

Environmental Consequences



CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

The “Environmental Consequences” chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternative elements described in this Draft Winter Use Plan and Environmental Impact Statement (plan/EIS). In addition, this chapter includes a summary of laws and policies relevant to each impact topic, intensity definitions (negligible, minor, moderate, and major) and methods used to analyze impacts including direct, indirect, and cumulative impacts. As required by the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA), a summary of the environmental consequences for each alternative is provided in table 12, which can be found in “Chapter 2: Alternatives.” The resource topics presented in this chapter, and the organization of these topics, correspond to the resource discussions contained in “Chapter 3: Affected Environment.”

For a complete discussion guiding authorities, refer to the section titled “Related Laws, Policies, Plans, and Constraints” in “Chapter 1: Purpose of and Need for Action.”

In addition to the related laws, plans and constraints discussed in chapter 1, section 4.5 of the Director’s Order 12 Handbook adds to this guidance by stating, “when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the National Park Service (NPS) will follow the provisions of the CEQ regulations (40 CFR 1502.22).” In summary, the NPS must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment, and; (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community. Collectively, these guiding laws and corresponding regulations provide a framework and process for evaluating the impacts of the alternatives considered in this draft plan/EIS.

GENERAL ASSUMPTIONS

Several guiding assumptions were made to provide context for this analysis. These assumptions are described below.

ANALYSIS PERIOD

This draft plan/EIS establishes objectives and specific management actions needed to manage winter use in Yellowstone National Park (Yellowstone or the park) for approximately the next 20 years; therefore, the analysis period used for assessing impacts is 20 years into the future. The impact analysis for each alternative is based on the principles of adaptive management, which would allow the NPS to change management actions over time as new information emerges through monitoring the results of management actions, ongoing research, or the development of new technology. When referring to the level of oversnow vehicle (OSV) use in the park, the timeline (table 37) has been broken into historic use levels (pre-2004), recent use (2004-2009), and the latest winter season for which the park has data (2009/2010 winter season). Because the level of winter use permitted has varied over the years, the analysis of the alternatives discusses various levels of use when referring to past use levels. Table 37 provides the use levels, average and peak, for OSV during these periods.

TABLE 37: OSV USE LEVELS REFERRED TO IN THE ANALYSIS

	Snowmobiles	Snowcoaches
Historic (pre-2004) Average	765	15
Historic (pre-2004) Peak	1457	35
Recent Use (2004-2009) Average	258	30
Recent Use (2004-2009) Peak Average	488 *	55*
Last season 2009/2010 Average	187	32
Last season 2009/2010 Peak	293	59
Use Limits by Alternative		
Alternative 1	0	0
Alternative 2	318**	78
Alternative 3	720	78
Alternative 4	110	30
Alternative 5	318 until 2004/2005 ⁺	78 until 2004/2005 ⁺
Alternative 6	Daily entry between 0 and 540, 32,000 per winter season	Daily entry between 0 and 78, 4,600 per winter season
Alternative 7	330 for ½ winter season, 220 1/3 for winter season, 132 for 1/6 winter season	80 for ½ winter season, 50 for 1/3 winter season, 30 for 1/6 winter season

Historic average and peak (1992-2000) was from the 2000 EIS page G-3 (NPS 200b).

*Actual Peak day was 557 snowmobiles and 60 snowcoaches both in 2007/2008. The numbers 488 and 55 represent averages of the five highest snowmobile and snowcoach days.

** Actual current average is about 187 snowmobiles per day.

+ After 2004/2005 season, use may be between 78 to 120 snowcoaches and 0 to 318 snowmobiles depending on demand.

GEOGRAPHIC AREA EVALUATED FOR IMPACTS

The general geographic study area for this draft plan/EIS is Yellowstone National Park in its entirety. However, the area of analysis may vary by impact topic beyond the boundaries of the park as applicable.

TYPE OF IMPACTS

The following general assumptions are used for all impact topics. Where the duration varies for an impact topic, it has been noted in the section “Assumptions, Methodology, and Intensity Definitions.”

- Short term: Impacts would be temporary (i.e., they would occur for a matter of hours up to weeks at a time), and would generally last no longer than one season, without lasting effects.
- Long term: Impacts would be continuous throughout the life of the plan potentially occurring every winter, with potentially permanent effects.
- Direct: Impacts would occur as a direct result of winter use management actions.

- Indirect: Impacts would occur from winter use management actions but would occur later in time or farther removed in distance.
- Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
- Adverse: A negative change to the appearance or condition of the resource.

INTENSITY DEFINITIONS

The terms “impact” and “effect” are used interchangeably throughout this document. The impacts are qualitatively and quantitatively assessed using definitions that provide the reader with an idea of the intensity of a given impact on a specific topic. The intensity definition is determined primarily by comparing the effect to a relevant standard based on applicable or relevant/appropriate regulations or guidance, scientific literature and research, or best professional judgment. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. Intensity definitions are provided throughout the analysis for negligible, minor, moderate, and major impacts. Except for the threatened and endangered species topic, the intensity definitions are provided for adverse impacts, and beneficial impacts are addressed qualitatively.

FORMAT OF THE ANALYSIS

For each impact topic, the assumptions, methodology, and intensity definitions (described above) for that topic are presented first to provide context for how the resource topic was evaluated. This framework for analysis is followed by a summary of impacts that provides an overview of the analysis that was performed. The summary is then followed by the detailed impact analysis for each alternative.

CUMULATIVE IMPACTS

The CEQ regulations that implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the no-action alternative.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans at the park and, if applicable, the surrounding region. Past actions are those that have been occurring since winter use planning efforts began in 1990 and reasonably foreseeable future projects are those that would occur within the life of the plan.

Table 38 summarizes the actions that could affect the various resources at the park. These actions are described in more detail in the “Related Policies, Laws, Plans, and Actions” section of this document (see “Chapter 1: Purpose of and Need for Action”).

TABLE 38: CUMULATIVE IMPACT SCENARIO

Impact Topic	Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Wildlife and Wildlife Habitat, including Rare, Unique, Threatened, or Endangered Species, and Species of Concern	Park boundary, plus adjacent land	Reconstruction of east entrance road (completed 2010) Construction of west entrance road (completed 2008) Development (2000) and implementation of the Interagency Bison Management Plan (IBMP). Development and implementation of the Northern Rockies Lynx Management Direction FEIS and Amendments (2007) Development and implementation of the Gallatin National Forest Travel Plan revision (2006) Timber harvest on national forest lands Consolidation of checkerboard lands in the Gallatin National Forest Development and implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Reclamation of historic mines above Cooke City. Active population management of bison and elk herds by NPS. Reintroductions of gray wolves to the Greater Yellowstone Area	Operation of new facilities at the west entrance Implementation of the IBMP. Implementation of the Northern Rockies Lynx Management Direction FEIS and Amendments (2007) Implementation of the Gallatin National Forest Travel Plan revision (2006) Timber harvest on national forest lands Consolidation of checkerboard lands in the Gallatin National Forest Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Gardiner Basin and Cutler Meadows restoration (currently in progress) Reclamation of McClaren Mine tailings (currently in progress) (MTDEQ 2010b) Development of the EIS for remote vaccine delivery for bison	Operation of new facilities at the west entrance Implementation of the IBMP. Implementation of the Northern Rockies Lynx Management Direction FEIS and Amendments (2007) Implementation of the Gallatin National Forest Travel Plan revision (2006) Timber harvest on national forest lands Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Remote vaccine delivery EIS for bison

Impact Topic	Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Air Quality	Park boundary, plus adjacent land	Reconstruction of east entrance road (completed 2010) Development and implementation of the Gallatin National Forest Travel Plan revision (2006) Consolidation of checkerboard lands in the Gallatin National Forest. Development and implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Oil and gas leasing	Implementation of the Gallatin National Forest Travel Plan revision (2006) Consolidation of checkerboard lands in the Gallatin National Forest Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Oil and gas leasing	Implementation of the Gallatin National Forest Travel Plan revision (2006) Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Oil and gas leasing
Soundscapes and the Acoustic Environment	Park boundary	Reconstruction of east entrance road (completed 2010) Development and implementation of the Gallatin National Forest Travel Plan revision (2006) Development and implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Consolidation of checkerboard lands in the Gallatin National Forest. Overflights	Implementation of the Gallatin National Forest Travel Plan revision (2006) Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Consolidation of checkerboard lands in the Gallatin National Forest Overflights	Implementation of the Gallatin National Forest Travel Plan revision (2006) Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Overflights
Visitor Use and Experience	Park boundary, plus adjacent land	Construction of new west entrance (completed 2008) Reconstruction of east entrance road (completed 2010)	Operation of new facilities at the west entrance Other winter use (outside of OSV use) activities occurring in the park	Operation of new facilities at the west entrance Other winter use (outside of OSV use) activities occurring in the park
Health and Safety	Park boundary	Construction of new west entrance (completed 2008) Reconstruction of east entrance road (completed 2010) Consolidation of checkerboard lands in the Gallatin National Forest	Operation of new facilities at the west entrance Consolidation of checkerboard lands on the Gallatin National Forest	Operation of new facilities at the west entrance

Impact Topic	Study Area	Past Actions	Present Actions	Reasonably Foreseeable Future Actions
Socioeconomic Values	Park boundary	Construction of new west entrance (completed 2008) Reconstruction of east entrance road (completed 2010) Development and implementation of the Gallatin National Forest Travel Plan revision (2006) Development and implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Consolidation of checkerboard lands in the Gallatin National Forest. Timber harvest on national forest lands Oil and gas leasing Reopening of the Sleeping Giant Ski Area near Yellowstone's east entrance (reopened in 2009)	Operation of new facilities at the west entrance Implementation of the Gallatin National Forest Travel Plan revision (2006) Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Consolidation of checkerboard lands in the Gallatin National Forest Operation of the Sleeping Giant Ski Area	Operation of new facilities at the west entrance Implementation of the Gallatin National Forest Travel Plan revision (2006) Implementation of the Beartooth District of Custer National Forest Travel Management Plan (2008) Operation of the Sleeping Giant Ski Area Rendezvous Ski Trail development plan
Park Operations and Management	Park boundary	Construction of new west entrance (completed 2008) Reconstruction of east entrance road (completed 2010)	Operation of new facilities at the west entrance	Operation of new facilities at the west entrance

The analysis of cumulative impacts was accomplished using four steps:

Step 1 — Identify Resources Affected

Fully identify resources affected by any of the alternatives. These include the resources addressed as impact topics in chapters 3 and 4 of this document.

Step 2 — Set Boundaries

Identify an appropriate spatial and temporal boundary for each resource. The temporal boundaries are noted above and the spatial boundary for each resource topic is listed under each topic.

Step 3 — Identify Cumulative Action Scenario

Determine which past, present, and reasonably foreseeable future actions to include with each resource. Reasonably foreseeable future actions include those federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a reasonable official of ordinary prudence would take such activities into account in reaching a decision. These activities include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified. Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite (U.S. Department of the Interior NEPA regulations 43 CFR 46.30).

Past, present and reasonably foreseeable future actions are listed in table 38 and described in chapter 1.

Step 4 — Cumulative Impact Analysis

Summarize impacts of these other actions (x) plus impacts of the proposed action (the alternative being evaluated) (y), to arrive at the total cumulative impact (z). This analysis is included for each resource in chapter 4.

WILDLIFE AND WILDLIFE HABITAT, INCLUDING RARE, UNIQUE, THREATENED, OR ENDANGERED SPECIES, AND SPECIES OF CONCERN

GUIDING REGULATIONS AND POLICIES

Servicewide NPS regulations and policies, including the NPS Organic Act of 1916, NPS *Management Policies 2006* (NPS 2006a), and the NPS Natural Resource Management Reference Manual 77, direct national parks to provide for the protection of park resources. The Organic Act directs national parks to conserve “wild life” unimpaired for future generations and is interpreted to mean that native animal and plant life is to be protected and perpetuated as part of a park unit’s natural ecosystem.

The NPS *Management Policies 2006* state that the NPS “will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems. The term “plants and animals” refers to all five of the commonly recognized kingdoms of living things and includes such groups as flowering plants, ferns, mosses, lichens, algae, fungi, bacteria, mammals, birds, reptiles, amphibians, fishes, insects, worms, crustaceans, and microscopic plants or animals” (NPS 2006a). The NPS will achieve this by

- Preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur
- Restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions
- Minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them (NPS 2006a).

Section 4.1 of NPS *Management Policies 2006* states that “natural resources will be managed to preserve fundamental physical and biological processes, as well as individual species, features, and plant and animal communities. The Service will not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, it will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems” (NPS 2006a). According to Section 8.2.2.1 of the NPS *Management Policies 2006*, “Superintendents will develop and implement visitor use management plans and take action, as appropriate, to ensure that recreational uses and activities in the park are consistent with its authorizing legislation or proclamation and do not cause unacceptable impacts on park resources or values” (NPS 2006a).

The NPS adheres to the North American Wildlife Conservation Model, which focuses on the health and management of wildlife *populations*. Overall, goal of the NPS is to minimize human impacts

(including impacts to individual wildlife) and avoid significant effects from disturbance to the abundance, diversity, dynamics, distributions, habitats, and behaviors of wildlife populations and communities and ecosystems in which they occur, pursuant to 36 CFR 2.18 and NPS *Management Policies 2006*, section 4.4.1. Although the focus of the impact analysis is predominantly the impacts to wildlife populations, the NPS acknowledges that adverse impacts to individual animals would likely occur and seeks to minimize them. In addition to NPS management policies, federally listed species in national parks are protected by the Endangered Species Act (ESA). The ESA (16 USC 1531 et seq.) mandates all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the NPS determines that an action may affect a federally listed species, consultation with the U.S. Fish and Wildlife Service (USFWS) is required to ensure that the action would not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat. NPS *Management Policies 2006* state that the NPS will survey for, protect, and strive to recover all species native to NPS units that are listed under the ESA, and proactively conserve listed species and prevent detrimental effects on these species (NPS 2006a, sec. 4.4.2.3). NPS *Management Policies 2006* also state that "[the NPS will] manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible" (NPS 2006a, sec. 4.4.2.3).

ASSUMPTIONS, METHODOLOGY, AND INTENSITY DEFINITIONS

Assumptions and Methodology

The impact analysis for wildlife and wildlife habitats was conducted separately for the individual species that had the potential to be impacted by each alternative. For each species, specific assumptions are provided; the impacts to the species from specific indicators are detailed. Impact findings for all species draw from the Scientific Assessment of Yellowstone National Park Winter Use (available at the Yellowstone Winter Use website at <http://www.nps.gov/yell/planyourvisit/winteruse.htm> and the Planning, Environment, and Public Comment (PEPC) website at <http://parkplanning.nps.gov/yell>).

Intensity Definitions

Negligible: There would be no observable or measurable impacts to native species, their habitats, or the natural processes sustaining them.

Minor: Impacts on native species, their habitats, or the natural processes sustaining them would be detectable. Responses by relatively few individuals could be expected. Small changes to local population numbers, population structure, and other demographic factors might occur. Some impacts might occur during critical reproduction periods for a species, but would not result in injury or mortality. Sufficient habitat in the park would remain functional to maintain a sustainable population in the park.

Moderate: Impacts on native species, their habitats, or the natural processes sustaining them would be small but detectable at the population level. Responses by limited numbers of individuals could be expected, with some negative impacts to feeding, reproduction, resting, or other factors affecting local population levels. Some impacts might occur during critical periods of reproduction or in key habitats in the park and result in harassment, injury, or mortality to one or more individuals. However, sufficient population numbers and habitat in the park would remain functional to maintain a sustainable population in the park.

