 557/$P^{0.9}$)	500 - 5.0 x P	300	Personal Watercraft: 350 / 5[f] Outboard: 350 / 10[f]	Personal Watercraft: 175 hours or 30 months Outboard Engines: 175 / 5

Abbreviations: HC = hydrocarbon; NO_x = nitrogen oxides; g = gram; kW = kilowatt; kW-hr = kilowatt hour; P = maximum engine power in kilowatts; CO = carbon monoxide

Notes:

a The numerical emission standards for hydrocarbons (HC) must be met based on the following types of HC emissions for engines powered by the following fuels: (1) total hydrocarbon equivalent for alcohol; (2) non-methane hydrocarbon for natural gas; and (3) total hydrocarbons for other fuels.

b Manufacturers may generate or use emission credits for averaging, but not for banking or trading.

c Useful life and warranty period are expressed hours or years of operation (unless otherwise indicated), whichever comes first.

d Also applies to model year (MY) 1997 engine families certified pursuant to 40 CFR 91.205.

e Not-to-exceed emission standards specified in 40 CFR 1045.107 also apply.

f A longer useful life in terms of hours must be specified for the engine family if the average service life is longer than the minimum value as described in 40 CFR 1045.103(e)(3).

TABLE B-5: MARINE SPARK-IGNITION ENGINES – EVAPORATIVE EMISSION STANDARDS

Model Year	Fuel Line Permeation ($g/m^2/day$)	Fuel Tank Permeation ($g/m^2/day$ @ 28°C)	Diurnal (g/gal/day)	Useful Life [a] (years)	Warranty Period (years)
2009	15 [b]	-	-	PWC: 5 All other vessels and portable marine fuel tanks: 10	2
2010		-	0.40 [c]		
2011+		1.5 [d, e]			

Abbreviations: $g/m^2/day$ = grams per square meter per day; g/gal/day = grams per gallon per day

Notes:

a A 2-year useful life period applies for fuel tanks or fuel caps certified to meet permeation emission standards in 2013 and earlier model years for small spark-ignition and marine spark-ignition engines.

b Applies to marine spark-ignition fuel lines, including fuel lines associated with outboard engines or portable marine fuel tanks. The emission standard for fuel lines starts for PWC, vessels, and portable marine fuel tanks manufactured on or after January 1, 2009. The emission standard for primer bulbs applies starting January 1, 2011. The emission standard for under-cowl fuel lines used with outboard engines applies over a phase-in period which is based on total length of fuel lines: 30% for 2010; 60% for 2011; 90% for 2012–2014; and 100% for 2015+. Manufacturers have the option to comply with the standard with 100% of the under-cowl lines across the full lineup of 2011 model year outboard engines. In this case, requirements would not apply to under-cowl fuel lines before the 2011 model year.

c Applies to marine spark-ignition fuel tanks, including engine-mounted fuel tanks, only. Portable marine fuel tanks must be self-sealing and remain sealed up to a positive pressure of 34.5 kilopascals (5.0 pounds per square inch gauge); however they may contain air inlets that open when there is a vacuum pressure inside the tank. In addition, detachable fuel lines that are intended for use with portable marine fuel tanks must be self-sealing (without any manual vents) when not attached to the engine or fuel tank. An alternative standard of 0.16 grams per gallon per day applies for fuel tanks installed in nontrailerable boats when measured using the corresponding fuel temperature profile in 40 CFR 1060.525. Diurnal requirements start: in the 2010 model year for PWC fuel tanks and January 1, 2010 for portable marine fuel tanks; other installed fuel tanks must meet the standards for vessels produced on or after July 31, 2011, except as allowed by 40 CFR 1045.625. See 40 CFR 1060.240(e) for the design-based option.

d Or 2.5 grams per square meter per day if testing performed at 40°C.

e Applies to marine spark-ignition fuel tanks, including engine-mounted and portable marine fuel tanks. Permeation standards start: January 1, 2011, for portable marine fuel tanks; with the 2011 model year for fuel tanks for PWC; and with the 2012 model year for other installed fuel tanks.

When an engine meets EPA requirements, the manufacturer applies the CARB sticker on the vessel, which must be affixed on PWCs 2–3 inches to the right of the assigned vessel number (CARB 2008). CARB stickers were determined in the CARB 2008 air emissions standards, which require that PWCs from 2008 and later meet the standards for HC and NO_X exhaust air emissions listed below in table B-6. EPA exhaust air emission standards for marine spark-ignition PWC model years after 2010 are consistent with CARB regulations after 2008 for HC and NO_X and for CO, while EPA air quality emissions standards for earlier models are less stringent than CARB standards (EPA 2012). EPA 2006 air quality emissions standards are consistent with the 2001 CARB standards

According to these standards, PWC also may not exceed CO exhaust emissions of 300 g/kW-hr for outboard and PWC engines greater than 40 kW and 500 – 5P (P stands for the maximum engine power in kilowatts) for PWC engines greater than 40 kW, as outlined below in table B-7 (CARB 2008).

The national lakeshore would use CARB stickers as a way to identify PWCs with air emissions that are at or under the required EPA air quality emissions standards without having to stop PWC users to look at the engine type.

TABLE B-6: CARB CORPORATE AVERAGE EMISSION STANDARDS BY IMPLEMENTATION DATE HYDROCARBONS AND NITROGEN OXIDES (G/KW-HR)

Model Year	Maximum Family Emission Limits	P_{tx}[a] < 4.3 kW[b]	P_{tx} > 4.3 kW[b]
2001–2003	N/A	81.00	$(0.25 \times (151+557/P_{tx}^{0.9})) + 6.0$
2004–2007	80	64.80	$(0.20 \times (151+557/P_{tx}^{0.9})) + 4.8$
2008 and Later[c]	44	30.00	$(0.09 \times (151+557/P_{tx}^{0.9})) + 2.1$

Source: CARB 2008

Abbreviations: kW = kilowatt

Notes:

a P_{tx} is the average power in kW of the total number of spark-ignition marine engines produced for sale in California in model year x (where X is the model year), calculated by the SAE standard J1228.

b For 2010 and subsequent model years, an engine or engine family's power category is based on maximum engine power; otherwise maximum rate power may be used.

c For 2010 and subsequent model years, standards are measured in total hydrocarbons plus oxides of nitrogen.

TABLE B-7: CARB PERSONAL WATERCRAFT CARBON MONOXIDE STANDARDS

Model Year	Power Category[a] (kW)	Carbon Monoxide Standard (g/kW-hr)
2009 and Later	kW < 40	$500 – 5 \times P^{b}$
	kW > 40	300.0

Source: CARB 2008

Abbreviations: kW = kilowatt; g/kW-hr = grams per kilowatt hour

Notes:

a For 2010 and subsequent model years, an engine or engine family's power category is based on maximum engine power, otherwise maximum rated power may be used.

b P is defined as maximum rated power or maximum engine power in kW.