Major: Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and would be permanent. Responses by many individuals would be expected, with negative impacts to feeding, reproduction, or other factors resulting in a decrease in park population levels or a failure to restore levels that are needed to maintain a sustainable population in the park. Impacts would occur during critical periods of reproduction or in key habitats in the park and result in direct mortality or loss of habitat. Local population numbers, population structure, and other demographic factors might experience large declines.

In addition to the analysis presented below, the ESA (16 USC 1531 et seq.) protects specific species and their habitats throughout the country including in national parks. The ESA mandates all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. The NPS determination for the preferred alternative is alternative 7. If the NPS determines that an action may affect a federally listed species, consultation with the USFWS would be completed prior to the release of the final plan/EIS.

Study Area

The study area for assessment of the various alternatives is the park. The study area for the cumulative impacts analysis is the park plus the lands adjacent to the park's boundaries.

SUMMARY OF IMPACTS (ALL SPECIES)

Impacts of actions to wildlife species proposed in each alternative were analyzed below based on four major concerns: displacement impacts; behavioral responses of wildlife groups to OSVs and associated human activities; physiological responses of wildlife groups and individuals to OSVs and associated human activities; and demographic effects at the population level. Each wildlife species section starts with an overall summary of each of the major concern topics and corresponding effects on wildlife, followed by detailed impact analysis of each alternative.

- Alternative 1 would greatly reduce OSV use in the park, allowing only administrative OSV use. With the reduction in use, no observable impact would occur to the wildlife species analyzed (bison, elk, trumpeter swans, eagles, lynx, wolverines, and wolves); therefore impacts would be short- and long-term, negligible, adverse for all species under alternative 1. Impacts to lynx and wolverines would be long-term beneficial due to the absence of OSV use and only occasional backcountry skier use at the east entrance.
- Alternative 2 would allow for use levels similar to the 2009 interim rule (up to 318 snowmobiles and 78 snowcoaches) with best available technology (BAT) requirements, commercial guiding regulations, speed limits, and restrictions on OSV access to park roads only. Continued

monitoring and adaptive management would allow for additional restrictions to be established should negative impacts on wildlife begin to occur. Overall impacts under alternative 2 would be short and long-term minor to moderate adverse for bison and elk, because encounters with OSVs would still occur, but would not cause population-level impacts. Impact to lynx and wolverines would be long-term minor adverse because OSV use near the east entrance would be limited to five groups of OSVs a day, reducing the potential for encounters with OSVs, where these two species are known to occur. If these species were to travel outside of the eastern sector of the park, impacts could be long-term moderate adverse due to the possibility of more frequent encounters with OSVs. Trumpeter swans, eagles, and wolves would experience short- to long-term negligible to minor adverse impacts, because OSV management, including commercial guiding requirements and use restrictions, would limit encounters between OSVs and these species.

- Alternative 3 would allow for daily use limits of up to 720 snowmobiles and 78 snowcoaches along with BAT requirements, commercial guiding regulations, speed limits, and restrictions on OSV access to park roads only would result in short- and long-term minor to moderate adverse impacts on bison and elk because encounters with OSV would still occur, but would not cause population-level impacts. Impacts to lynx and wolverines would be long-term moderate adverse because OSV use, and the potential for encounters with OSVs, where they are known to occur (near the east entrance of the park) would be limited to five groups of OSVs a day, with overall levels of OSV use in other areas of the park possibly impacting these species. Trumpeter swans, eagles, and wolves would experience short- to long-term minor adverse impacts, because OSV management, including commercial guiding requirements and use restrictions, would limit encounters between OSVs and these species but overall use levels would be at a higher level.
- Alternative 4 would allow for daily use limits of up to 110 snowmobiles, 100 guided, commercial wheeled vehicles, and 30 snowcoaches, along with BAT requirements, commercial guiding regulations, speed limits, plowing design, and restrictions on OSV access to park roads only. This alternative would result in short- and long-term, negligible to minor adverse impacts on bison and elk, because a limited number of encounters would occur. Impacts to lynx and wolverines would be short-and long-term minor adverse, because OSV use and the potential for encounters with OSVs, where they are known to occur (near the east entrance of the park) would not occur because this entrance would be closed under alternative 4. The absence of human presence at this entrance would have long-term beneficial impacts. Trumpeter swans and eagles would experience short- to long-term negligible adverse impacts and wolves would experience short- to long-term negligible to minor impacts, because OSV management, including commercial guiding requirements and use restrictions, would limit encounters between OSVs and these species and the overall number of OSVs would be lower than those that have historically resulted in observable impacts to wildlife species.
- Under alternative 5, daily use levels would be the same as under alternative 2, but would vary between 318 commercially guided snowmobiles and 78 commercially guided snowcoaches and 0 snowmobiles and 120 commercially guided snowcoaches, depending on user demand, and until (if) the transition to snowcoach only occurs. The existing data suggest that the higher visual profile of a snowcoach may elicit stronger bison and elk behavioral responses than snowmobiles. Therefore, restricting OSVs to just commercially guided snowcoaches would not eliminate adverse effects on wildlife. However, due to the lower number of OSVs in the park, compared to impacts shown in studies on the current level of OSV use, impacts on bison and elk would be short and long-term minor adverse. Impacts to lynx and wolverines would be short-and long-term minor adverse because the level of OSV use would be expected to have few impacts on reproductive success, dispersal, and overall genetic sustainability of the species. Trumpeter swans and eagles would experience short- to long-term negligible adverse impacts and wolves would

experience short- to long-term negligible to minor adverse impacts, because OSV management, including commercial guiding requirements and low use limits, would limit encounters between OSVs and these species.

- Alternative 6 would allow for variable use levels, with OSV use ranging from zero to 540 snowmobiles per day and zero to 78 snowcoaches per day over the season. Unguided/non-commercially guided use would account for up to 25% of snowmobile users per day. This variable level would likely increase the behavioral responses of bison and elk due to daily unpredictability and reduced potential for habituation. Impacts under alternative 6 to bison and elk would be long-term minor to moderate adverse, due to unguided/non-commercially guided provisions, variable use limits, and increased group size. Impacts to lynx and wolverines would be long-term moderate adverse due to the increased presence of OSVs and the potential for higher OSV entry use at the east entrance during high use days, and due to the unguided/non-commercially guided component that could increase impacts on reproductive success, dispersal, and overall genetic sustainability of the species. Trumpeter swans, eagles, and wolves would experience long-term minor to moderate adverse impacts because OSV management, including commercial guiding requirements and use restrictions, would limit encounters between OSVs and these species, but increased use limits would increase the potential for impacts.
- Alternative 7 would allow for use levels similar to alternative 2 (similar use levels to the 2009 interim rule), of up to 318 snowmobiles and 78 snowcoaches per day, with BAT requirements, commercial guiding regulations, speed limits, and restrictions on OSV access to park roads only. Variable use limits under alternative 7 would allow the park to more effectively monitor impacts to wildlife under the adaptive management framework. Overall impacts for alternative 7 would be short and long-term minor to moderate adverse for bison and elk. Impacts to lynx and wolverines would be long-term minor adverse, with the potential for long-term moderate adverse, as described under alternative 2. Trumpeter swans, eagles, and wolves, would experience short- to long-term negligible to minor adverse impacts because OSV management, including commercial guiding requirements and use restrictions, would limit encounters between OSVs and these species

DETAILED IMPACT ANALYSIS

BISON AND ELK

Bison and elk are large ungulates with herds that winter in the park. These two species are more frequently encountered by OSV users than other wildlife species in the park. Both species are readily observed by OSVs and provide ample opportunities for wildlife viewing. These species are combined for analysis because they are similar in habitat preference, winter in Yellowstone's north and central ranges, are herbivorous, are active and mobile during winter, and have been extensively analyzed in relation to winter use.

General Description of Potential Impacts

Displacement of Bison and Elk

As discussed in chapter 3, elk and bison displacement due to OSV use in the park appears to be localized and short term. Even during the highest historical OSV use levels in the park, bison and elk continued to occupy their historical winter range in the Madison and Firehole drainages of Yellowstone. Consequently, the following analyses assume that increases in OSV use would cause short-term localized displacement, but not long-term displacement, in large part because the winter use season lasts less than 90 days. Also as discussed in "Chapter 3: Affected Environment,"

particularly in regard to bison, this analysis proceeded with the understanding that groomed roads are not the primary factor influencing bison population dynamics or westward range expansion of bison.

Behavioral Responses of Bison and Elk

Bison and elk behavioral responses to OSVs in Yellowstone suggest some level of habituation. The level and frequency of observed responses to OSVs are lower than those demonstrated by bison, elk, and other ungulates in areas of North America outside Yellowstone (White et al. 2008; Hardy 2001). These responses are species-specific, and comparison of Yellowstone's bison and elk to other ungulates, or to elk or bison in parks with more variable use or different levels of use, may be a poor basis for these conclusions. For example, Yellowstone's elk exhibited an increase in the likelihood of a vigilance response as cumulative OSV traffic increased over the course of a winter. In contrast, the likelihood of a vigilance response by bison decreased in winters with high visitation. Movement responses by both bison and elk appeared unchanged at 8%–9% of observed interactions (White et al. 2006).

A predictable daily pattern of OSV use, such as that which occurs with guided OSV use only, would be more likely to decrease overall behavioral responses by bison and elk throughout the winter, because animals are more likely to become habituated to a disturbance if it is predictable in time and space, not directly harmful, and limited in duration (Thompson and Henderson 1998; White et al. 2008). Also, the frequency of exposure to OSV disturbance (which may increase with higher allowable use limits) is an important consideration when assessing the likelihood of habituation, because there appears to be a threshold of disturbance at which wildlife are no longer able to habituate (White and Thurow 1985; Steidl and Anthony 2000). This threshold is generally species-specific and may be reached more quickly if a disturbance is novel, represents a greater threat, or occurs during a time of additional stress, such as increased predation pressure, harsh winters, or low food availability.

An issue raised by commenters in past planning processes is that oversnow vehicle numbers under the action alternative scenarios below would exceed those recommended by wildlife biologists. That is not the case. Park wildlife biologists have recommended that oversnow use be limited to the numbers observed during the “past three years of their study” (referring to the 2001 – 2004 period) (for example, a memo by P.J. White of November 9, 2008). This has been interpreted by some to mean that snowmobile use should be limited to no more than approximately 260 snowmobiles per day and

When wildlife are frequently disturbed, the animals may demonstrate fewer visible responses to disturbance, which may be evidence of habituation. It is difficult to determine whether an animal is habituated to a disturbance, or if another process is occurring, because wildlife responses to disturbance stimuli vary from species to species, and between individuals of the same species. Therefore, there is no generalized pattern of behavior by all species or individuals within a species that demonstrates habituation. Behavioral responses by an animal may vary with sex, age, nutritional status, time of year, animal group size, and predation pressure. What causes an animal to move from a disturbed area depends on a number of factors including the quality of the site occupied, distance to and quality of other sites, relative risk of predation or competition, dominance rank, and investment a given individual has made in its current site.

In studies of changing wildlife response to human disturbance, it is also important to try to distinguish between habituation and tolerance. Habituation occurs when animals diminish their responses because the threats are increasingly viewed as non-threatening. This may help the animals avoid undue energetic expenditures, but can make habituated animals more vulnerable to natural predators. Tolerance may occur, for example, when responses are diminished because the animals cannot afford to move from a disturbed area in the face of needing to maintain food intake.

snowcoaches be limited to no more than approximately 30 per day (e.g., 2001-2004 period). Subsequent additional reports by the same authors discuss a wider cumulative timeframe (1999-2006), that included higher levels of winter use than were observed in 2001-2004. The current definitive report on this topic is the peer reviewed scientific article entitled “Behavioral Responses of Bison and Elk in Yellowstone to Snowmobiles and Snow Coaches” (Borkowski et al. 2006) (see P.J. White memo of Oct 14, 2009). On pages 1911-1925 of this journal article, the authors make it clear that the cumulative monitoring period they are referring to is from 1999 -2004 that included average daily oversnow vehicle use up to 593 per day (2002), maximum daily numbers extended up to 1168 oversnow vehicles (1998), and cumulative oversnow vehicle entries for the winter season at the West Entrance alone up to 46,885 (2002). The results of this paper are considered in the impact analysis below.

Although habituation is an impact that is difficult to predict and even more difficult to quantify, behavioral data indicate that more recreationists produce behavioral responses in a larger number of individual animals, a data-based assumption that is carried forward in the following analyses. Another assumption based on behavioral data is that the use of commercial guides may help to reduce interactions that result in energetically costly movement responses by wildlife (e.g., flight), because guides are trained to limit their groups’ interaction time with animals, to prevent wildlife harassment and chasing, and to control the distance at which their groups approach animals. Similarly, based on experience and familiarity with the wildlife behavior and with factors that may contribute to active responses by animals, guides may be able to recognize and minimize those situations where two or more factors such as distance of the wildlife group to the road and interaction time, may increase wildlife stress and exacerbate behavioral responses.

Physiological Responses of Bison and Elk

The majority of responses by wildlife documented in Yellowstone have been low-intensity vigilance (look and resume) or, more rarely, sustained movement (travel) (Borkowski et al. 2006; White et al. 2006). The fact that an animal exhibits no visible external response does not mean physiological responses are absent. Apparent habituation, as demonstrated by behavioral studies on bison and elk, may be due to an array of other factors resulting in decreases in visible response. These other factors may adversely affect bison or elk heart rate, stress levels, habitat use, and foraging time. No comprehensive studies have analyzed the energetic effects of bison and elk behavioral responses to OSV in Yellowstone, due in part to the difficulties associated with separating the energetic costs associated specifically with responses to OSVs from the total daily energy expenditure (Borkowski et al. 2006). Numerous assumptions are required when making energy analyses, and poorly defined parameter estimates can strongly affect research and outcomes. Despite apparent low-level behavioral responses, associated physiological responses by bison and elk could increase the potential impacts of winter stress on some animals and decrease winter survival and spring reproductive rates of animals thus affected (Gill et al. 2001). Given the difficulties with quantitatively analyzing physiological responses to recreationists by wildlife, analyses for this document were made on the qualitative but conservative assumptions that increasing levels of disturbance, including OSV traffic, would likely result in increased stress to wintering wildlife (Hardy 2001; Creel et al. 2002).

Population-Level Impacts/Demographics

As discussed in “Chapter 3: Affected Environment,” researchers have not observed that OSV use and winter recreation in Yellowstone have affected bison and elk at the population level. An unknown number of individual bison and elk would incur adverse effects when exposed to OSV traffic, wheeled vehicles and winter recreation under the alternatives of this EIS. Behavioral monitoring (winter 1999 to winter 2009) found that 8%–10% of bison and elk displayed active responses including travel,

flight, alert-attention, and defense (White et al. 2008). Small numbers or groups of bison and elk may be displaced, demonstrate increased physiological and stress responses and/or demonstrate increased vigilance or active movement responses. Mitigation measures listed under each alternative strive to minimize the frequency and intensity of impacts to individual animals.

Overall, based on the available science and literature and the research summarized in “Chapter 3: Affected Environment,” it was assumed for the following analyses that those forms of winter recreation practiced in the park may have cumulative effects on individual animals, but that such impacts have not risen to the level at which they exceed minor adverse impacts on wildlife populations in the park.

Bison and Elk Responses to Non-Motorized Users

Bison and elk may occasionally respond to skiers and snowshoers; however, the overall frequency of interactions and behavioral, physiological, and/or displacement effects on bison or elk is quite low. This is primarily because few people travel far from roads, established trails, or other areas of concentrated human activity (e.g., Geyser Basin trails, Old Faithful Visitor Education Center, warming huts). Ski and snowshoe trails in Yellowstone are managed as wilderness, with groomed tracks set on only a few snow roads. The difficulties associated with non-motorized winter travel in the park (e.g., limited daylight, extreme cold and wind, poor visibility, drifted or deep snow, storms), restrict most of these users to within two miles of motorized-accessible travel corridors and restrict total daily movements of skiers or snowshoers, which further limits the potential for an encounter (NPS 2008a). During periods of extreme weather, areas of the park may be closed to backcountry use to protect wildlife (see the “Adaptive Management” section in chapter 2). Visitors are instructed to maintain a distance of at least 25 yards from bison and elk, and it is illegal to approach bison or elk in a way that precipitates any behavioral response (NPS 2010e).

Non-motorized uses during the winter season include cross-country skiers and snowshoers. Interactions between these users and wildlife are rare due to the difficulties associated with non-motorized winter travel in the park (limited daylight, extreme cold and wind, poor visibility, drifted or deep snow, storms). These conditions restrict most of these users to within two miles of motorized-accessible travel corridors and restrict total daily movements of skiers or snowshoers, which further limits the potential for an encounter. Interactions with non-motorized users in the front country accounts for less than 1% of observed interactions between wildlife and winter users during winters 2007 to 2009, compared to those between OSVs and wildlife, and 100% of these encounters have elicited no visible response over the past three winter seasons as observed during annual wildlife monitoring.

Researchers in areas outside of Yellowstone have observed that non-motorized users elicit similar levels of wildlife behavioral responses as motorized users. Therefore, non-motorized users may elicit physiological or behavioral responses in bison or elk, but encounters between non-motorized users and wildlife are relatively rare.

No observations or monitoring have documented non-motorized users and corresponding bison and elk responses in backcountry areas except for Cassirer et al. (1992), which found that elk in Yellowstone demonstrated strong flight and physiological responses to skiers who were travelling in the backcountry. The vast majority of winter visitors to the park travel in the front country, and do not visit the backcountry areas where this study was conducted. Thus, non-motorized users generally encounter animals that are also exposed to OSVs, and associated human presence. This is demonstrated by observations of wildlife responses in winters 2007 to 2009, within 2 miles of motorized corridors conducted in the front country along groomed OSV roads.

In contrast to the high level responses Cassirer et al. (1992) observed by elk in the backcountry, observations in the front country, along groomed road corridors, found that bison and elk never

showed a visible response to skiers or snowshoers out of a total of 16 observed interactions. These interactions with skiers or snowshoers accounted for less than 1% of all observed wildlife-human interaction events observed during the course of the three winter seasons 2007/2008 to 2009/2010 (Davis et al. 2007; McClure et al. 2008; McClure et al. 2009). Wildlife response monitoring data indicate that bison or elk encounters with skiers and snowshoers were relatively rare along OSV routes and, when they did occur, there was almost never any visible response by the wildlife to non-motorized users. Encounters between non-motorized users that occur in other areas of the park, such as along groomed ski trails or in backcountry off of the road, have not been monitored, but the number and location of these trails would not vary between alternative, and such encounters with non-motorized users in the backcountry would continue under any alternative. Researchers working outside of Yellowstone observed that non-motorized users elicit similar behavioral responses in bison compared to behavioral responses elicited by OSV users, but this study was conducted in areas with lower visitor use levels and different use timing and intensity, making it a poor comparison to Yellowstone (Fortin and Andruskiw 2003).

Thus, although non-motorized recreationists allowed under any of the proposed alternatives may occasionally elicit movement or vigilance responses from bison and elk, and also may cause associated physiological effects, the effects would be minimal and would occur rarely in Yellowstone. Because the number of interactions between non-motorized users and wildlife are rare (less than 1% of observed interactions between wildlife and winter users over the winter seasons from 2007/2008 to 2009/2010) compared to those between OSVs and wildlife, and 100% of these encounters have elicited no visible response over winter seasons 2007/2008 to 2009/2010 based on wildlife monitoring reports, non-motorized users are expected to have short-term negligible adverse impacts on bison and elk across all alternatives. Therefore, this discussion is not included separately under each alternative.

Vehicle-caused Mortality

Bison and elk OSV collision mortality during both historical and current levels of OSV use in Yellowstone is rare. Most road kill mortalities result from collisions with wheeled vehicles, and occur year round, not just during the winter months. Few OSV-caused road kills occurred even when the level of use was higher (up to a daily average of 950 snowmobiles) than the current levels (White et al. 2008). During the winters from 1989 to 1998, when winter use was not managed, only 10 bison, 3 elk, 2 coyotes, 1 red fox, and 1 pine marten were reported killed by snowmobiles in Yellowstone. In contrast, 98 bison, 427 elk, 75 coyotes, 84 moose, and 406 other large mammals (e.g., bighorn sheep, deer, pronghorn, wolves) were killed by wheeled vehicles in Yellowstone during the winter and summer seasons from 1989 to 1998 (Gunther et al. 1998). In sum, of the total 1,080 animals killed by motorized vehicles between 1989 and 1998, only 17 animals were killed by OSVs during the winter season. No animals have ever been reported killed by snowcoaches and, since guiding requirements were established, no wildlife deaths have been reported due to collisions with OSVs. Alternative 4, which would allow up to 100 wheeled vehicles into the park per day, would minimize wildlife collisions by requiring buses to be operated by trained guides who are experienced with winter driving and the location of wildlife. Thus, the probability of wildlife collisions from these vehicles would be similar to that from snowcoaches, at around zero. Alternative 6 would allow up to 25% of snowmobiles entering the park to be unguided or non-commercially guided, which would result in a lower number of unguided snowmobiles in the park than from 1989 to 1998. The probability of these vehicles colliding with bison or elk would be low. Therefore, the impacts to bison and elk from OSV-collision mortality would be negligible adverse under all alternatives, and thus are not discussed separately under each alternative.

When determining impacts under the following alternatives, the data used were generally collected from ongoing monitoring of the bison and elk in Yellowstone rather than through modeling or

simulation. However, modeling or simulation are useful tools by which to discuss the long-term implications of certain alternatives, and therefore modeling results are included when useful or applicable.

IMPACTS ON BISON AND ELK BY ALTERNATIVE

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Displacement of Individual Animals

Under alternative 1, OSV traffic through bison and elk ranges would be greatly reduced to a nominal level (fewer than 20 OSVs in the park per day based on administrative needs). Thus, the potential for displacement by individual animals would be decreased to nearly zero. Impacts of displacement of individual animals under alternative 1 would be localized, short-term, negligible, and adverse.

Behavioral and Physiological Responses

Under alternative 1, the number of winter use encounters would be fewer than 20 per day and the potential for bison and elk to be adversely affected or to have physiological responses would be minimized. This alternative reduces the potential for behavioral responses and would have localized short-term negligible adverse impacts.

Population-level Impacts

After establishment of the park, bison and elk populations in Yellowstone were actively managed by the park, which kept their population at a pre-determined level. This type of culling to reach a pre-set population stopped in the 1960s. At this time, OSV routes and OSVs were introduced to the park, and bison crossing park boundaries continue to be culled by the state of Montana and the NPS. Because there was never a time without either active management or OSV use, the overall bison and elk populations, as well as individual bison and elk, have been subject to various degrees of direct and indirect human influence since the founding of Yellowstone. Therefore, it is difficult to predict what effect, if any, the absence of groomed roads may have on bison movements. Studies show that elk do not use groomed road corridors for travel to the same extent as bison, and that elk home range and movement patterns have remained stable during the period in which winter recreation became prevalent in Yellowstone. Many of the road corridors are in locations that are natural migration paths for bison, such as along riverbanks and in valleys between steep-sided canyons. Thus, road grooming in these areas may not affect bison migration and travel routes, as self-groomed bison trail corridors would likely occur in these areas even in the absence of park roads or road grooming.

There is a vast library of research and modeling on bison population growth and westward range expansion. Most researchers have concluded that bison population growth is based primarily on the cessation of active management and culling of the park's bison population, rather than any energetic savings and associated increased survival from travel on groomed OSV routes (Bjornlie and Garrett 2001; Gates et al. 2005; Bruggeman et al. 2009a; Plumb et al. 2009; White et al. 2008). No population-level impacts have been documented on bison or elk from OSV and/or other human-caused disturbance, or the presence of groomed roads. Coughenour (2005) proposed a possible minimal decrease in bison survival, due to increased energetic costs, from travel through deep snow in the absence of groomed roads. With very little OSV travel in the park, the energetic costs associated with movement through deep snow in the absence of groomed roads may be offset by the energy savings due to greatly reduced alert time and flight responses by bison to OSVs. Under this alternative, OSV use in the park would be minimal; therefore, bison and elk would only rarely exhibit flight behavior

due to OSVs. Additionally, bison are naturally adapted to travel in deep snow and form self-groomed trails (Gates et al. 2005). Even in the absence of road grooming, many of these trails would likely overlap park roads, because park roads are multi-season wildlife travel corridors. Although it is difficult to differentiate between the additional movement costs that may be associated with travel through deep snow, and the energy savings due to lack of active movement responses, it is likely that costs and benefits would more or less balance out for bison. Therefore, population-level impacts are predicted to be long-term negligible, and adverse; any population changes due to the absence of groomed roads in the park, or to low OSV levels, would likely take place over the course of several decades. Park managers conduct annual population counts of bison, but the cause and effect of bison population fluctuations are difficult to determine. The contribution of OSV use on bison mortality is hard to distinguish from the impacts of severe winter weather, bison control measures including culling, or predation pressure.

Cumulative Impacts

Past, current, and future planning efforts by the NPS have affected bison and elk populations in Yellowstone. Prior to 1969, populations were maintained at predetermined levels by park management. These levels were met through lethal control of the herds, resulting in major, short- and long-term impacts on bison and elk. After active population management ceased, bison and elk populations grew rapidly, with approximately 3,100 bison culled by park management or the state of Montana from 1984 to 2000. In 2000, an IBMP endorsed by the federal government and the state of Montana, established guidelines for managing the risk of brucellosis transmission from bison to cattle. In 2008, adaptive adjustments to the IBMP were set in place to provide for additional management activities as identified below.

Bison leaving Yellowstone are currently subject to management control at the park boundary, pursuant to the 2008 adaptive adjustments to the IBMP and the 2000 IBMP (NPS 2000b, 2008a). New policies allow untested females or mixed groups of bison to migrate onto and occupy Horse Butte peninsula and the Flats each winter and during spring calving season. Controls include hazing bison back into the park in May, lethal removal, and retaining animals in facilities for brucellosis testing and eventual release or culling. If populations drop below 2,300 bison, the agencies increase implementation of non-lethal measures and, if populations drop below 2,100 bison, agencies cease lethal management and hunting and shift to non-lethal management measures. The IBMP Adaptive Adjustments to the 2000 IBMP (NPS 2008a) also calls for an increase in bison vaccinations via completion of the EIS processes for remote delivery vaccination of bison and to use the outcome of the EIS and NEPA process to determine active management practices. The goal of the proposed Brucellosis Remote Vaccination Program for Bison is to protect Yellowstone bison by reducing brucellosis infection and, ultimately, further reduce risk of transmission to cattle outside of the park. If this program, and other measures implemented under the 2008 Adaptive Adjustments are successful, hazing and lethal control of Yellowstone bison that travel beyond the park's border may become unnecessary, or occur less frequently, and bison may continue the westward expansion of their range into Montana. This may have an overall positive impact on the bison population in the greater Yellowstone area and may result in increased range and forage availability, nutritional uptake, and total population growth of bison if they are allowed to access and remain in suitable habitat outside of park boundaries. If bison expand their range, there may be decreased population density, and reduced mortality of new-born calves, which are currently subject to hazing (in the Horse Butte area). Decreased population density may result in better body condition and increased reproductive success of cows. However, current management practices limit any western range expansion of Yellowstone bison, which in turn limit natural density dependent dispersal of bison, and the control methods currently used have an overall long-term minor to major adverse impact on bison population and viability. Impacts from these actions would depend on the success of a long-term remote brucellosis vaccination program. Short-

term impacts would be adverse, minor to major, and direct (based on how many bison are culled each year, which is a direct result of the number of bison that leave the park, which in turn primarily depends on winter severity and the number of consecutive harsh winters). Long-term impacts may range from negligible to moderate adverse, because implementation of the remote brucellosis vaccine program would likely have some success in reducing the number of infected bison and may in the future limit or eliminate the need for culling.

The Gallatin National Forest has consolidated the checkerboard of private and public holdings in recent years, accompanied by a consolidation of private holdings, including within the Big Sky Area. It is difficult to predict the net effect of these actions on bison and elk, since the consolidated U.S. Forest Service (USFS) lands are less likely to be developed, whereas the private lands are more likely to be developed. Current actions also include reclamation of McClaren Mine tailings (MTDEQ 2010b) and Gardiner Basin and Cutler Meadows restoration. These actions would have variable effects on bison and elk, sometimes stimulating the growth of their preferred forage and habitat and sometimes limiting it, due to providing or fragmenting habitat for these species.

Future highway-and vehicle travel related plans include the Gallatin Travel Plan revision, and the Beartooth District of Custer National Forest Travel Management Plan. Whereas plans in the national forest are designed to minimize adverse impacts on wildlife, regional plans designed to increase ease of travel for vehicles may not prioritize wildlife. Any increases in traffic, road width, and the number of roads may have long-term adverse impacts on bison and elk in the greater Yellowstone area. Additional roads and vehicles may lead to increased mortality caused by vehicle collisions, limited dispersal and travel of bison or elk to new habitat or preferred habitat locations, and habitat fragmentation. Impacts due to highway plans and road development would be long-term, ranging from minor to moderate adverse.

The reintroduction of gray wolves has contributed to decreases in the elk population in the greater Yellowstone area from the mid 1990s to present, because elk are the primary prey of wolves in the park (White and Garrott 2005, Christianson and Creel 2010). The driving force behind the elk population decline is unclear, and the decline has been attributed to one or more factors other than wolves, including changes in vegetation, hunting, drought, and other variations in the ecosystem, with grizzly bears, rather than wolves, observed to be the primary predator of elk calves (Creel and Christianson 2008; Barber-Meyer et al. 2008). Regardless of whether they precipitated the elk population decline, the presence of wolves increases the predation pressure on elk. The presence of wolves possibly increases the behavioral and physiological responses of elk to anything perceived as a predation threat, including OSVs, humans, and sound from OSVs (Creel and Christianson 2008). Increased responses by elk to winter users may increase stress levels, energy expenditure, and displacement, and decrease energy intake, potentially resulting in poorer body condition, decreased reproductive rates, and an overall decrease in survival (White et al. 2008; Creel 2009; Christianson and Creel 2010). The same is true, but to a much lesser degree, for bison. Bison calves are subject to predation by wolves (Barber et al. 2005), but wolves generally avoid attacking a full-grown bison due to the risk of injury and the difficulty in taking down a large adult animal. Therefore, although impacts by wolves on elk populations are unclear, the increase in perceived predation risk may increase the behavioral and physiological responses by elk and possibly bison, to winter users.

Major cumulative impacts would occur due to bison management and control measures under the IBMP, which is unrelated to direct impacts of winter use in the park. The long-term negligible to major impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible adverse impacts of alternative 1, would result in long-term minor to major adverse cumulative impacts on bison and elk, of which winter use activities would comprise a small part.