AIR QUALITY ANALYSIS METHODOLOGY

Pictured Rocks National Lakeshore, located in Alger County, Michigan, is in an area designated as attainment for all National Ambient Air Quality Standards (NAAQS). Hence, emissions of criteria pollutants including particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and volatile organic compounds are not as stringently regulated as in non-attainment areas. Personal watercraft (PWC) usage at the national lakeshore is fairly limited; only approximately 100 PWCs were observed in use during the 2012 summer period. With the assumption that the maximum daily usage for each was approximately 3 hours, emissions from the 2,352 annual hours of PWC operation would probably represent only a small fraction of total emissions from all mobile sources, including larger powered watercraft and light, medium, and heavy-duty vehicles operated with in the park unit. Given this relatively small contribution from PWCs to total mobile source emissions, the percentage of the operating fleet able to comply with the emission standards effective in 2010 (versus the 2006 standards), will probably not effect this significantly. Detailed analysis methodology and assumptions are described below.

AIR EMISSIONS CALCULATIONS

Air emission rates were estimated using US Environmental Protection Agency (EPA) National Mobile Inventory Model (NMIM), which incorporates the EPA NONROAD 2008a and MOBILE 6.2.03 programs. In order to quantify emissions, the NMIM model requires certain input parameters such as fuel type; temporal information; geographic region (state and county); and equipment source

classification codes (SCC), equipment technology type, equipment population, and monthly activity distribution ratio. The model contains a database of emission factors which are a function of equipment SCC, equipment technology type, fuel type and metrological data of the geographical region. In any event where user-defined information is not provided for any project-specific parameter, the model will use the default value available within the software database for that parameter. The NMIM model emissions output results are provided in tons of pollutant emitted per year. Modeling inputs to the NMIM model are presented in attachment E1.

AIR DISPERSION MODELING

EPA AERSCREEN was used to quantify and assess the potential air quality impacts from PWC emissions. AERSCREEN is the EPA guideline screening-level air quality model based on AERMOD (EPA 2014). The model produces estimates of "worst-case" 1-hour concentrations for a single source that represents a conservative estimate of the maximum post-action ambient concentration at the modeled (maximum) emission rate, without the need for hourly meteorological data, and also includes conversion factors to estimate "worst-case" 3-hour, 8-hour, 24-hour and annual concentrations. AERSCREEN is intended to produce concentration estimates that are equal to or greater than the estimates produced by AERMOD, using a fully developed set of meteorological and terrain data.

AERSCREEN dispersion modeling was performed for carbon monoxide; no dispersion modeling was performed for other criteria pollutants because their estimated emissions were minimal, less than 5 tons/yr.

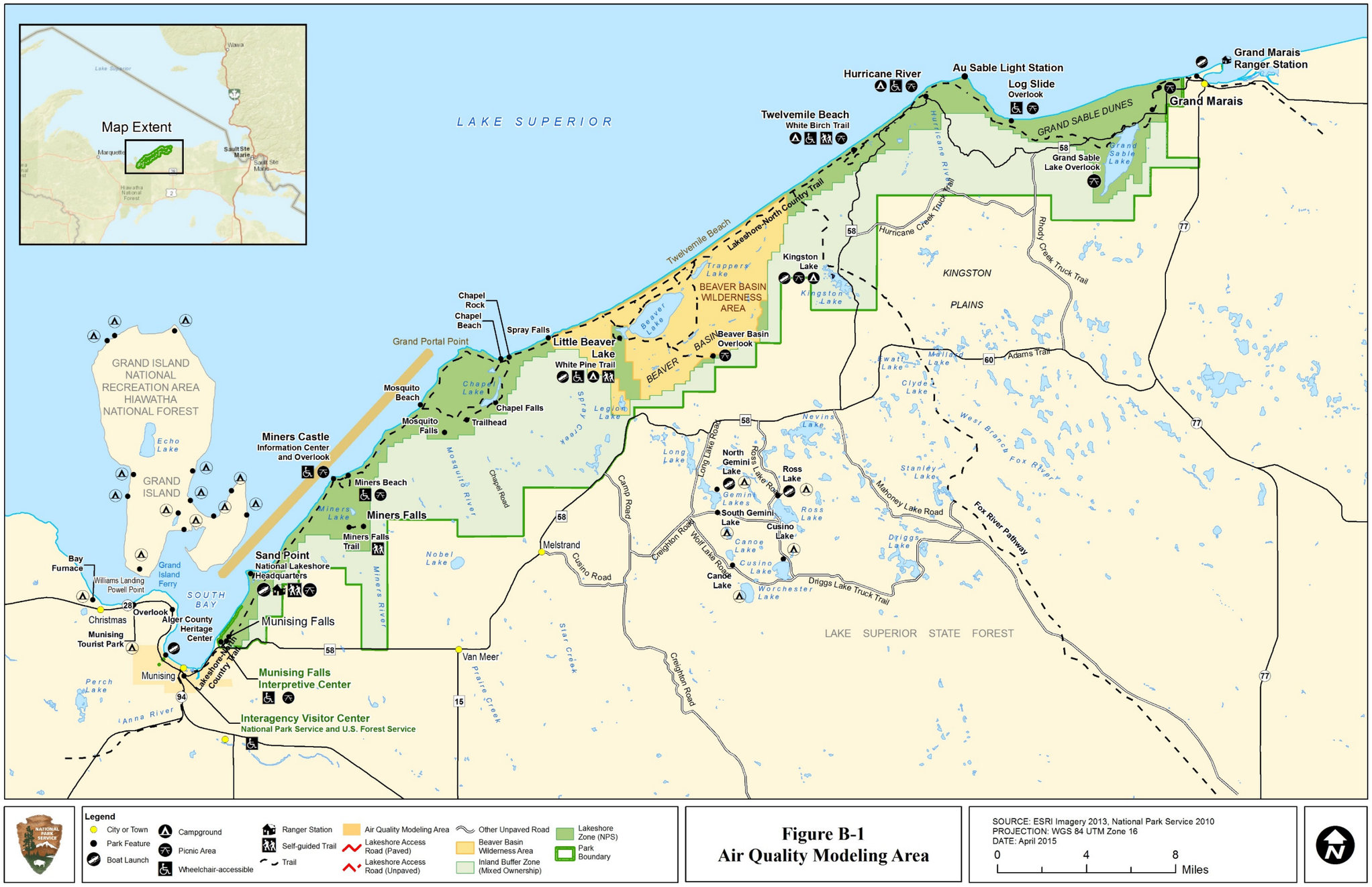
EMISSION SOURCE DESCRIPTIONS

Emissions from PWC use were modeled as multiple area sources because the model limit on the aspect ratio of the PWC use area rectangle necessitated separation into multiple rectangles. Rectangular area sources were located along shoreline of the national lakeshore. Since AERSCREEN is a single source model, it is assumed that all of emissions were evenly distributed throughout multiple rectangular area sources along the shoreline of the national lakeshore for the alternatives. Table B-8 shows inputs to the model.

TABLE B-8: AREA SOURCE PARAMETERS

Parameter	Value	Unit
Release Height	0	meter
Length	4000	meter
Width	400	meter
Orientation Angle	-48	deg

With AERSCREEN, a Gaussian model with a single source and no chemical transformations or deposition depletion modeling, concentration impacts scale in a linear fashion with the modeled emission rate. Therefore, a unit mass emission rate of 1 pound per hour was used to predict the maximum ground level concentration. The predicted ground level concentration was then used as dispersion coefficient to estimate the ambient concentration of carbon monoxide for 1-hour and 8-hour averaging periods; the EPA screening guidance (EPA 1992) recommends that the maximum 1-hour concentration be conservatively assumed to apply for averaging periods up to 24 hours.