Conclusion

Based on an analysis of the available data and literature regarding bison and elk in the greater Yellowstone area, the no-action alternative would result in short and long-term negligible adverse impacts on bison and elk in the park, because OSV use would be limited to minimal administrative use and non-motorized use would be more limited, resulting in no observable impacts. Human activity during the winter months would be reduced and any beneficial wildlife impacts would likely only be apparent over several decades of minimal OSV traffic in the park. Cumulative impacts under alternative 1 would be long-term minor to major adverse. Alternative 1 would contribute minimally to cumulative impacts because there would be no visitor OSVs in the park.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Displacement of Individuals

The level of OSV use under alternative 2 (up to 318 snowmobiles and 78 snowcoaches) would be equal to that permitted under the currently implemented 2009 interim rule. There has not been any observed long-term displacement of bison or elk from 1969 to present, based on observations from winter seasons when similar numbers of OSVs entered the park (winter 2003 to winter 2006, when daily OSV entrance numbers were 250-300), or during winter seasons with higher levels of use prior to 2003 (average 950 OSVs per day; White et al. 2008; McClure et al. 2009). Bison and elk have continued to use the same core winter ranges during the past three and a half decades, even when OSV use fluctuated dramatically from winter to winter (Craighead et al. 1973; Aune 1981; Hardy 2001). Thus range-wide displacement of individual bison or elk would be unlikely under alternative 2, because conditions similar to the existing condition would continue (where long-term displacement of individuals has not been observed). Although bison and elk may temporarily avoid areas of OSV use, resulting in short-term displacement, these short-term responses have not caused shifts in core winter habitat use.

Despite no observed large-scale shifts in habitat use due to the presence of OSVs in the park, both bison and elk have demonstrated flight from OSVs or avoidance of OSV use areas, resulting in small-scale, temporary shifts in habitat use by bison or elk (White et al. 2008). Although these displacement events are brief and temporary, if they occur frequently over the course of a winter, this may decrease both the amount of time elk, and to a lesser extent bison, have to feed, and may also increase energy demands due to movement. Because elk and bison generally suffer a decline in body condition associated with increased energy demands and poorer forage quality over the course of a winter, these factors may contribute to this energy imbalance. As a result, individual bison and elk that frequently avoid OSV use may demonstrate poorer body condition. However, despite short-term responses to OSVs, overall habitat use by bison and elk does not appear to be affected (Hardy 2001; White et al. 2008). Researchers attribute changes in distribution of elk during the winter primarily to snow mass and heterogeneity (Messer 2003). Researchers attribute changes in distribution of elk during the winter primarily to snow mass and the snow depth, snow type, and melting characteristics that are influenced by Yellowstone's many geothermal features and vary in both timing and location during Yellowstone's severe winters (Messer 2003). Researchers attribute bison distribution primarily to population density, snow characteristics, drought, and other factors affecting resource availability (Bruggeman et al. 2006).

Thus, displacement impacts to individual bison and elk under alternative 2 would be localized, short-term moderate adverse. Displacement events may be brief and temporary, and over the course of a winter such events may reduce energy consumption by elk, and to a lesser extent, bison, potentially resulting in poorer body condition.

Behavioral and Physiological Responses

Under all action alternatives, except alternative 6 where up to 25 % of snowmobile users would be non-commercially guided/unguided, trained guides would maintain buffer zones and instruct visitors to behave in a manner that minimizes the likelihood of a strong, energetically costly behavioral response by bison or elk (White et al. 2008). Based on the current managed use, guiding would also result in defined morning and evening peaks in OSV traffic, which may result in increased behavioral responses by ungulates during that time due to more concentrated OSV use. However, a predictable daily pattern of OSV use would be more likely to decrease overall behavioral responses by bison and elk throughout the winter. This is because animals are more likely to become habituated to a disturbance if it is predictable in time and space, not directly harmful, and limited in duration (Thompson and Henderson 1998; White et al. 2008). Depending on the frequency of OSV encounters, active responses by bison and elk (which based on studies would occur during 8% to 9% of encounters (Borkowski et al. 2006; White et al. 2008)) may result in minor or moderate energy costs. However, no adverse population-level effects would be expected, because there have been no observed impacts on population growth or demographics correlating to increased or decreased OSV use in the park over the last 38 years, including the winters from 2004 to 2009 where daily entrance numbers for OSVs (258 snowmobile and 30 snowcoach daily average) were similar to those proposed under alternative 2. Peak OSV use during the winters from 2004 to 2009 was 488 snowmobiles and 55 snowcoaches, which is above the daily limits proposed under alternative 2. Daily limits of up to 318 snowmobiles and 78 snowcoaches were not met in winter 2010 after implementation of the 2009 interim rule, with actual averages of only 187 snowmobiles and 32 snowcoaches per day. Based on behavioral observation from winters that had similar levels of use to those proposed under alternative 2 (winters 2006 to 2009), impacts to bison and elk resulting from continued OSV levels are predicted to be localized, short-term minor adverse under alternative 2.

Population-level Impacts

Historically, researchers have not observed population-level effects for bison and elk during periods of un-guided travel, and higher daily numbers of OSVs in the park. During recent wildlife behavioral monitoring, no short-term population-level effects from OSV use were observed for bison and elk, including when an average of 795 snowmobiles and 15 snowcoaches entered the park daily (Fuller 2006; White et al. 2008). Long-term impacts on populations could conceivably occur under this alternative if there were large-scale cumulative effects resulting from series of small-scale displacement, reduced forage intake, and increased energy expenditure resulting from behavioral responses. Over time these may lead to observable impacts on the population, but such impacts have not been observed under historical levels of use. Population-level impacts are predicted to be long-term minor adverse under alternative 2.

Cumulative Impacts

Impacts on bison and elk from other past, present, and reasonably foreseeable future would be the same as described for alternative 1. The major impacts stated are a result of bison control measures and management under the IBMP, which is unrelated to winter use in the park. The long-term negligible to major adverse impacts of these cumulative actions, when combined with the long-term minor to moderate adverse impacts of alternative 2, would result in long-term minor to major adverse cumulative impacts on these species. Implementation of alternative 2 would contribute only a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 2 would allow for use levels similar to the 2009 interim rule, with BAT requirements, guiding regulations, speed limits, and restrictions on OSV access to park roads only. Continued monitoring and adaptive management would allow for additional restrictions to be established should negative impacts on wildlife begin to occur. Thus, overall impacts under alternative 2 would be short and long-term minor to moderate adverse. Cumulative impacts would be long-term minor to major adverse, of which alternative 2 would contribute minimally.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Displacement of Individuals

The level of OSV use under alternative 3 (up to 720 snowmobiles and 78 snowcoaches) would be similar to OSV use from winter 1995 to winter 2001 (Fuller 2006), when an average of 795 snowmobiles and 15 snowcoaches entered the park daily. There has been no observed long-term displacement of individual bison or elk from 1969 to present, and bison and elk have continued to use the same core winter ranges during the past three and a half decades, even when OSV use fluctuated dramatically from winter to winter (Craighead et al. 1973; Shea 1979; Aune 1981; Hardy 2001).

Studies have found that movement responses were observed during 8% to 9% of interactions with OSVs, meaning that the greater number of OSVs allowed into the park under this alternative would increase the number of times individual bison or elk would demonstrate an energetically costly movement response because the number of interactions would increase, resulting in minor to moderate impacts. Although displacement events may be brief and temporary over the course of a winter, the events may reduce the forage time and quality for elk, and to a lesser extent, bison, potentially resulting in poorer body condition, increased susceptibility to winter weather, and decreased reproductive rates. Displacement impacts to bison and elk under alternative 3 would be localized, short-term moderate adverse.

Behavioral and Physiological Responses

Depending on the frequency with which they occur, active responses by bison and elk may result in minor to moderate energy costs. No adverse population-level effects would be expected, based on population growth and behavioral responses at similar use levels to those proposed under alternative 3 (Borkowski et al. 2006; White et al. 2008). Any increase in OSV numbers entering the park, up to the daily limits, would be likely to increase bison and elk behavioral and physiological responses beyond those observed in the winters of 2004 to 2009, when use levels were less than proposed under alternative 3, ranging from 250 to 557 snowmobiles and to 60 snowcoaches per day. Therefore, impacts to bison and elk resulting from alternative 3 are predicted to be localized, short-term minor to moderate adverse.

Population-level Impacts

Population-level impacts would be long-term minor adverse under alternative 3 because no population-level effects from OSV use have been observed in bison and elk even during periods of higher permitted winter use than that proposed in alternative 3 (Fuller 2006; White et al. 2008). Specifically, the bison population increased exponentially from 1980 to 1994, despite a 20-fold increase in winter visitation during this same period. Also, the survival rate of female bison was high (96%) and remained constant from 1995 to 2001 (Fuller 2006), when an average of 795 snowmobiles

and 15 snowcoaches entered the park daily, which are similar to the proposed 720 daily snowmobile limits under alternative 3 (same as 2004 rule).

Cumulative Impacts

Impacts on bison and elk from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The major impacts stated are a result of bison control measures and management under the IBMP, which is unrelated to winter use in the park. These long-term negligible to major adverse impacts, when combined with the long-term minor to moderate adverse impacts of alternative 3, would result in long-term minor to major adverse cumulative impacts. Implementation of alternative 3 would contribute a noticeable amount to cumulative impacts because of high daily entrance numbers.

Conclusion

Under alternative 3, daily use limits of up to 720 snowmobiles and 78 snowcoaches along with BAT requirements, guiding regulations, speed limits, and restrictions on OSV access to park roads only would result in short and long-term minor to moderate adverse impacts. Continued monitoring and adaptive management would allow for additional restrictions to be established should negative impacts on wildlife begin to occur. Cumulative impacts on bison and elk under alternative 3 would be long-term minor to major adverse.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Displacement of Individuals

Under alternative 4, the number of OSVs entering the park on a daily basis would be reduced from current levels up to 110 snowmobiles and 30 snowcoaches; alternative 4 would also provide for up to 100 commercial wheeled vehicles. Reducing the number of OSVs permitted in the park per day would decrease impacts related to displacement of individuals, because there would be less total exposure to OSVs over the course of the winter. Additionally, OSVs traveling from the south and through the east portions of the park would be traveling through areas where there are few, if any bison, further limiting impacts to that species. Any increase in the numbers of OSV groups in the park traveling through areas where bison and elk are present would increase the number of times that elk and bison are exposed to the presence of OSVs, the duration of exposure to sound produced by OSVs, and the total duration of time OSVs are visible (McClure et al. 2009; Burson 2004 to 2010). These factors have been found to increase the intensity of behavioral responses in wildlife, resulting in avoidance or changes in habitat use, and may also result in avoidance of OSV corridors by bison and elk, changing the localized use patterns of these species (Hardy 2001; White et al. 2008). Therefore, because the number of OSVs allowed in the park per day would decrease under alternative 4, as would the numbers of OSVs traveling through bison and elk habitat, the potential for displacement of individual bison and elk under alternative 4 would be reduced from the conditions on which the above studies are based.

Monitoring reports for current winter use have recorded high numbers of OSV-bison or elk interactions in habitats adjacent to the road corridor, and it is expected that if the roads were plowed and wheeled vehicles were permitted, this same level of interaction would occur. There may be congestion within the road corridor due to the road plowing because snow berms may prevent bison from exiting the road when encountering motorized vehicles, requiring vehicles to stop when encountering bison in the road. Snow berms may also make it difficult for bison or elk to enter or

cross road corridors. However, a plowing design would be developed for wildlife that would include escape routes between the berms at appropriate intervals to minimize this problem. Providing such escape routes would be critical, especially during severe winters with heavy snow pack. During high snow years, high berms resulting from plowing could be formed on either side of the road, forming a corridor that may funnel wildlife along the road for a distance, unless escape routes are provided to allow for crossings and movement off of the road. Road plowing design would be intended to minimize such displacement of wildlife. There is very limited historical information available on bison and elk habitat use, movements, or dispersal prior to the construction of vehicle roads in the park; and this limited information is not comparable to recent scientific information.

Potential impacts to bison and elk from wheeled vehicles can be seen in the current interactions that occur in the winter along the northern road between Mammoth and Cooke City. Bison and elk populations in the northern section of Yellowstone have not been displaced along this section of roadway, which has higher use levels from wheeled vehicles than would occur under alternative 4 (100 wheeled vehicles per day), nor have bison and elk populations been displaced due to private wheeled vehicle travel during the summer (Craighead et al. 1973; Aune 1981; Hardy 2001). Therefore, it is unlikely that range disrupting displacement effects would occur with the low level of commercial (guided) wheeled vehicle use proposed under alternative 4, especially with a plowing design that allows for ample escape routes.

During high snow years, high berms resulting from plowing are formed on either side of the road, forming a corridor that may funnel wildlife along the road for a distance, unless escape routes are provided to allow for crossings and movement off of the road. Wildlife need to have egress from the road corridor to access food and shelter. A plowing design that provides escape routes for wildlife would be used, especially during severe winters with heavy snow pack.

Taken together, wheeled vehicles and OSV use under alternative 4 represent lower motorized vehicle numbers in the park during the winter season than historical levels. Although individual bison and elk may be displaced when exposed to OSVs and motorized vehicles, or funneled along the road for short stretches during high snow years, such effects would likely be short-term, and infrequent. Therefore, the impacts of displacement under alternative 4 are predicted to be localized, short-term minor adverse because, though displacement events may be brief and temporary over the course of a winter, this may reduce grazing time and amount of food consumed by elk and, to a lesser extent, bison, potentially resulting in poorer body condition.

Behavioral and Physiological Responses

Access by both wheeled vehicles and OSVs would be lower than historical use numbers, and bison and elk would likely have similar behavioral and associated physiological responses to wheeled commercial vehicles (e.g., buses, vans) as they have to snowcoaches. Wheeled traffic would occur on routes that are currently groomed for OSV use during the winter, and combined entrance levels for OSV and wheeled vehicles of 240 per day would be lower than the 396 total and 798 total permitted under alternatives 2 and 3, respectively. A sound level limit would be placed on wheeled vehicles. The sound level limit would limit the duration and distance at which wheeled vehicles could be heard, thus limiting duration and intensity of behavioral or physiological responses of bison or elk to motorized sounds in this area. Buses do have a larger visual presence than snowmobiles, and, like snowcoaches, may elicit more intense behavioral responses by bison, but less frequent vigilance responses (Borkowski et al. 2006; White et al. 2008). Therefore, due to the overall decrease in total daily vehicle limits, the limited area where wheeled vehicles would be able to access, and the corresponding decrease in OSVs on all other park roads, alternative 4 would have a low potential for interactions that would result in elk or bison movement or disruption of feeding that would result in decreased food

intake and/or increased energy expenditure due to flight or travel. Impacts under alternative 4 would be long-term minor adverse due to the overall reduction in the frequency of interactions between motorized vehicles and bison or elk.

Population-level Impacts

No adverse population-level impacts to bison and elk have been detected under higher levels of winter use, as described above (Borkowski et al. 2006; White et al. 2008); therefore, a decreased level of use as proposed under alternative 4 should further minimize any undetected impacts on wildlife, resulting in no more than long-term negligible adverse impacts.

Cumulative Impacts

Impacts on bison and elk from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The major impacts stated are a result of bison control measures and management under the IBMP, which is unrelated to winter use in the park. These long-term negligible to major adverse impacts, when combined with the short and long-term negligible to minor adverse impacts of alternative 4, would result in long-term minor to major adverse cumulative impacts. Alternative 4 would reduce the daily number of vehicles entering the park and would contribute a small amount to the overall cumulative impacts to bison and elk.

Conclusion

Under alternative 4, daily use limits of up to 110 snowmobiles, 100 guided wheeled vehicles, and 30 snowcoaches, along with BAT requirements, guiding regulations, speed limits, plowing design, and restrictions on OSV access to park roads only, would result in short- and long-term, negligible to minor adverse impacts. Continued monitoring and adaptive management would allow for additional restrictions to be established should negative impacts on wildlife begin to occur. Cumulative impacts would be long-term minor to major adverse, of which alternative 4 would be a small part.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Displacement of Individuals

Snowmobiles and snowcoaches elicit slightly different intensities and amounts of responses from bison and elk. Based on recent behavioral monitoring data and modeling, it appears that snowmobiles are slightly more likely to elicit a visible behavioral response from bison or elk (vigilance or movement), but that snowcoaches elicit slightly stronger levels of behavioral responses, such as movement or flight, due to the larger visual profile of these vehicles (Borkowski et al. 2006; McClure et al. 2009; White et al. 2008). Increased OSV group size also has been found to increase response, but group size in snowcoaches reached a maximum effect at three snowcoaches, after which there was no increase (White et al. 2008). Individual bison and elk may still be locally displaced if access is limited to snowcoach only, as would occur under alternative 5 if snowmobiles were completely phased out, but impacts would likely be small and localized. Alternative 5, when initially implemented, would

Snowmobiles and snowcoaches differ in size, noise levels, size of groups, and amount of group activity. They therefore elicit slightly different intensity and amount of responses from bison and elk. Based on recent behavioral monitoring data and modeling, it appears that snowmobiles are slightly more likely to elicit any visible behavioral response from bison or elk (vigilance or movement), but that snowcoaches elicit slightly stronger levels of behavioral responses, such as movement or flight, due to the larger visual profile of these vehicles. Use of snowcoaches can reduce the total number of OSVs in the park on a daily basis, but have a slightly higher likelihood of initiating a movement response by bison and elk.

have OSV use levels (up to 318 snowmobiles and 78 snowcoaches) similar to those currently permitted and impacts during this time would be the same as alternative 2.

Based on user demand, starting after the winter 2015 season, a five-year phase out could occur and could result in use levels of 120 snowcoaches and no snowmobiles, which would represent a reduction in the total number of OSVs in the park on a daily basis compared to current conditions. Because the transition to snowcoaches would be based on user demand, or at the discretion of the Superintendent, this alternative could also result in continuation of current use levels of up to 318 snowmobiles and 78 snowcoaches per day, resulting in the same short-term minor impacts as those under alternative 2. Therefore, despite the potential for an increase in the total number of snowcoaches under alternative 5, the total number of vehicles in the park could decrease, which would limit the duration of encounters between OSVs and bison or elk, and with BAT requirements, would also reduce the total time the animals are exposed to OSV related sounds. Although snowcoaches have a slightly higher likelihood of initiating a movement response by bison and elk, the total number of OSV groups would be similar to that occurring under current conditions. Therefore, impacts under alternative 5 are predicted to be localized, short-term minor to moderate adverse. These impacts would be similar to those occurring under alternative 2. This is because it is unclear whether the phase-out of snowmobiles would occur. If the transition to snowcoaches only does happen, OSV group numbers would be similar to those under alternative 2, likely resulting in similar movement and associated displacement effects.

Behavioral and Physiological Responses

Behavioral and physiological responses by individual bison and elk would still occur under alternative 5, but such effects are predicted to be long-term minor adverse. This is because, until the phase out occurs, the frequency of encounters between OSVs and would be the same as alternative 2. Should a complete phase-out occur, the number of snowmobile groups and individual OSVs would be similar. If the phase out does not occur, minor impacts would continue at the same level as under alternative 2. Based on recent behavioral monitoring data and modeling, it appears that snowmobiles are slightly more likely to elicit a visible behavioral response from bison or elk but snowcoaches elicit slightly stronger levels of behavioral responses, such as movement or flight (Borkowski et al. 2006; McClure et al. 2009; White et al. 2008). Recent behavioral observations found that bison and elk demonstrate a movement response during 8% to 9% of encounters with snowcoaches (Borkowski et al. 2006; White et al. 2008), which may result in minor to moderate energy costs. However, no adverse population-level effects would be expected because there have been no observed impacts on population growth or demographics correlating to increased or decreased OSV use in the park over the last 38 years. Behavioral responses and associated physiological effects resulting from exposure to human disturbance would result in localized, short-term minor adverse impacts.

Population-level Impacts

No short-term population-level effects from OSV use have been observed for bison and elk historically, including when an average of 795 snowmobiles and 15 snowcoaches entered the park daily (greater than the level proposed under alternative 5) (Fuller 2006; White et al. 2008). Simulation indicates that long-term population-level impacts could occur due to the presence of groomed roads (Coughenour 2005). But most researchers have concluded that bison population growth is based primarily on the cessation of active management and culling of the park's bison population, rather than any energetic savings and associated increased survival from travel on groomed OSV routes (Bjornlie and Garrott 2001; Gates et al. 2005; Bruggeman et al. 2009a; Plumb et al. 2009; White et al. 2008). Behavioral response monitoring indicates movement responses in 8% to 9% of bison and elk observed, and these active travel and flight behaviors may result in small scale displacement and increased energy expenditure. There has been no data indicating that these responses have resulted in

observable impacts on population, but impacts to individuals that eventually lead to population-level impacts may occur over time, or with especially harsh winters. Population-level impacts are predicted to be long-term minor adverse under alternative 5, because of the long-term impacts that could occur due to behavioral responses, potentially resulting in small-scale displacement that may lead to observable impacts on the population.

Cumulative Impacts

Impacts on bison and elk from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The major impacts stated are a result of bison control measures and management under the IBMP, which is unrelated to winter use in the park. These long-term negligible to major adverse impacts, when combined with the short and long-term minor adverse impacts of alternative 5 would result in long-term minor to major adverse cumulative impacts. Alternative 5 would contribute little to the cumulative impacts on bison and elk due to low OSV numbers.

Conclusion

The existing data suggest that the higher visual profile of a snowcoach may elicit stronger bison and elk behavioral responses than snowmobiles. Thus, restricting OSVs to just snowcoaches would not eliminate adverse effects on wildlife. However, the available literature on bison and elk indicate that lower OSV numbers and associated recreation reduce vehicle-caused mortality, wildlife displacement, behavior or physiology-related energy costs, and the potential for adverse demographic impacts, resulting in short and long-term minor adverse impacts. Cumulative impacts on bison and elk under alternative 5 would be long-term minor to major adverse, to which alternative 5 would contribute a small amount.

Impacts of Alternative 6: Implement Variable Management

Displacement of Individuals

In general, impacts related to displacement of individuals would be similar to those under alternatives 2 and 3, with use levels under alternative 6 ranging from zero to 540 snowmobiles per day and zero to 78 snowcoaches per day over the season; therefore, impacts would be long-term minor to moderate adverse. However, alternative 6 also would include an element that would allow for up to 25% of the snowmobile use to be unguided or non-commercially guided. Guided groups are much more likely to pass bison and other animals that are on or near park roadways with a minimum of wildlife reaction or harassment. Non-commercial guides and unguided users would be required to go through some level of training, which would include instruction on how to avoid harassing animals in the park. In 2001, several seasons before guiding started, nearly 60% of encounters between OSVs and bison on roads resulted in negative behavioral responses by bison, including OSV-hastened movement of bison along long stretches of road or bison being pushed off the road and into the snow (Borkowski et al. 2006; Aune 1981). This same season, Hardy found that elk were displaced about 60 meters from heavily traveled OSV routes, including the Madison to Old Faithful road segment, because the number of total OSVs increased over the course of a winter (Hardy 2001). The displacement of elk and movement behaviors by bison in response to snowmobiles were observed in 2001 when a total of 69,156 OSVs entered the park, which is nearly double the annual limit of 32,000 snowmobiles and 4,600 snowcoaches (totaling 36,600 OSVs) proposed in alternative 6. Although alternative 6 would allow up to 25% of snowmobiles entering the park to be unguided or non-commercially guided, the number of unguided or non-commercially guided snowmobiles would be much lower than those entering the park from 1999 to 2003. Between 1999 and 2003 there were no implemented guiding requirements and

daily entrance numbers were frequently above the maximum 540 per day proposed under alternative 6 (daily average of 795 snowmobiles and 15 snowcoaches). However, although the numbers of OSVs allowed in the park daily under alternative 6 (up to 540 snowmobiles and 78 snowcoaches) are lower than the historical high of 795, there would be a higher potential for direct harassment of bison and elk due to the allowance for 25% of unguided or non-commercially guided snowmobiles. Alternative 6 would allow up to 135 unguided/non-commercially guided snowmobiles per day and 8,000 total unguided/non-commercially guided snowmobiles per year. Training of unguided/non-commercially guided users, if effective, would minimize behaviors by unguided users that result in energetically costly behaviors by wildlife. Despite training, it is more likely that unguided/non-commercially guided users would be less familiar with park roads, probable locations of wildlife, and wildlife behavior, increasing the potential for wildlife behavioral responses to these users. Additionally, unguided/non-commercially guided users are likely to travel in a more random fashion throughout the day, without the morning/evening peaks observed for guided users. This may limit the potential for wildlife habituation to OSVs.

Under alternative 6, group size limits would be 22 snowmobiles per group rather than the 11 snowmobiles per group limit currently implemented. This would increase the likelihood of bison or elk showing strong behavioral responses, because behavioral studies indicate that bison or elk are much more likely to demonstrate vigilant or movement responses with large snowmobile group size, with longer interaction times (interaction times would also increase with group size, as a result of the longer amount of time it would take for twice as many snowmobiles to get out of visual and auditory range of bison or elk), when snowmobilers directly approach bison or elk, especially if the animals are on the roads, and with smaller bison or elk group size (Borkowski et al. 2006; White et al. 2008). Fewer daily groups may offset the effects of larger group size; however, the exact cause-effect relationship is difficult to determine. Data demonstrates the likelihood of a response to OSV disturbance also increased with cumulative OSV use in the park for elk, whereas the likelihood of a response decreased for bison with cumulative OSV use. Also, the likelihood of a movement response by elk increased for each additional snowmobile in a group past 3 snowmobiles, whereas the likelihood of a movement response by bison increased with each additional snowmobile in a group up to a limit of 7 to 18 snowmobiles (White et al. 2006). Therefore, the overall impacts of this alternative would likely increase behavioral responses, despite possible benefits associated with fewer snowmobile groups.

Other factors also increase the risk of displacement or movement responses by individuals by contributing to a reduced potential for wildlife habituation under this alternative. Not only would OSV use occur in a less regular pattern than with guided OSV use, unguided/non-commercially guided OSV drivers likely show less predictable behavior during interaction with wildlife than drivers with a guided group. Unguided/non-commercially guided users would also have less overall education of the

Commercial guiding involves use of a paid guide as part of a commercial tour; such tours are permitted by the park. "Non-commercial guided" tours means that the tour is a private group under the direction of a selected guide who is responsible for his/her group. "Unguided" means any individual or group of individuals that has no one responsible party acting as a tour guide. Annual monitoring data and historical records indicate that direct harassment of wildlife is more likely to occur from unguided snowmobile users.

Non-commercial guides and unguided users would receive training on how to avoid harassing animals in the park. This training, if effective, would minimize behaviors by unguided users that result in energetically costly behaviors by wildlife. Despite training, it is more likely that unguided/non-commercially guided users would be less familiar with park roads, probable locations of wildlife, and wildlife behavior, and may travel in a less predictable pattern, thereby increasing the potential for wildlife behavioral responses to these users.

park and the wildlife than commercial guides, which may inadvertently lead to more behaviors that result in harassment. Additional variation would also result from the daily variance in entrance numbers (from 0 to 540 snowmobiles and from 0 to 78 snowcoaches) and would increase the unpredictability of OSV traffic on a day-to-day, and not just an hour-to-hour, basis. Wildlife habituate best to a disturbance when disturbances are regular in time, space, and duration, and when the disturbance itself occurs in a predictable manner (e.g., not stopping when encountering bison off road, or stopping more than 500 meters away when bison are on the road) (Gill et al. 2001). Therefore, bison and elk are less likely to habituate under this alternative, and thus may show more frequent and more intense behavioral responses to OSV traffic (White et al. 2008).

However, the core range of bison and elk has not changed over the past 38 years, despite periods of unguided OSV use at daily averages and yearly totals of OSVs well above (about double) those proposed under alternative 6. Despite the increase in potential displacement, individual bison and elk would likely demonstrate temporary, short-term displacement, with longer-term displacement possible in certain habitats (e.g., thermal, wet meadow), under certain winter conditions (e.g., exceptionally heavy snowpack and cold), and with higher pressure from OSV users (higher daily numbers, as the number of total OSVs increases over the course of a winter season) (Bruggeman et al. 2006; White et al. 2008). Therefore, the impacts of displacement under alternative 6 would be localized, short-term moderate adverse because frequent or stronger movement responses by bison or elk and/or temporary displacement from prime foraging areas could lead to an increased negative energy balance for these animals. Small energy imbalances could, over the course of many seasons, affect individual animal survival and reproductive success.

Behavioral and Physiological Responses

Under alternative 6, several factors would increase the potential for increased behavioral and associated physiological responses by bison and elk. Variable daily limits (0 to 540 snowmobiles and 0 to 78 snowcoaches) would result in OSV use that would be less predictable, as described above. Bison and elk in Yellowstone show some degree of habituation to OSV use, and habituation increases when disturbance occurs in a regular pattern (Borkowski et al. 2006; White et al. 2008). Allowing unguided/non-commercially guided snowmobile users in the park could increase the potential for snowmobile drivers to engage in activities such as directly approaching animals or riding off road (Aune 1981; Borkowski et al. 2006). Such behavior would both contribute to reduced habituation and directly increase the potential for a negative behavioral response and/or increased physiological stress and energy expenditures (White et al. 2008). Finally, this alternative would allow larger group sizes—up to 22 snowmobiles per group. Behavioral studies have indicated that larger group sizes elicit stronger behavioral responses from bison and elk (Borkowski et al. 2006; White et al. 2008). Taken together, these factors would increase the potential for adverse impacts on bison and elk behavioral and physiological responses. Therefore, the impacts on behavioral and physiological responses under alternative 6 are predicted to be localized, short-term minor to moderate adverse because of decreased bison and elk habituation, and increased potential for frequently occurring, high-level behavioral responses by bison and elk due to variable use limits, group size increases to 22, and the 25% unguided/non-commercially guided provision for snowmobiles.

Population-level Impacts

Population-level impacts would be long-term minor to moderate adverse under alternative 6 because of the potential for short- or long-term displacement, and higher-level, more frequent behavioral and physiological responses by bison and elk, as described above. No population-level effects from OSV use have been observed for bison and elk during annual behavioral monitoring from winter 1999 to winter 2009. This was true even when an average of 795 snowmobiles and 15 snowcoaches entered

the park daily, which is slightly higher than the maximum total number of OSVs allowed in the park under alternative 6 (810 OSV daily average compared to 618 OSV daily limit under alternative 6). Also, no population-level impacts were observed prior to use limits, when peak days were up to 1,457 snowmobiles and 35 snowcoaches per day. However, over the long-term, the daily entrance levels under alternative 6, and variable entrance provisions, combined with the decreased habituation potential and possible impacts of unguided/non-commercially guided users, may result in small-scale impacts on demographics, reproduction, and survival (Fuller 2006; White et al. 2008). These impacts are especially likely during harsh winters, when elk and bison are in more energetically stressed due to decreased food intake and increased energy demands because of cold and snow conditions, and more susceptible to the relatively small energy costs associated with increased vigilance, movement, or displacement due to OSVs.

Cumulative Effects

Impacts on bison and elk from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The major impacts stated are a result of bison control measures and management under the IBMP, which is unrelated to winter use in the park. These long-term negligible to major adverse impacts, combined with the short and long-term minor to moderate adverse impacts of alternative 6 would result in long-term minor to major adverse cumulative impacts. Alternative 6 would contribute a noticeable amount to cumulative impacts because of the unguided/non-commercially guided provision, variable daily OSV numbers, and high use limits.