Map Extent
Wawa
Lake Superior
Marquette
Sault Ste Marie
Hiawatha National Forest
LAKE SUPERIOR
Hurricane River
Au Sable Light Station
Log Slide Overlook
Grand Marais Ranger Station
Grand Marais
Twelvemile Beach
White Birch Trail
GRAND SABLE DUNES
Grand Sable Lake Overlook
Grand Sable Lake
Hurricane River Trail
Lakeshore-North Country Trail
Twelvemile Beach
Trappers Lake
BEAVER BASIN WILDERNESS AREA
Kingston Lake
Hurricane Creek Truck Trail
Rhody Creek Truck Trail
KINGSTON PLAINS
Chapel Rock
Chapel Beach
Spray Falls
Little Beaver Lake
White Pine Trail
Beaver Basin Overlook
Beaver Lake
BEAVER BASIN
Grand Portal Point
Mosquito Beach
Mosquito Falls
Chapel Falls
Trailhead
Chapel Lake
Split Rock Creek
Legion Lake
Miners Castle
Information Center and Overlook
Miners Beach
Miners Falls
Miners Falls Trail
Miners Lake
Mosquito River
Chapel Road
Nobel Lake
Miners River
Sand Point
National Lakeshore Headquarters
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Munising Falls Interpretive Center
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Adams Trail
Mallard Lake
Swartz Lake
Clyde Lake
West Branch Fox River
Nevins Lake
Long Lake
Long Lake Road
North Gemini Lake
Gemini Lakes
Ross Lake
Ross Lake Road
South Gemini Lake
Cusino Lake
Canoe Lake
Wolf Lake Road
Worchester Lake
Driggs Lake Truck Trail
Mahoney Lake Road
Stanley Lake
Driggs Lake
Fox River Pathway
LAKE SUPERIOR STATE FOREST
GRAND ISLAND NATIONAL RECREATION AREA HIAWATHA NATIONAL FOREST
Echo Lake
GRAND ISLAND
Bay Furnace
Williams Landing
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Air Quality Modeling Area
Lakeshore Access Road (Paved)
Lakeshore Access Road (Unpaved)
Other Unpaved Road
Beaver Basin Wilderness Area
Inland Buffer Zone (Mixed Ownership)
Lakeshore Zone (NPS)
Park Boundary
Figure B-1
Air Quality Modeling Area
SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
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4
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Miles

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LAND USE CLASSIFICATION

The national lakeshore is categorized as rural, based on the land use procedures described in the EPA's Guideline on Air Quality Models (Revised) (EPA 1993) and the method of Auer (Auer 1978). The percentage of land falling into one of five land use types (I1, I2, C1, R2, R3) within a 3-kilometer circle around the national lakeshore was subjectively determined using US Geological Survey 7.5-minute series topographic maps. By inspection, it was determined that over 50% of the area is rural in nature. Thus, the rural option was used.

METEOROLOGICAL DATA

The MAKEMET processor in AERSCREEN generates meteorological conditions based on user-specified surface characteristics, ambient temperature extremes, minimum wind speed, and anemometer height. For this analysis, the suggested default values of MAKEMET are used for ambient extreme temperatures, the minimum wind speed of 0.5 meters per second and the anemometer height of 10 meter. AERSURFACE was used to calculate surface characteristics based on the land cover data file.

SCREENING RESULTS

The concentration output from AERSCREEN is the maximum 1-hour dispersion coefficient. This maximum dispersion coefficient is multiplied by carbon monoxide emission rate to obtain the maximum 1-hour and 8-hour carbon monoxide concentrations. Then the maximum concentrations are added to the maximum background concentration monitored at Duluth, Minnesota to compare with the respective NAAQS. Electronic copies of all AERSCREEN input and output files are provided in attachment E-2.

Table B-9 summarizes the results of the screening modeling, demonstrating compliance with NAAQS. Therefore, carbon monoxide emissions will not adversely affect public health and welfare.

TABLE B-9: AERSCREEN MODELING RESULTS AND NAAQS COMPARISON

	Emission Rate (lb/hr)	Averaging Period	Maximum Modeled Concentration (ppm)	Maximum Background Concentration (ppm)	Total Concentration (ppm)	NAAQS (ppm)
2015/2016	113.8	1-hour	2.51	8.7	11.21	35
	42.7	8-hour	0.94	3	3.94	9
2017	105.2	1-hour	1.97	8.7	10.67	35
	39.4	8-hour	0.74	3	3.74	9

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1993 Guideline on Air Quality Models (Revised) and Supplement A. EPA-450/2-78-027R.

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2008c EPA Finalizes Emission Standards for New Nonroad Spark-Ignition Engines, Equipment, and Vessels. September. EPA420-F-08-013. Available [online]: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P10017GK.txt. Accessed June 3, 2013.

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ATTACHMENT B-1: NMIM MODEL INPUT DATA