Conclusion

The variable number of OSVs allowed per day under this alternative would likely increase the behavioral responses of bison and elk due to daily unpredictability and reduced potential for habituation. These increased responses are due in part to the larger snowmobile group sizes (22 individual vehicles rather than 11) allowed under this alternative, which have been found to increase the probability of strong behavioral and associated physiological responses, leading to possible displacement of bison and elk and resulting in long-term moderate adverse impacts. Additionally, the unguided/non-commercially guided provision, variable daily OSV numbers, and high use limits may result in decreased habituation and increased behavioral, physiological and displacement responses by bison and elk. Measures under this alternative, including BAT snowmobiles, variable use limits, closing of certain roads to motorized traffic two weeks prior to the end of the season, and setting limits on seasonal numbers of snowmobiles and snowcoaches in the park, would help limit wildlife impacts. Impacts under alternative 6 would be long-term minor to moderate adverse, due to unguided provision, variable limits, and increased group size. Cumulative impacts on bison and elk under alternative 6 would be long-term minor to major adverse, to which alternative 6 would contribute a noticeable amount.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Displacement of Individuals

The maximum daily level of OSV use under alternative 7, which would occur for half of the winter season (330 snowmobiles and 80 snowcoaches) would be higher than use levels occurring under recent conditions, with an average of 187 snowmobiles and 31 snowcoaches per day, and peak use of up to 293 snowmobiles and 59 snowcoaches per day during winter 2010. Based on observations from winter seasons when similar numbers of OSVs to those proposed under alternative 7 entered the park (winter 2004 to winter 2009 when daily OSV entrance numbers were on average 258 snowmobiles and

30 snowcoaches per day, with peaks of 488 snowmobiles and 55 snowcoaches per day), researchers have not observed any long-term displacement of individual bison or elk. Researchers have not observed long-term displacement of bison or elk during winter seasons with higher levels of use prior to winter 2004 (peaks of 1,457 snowmobiles and 35 snowcoaches per day and averages of 765 snowmobiles and 15 snowcoaches per day); nor was any long-term displacement attributed to OSV use in the park from 1969 to the present. Over the past three and a half decades, OSV use numbers have fluctuated dramatically from winter to winter, and bison and elk have continued to use the same core winter range (Craighead et al. 1973; Aune 1981; Hardy 2001). Thus, range-wide displacement of bison or elk would be unlikely under alternative 7 because conditions similar to or with lower OSV use than that occurring under recent conditions would continue (under which conditions displacement has not been observed). Half of the winter season would have lower use levels than those occurring under recent conditions, with daily entrance limits of up to 220 snowmobiles and 50 snowcoaches for one third of the season and up to 132 snowmobiles and 30 snowcoaches for one-sixth of the winter season. There would be fewer interactions between OSVs and bison and elk would be reduced during periods of lower OSV entrance numbers, reducing the potential for high level behavioral responses leading to displacement. Side roads would be closed, and the east entrance road would be close two weeks prior to the end of the winter season, limiting disturbance to individuals in these areas.

Despite no observed large-scale shifts in habitat use due to the presence of OSVs in the park, both bison and elk have demonstrated flight from OSVs or avoidance of OSV use areas, resulting in small-scale and temporary shifts in habitat use by bison and elk (White et al. 2008). Although these displacement events are brief and temporary, if they occur frequently over the course of a winter this may decrease both the amount of time elk, and to a lesser extent bison, have to feed, and may also increase energy demands due to movement. Because elk and bison generally suffer a decline in body condition associated with increased energy demands and poorer forage quality over the course of a winter, these factors may further contribute to this energy imbalance. As a result, individual bison and elk that frequently avoid OSV use may demonstrate poorer body condition. However, despite short-term responses to OSVs, overall habitat use by bison and elk does not appear to be affected by exposure to OSVs and associated movement or alert responses (Hardy 2001; White et al. 2008). Researchers attribute changes in distribution of elk during the winter primarily to snow mass and heterogeneity (Messer 2003). Researchers attribute bison distribution primarily to population density, snow characteristics, drought, and other factors affecting resource availability (Bruggeman et al. 2006).

Thus, displacement impacts to individual bison and elk under alternative 7 would be localized, short-term moderate adverse. Although displacement events may be brief and temporary, over the course of a winter this may reduce energy consumption by elk, and to a lesser extent, bison, potentially resulting in poorer body condition.

Behavioral and Physiological Responses

Under all action alternatives, trained guides would maintain buffer zones and instruct visitors to behave in a manner that minimizes the likelihood of a strong, energetically costly behavioral response by bison or elk (White et al. 2008). Under recent managed use, guiding has resulted in defined morning and evening peaks in OSV traffic, which may cause increased behavioral responses by ungulates during this time due to more concentrated OSV use. Under alternative 7, the provision that all OSV traffic must enter the park by 10:30 a.m. would further concentrate this pulse of OSV use in the park, specifically along high use corridors such as the Madison to Old Faithful road segment, where bison and elk are frequently encountered (McClure et al. 2009). Borkowski et al. (2006) found that the likelihood of eliciting a movement response from elk increased by 1.1 times with each additional snowmobile added to a group with no threshold, whereas the likelihood of eliciting a

movement response by bison increased by 1.1 times with each additional snowmobile up to a threshold of 7 to 18 snowmobiles. This indicates the importance snowmobile group size has on the likelihood of eliciting behavioral responses by both bison and elk. Borkowski et al. 2006; White et al. 2006; White et al. 2008). Snowmobile group size would be limited to a maximum of 11 under alternative 7, but frequent encounters with OSV groups during periods of intense OSV use may have similar impacts on bison and elk similar to increased group size.

A predictable daily pattern of OSV use would be more likely to decrease overall behavioral responses by bison and elk throughout the winter. This is because animals are more likely to become habituated to a disturbance if it is predictable in time and space, not directly harmful, and limited in duration (Thompson and Henderson 1998; White et al. 2008). Depending on the frequency of OSV encounters, active responses by bison and elk (which based on studies would occur during 8% to 9% of encounters (Borkowski et al. 2006; White et al. 2008)) may result in minor or moderate energy costs.

High-level behavioral responses are also possible due to potential OSV intensive periods resulting from a combination of flexible daily use limits and the 10:30 a.m. cutoff for OSV entrance to the park. Flexible scheduling of daily entrance numbers reduces the total number of OSVs in the park on the annual scale; however, with regard to actual use numbers in the park, flexible scheduling may have little impact. This is because flexible scheduling of higher and lower daily use limits would allow for holidays, or periods of higher demand to be filled to the highest use levels, whereas periods of lower demand would not be filled due to natural lower visitor demand, according to actual use levels from 2004 to 2010. This could potentially result in blocks of high use, and blocks of low use, because of higher and lower use limits. When combined with the 10:30 a.m. entrance cut-off, OSV use may be compacted into a short time period along routes, such as Madison to Old Faithful, where OSV and bison or elk encounters are common. The likelihood of both species demonstrating a heightened behavioral response increases with larger OSV group size, shorter distance between wildlife and OSVs, smaller bison or elk group size, direct approach or harassment by winter visitors, increased interaction time between OSV groups and bison or elk, and the visual profile of the vehicle (Borkowski et al. 2006; White et al. 2006; White et al. 2008). Even with group size limits, frequent encounters with OSVs may increase the likelihood of a heightened behavioral response, because closely spaced OSV groups may have similar effects to those of larger OSV group size and longer interaction time between OSVs and wildlife.

Any increase in actual OSV numbers entering the park, up to the proposed daily limits, would likely increase bison and elk behavioral and physiological responses beyond those observed in winter 2009. Based on behavioral observation from winters that had similar levels of use to those proposed under alternative 7 (winters 2006 to 2009), impacts to bison and elk resulting from continued OSV levels are predicted to be localized, short-term minor adverse under alternative 7.

Population-level Impacts

Historically, researchers have not observed population-level impacts on bison and elk under periods of un-guided travel, and higher daily numbers of OSVs in the park. No adverse population-level impacts are expected, because there have been no observed impacts on population growth or demographics correlating to increased or decreased OSV use in the park over the last 38 years. This includes the winters from 2004 to 2009, when daily entrance numbers for snowmobiles (258 snowmobiles and 30 snowcoaches daily average, peak use of up to 488 snowmobiles and 55 snowcoaches per day) were similar to those proposed under alternative 7. Daily limits of up to 318 snowmobiles and 78 snowcoaches were not met in winter 2010 after implementation of the 2009 interim rule, with actual averages of 187 snowmobiles and 32 snowcoaches per day. Wildlife behavioral monitoring prior to 2004 also observed no short-term population-level effects from OSV use for bison and elk, including

when an average of 795 snowmobiles and 15 snowcoaches entered the park daily (Fuller 2006; White et al. 2008). Long-term impacts on population could occur under alternative 7 because of the small-scale displacement, reduced forage intake, and increased energy expenditure resulting from behavioral responses. Over time these lead to observable impacts on the population, but such impacts have not been observed under historical levels of use. Population-level impacts are predicted to be long-term minor adverse under alternative 7.

Cumulative Impacts

Impacts on bison and elk from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The major impacts stated are a result of bison control measures and management under the IBMP, which is unrelated to winter use in the park. The long-term negligible to major adverse effects of these actions, when combined with the long-term minor to moderate adverse impacts of alternative 7, would result in long-term minor to major adverse cumulative impacts on these species. Alternative 7 would contribute a little to the overall adverse cumulative impacts on bison and elk.

Conclusion

Alternative 7 would allow use levels similar to the 2009 interim rule, with BAT requirements, guiding regulations, speed limits, and restrictions on OSV access to park roads only. Variable use levels allow for continued monitoring and adaptive management to establish additional restrictions to be established should negative impacts on wildlife begin to occur. Thus, overall impacts under alternative 7 would be short- and long-term minor to moderate adverse. Cumulative impacts would be long-term minor to major adverse, to which alternative 7 would contribute a small amount.

LYNX AND WOLVERINES

Lynx and wolverines use similar habitat in Yellowstone and are primarily found in the eastern sector of the park, crossed by the east entrance road, and containing Sylvan Pass. Both species are highly mobile, with large home ranges and the ability to travel great distances in a day. Lynx and wolverines are rare in the greater Yellowstone area and their populations are limited to sparsely distributed mountainous or wooded habitat, so that the persistence of the species in an area may be dependent on genetic dispersal. Both species generally avoid areas of heavy human use, and are rarely observed by park researchers or visitors. Canada lynx in the lower 48 states were listed as threatened under the ESA in March 2000 (USFWS 2000).

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Displacement, Behavioral, and Physiological Effects

Though a few visitors may travel into the park by non-motorized means during the winter, it is unlikely that a large number of visitors would penetrate the backcountry and mountainous areas preferred by lynx and wolverines (due to the distance that would need to be covered by a skier or snowshoer in a harsh winter environment). Under alternative 1, non-motorized use at the east entrance (Sylvan Pass), where lynx are known to occur, would not be expected because this area is an avalanche zone and with Sylvan Pass closed, avalanche mitigation activities would not occur. It is also unlikely that visitors would encounter roaming lynx or wolverines anywhere else in the park due to the animals' scarcity, elusiveness, and propensity for night or dusk travel, when humans are generally not active in the park. Therefore, impacts from displacement would be localized, short-term negligible

adverse, under alternative 1, whereas behavioral and physiological effects would be extremely rare and negligible with long-term beneficial impacts due to the elimination of human presence.

Population-level Effects

Under this alternative there would be no population-level effects, due to a nearly complete lack of interaction or encounters between winter users and lynx or wolverines, resulting in long-term negligible adverse impacts.

Cumulative Effects

Wolverines are still trapped in parts of the greater Yellowstone area, and such harvest may result in mortality of critical members of the population, limiting reproduction, genetic dispersal, and long-term viability of the species in the area. Although only a few individuals are trapped each year, the small population of wolverines may suffer long-term, moderate, adverse impacts from trapping activities (Squires et al. 2007).

Several of the forests in the region are revising their forest plans and/or travel plans, including the Gallatin National Forest Travel Plan Revision, and the Beartooth Custer National Forest Travel Management Plan. Actions associated with these plans could affect lynx and wolverines. The federal and state wildlife management agencies are required to ensure the long-term viability of lynx (for the forests, pursuant to the Northern Rockies lynx amendment to all USFS forest plans). Impacts to lynx as a result of implementation of the Northern Rockies lynx amendment to USFS plans would be long-term beneficial. Also, the USFWS has initiated a status review of the wolverine to determine whether the species warrants protection under the ESA and is currently in the process of gathering information. This should help further determine cumulative effects on the elusive and rarely studied wolverine. If the status review results in listing of wolverines as threatened or endangered, long-term beneficial impacts would occur from implementation of measures to ensure the long-term viability of this species in the greater Yellowstone area.

The Gallatin National Forest has recently consolidated much of its checkerboard public and private land holdings, accompanied by the consolidation of private lands, particularly in the Big Sky area. This means there are larger tracts of public land that are less likely to be developed, but also large areas of private lands that are more likely to be developed. Many of the private lands are in relatively high altitude areas (in contrast to other areas of rapid subdivision and growth in greater Yellowstone area), and may once have been, or could be, important range for wolverines and lynx. Impacts from this consolidation would be long-term minor to moderate adverse, because development changes the landscape forever, eliminating habitat for existing lynx or wolverines using these areas and for any future lynx or wolverines dispersing into these areas.

Road construction is a recurring event in the park, including recent projects at the east entrance and Madison to Norris roads. Any activities in the park are undertaken in such a way as to minimize adverse effects on wildlife and wildlife habitat; this is also true for projects in the national forests, as required by the Northern Rockies Lynx Amendment to all USFS plans. For example, most facility construction projects in parks and forests take place at previously disturbed sites and replace existing structures, minimizing new effects on wildlife. The east entrance project within the park involved only minimal realignment of existing roadways. The Madison to Norris construction moved the road about half a mile from its original location, for a distance of about two miles, and restored two miles of road adjacent to the Gibbon River. Impacts on wolverines and lynx from road construction in the park would be long-term negligible adverse, but would range from long-term minor to moderate adverse in the greater Yellowstone area. This is because lynx tend to limit their movements around roads and are

prone to road kill mortality. Wolverines also avoid human activity, including roads, and may adjust their dispersal and movements where roads cross their territory (Banci 1994; Copeland 1996; Hornocker and Hash 1981). Additionally, road improvements in critical areas of wolverine or lynx habitat, such as mountain passes, could limit the animals' movements because roads in mountainous areas often occur in natural travel routes where the terrain is less demanding. Because so little is known about how wolverines travel across the landscape, it is difficult to determine the impacts of roads on this species.

Separately or combined, the actions discussed above would result in an increase or decrease in the population of prey/carcass availability for wolverines and lynx, on an available habitat, which would affect wolverine and lynx habitat use and population in these areas, and in the entire greater Yellowstone area. Impacts of reduced prey or carcass availability would result in minor to major impacts on lynx, and minor impacts on wolverines, because lynx are more susceptible to starvation mortality.

The long-term minor to major adverse impacts of these past, present, and reasonably foreseeable future actions, combined with the short- and long-term negligible adverse impacts of alternative 1, would result in long-term minor to major adverse cumulative impacts on lynx and wolverines. Alternative 1 would contribute minimally, if at all, to cumulative impacts because there would be no visitor OSVs in the park.

Conclusion

Alternative 1 would result in short- and long-term negligible adverse impacts on lynx and wolverines in the park because OSV use would be limited to minimal administrative use and there would be no observable impacts, with long-term beneficial impacts from the removal of human presence. Cumulative impacts of alternative 1 would be long-term minor to major adverse, of which alternative 1 would contribute minimally.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Displacement, Behavioral, and Physiological Effects

Alternative 2 would continue road grooming and management of Sylvan Pass, the closest OSV route to prime lynx and wolverine habitat in the eastern sector of the park. Wolverine females give birth to young in mid-February, during peak OSV season, where one natal den was found at Sylvan Pass in 2009. Because denning females are likely sensitive to human disturbance (Myrberger 1968; Pullianian 1968), OSV use and maintenance activities (particularly avalanche control methods) may cause wolverines using the area to leave, and/or cause females to abandon their dens for poorer den sites, increasing kit mortality and decreasing the reproductive success of wolverines. Also, groomed roads in other areas of the park may limit critical dispersal and movements of wolverines between the high-elevation alpine habitats that make up their range. Wolverines and lynx in Yellowstone are on the southern tip of their range in North America, and suitable habitat for both species in the greater Yellowstone area occur in patches, separated by poor habitat (Brock et al. 2007). There have been documented movements of a dispersing, Global Positioning System (GPS) collared wolverine across the central range of Yellowstone, indicating that disturbance in any area of the park could impact dispersal and movements of wolverines if disturbances occur outside of areas of ideal habitat for either species (Wildlife Conservation Society 2007).