PWC Year 2000 Model

SCC, HPMAX, Model Year, Tech Type, Population, Hours/Year

Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

2282005015, 175, 2000, All, 14, 168

0, 0, 0, 0, 0, 0.333, 0.333, 0.333, 0, 0, 0, 0

PWC Year 2014 Model

SCC, HPMAX, ModelYear, TechType, Population, Hours/Year

Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

2282005015, 175, 2014, All, 14, 168

0, 0, 0, 0, 0, 0, 0.5, 0.5, 0, 0, 0, 0

ATTACHMENT B-2: AERSCREEN MODELING FILE

```
AERSCREEN 11126 / AERMOD 1206                    06/04/14
                                  13:41:40

TITLE: SCENARIO 4

------------------------------------------------------------------------------
****************************** AREA PARAMETERS ***************************
 ------------------------------------------------------------------------------
-
SOURCE EMISSION RATE:      0.1260 g/s         1.000 lb/hr

AREA EMISSION RATE:      0.787E-07 g/(s-m2)    0.625E-06 lb/(hr-m2)
AREA HEIGHT:            0.00 meters        0.00 feet
AREA SOURCE LONG SIDE:     4000.00 meters      13123.36 feet
AREA SOURCE SHORT SIDE:     400.00 meters      1312.34 feet
INITIAL VERTICAL DIMENSION:    0.00 meters        0.00 feet
RURAL OR URBAN:          RURAL

INITIAL PROBE DISTANCE =     10000. meters       32808. feet

------------------------------------------------------------------------------
********************** BUILDING DOWNWASH PARAMETERS **********************
------------------------------------------------------------------------------
               BUILDING DOWNWASH NOT USED FOR NON-POINT SOURCES

------------------------------------------------------------------------------
************************** FLOW SECTOR ANALYSIS **************************
             25 meter receptor spacing: 1. meters - 5000. meters
           50 meter receptor spacing: 5050. meters - 10000. meters
------------------------------------------------------------------------------
  MAXIMUM IMPACT RECEPTOR

  Zo    SURFACE  1-HR CONC RADIAL DIST  TEMPORAL
  SECTOR  ROUGHNESS (ug/m3)  (deg)  (m)  PERIOD
  ------------------------------------------------
    1    1.127   38.51    0 2000.0   ANN
    2*    0.498   63.01    0 2000.0   ANN
 * = worst case diagonal

------------------------------------------------------------------------------
********************** MAKEMET METEOROLOGY PARAMETERS *********************
------------------------------------------------------------------------------
MIN/MAX TEMPERATURE:  250.0 / 310.0 (K)

MINIMUM WIND SPEED:    0.5 m/s

ANEMOMETER HEIGHT:   10.000 meters

SURFACE CHARACTERISTICS INPUT: C:\Lakes\AERMOD
View\piro_AERSURF1\AERSURFACE.OUT

DOMINANT SECTOR:      2 (225 45)

ALBEDO:         0.12
```

```
BOWEN RATIO:       0.21
ROUGHNESS LENGTH:    0.498 (meters)

    METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT
    ------------------------------------------------------------

 YR MO DY JDY HR
 -- -- -- --- --
 10 01 01  1 01

   H0   U*   W* DT/DZ ZICNV ZIMCH M-O LEN  Z0 BOWEN ALBEDO REF WS
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 -0.78 0.033 -9.000 0.020 -999.  14.   3.6 0.498  0.21  0.12  0.50

   HT REF TA   HT
 - - - - - - - - - -
  10.0  250.0  2.0


    METEOROLOGY CONDITIONS USED TO PREDICT AMBIENT BOUNDARY IMPACT
    -------------------------------------------------------------

 YR MO DY JDY HR
 -- -- -- --- --
 10 01 01  1 01

   H0   U*   W* DT/DZ ZICNV ZIMCH M-O LEN  Z0 BOWEN ALBEDO REF WS
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 -0.78 0.033 -9.000 0.020 -999.  14.   3.6 0.498  0.21  0.12  0.50

   HT REF TA   HT
 - - - - - - - - - -
  10.0  250.0  2.0
```

```
------------------------------------------------------------------------------
********** AERSCREEN AUTOMATED DISTANCES **********
          OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE
------------------------------------------------------------------------------
            MAXIMUM                MAXIMUM
       DIST   1-HR CONC          DIST   1-HR CONC
        (m)    (ug/m3)            (m)    (ug/m3)
     ---------------------      ---------------------
       1.00    50.63           3775.00    21.31
      25.00    50.84           3800.00    21.16
      50.00    51.05           3825.00    21.01
      75.00    51.25           3850.00    20.86
     100.00    51.46           3875.00    20.72
     125.00    51.66           3900.00    20.57
     150.00    51.87           3925.00    20.43
     175.00    52.07           3950.00    20.29
     200.00    52.26           3975.00    20.15
     225.00    52.46           4000.00    20.02
     250.00    52.66           4025.00    19.88
     275.00    52.85           4050.00    19.75
     300.00    53.04           4075.00    19.62
     325.00    53.23           4100.00    19.48
     350.00    53.42           4125.00    19.35
     375.00    53.61           4150.00    19.22
     400.00    53.79           4175.00    19.09
     425.00    53.97           4200.00    18.97
     450.00    54.15           4225.00    18.84
     475.00    54.33           4250.00    18.72
     500.00    54.51           4275.00    18.60
     525.00    54.69           4300.00    18.48
     550.00    54.87           4325.00    18.37
     575.00    55.04           4350.00    18.25
     600.00    55.21           4375.00    18.13
     625.00    55.38           4400.00    18.01
     650.00    55.55           4425.00    17.90
     675.00    55.72           4450.00    17.79
     700.00    55.89           4475.00    17.68
     725.00    56.05           4500.00    17.57
     750.00    56.22           4525.00    17.46
     775.00    56.38           4550.00    17.35
     800.00    56.54           4575.00    17.25
     825.00    56.70           4600.00    17.14
     850.00    56.86           4625.00    17.04
     875.00    57.02           4650.00    16.93
     900.00    57.18           4675.00    16.83
     925.00    57.33           4700.00    16.73
     950.00    57.49           4725.00    16.63
     975.00    57.64           4750.00    16.53
    1000.00    57.79           4775.00    16.43
    1025.00    57.94           4800.00    16.33
    1050.00    58.09           4825.00    16.24
    1075.00    58.24           4850.00    16.14
    1100.00    58.39           4875.00    16.05
    1125.00    58.53           4900.00    15.96
    1150.00    58.68           4925.00    15.86
    1175.00    58.82           4950.00    15.77
    1200.00    58.96           4975.00    15.68
```

1225.00	59.10	5000.00	15.59
1250.00	59.24	5050.00	15.41
1275.00	59.38	5100.00	15.23
1300.00	59.52	5150.00	15.06
1325.00	59.66	5200.00	14.90
1350.00	59.79	5250.00	14.73
1375.00	59.93	5300.00	14.57
1400.00	60.06	5350.00	14.42
1425.00	60.20	5400.00	14.26
1450.00	60.33	5450.00	14.11
1475.00	60.46	5500.00	13.96
1500.00	60.59	5550.00	13.81
1525.00	60.72	5600.00	13.67
1550.00	60.85	5650.00	13.52
1575.00	60.97	5700.00	13.38
1600.00	61.10	5750.00	13.25
1625.00	61.23	5800.00	13.11
1650.00	61.35	5850.00	12.98
1675.00	61.48	5900.00	12.85
1700.00	61.60	5950.00	12.72
1725.00	61.72	6000.00	12.59
1750.00	61.85	6050.00	12.46
1775.00	61.96	6100.00	12.34
1800.00	62.08	6150.00	12.22
1825.00	62.20	6200.00	12.11
1850.00	62.32	6250.00	11.99
1875.00	62.44	6300.00	11.88
1900.00	62.55	6350.00	11.77
1925.00	62.67	6400.00	11.66
1950.00	62.78	6450.00	11.55
1975.00	62.90	6500.00	11.44
2000.00	63.01	6550.00	11.33
2025.00	52.98	6600.00	11.23
2050.00	49.80	6650.00	11.13
2075.00	47.61	6700.00	11.03
2100.00	45.95	6750.00	10.93
2125.00	44.54	6800.00	10.83
2150.00	43.32	6850.00	10.73
2175.00	41.97	6900.00	10.64
2200.00	41.09	6950.00	10.55
2225.00	40.27	7000.00	10.46
2250.00	39.51	7050.00	10.37
2275.00	38.79	7100.00	10.28
2300.00	38.12	7150.00	10.19
2325.00	37.48	7200.00	10.10
2350.00	36.88	7250.00	10.01
2375.00	36.31	7300.00	9.928
2400.00	35.76	7350.00	9.845
2425.00	35.25	7400.00	9.763
2450.00	34.75	7450.00	9.682
2475.00	34.27	7500.00	9.603
2500.00	33.81	7550.00	9.524
2525.00	33.37	7600.00	9.448
2550.00	32.95	7650.00	9.372
2575.00	32.54	7700.00	9.297
2600.00	32.14	7750.00	9.224
2625.00	31.75	7800.00	9.152

2650.00	31.38	7850.00	9.081
2675.00	31.02	7900.00	9.011
2700.00	30.67	7950.00	8.940
2725.00	30.33	8000.00	8.870
2750.00	30.00	8050.00	8.802
2775.00	29.68	8100.00	8.734
2800.00	29.36	8150.00	8.667
2825.00	29.06	8200.00	8.600
2850.00	28.76	8250.00	8.535
2875.00	28.47	8300.00	8.470
2900.00	28.19	8350.00	8.406
2925.00	27.91	8400.00	8.343
2950.00	27.64	8450.00	8.281
2975.00	27.38	8500.00	8.220
3000.00	27.14	8550.00	8.160
3025.00	26.91	8600.00	8.101
3050.00	26.68	8650.00	8.042
3075.00	26.45	8700.00	7.984
3100.00	26.23	8750.00	7.927
3125.00	26.01	8800.00	7.871
3150.00	25.79	8850.00	7.816
3175.00	25.58	8900.00	7.761
3200.00	25.38	8950.00	7.707
3225.00	25.17	9000.00	7.654
3250.00	24.97	9050.00	7.600
3275.00	24.77	9100.00	7.547
3300.00	24.57	9150.00	7.494
3325.00	24.38	9200.00	7.442
3350.00	24.19	9250.00	7.391
3375.00	24.00	9300.00	7.341
3400.00	23.81	9350.00	7.291
3425.00	23.63	9400.00	7.242
3450.00	23.45	9450.00	7.193
3475.00	23.28	9500.00	7.145
3500.00	23.10	9550.00	7.098
3525.00	22.93	9600.00	7.051
3550.00	22.75	9650.00	7.005
3575.00	22.58	9700.00	6.959
3600.00	22.42	9750.00	6.914
3625.00	22.25	9800.00	6.870
3650.00	22.09	9850.00	6.826
3675.00	21.93	9900.00	6.783
3700.00	21.77	9950.00	6.740
3725.00	21.61	10000.00	6.697
3750.00	21.46		

```
--------------------------------------------------------------------------------
********************** AERSCREEN MAXIMUM IMPACT SUMMARY ******************
--------------------------------------------------------------------------------
3-hour, 8-hour, and 24-hour scaled
concentrations are equal to the 1-hour concentration as referenced in
SCREENING PROCEDURES FOR ESTIMATING THE AIR QUALITY
IMPACT OF STATIONARY SOURCES, REVISED (Section 4.5.4)
Report number EPA-454/R-92-019
http://www.epa.gov/scram001/guidance_permit.htm
under Screening Guidance

            MAXIMUM   SCALED   SCALED   SCALED   SCALED
             1-HOUR   3-HOUR   8-HOUR   24-HOUR   ANNUAL
  CALCULATION     CONC    CONC    CONC    CONC    CONC
  PROCEDURE     (ug/m3)   (ug/m3)   (ug/m3)   (ug/m3)   (ug/m3)
 ---------------  ---------- ---------- ---------- ---------- ----------
FLAT TERRAIN    63.01    63.01    63.01    63.01     N/A

DISTANCE FROM SOURCE    2000.00 meters

IMPACT AT THE
AMBIENT BOUNDARY  50.63    50.63    50.63    50.63     N/A

DISTANCE FROM SOURCE     1.00 meters
```

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APPENDIX C:
SPECIAL-STATUS SPECIES FOUND IN ALGER COUNTY, MICHIGAN

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SPECIAL-STATUS SPECIES FOUND IN ALGER COUNTY, MICHIGAN

TABLE C-1: LIST OF SPECIAL-STATUS ANIMALS IN ALGER COUNTY, MICHIGAN

Scientific Name	Common Name	State Status	Federal Status
Mussels			
Ligumia nasuta	Eastern pondmussel	E	
Fish			
Acipenser fulvescens	Lake sturgeon	T	
Coregonus artedi	Lake herring or Cisco	T	
Coregonus kiyi	Kiyi	SC	
Coregonus zenithicus	Shortjaw cisco	T	
Cottus ricei	Spoonhead sculpin	SC	
Insects			
Erora laeta	Early hairstreak	SC	
Lycaeides idas nabokovi	Northern blue	T	
Nicrophorus americanus	American burying beetle	X	LE
Phyciodes batesii	Tawny crescent	SC	
Trimerotropis huroniana	Lake Huron locust	T	
Birds			
Accipiter gentilis	Northern goshawk	SC	
Ammodramus savannarum	Grasshopper sparrow	SC	
Botaurus lentiginosus	American bittern	SC	
Buteo lineatus	Red-shouldered hawk	T	
Charadrius melodus	Piping plover	E	LE
Coturnicops noveboracensis	Yellow rail	T	
Dendroica cerulea	Cerulean warbler	T	
Falco columbarius	Merlin	T	
Falco peregrinus	Peregrine falcon	E	
Gavia immer	Common loon	T	
Haliaeetus leucocephalus	Bald eagle	SC	
Pandion haliaetus	Osprey	SC	
Picoides arcticus	Black-backed woodpecker	SC	
Spiza americana	Dickcissel	SC	
Tympanuchus phasianellus	Sharp-tailed grouse	SC	

State Status: E = endangered; T = threatened; SC = special concern; X = presumed extirpated

Federal Status: LE = listed endangered; LT = listed threatened

TABLE C-2: LIST OF SPECIAL-STATUS PLANTS IN ALGER COUNTY, MICHIGAN

Scientific Name	Common Name	State Status	Federal Status
Ferns and Fern Allies			
Botrychium acuminatum	Moonwort	E	
Botrychium campestre	Prairie Moonwort or Dunewort	T	
Botrychium hesperium	Western moonwort	T	
Botrychium mormo	Goblin moonwort	T	
Botrychium spathulatum	Spatulate moonwort	T	
Huperzia selago	Fir clubmoss	SC	
Flowering Plants			
Astragalus canadensis	Canadian milk vetch	T	
Callitriche hermaphroditica	Autumnal water-starwort	SC	
Calypso bulbosa	Calypso or fairy-slipper	T	
Cirsium pitcheri	Pitcher's thistle	T	LT
Crataegus douglasii	Douglas's hawthorn	SC	
Cypripedium arietinum	Ram's head lady's-slipper	SC	
Elymus glaucus	Blue wild-rye	SC	
Empetrum nigrum	Black crowberry	T	
Gnaphalium sylvaticum	Woodland everlasting	T	
Leymus mollis	American dune wild-rye	SC	
Listera auriculata	Auricled twayblade	SC	
Littorella uniflora	American shore-grass	SC	
Luzula parviflora	Small-flowered wood rush	T	
Myriophyllum alterniflorum	Alternate-leaved water-milfoil	SC	
Myriophyllum farwellii	Farwell's water milfoil	T	
Oryzopsis canadensis	Canada rice grass	T	
Pinguicula vulgaris	Butterwort	SC	
Potamogeton confervoides	Alga pondweed	SC	
Senecio indecorus	Northern ragwort	T	
Stellaria longipes	Stitchwort	SC	
Tanacetum huronense	Lake Huron tansy	T	
Trisetum spicatum	Downy oat-grass	SC	
Vaccinium cespitosum	Dwarf bilberry	T	

State Status: E = endangered; T = threatened; SC = special concern

Federal Status: LT = listed threatened

APPENDIX D:
PWC DATA COLLECTED FROM MARCH TO OCTOBER OF 2012 BY THE CAPTAINS OF THE PICTURED ROCKS CRUISES

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PWC DATA COLLECTED FROM MARCH TO OCTOBER OF 2012 BY THE CAPTAINS OF THE PICTURED ROCKS CRUISES