Behavioral and associated physiological effects associated with OSV use have never been specifically investigated for these species. However, observations of habitat use indicate that wolverines avoid

areas of human activity, including snowmobile routes (Banci 1994). Studies conducted on the Rocky Mountain lynx populations have found that lynx may avoid crossing highways, avoid areas of human presence, and use roads as territory boundaries (Apps 1999). Lynx do not appear to avoid crossing logging roads or roads with lower levels of vehicle use (Koehler and Brittel 1990; McKelvey et al. 1999). Mowat et al. (1999), who studied lynx in Canada where habitat is generally less fragmented than lynx habitat in the lower 48 states, observed that lynx appeared to tolerate moderate levels of snowmobile traffic, readily crossed highways, and established home ranges in proximity to roads. Under alternative 2, an average of 5 OSV groups would be expected to travel through the pass daily (up to 22 OSVs per day). Avalanche control work has been ongoing in Sylvan Pass since 1973 and includes the use of explosives. Researchers do not know whether the recently located wolverine den site at Sylvan Pass is new, or if the den site has persisted for years despite avalanche control activities and OSV use in the area. Impacts to lynx and wolverines under this alternative are predicted to be localized, short-term minor adverse because disturbance from OSVs on the Sylvan Pass road and maintenance activities could adversely impact reproductive success of denning wolverine females. Depending on how far these species travel outside the eastern section of the park, where use would be more limited, impacts have the potential to be moderate adverse, because groomed OSV roads in other areas of the park could limit movements and dispersal of both species. Specific behavioral and physiological effects are unknown, because habituation by lynx or wolverine to the levels of OSV use that would occur in Yellowstone under alternative 2 has never been observed. However, it is likely that increased human disturbance would result in higher rates of flight or avoidance by wolverines and lynx. Additionally, associated physiological responses would also likely be increased in these species, with exposure to OSVs. Physiological responses generally result in increased energy expenditure and during the severe winter months such responses may result in a critical energy imbalance.

Population-level Effects

The two recent sightings of lynx in the north-central section of the park, along the popular Norris Geyser Basin to Mammoth Hot Springs route, support the possibility that lynx may travel or may be found outside of the park's east sector. Additionally, radio collar tracking indicates that wolverines may travel up to 50 miles in a 17-hour period, and travel through non-preferred habitat, including the central portion of Yellowstone (Inman et al. 2007a). These travels may result in fairly regular encounters between OSVs or groomed roads and these animals, even if lynx and wolverines are rarely seen by winter users due to their keen senses and general avoidance of human activity. Additionally, road density and associated human activity is proposed as one of the driving factors behind the extirpation of wolverines from formerly occupied wolverine habitat in California, Oregon, and Washington (Ruediger et al. 2000). Impacts to highly mobile lynx and wolverines due to groomed roads and human activity would be long-term, minor adverse, because groomed roads and OSV presence under alternative 2 may disrupt their winter movements.

Wolverines reproduce at slow rates, with females reaching reproductive maturity at about 3 years of age. Wolverines birth only one kit an average of every 2.3 years (Inman et al. 2007b) and female reproductive success is critical to ensuring the long-term viability of the species in the area. Under this alternative Sylvan Pass would remain open, and because wolverine females give birth in mid-February, with at least one known den in Sylvan Pass, there is a risk of increased kit mortality and lower quality parental care by female wolverines if they are disturbed by OSVs and Sylvan Pass maintenance activities (Pullianian 1968). Impacts to wolverine reproductive success would be long-term, minor adverse.

Impacts to lynx may be long-term minor adverse effects because their mating season overlaps OSV use in the park by about 2 weeks, and roaming lynx may be limited by groomed OSV use and disturbance (Copeland 1996; Mowat and Slough 1998). As discussed under "Displacement,

Behavioral, and Physiological Effects” above, lynx appear to be able to adapt to moderate levels of snowmobile use and human disturbance. The east entrance levels of 20 snowmobiles and 2 snowcoaches per day, resulting in about 5 OSV groups/day proposed under alternative 2 would keep snowmobile traffic in the area at low levels.

Population-level impacts on lynx and wolverines under alternative 2 are predicted to be long-term minor adverse because lynx or wolverines may avoid areas of OSV use, or may limit their range and associated genetic dispersal due to the presence of groomed roads, in the park, due to their large home range size and the importance of travel between patchy habitat. These responses to OSV use areas could ultimately result in population-level impacts on the relatively slow reproducing lynx and wolverines.

Overall, these impacts would be mitigated under this alternative through monitoring and closures of areas if deemed necessary. Monitoring of human-wildlife interactions would continue under all alternatives. If NPS monitoring indicates that human presence or activities have unacceptable effects on lynx or wolverines that cannot be otherwise mitigated, selected areas of the park (including sections of roads) may be closed to visitor use. However, it is difficult to determine lynx or wolverine population numbers in Yellowstone, and lynx and wolverines are rarely observed by researchers. Therefore, NPS monitoring would require intensive surveys to determine any effects from OSVs on lynx or wolverines, due to the species’ scarcity and their propensity to inhabit steep, mountainous areas of the park, limiting the effectiveness of this mitigation measure. The park has the authority to close areas of the park for wildlife protection; for example, to prevent disturbance of denning wolverines. If a wolverine or lynx den is found in an area of the park near human activity, where disturbance is likely, the superintendent could implement closures.

Cumulative Effects

Impacts on lynx and wolverines from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor to major adverse effects of these actions, when combined with the short- and long-term minor adverse impacts to potentially long-term moderate adverse impacts of alternative 2, would result in short- and long-term minor to major adverse cumulative impacts on these species. Alternative 2 would contribute a minimal amount to cumulative impacts, primarily due to continued OSV use in the park and at Sylvan Pass.

Conclusion

This alternative would maintain and allow OSV use at Sylvan Pass, the area of the park where human-wolverine interactions would be most likely to occur. However, daily entrance limits restrict the east entrance to just 20 snowmobiles and two snowcoaches per day, (five groups of OSVs), resulting in little use in this area, and minimal disturbance to wolverines. Restrictions on movements of lynx or wolverines during the winter months due to the presence and use of OSV routes in other areas of the park may limit reproductive success, dispersal, and overall genetic sustainability of the species, but such impacts are difficult to predict. Therefore, impacts predicted under this alternative would be long-term minor adverse, with the potential for moderate adverse impacts if lynx and wolverines travel outside the eastern area of the park. Cumulative impacts to lynx and wolverines under alternative 2 would be long-term minor to major adverse, of which alternative 2 would contribute a minimal amount.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Displacement, Behavioral, and Physiological Effects

Alternative 3 would continue road grooming and management of Sylvan Pass (as described under alternative 2) and would also allow daily use limits of up to 720 snowmobiles and 78 snowcoaches per day. There is little to no data indicating what, if any, displacement, behavioral, and physiological effects historically higher levels of OSV use (daily averages of snowmobiles up to 950 per day) have on lynx and wolverines in Yellowstone; however, both species generally avoid areas of human activity (Mowat et al. 1999; Banci 1987). The high levels of OSV use limits under alternative 3 would increase the frequency with which wolverines or lynx traveling outside of the park's east sector may be exposed to human use because more OSVs means that OSVs would be heard and seen for longer periods of time. However, alternative 3 would allow for only 20 snowmobiles and 2 snowcoaches at the east entrance, meaning impacts to any wolverine females denning in Sylvan Pass or lynx and wolverines using habitat in the eastern sector of the park would be similar to those under alternatives 2 and 5, with approximately 5 OSV groups traversing the pass each day. These impacts would occur because OSV use and maintenance activities (particularly avalanche control methods) may cause wolverines to leave the Sylvan Pass area, or may cause females to abandon their dens for poorer den sites, increasing kit mortality and decreasing reproductive success of wolverines in the greater Yellowstone area (Myberger 1968; Pullianian 1968). More importantly, groomed roads in the park may limit critical dispersal and movements of wolverine and lynx between the high-elevation alpine habitats that make up their range, primarily due to the limited availability and patchy distribution of quality habitat for both species in the greater Yellowstone area. There have been documented movements of a dispersing, GPS collared wolverine and lynx traveling across the central range of Yellowstone, indicating that disturbance in any area of the park could impact dispersal and movements of wolverines and lynx if disturbances occur outside of areas of ideal habitat for either species (Greater Yellowstone Wolverine Program, Wildlife Conservation Society 2007; Squires and Oakleaf 2005).

Behavioral and associated physiological effects have never been comprehensively observed, but known movements of wolverine and lynx in relation to preferred habitat and human activity provide an estimate of effects. Observations and GPS data on habitat use and movements indicate that wolverines avoid areas of human activity such as snowmobile routes (Banci 1994). Studies conducted on the Rocky Mountain lynx populations have found that lynx may avoid crossing highways, avoid areas of human presence, and use roads as territory boundaries (Apps 1999). Lynx do not appear to avoid crossing logging roads or roads with lower levels of vehicle use (Koehler and Brittel 1990; McKelvey et al. 1999). Mowat et al. (1999), who studied lynx in Canada where habitat is generally less fragmented than lynx habitat in the lower 48 states, observed that lynx appeared to tolerate moderate levels of snowmobile traffic, readily crossed highways, and established home ranges in proximity to roads. Thus, lynx are likely somewhat able to adapt to moderate levels of human disturbance.

Impacts to these two species under alternative 3 would be localized, short-term, moderate adverse, because higher use levels of groomed OSV roads in the park could limit movements and dispersal of both species. It is likely that increased human disturbance would result in higher rates of flight or avoidance by wolverines and lynx, because the relatively high OSV use limits under alternative 3 would likely cross the unknown 'low' disturbance threshold for lynx proposed by Mowat et al. (1999), and the low disturbance threshold for wolverines (Banci 1994), although this exact limit is also unknown. Physiological responses generally result in increased energy expenditures, which may result in a critical energy imbalances during the severe winter months.

Population-level Effects

The two recent sightings of lynx in the north-central section of the park, along the popular Norris Geyser Basin to Mammoth Hot Springs route, support the possibility that lynx may travel or may be found outside of the park's east sector. Additionally, radio collar tracking indicates that wolverines may travel up to 50 miles in less than a 24-hour period, and travel through non-preferred habitat, including the central portion of Yellowstone (Inman et al. 2007a). These travels may result in fairly regular encounters between OSVs or groomed roads and these animals, even if lynx and wolverines are rarely seen by winter users due to the animals' keen senses and general avoidance of human activity. Additionally, road density and associated human activity is proposed as one of the driving factors behind the extirpation of wolverines from formerly occupied wolverine habitat in California, Oregon, and Washington (Ruediger et al. 2000). Therefore, population-level impacts on lynx and wolverine under alternative 3 are predicted to be long-term moderate adverse because the levels of OSV presence proposed in alternative 3 would likely result in more frequent and higher levels of behavioral responses and displacement by lynx and wolverines traveling through the central Yellowstone area. Avoidance of areas of OSV use may also cause lynx or wolverines to limit their movements, decreasing genetic dispersal. Also, OSV use in Sylvan Pass may result in loss of reproductive success for female wolverines denning in the Sylvan Pass area. Both of these factors could ultimately result in population-level impacts on the relatively slow reproducing lynx and wolverine.

Cumulative Effects

The impacts on lynx and wolverines from past, present, and foreseeable future actions under alternative 3 would be the same as those under alternative 1. These long-term minor to major adverse impacts, when combined with the long-term moderate adverse impacts of alternative 3, would result in long-term minor to major adverse cumulative impacts on wolverine and lynx populations in Yellowstone. Alternative 3 would contribute a minimal amount to the overall adverse cumulative impacts due to the high level of OSV use in the park.

Conclusion

This alternative continues to maintain and allow OSV use in Sylvan Pass, the area of the park where human-wolverine interactions are most likely to occur. Restrictions to movements of lynx or wolverines during the winter months due to the presence and high levels of use of OSV routes under alternative 3 (up to 720 snowmobiles and 78 snowcoaches) may also limit reproductive success, dispersal, and overall genetic sustainability of the species due to increased frequency of exposure and duration of exposure to the sights and sounds of human activity. Therefore, impacts predicted under this alternative would be long-term moderate adverse. Cumulative impacts to lynx and wolverines under alternative 3 would be long-term minor to major adverse, of which alternative 3 would contribute a minimal amount.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Displacement, Behavioral, and Physiological Effects

The closure of Sylvan Pass under alternative 4 and lack of avalanche control activities by the park would virtually eliminate any OSV use in the eastern sector of the park, minimizing human travel through prime lynx and wolverine habitat. Therefore, wolverine females denning in Sylvan Pass would not be adversely affected by OSV use, and in the long term, closure of the area would result in

beneficial impacts from the removal of human presence. Groomed roads in the park to allow for OSV use from the south entrance may limit critical dispersal and movements of wolverines between the high-elevation alpine habitats that make up their range, but disturbance would be limited due to the overall lower numbers of motorized vehicles (up to 100 commercially guided wheeled vehicles, 110 snowmobiles, and 30 snowcoaches) in the park, particularly in the park's central sector.

Under alternative 4, the park would plow the roads from West Yellowstone and Mammoth to Old Faithful and allow 100 guided commercial wheeled vehicles per day. This would mean the daily limit of total motorized vehicles in the park would be 240, which is lower than the total number of vehicles allowed currently in the park. Although plowing roads may adversely affect both wolverine and lynx movements, genetic dispersal (e.g., male travels to find a mate and periodically check in on mate and offspring), natal dispersal (the dispersal of the year's young to new home ranges) adult dispersal to more productive habitat, and general use of an area, there would be no additional winter use areas, beyond those currently open. Guided buses would likely have impacts similar to snowcoaches. There have been documented movements of a dispersing, GPS collared wolverine traveling across the central sector of Yellowstone. Also, travelling lynx have been recently sighted in the north-central area of the park, near snow roads. This indicates that disturbance in any area of the park could impact dispersal and movements of lynx and wolverines even if disturbances occur outside of areas of ideal habitat for either species (Greater Yellowstone Wolverine Program, Wildlife Conservation Society 2007). However, the relatively low numbers of motorized vehicles allowed in the park under this alternative would reduce the amount of time that sights and sounds associated with motorized vehicles are present in the park, along with decreasing the frequency with which OSVs are present along the road corridors.

Behavioral and associated physiological effects from OSV use on wolverines and lynx have never been comprehensively observed. Observations of habitat use indicate that wolverines avoid areas of human activity, including snowmobile routes (Banci 1994; Greater Yellowstone Wolverine Annual Report 2008). Lynx appear to be able to adapt to moderate levels of human disturbance (Koehler and Brittel 1990; Mowat et al. 1999). Therefore, impacts to these two species under this alternative are predicted to be localized short-term minor adverse, because there would be no disturbance from OSVs on wolverine denning habitat near the Sylvan Pass road, and there would be less disturbance in the rest of the park because of fewer overall vehicles. The amount of motorized vehicle roads would remain the same, however, and groomed OSV roads in the park could limit movements and dispersal of both species. Specific studies on behavioral and physiological effects have not been conducted; however, it is likely that the lower levels of human disturbance that would occur under alternative 4 would result in less frequent flight and avoidance responses by wolverines and lynx, reducing energy expenditures and population effects.