TABLE D-1: PWC DATA COLLECTED BY THE CAPTAINS OF THE PICTURED ROCKS CRUISES, 2012

Date	Time	Daily Max Temp (°F)	Location of PWC	PWC #	PWC Description	Comments
6/28/2012	13:45	80	200 yards off East end of Miners Beach	1	Blue/Yellow	2 people on board
6/29/2012	15:20	77	Sand Point	2		
6/29/2012	19:41	77	Sand Point	1		
7/2/2012	13:25	77	Chapel	2		
7/2/2012	13:58	77	20 yard off Rainbow Cave	1	Orange	2 people on board, heading SW
7/2/2012	14:25	77	50 yards SW of Indianhead	2	White/Blue	2 people/1 person heading SW
7/2/2012	18:50	77	100 yards off Bridanveil	2	Yellow	4 people heading SW
7/2/2012	20:55	77	Miners Beach East	2	White	4 people
7/3/2012	13:45	88	20 yards off Bridal Falls heading E	2	both Yellow/White	3 people on one, 2 on other
7/3/2012	20:48	88	50 yards off the Grand Portal	2	Yellow/White	2 single seat machines
7/5/2012	11:54	74	Miners Beach	2		Two 2-seaters riding along beach
7/5/2012	13:30	74	50 feet off Rainbow Cave (W of Miners Beach)	1	White/Yellow	3 Passengers (2 adults, 1 child)
7/5/2012	13:40	74	900 feet off Mosquito Harr. (W of Miners Beach)	2	Yellow	1 passenger each
7/5/2012	14:15	74	20 yards off of Indian Drums	1	Yellow/White	3 people on board, towing raft with 3 people
7/5/2012	14:55	74	30 yards off of Bridalveil	1	Yellow	2 people on board
7/5/2012	17:15	74	500 feet off Sand Point	1	White/Green	2 passengers
7/5/2012	19:12	74	150 feet off Miners Castle	2	1-White/Aqua with Pink Stripe 2-White/Teal	1 passenger each
7/6/2012	17:35	90	30 yards off shore just SE of Miners Castle	2	1-Red/White 2-Green/White	1 person on one, 2 people on other
7/11/2012	11:51	73	200 feet off Bridal Veil	1	Blue/White with black hull	2 passengers
7/13/2012	14:03	87	500 feet off Rainbow Cave	2	Gold/White	5 passengers heading SW
7/15/2012	17:22	88	100 feet off Chapel Rock	3	Red/Blue and White/Green	1 passenger each
7/15/2012	17:46	88	Bridalveil Falls	2	1-Red/White 2-Black	
7/15/2012	17:48	88	Paint Coves	1	Green/White	

Date	Time	Daily Max Temp (°F)	Location of PWC	PWC #	PWC Description	Comments
7/16/2012	19:00	75	Indian Drums/Chapel Rock/Spray Falls	1	Blue/White	1 passenger
7/20/2012	11:54	73	East End Miners Beach	1	Black/White	1 passenger
7/20/2012	13:30	73	50 feet off bow at Stony Point	1	Yellow/White	1 passenger
7/20/2012	14:28	73	Chapel Beach	5	4-Stand ups 1-sit down	5 passengers, 1 stand up was probably same one from July 20 at 11:54
7/22/2012	12:47	79	1,000 feet from Bridalveil	1	Teal/Indigo	2 passengers
7/22/2012	13:20	79	800 feet of Battleship Rock	2	Forest Green	1 passenger each
7/24/2012	15:45	86	200 yards off between Coves and Mosquito	3		2 people on each heading NE
7/29/2012	13:55	72	Miners Castle	1	Obsidian	2 passengers (adult/child)
7/29/2012	16:17	72	Sand Point Beach	1	Fusia/Ebony	1 passenger (adult)
8/1/2012	17:37	67	200 yards off Miners Castle Heasing SW	2		2 people on each, one pulling a tube
8/2/2012	15:32	84	Between Miners and Sand Point	1	Black/Yellow	2 passengers
8/4/2012	15:34	72	Between Miners and Sand Point	4	3-Green/White 1-Chrome/White	6 passengers (4 women, 2 men)
8/6/2012	14:32	69	Rainbow Cave	2	1-Red 1-Black	1 passenger each (1 man, 1 woman)
8/6/2012	15:10	69	30 yards off Battleship Heading NE	2		1 person on each
8/12/2012	14:50	69	Bridal Veil	2	Dark Violet/Piano Key Black	1 passenger each (1 man, 1 woman)
8/12/2012	15:45	69	Bridalveil	1	Yellow/White	2 people
8/13/2012	12:45	72	Miners Beach	1		
8/13/2012	14:45	72	Bridal Veil	2	1-Golden Rod 1-Blanco	2 passengers each
8/13/2012	15:15	72	20 yards off Chapel Beach	2	White	2 persons on each
8/15/2012	10:55	72	400 feet off Mosquito	2	Red	1 passenger and 2 passengers
8/15/2012	14:41	72	100 feet off Mosquito	2	Green/White	1 passenger each
8/15/2012	15:10	72	Between Chapel Beach and Battleship pt. heading West	2	Both White/Green	1 person each
9/1/2012	9:38	74	Miners Castle	1	White/Green	1 passenger
9/3/2012	17:20	76	Spray Falls	2	1-Green 2-Black	with powerboat

Source: NOAA National Climatic Data Center http://www.ncdc.noaa.gov/; NPS PR Cruises 2012 PWC Count

APPENDIX E:
ACOUSTIC ENVIRONMENT AND SOUNDSCAPES

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ACOUSTIC ENVIRONMENT AND SOUNDSCAPES

SOUND ATTENUATION MODELING

Sound attenuation modeling was conducted to determine the level of noise produced by PWCs and how that noise affects the soundscape at the national lakeshore under the action alternatives. The modeling was completed for shoreline visitors in seven locations throughout the national lakeshore and in one location for a kayaker on the water, as described in the "Soundscapes and Acoustic Environment" section of chapter 4. When reviewing the modeling results, it became apparent that though the conditions of the location of the visitor changed (distance from shoreline, habitat, elevation above the PWC), the noise experienced by the visitors differed by only 1.6 to 1.8 dBA. To simplify the analysis, the average noise levels experienced are presented in chapter 4 for comparison to the baseline sound levels recorded during the 2012 acoustical monitoring survey at the national lakeshore (NPS 2013f). This appendix presents the full results of the sound attenuation modeling for each visitor location – Sand Point, Miners Beach (visitor on shore and kayaker), the North Country National Scenic Trail at Grand Portal, Chapel Beach, the North Country National Scenic Trail at Spray Falls, Twelvemile Beach at Beaver Creek (within the Beaver Basin Wilderness Area), and the North Country National Scenic Trail north of Hurricane River.

Table E-1 presents the location of the PWC, the location of the visitor, the type of terrain or habitat in which the visitor is located, the type of visitor experience that could be interrupted by PWC noise, the type of PWC behavior that would be expected, the total distance between the PWC and the visitor, and the elevation of the visitor above the PWC. Tables E-2 through E-13 present the modeling results for alternatives 1 and 2 for carbureted two-stroke PWC engines and direct injection two-stroke and four-stroke PWC engines for peak noise levels, average noise levels, and noise levels while transiting and during play behavior. Figure E-1 presents the sound attenuation modeling locations.

Model Limitations

As discussed in the "Acoustic Environment and Soundscapes" sections of chapters 3 and 4, there are many factors that influence how sound travels. The sound attenuation modeling accounts for several of these factors, but the model has some limitations. The model integrates into the results the effects of the following:

- divergence, or spreading loss – as sound leaves the source, it radiates out and the sound level is reduced as it gets further away from the source
- ground absorption – sound levels are reduced from reflection off the ground surface; the amount of loss is dependent on the surface (e.g., solid ground, open water)
- atmospheric absorption – factors such as temperature, relative humidity, and precipitation can absorb sound, thus reducing sound levels

The sound attenuation model does not consider several pertinent environmental factors, including the following:

- terrain shielding – the model does not incorporate the effects of obstacles on sound travel, which results in inflated sound level estimates
- vegetation – the model does not incorporate the absorption effects of vegetation, which results in inflated sound level estimates

- refractive effects of atmospheric profiles – the model assumes that sounds are traveling downwind in weather conditions favorable to long-range travel and does not account for inversion conditions over water surfaces, which results in lower sound level estimates

Although the sound attenuation model does not include all factors that affect how sound would be experienced by a visitor, the model does assume certain conditions that are representative of park conditions.

TABLE E-1: SOUND MODELING RECEIVER LOCATIONS

PWC Location	Affected Visitor Location	Type of Terrain	Affected Visitor Experience	Primary PWC Use	Distance of Visitor from PWC (feet)	Elevation of Visitor above PWC (feet)
200 feet from the shoreline at the Sand Point picnic area	Sand Point picnic area	Beach	Overlook	Play	313	3
200 feet from the shoreline at the Miners Beach steps	Miners Beach steps	Beach	Overlook	Play	303	10
200 feet from the shoreline at the Miners Beach steps	Kayak on water, 50 feet from shore	Water	Kayaking	Play	150	0
200 feet from the shoreline at the Grand Portal	Grand Portal	Cliffs	Short hike	Transit	363	197
200 feet from the shoreline at the Chapel Beach Trail steps	Chapel Beach Trail steps	Beach	Short hike	Play	303	4
200 feet from the shoreline at the North Country Trail at Spray Falls	North Country Trail at Spray Falls	Cliffs	Short hike	Play	343	60
200 feet from the shoreline at the Twelvemile Beach at Beaver Creek	Twelvemile Beach at Beaver Creek	Beach	Short hike	Transit	301	1
200 feet from the shoreline at the North Country Trail North of Hurricane River	North Country Trail	Beach	Short hike	Play	320	18

ALTERNATIVE 1, DURING THE PHASE-OUT PERIOD

TABLE E-2: PEAK AND AVERAGE NOISE LEVELS FROM A CARBURETED TWO-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	60.9	50.7

200 feet from Miners Beach steps (beach)	303	61.7	51.2
200 feet from Miners Beach steps (kayak)	150	72.8	59.3

PWC type = Sea-Doo GTS; Number of PWCs = 1; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-3: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	30.6	36.6	39.6
200 feet from Miners Beach steps (beach)	31.2	37.2	40.2
200 feet from Miners Beach steps (kayak)	39.3	45.3	48.3

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-4: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	60.5	63.5	65.3
200 feet from Miners Beach steps (beach)	61.1	64.1	65.9
200 feet from Miners Beach steps (kayak)	68.9	71.9	73.7

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

ALTERNATIVE 1, POST PHASE-OUT PERIOD

TABLE E-5: PEAK AND AVERAGE NOISE LEVELS FROM A DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	55.2	44.9
200 feet from Miners Beach steps (beach)	303	55.9	45.4
200 feet from Miners Beach steps (kayak)	150	67.1	53.6

PWC type = Sea-Doo GTS QT; Number of PWCs = 1; Speed = 50 mph

TABLE E-6: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	24.9	30.9	33.9
200 feet from Miners Beach steps (beach)	25.4	31.4	34.4
200 feet from Miners Beach steps (kayak)	33.6	39.6	42.6

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-7: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	54.8	57.8	59.6
200 feet from Miners Beach steps (beach)	55.3	58.3	60.1
200 feet from Miners Beach steps (kayak)	63.2	66.2	68.0

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

ALTERNATIVE 2, DURING THE PHASE-OUT PERIOD

TABLE E-8: PEAK AND AVERAGE NOISE LEVELS FROM A CARBURETED TWO-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	60.9	50.7
200 feet from Miners Beach steps (beach)	303	61.7	51.2
200 feet from Miners Beach steps (kayak)	150	72.8	59.3
200 feet from Grand Portal	363	60.6	50.9
200 feet from Chapel Beach Trail steps	303	61.1	50.6
200 feet from North Country Trail at Spray Falls	343	62.2	52.3
200 feet from Twelvemile Beach at Beaver Creek	301	61.0	50.5
200 feet from North Country Trail North of Hurricane River	320	61.4	51.2

PWC type = Sea-Doo GTS; Number of PWCs = 1; Speed = 50 mph

TABLE E-9: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	30.6	36.6	39.6
200 feet from Miners Beach steps (beach)	31.2	37.2	40.2
200 feet from Miners Beach steps (kayak)	39.3	45.3	48.3
200 feet from Grand Portal	30.9	36.9	39.9
200 feet from Chapel Beach Trail steps	30.6	36.6	39.6
200 feet from North Country Trail at Spray Falls	32.3	38.3	41.3
200 feet from Twelvemile Beach at Beaver Creek	30.5	36.5	39.5
200 feet from North Country Trail North of Hurricane River	31.2	37.2	40.2

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-10: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	60.5	63.5	65.3
200 feet from Miners Beach steps (beach)	61.1	64.1	65.9
200 feet from Miners Beach steps (kayak)	68.9	71.9	73.7
200 feet from Grand Portal	60.9	63.9	65.6
200 feet from Chapel Beach Trail steps	60.5	63.5	65.3
200 feet from North Country Trail at Spray Falls	62.2	65.2	67
200 feet from Twelvemile Beach at Beaver Creek	60.4	63.4	65.2
200 feet from North Country Trail North of Hurricane River	61.1	64.1	65.9

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

ALTERNATIVE 2, POST PHASE-OUT PERIOD

TABLE E-11: PEAK AND AVERAGE NOISE LEVELS FROM A DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	55.2	44.9
200 feet from Miners Beach steps (beach)	303	55.9	45.4
200 feet from Miners Beach steps (kayak)	150	67.1	53.6
200 feet from Grand Portal	363	54.8	45.1
200 feet from Chapel Beach Trail steps	303	55.4	44.9
200 feet from North Country Trail at Spray Falls	343	56.4	46.5
200 feet from Twelvemile Beach at Beaver Creek	301	55.3	44.8
200 feet from North Country Trail North of Hurricane River	320	55.7	45.5

PWC type = Sea-Doo GTS QT; Number of PWCs = 1; Speed = 50 mph

TABLE E-12: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

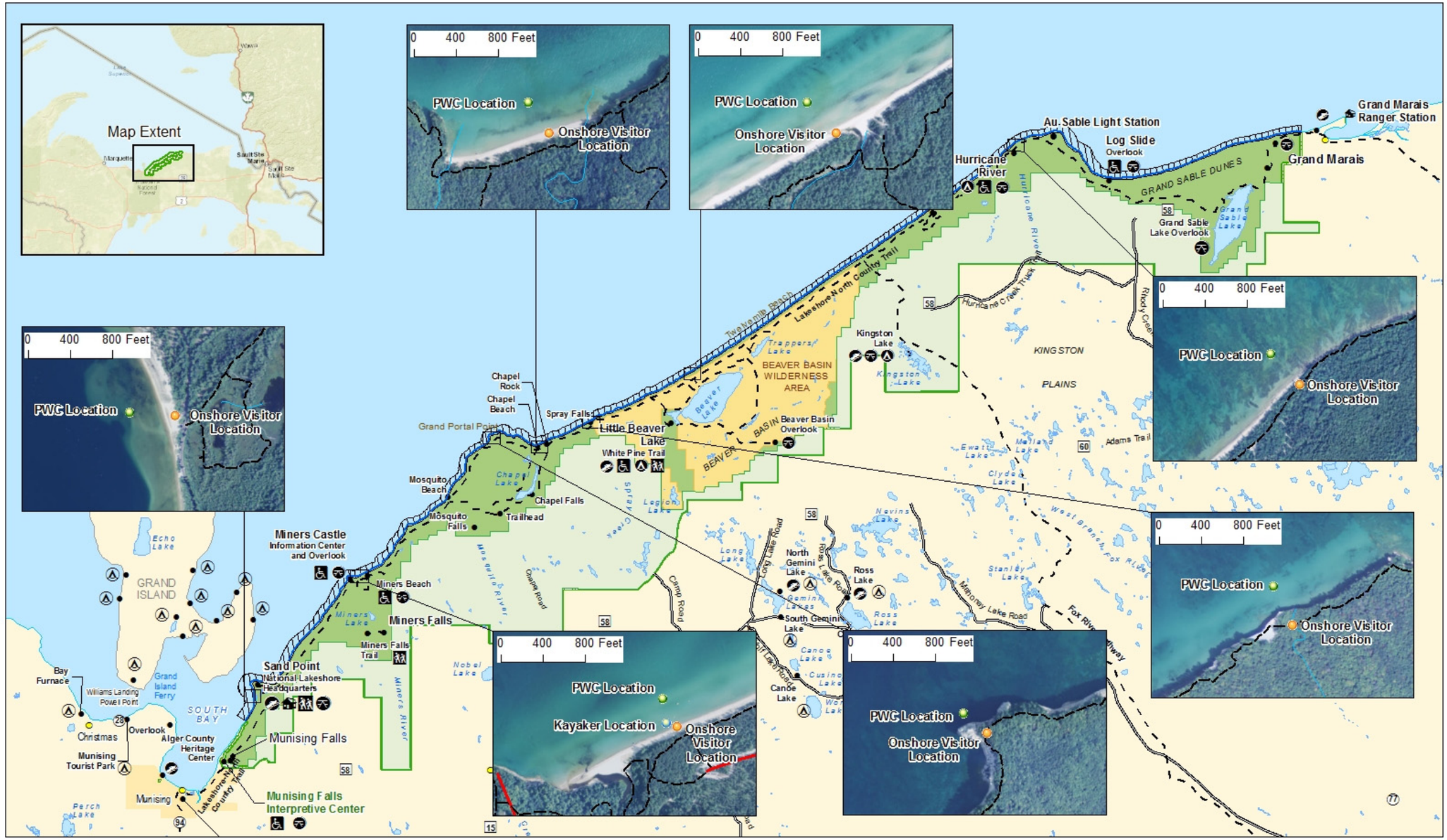
Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	24.9	30.9	33.9
200 feet from Miners Beach steps (beach)	25.4	31.4	34.4
200 feet from Miners Beach steps (kayak)	33.6	39.6	42.6
200 feet from Grand Portal	25.1	31.1	34.1
200 feet from Chapel Beach Trail steps	24.9	30.9	33.9
200 feet from North Country Trail at Spray Falls	26.5	32.5	35.5
200 feet from Twelvemile Beach at Beaver Creek	24.8	30.8	33.8
200 feet from North Country Trail North of Hurricane River	25.5	31.5	34.5

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-13: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	54.8	57.8	59.6
200 feet from Miners Beach steps (beach)	55.3	58.3	60.1
200 feet from Miners Beach steps (kayak)	63.2	66.2	68.0
200 feet from Grand Portal	55.1	58.1	59.9
200 feet from Chapel Beach Trail steps	54.8	57.8	59.6
200 feet from North Country Trail at Spray Falls	56.4	59.4	61.2
200 feet from Twelvemile Beach at Beaver Creek	54.7	57.7	59.5
200 feet from North Country Trail North of Hurricane River	55.4	58.4	60.2

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet


Map Extent
0 400 800 Feet
PWC Location
Onshore Visitor Location
Kayaker Location
Au Sable Light Station
Log Slide Overlook
Grand Marais Ranger Station
Grand Marais
Hurricane River
GRAND SABLE DUNES
Grand Sable Lake Overlook
Twelvemile Beach
Lakeshore North Country Trail
Trappers Lake
BEAVER BASIN WILDERNESS AREA
Kingston Lake
KINGSTON PLAINS
Hurricane Creek Trail
Hurricane River
Rocky Creek
Chapel Rock
Chapel Beach
Spray Falls
Grand Portal Point
Little Beaver Lake
White Pine Trail
Beaver Basin Overlook
Mosquito Beach
Chapel Falls
Trailhead
Mosquito Falls
Miners Castle
Information Center and Overlook
Miners Beach
Miners Falls
Miners Falls Trail
Sand Point
National Lakeshore Headquarters
Munising Falls
Munising Falls Interpretive Center
GRAND ISLAND
Bay Furnace
Williams Landing
Powell Point
Grand Island Ferry
SOUTH BAY
Christmas
Overlook
Alger County Heritage Center
Munising Tourist Park
Munising
Echo Lake
Perch Lake
Nobel Lake
Miners Lake
Chapel Lake
Legion Lake
Clyde Lake
Ewart Lake
Mellen Lake
Adams Trail
Nevins Lake
North Gemini Lake
Ross Lake
South Gemini Lake
Canoe Lake
Long Lake Road
Ross Lake Road
Camp Road
Stanley Lake
Mahoney Lake Road
West Branch Fox River
Fox River Road
Legend
City or Town
Park Feature
Boat Launch
Campground
Picnic Area
Wheelchair-accessible
Ranger Station
Self-guided Trail
Trail
Proposed PWC Use Area
Proposed PWC Flat-Wake Zone (200 Ft. From Shore)
Lakeshore Access Road (Paved)
Lakeshore Access Road (Unpaved)
Other Unpaved Road
Beaver Basin Wilderness Area
Inland Buffer Zone (Mixed Ownership)
Lakeshore Zone (NPS)
Park Boundary
Figure E-1
Sound Modeling Locations
SOURCE: ESRI Imagery 2013, National Park Service 2010
PROJECTION: WGS 84 UTM Zone 16
DATE: April 2015
0 3.5 7
Miles

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

October 2017

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