Population-level Effects

Population-level impacts on lynx and wolverines under alternative 4 are predicted to be long-term minor adverse because the levels of OSV presence proposed in alternative 4 would likely result in less frequent and lower levels of behavioral responses and displacement effects on lynx and wolverines in the area. Avoidance of areas of OSV use may cause lynx or wolverine to limit their movements, decreasing genetic dispersal. The closure of Sylvan Pass would limit OSV impacts on any females and kits using the denning habitat in that area and on lynx using this area of prime subalpine habitat starting in mid- February, and the lower use levels of motorized vehicles in the rest of the park would limit direct impacts, in turn limiting population-level impacts.

Cumulative Effects

The impacts on lynx and wolverines from past, present, and foreseeable future actions under alternative 4 would be the same as those under alternative 1. These long-term minor to major adverse impacts, when combined with the long-term minor adverse impacts of alternative 4, would result in long-term minor to major adverse cumulative impacts on wolverine and lynx populations in Yellowstone. Alternative 4 would contribute a minimal amount to cumulative impacts, primarily due to continued OSV use in the park.

Conclusion

Under this alternative Sylvan Pass would be closed to OSVs and maintenance activities would cease in the area of the park where human-wolverine interactions are most likely to occur. Restrictions to movements of lynx or wolverines during the winter months due to the presence and relatively low levels of use of OSV routes under alternative 4 (up to 110 snowmobiles, 100 wheeled buses, and 30 snowcoaches) would have few impacts on the reproductive success, dispersal, and overall genetic sustainability of the species due to decreased frequency and duration of exposure to the sights and sounds of human activity. Therefore, impacts under alternative 4 would be short and long-term minor adverse, with long-term beneficial impacts from the removal of human presence at Sylvan Pass. Cumulative impacts under alternative 4 would be long-term minor to major adverse, of which alternative 4 would contribute a minimal amount.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Displacement, Behavioral, and Physiological Effects

Under this alternative road grooming and management of Sylvan Pass would continue, but daily use limits would decrease to roughly a third of current conditions (120 snowcoaches per day) only once the phase out is complete. Prior to the phase out, impacts would be the same as under alternative 2.

After the phase out, under alternative 5, only four to five snowcoaches would be allocated to the east entrance per day, reducing impacts to any wolverine females denning in Sylvan Pass or lynx and wolverines using habitat in the eastern sector of the park, minimizing effects on any reproductive females denning in the area (Pullianian 1968). The continued presence of groomed roads in the park may limit critical dispersal and movements of wolverine between the high-elevation alpine habitats that make up their range. However, the lower OSV limits proposed under alternative 5 would decrease the amount of time that OSV sights and sounds are present in the park. In addition, the reduced frequency at which OSVs traveling the roads maybe encountered would minimize impacts on traveling lynx and wolverines in the central sector of the park. Behavioral and associated physiological effects have never been comprehensively observed, but displacement and movements of wolverine and lynx in relation to habitat and human activity provide an estimate of effects. Observations and GPS data on habitat use and movements indicate that wolverines avoid areas of human activity, including snowmobile routes (Banci 1994). Lynx appear to be able to adapt to moderate levels of human disturbance (Koehler and Brittel 1990; Mowat et al. 1999). Therefore, impacts to these two species under alternative 5 would be localized, short-term negligible to minor adverse. This is because the low-level disturbance from OSVs on the Sylvan Pass road and maintenance activities could adversely impact reproductive success of denning wolverine females, and reduced use levels of groomed OSV roads in the park would minimally limit movements and dispersal of both species. Specific behavioral and physiological effects of human disturbance are unknown. However, it is likely that decreased human disturbance under alternative 5 would result in higher rates of flight or avoidance by wolverines and lynx, because the relatively low OSV limits under alternative

5 would be less likely to cross the unknown 'low' disturbance threshold for lynx (Mowat et al. 1999), or for wolverines (Banci 1994). Associated physiological responses would also likely be decreased in these species, with lower levels of exposure to OSVs. This would limit physiological responses.

Population-level Effects

Population-level impacts on lynx and wolverine under alternative 5 would be long-term negligible to minor adverse because the levels of OSV presence would likely result in less frequent and lower levels of behavioral responses and displacement effects on lynx and wolverines in the area. Avoidance of OSV use areas in the central sector of the park may cause lynx or wolverine to limit their movements, decreasing genetic dispersal. But limiting entrance numbers at Sylvan Pass (east entrance) to 4-5 OSVs per day would limit OSV impacts on females and kits in using the denning habitat in the Sylvan Pass area, and on lynx using this area of prime subalpine habitat, and the lower levels of motorized vehicle use in the rest of the park would limit direct impacts, in turn limiting population-level impacts.

Cumulative Effects

The impacts on lynx and wolverines from past, present, and foreseeable future actions under alternative 5 would be the same as those under alternative 1. These long-term minor to major adverse impacts, when combined with the short and long-term negligible to minor adverse impacts of alternative 5, would result in long-term minor to major adverse cumulative impacts on wolverine and lynx populations in Yellowstone. Alternative 5 would contribute a minimal amount to cumulative impacts due to the low levels of OSV use.

Conclusion

Restrictions to movements of lynx or wolverines during the winter months due to the presence and relatively low levels of use of OSV routes under alternative 5 (up to 120 snowcoaches) and the low levels of OSV entry limits at the east entrance would have few impacts on reproductive success, dispersal, and overall genetic sustainability of the species due to decreased frequency and duration of exposure to the sights and sounds of human activity. Therefore, impacts predicted under alternative 5 would be short and long-term negligible to minor, adverse. Cumulative impacts to lynx and wolverines under alternative 5 would be long-term minor to major adverse, to which alternative 5 would contribute minimally.

Impacts of Alternative 6: Implement Variable Management

Displacement, Behavioral, and Physiological Effects

Alternative 6 would allow for up to 540 snowmobiles and 78 snowcoaches per day, variable entrance allocations, and 25% of snowmobiles entering the park to be unguided/non-commercially guided. Allowing more OSV use, with a portion of that use unguided/non-commercially guided, could increase the amount of OSV traffic in Sylvan Pass, the prime habitat for lynx and wolverines in the park, increasing the potential for displacement, behavioral, and physiological effects. The end of season closure of Sylvan Pass and the east entrance, after March 1, would reduce impacts on denning wolverines or lynx, during a critical time. Unguided snowmobile users in the park could be more likely to engage in activities that cause increased behavioral responses, displacement, and associated physiological effects, such as traveling at high rates of speed and engaging in improper interactions with wildlife. Such activities have been observed during past winter use seasons (White et al. 2008). Behavioral observations of wildlife also indicate that larger OSV group sizes, such as those allowed under alternative 6, increase behavioral and associated physiological responses by wildlife. Impacts

under alternative 6 would be long-term minor adverse due to potential disturbance to wolverine kits and females using the Sylvan Pass area (which may increase displacement of wolverines from the this habitat area), the increased levels of disturbance from more frequent OSV presence on park roads and from larger group sizes, and the higher potential for unguided users to engage in activities that would increase behavioral responses by wolverines and lynx (activities such as off-road travel or high rates of speed).

Population-level Effects

Under alternative 6 road grooming and management of Sylvan Pass would continue, and daily use limits would allow up to 200 more snowmobiles per day than permitted under the 2009 interim rule. Historically, when there were no limits, up to 1,457 and an average of 765 snowmobiles entered the park daily. With the uncertainty regarding avalanche operations and unscheduled closures in Sylvan Pass, use levels Sylvan Pass may increase, but it is not likely to approach historic levels, even on days in which up to 540 snowmobiles are permitted into the park.

Whereas some days may allow for high use, other days would allow for low use, including days with no OSVs entering the park. Variable entrance limits would allow an unspecified number of OSVs to enter the park at the east entrance and travel into the Sylvan Pass area, potentially increasing disturbance of females using the denning habitat found in this part of the park. Observations and GPS data on habitat use and movements indicate that wolverines avoid areas of human activity, including snowmobile routes (Banci 1994), lynx appear to be able to adapt to moderate levels of human disturbance, roads, and snowmobile use (Koehler and Brittel 1990; Mowat et al. 1999). Impacts to lynx and wolverines under this alternative are predicted to be localized, short-term moderate adverse. This is because the possible frequent disturbances from unguided/non-commercially guided and guided OSVs on the Sylvan Pass road (which could increase over current levels due to flexible entrance allocations) and maintenance activities could adversely impact the reproductive success of denning wolverine females. Also, high levels of snowmobile and snowcoach use on groomed OSV roads in the park could limit movements and dispersal of both species. It is likely that the increased human disturbance would result in a more frequent need for flight or avoidance by wolverines and lynx. This is because the high daily OSV limits under alternative 6 may exceed the moderate disturbance threshold for lynx and would likely surpass the low disturbance threshold for wolverines proposed by Banci (1994). There would likely be increased physiological responses in these species with associated higher energy expenditure, because frequency and duration of exposure to OSVs increases, resulting in reduced winter survival rates, and decreased population growth.

Cumulative Effects

The impacts on lynx and wolverine from past, present, and foreseeable future actions under alternative 6 would be the same as those under alternative 1. These long-term minor to major adverse impacts, when combined with the short- and long-term moderate adverse impacts of alternative 6, would result in long-term minor to major adverse cumulative impacts on wolverine and lynx populations in Yellowstone. Alternative 6 would contribute a noticeable amount to cumulative impacts on lynx and wolverines.

Conclusion

Restrictions to movements of lynx or wolverines during the winter months due to the presence and relatively high levels of use of OSV routes under alternative 6 (up to 540 snowmobiles and 78 snowcoaches), and the potential for higher OSV entry limits at the east entrance would have increased impacts on reproductive success, dispersal, and overall genetic sustainability of the species due to the

increased frequency and duration of exposure to the sights and sounds of human activity. Therefore, impacts predicted under alternative 6 would be short and long-term moderate adverse. Cumulative impacts to lynx and wolverines under alternative 6 would be long-term minor to major adverse, of which alternative 6 would contribute a noticeable amount.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Displacement, Behavioral, and Physiological Effects

Alternative 7 would continue road grooming and management of Sylvan Pass, the closest OSV route to prime lynx and wolverine habitat in the eastern sector of the park. Wolverine females give birth to young in mid-February, during peak OSV season, and one natal den was found in Sylvan Pass. Because denning females are likely sensitive to human disturbance (Myrberget 1968; Pullianian 1968), OSV use and maintenance (particularly avalanche control methods) may cause wolverines using the area to leave, and/or cause females to abandon their dens for poorer den sites, increasing kit mortality and decreasing the reproductive success of wolverines. The end of season closure of the east entrance and east side road would reduce the impacts of OSVs on wolverines in the area, but OSV use would still overlap for about two weeks. Male wolverines travel extensively during the winter, periodically checking in with females they have mated with, and with females and kits after the birth of young. Wolverine and lynx in Yellowstone are on the southern tip of their range in North America, and suitable habitat for both species in the greater Yellowstone area occurs in patches, separated by poor habitat (Brock et al. 2007). Documented movements of a dispersing, GPS collared wolverine during the winter months traveling across the central range of Yellowstone, indicates that disturbance in any area of the park could impact dispersal and movements of wolverines, even if disturbances occur outside of areas of ideal habitat for either species (Wildlife Conservation Society 2007).

Behavioral and associated physiological effects associated with OSV use have never been specifically investigated for these species. However, observations of habitat use indicate that wolverines avoid areas of human activity, including snowmobile routes (Banci 1994). Lynx appear to be able to adapt to moderate levels of human disturbance and snowmobile use (Koehler and Brittel 1990; Mowat et al. 1999). Therefore, impacts to these two species under alternative 7 are predicted to be localized, short-term minor adverse because disturbance from OSVs on the Sylvan Pass road and maintenance activities could adversely impact the reproductive success of denning wolverine females. Although early closure of Sylvan Pass and the east side to OSV travel (March 2 to 15), would reduce disturbance of female wolverines by OSVs, female wolverines may begin denning in mid-February, and thus OSV use may overlap with wolverine denning time. Depending on how far these species travel outside the minimally travelled, eastern section of the park, impacts have the potential to be moderate adverse, because groomed OSV roads in other areas of the park could limit movements of both species. For lynx and wolverines traveling outside the park, early closure of the east entrance would have little effect.

Specific behavioral and physiological effects are unknown, because habituation to the levels of OSV use that would occur in Yellowstone under alternative 7 has never been observed. However, it is likely that increased human disturbance would result in higher rates of flight or avoidance by wolverines and lynx. Additionally, associated physiological responses would also likely be increased in these species with exposure to OSVs. Physiological responses generally result in increased energy expenditures.

Population-level Effects

Under this alternative Sylvan Pass would remain open. Because wolverine females give birth in mid-February and there is at least one known den in Sylvan Pass, there is a risk of disturbance of denning females and kits. Disturbance by OSVs and Sylvan Pass maintenance activities may result in lower quality parental care by female wolverines both prior to weaning at 10 weeks, and before young wolverines set off on their own, generally at around one year old (Pulliam 1968). Wolverines reproduce at very slow rates, with females reaching reproductive age at about 3 years of age. Wolverines birth only one kit an average of every 2.3 years (Inman et al. 2007b) and female reproductive success is critical to ensure the long-term viability of the species in the area.

Impacts to lynx may be long-term minor adverse effects because the mating season of the lynx overlaps OSV use in the park by about 2 weeks, and roaming lynx or wolverine's travels may be limited by groomed OSV use and disturbance (Copeland 1996; Mowat and Slough 1998). The early closure of the east entrance to OSV use (March 2 to 15), would minimize OSV disturbance to lynx in this area, but lynx traveling between territories may still be affected by OSV use in the park. Lynx appear somewhat able to adapt to moderate levels of human disturbance, thus the highest east entrance levels of 22 snowmobiles and 2 snowcoaches per day, resulting in up to 5 OSV groups/day proposed under alternative 7 would keep snowmobile traffic in the area at low levels. Radio/GPS collar tracking indicates that wolverines may travel up to 50 miles in a 17-hour period, and travel through non-preferred habitat, including the central portion of Yellowstone (Inman et al. 2007a). These travels may result in interactions between these animals and OSVs or groomed roads, even if lynx and wolverines are rarely seen by winter users due to the animals' keen senses and general avoidance of human activity.

Population-level impacts on lynx and wolverines under alternative 7 are predicted to be long-term minor adverse. Lynx and wolverines have large home range sizes and the travel between patchy habitat is important to population viability. Groomed roads and OSV presence may disrupt travel patterns of lynx or wolverines.

Cumulative Effects

Impacts on lynx and wolverines from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor to major adverse effects of these actions, when combined with the short- and long-term minor adverse impacts to potentially long-term moderate adverse impacts of alternative 7, would result in short- and long-term minor to major adverse cumulative impacts on these species. Alternative 7 would contribute a small amount to cumulative impacts, primarily due to continued OSV use in the park, and Sylvan Pass.

Conclusion

This alternative would maintain and allow OSV use in Sylvan Pass, the area of the park where human-wolverine interactions would be most likely to occur. However, daily entrance limits restrict the east entrance to just 22 snowmobiles and 2 snowcoaches per day, (five groups of OSVs), resulting in little use in this area, and minimal disturbance to wolverines. Restrictions on movements of lynx or wolverines during the winter months due to the presence and use of OSV routes in other areas of the park may limit the reproductive success, dispersal, and overall genetic sustainability of the species, but such impacts are difficult to predict. Therefore, impacts predicted under this alternative would be long-term minor adverse, with the potential for moderate adverse impacts if lynx and wolverines travel outside the eastern area of the park. Cumulative impacts to lynx and wolverines under

alternative 7 would be long-term minor to major adverse, to which alternative 7 would contribute a small amount.

TRUMPETER SWANS AND EAGLES

Both swans and eagles primarily use riparian or lakeside habitat in the park, and were regularly observed during NPS annual behavioral monitoring. Both are able travel via flight, limiting barrier impacts of roads in or outside the park, and of ground disturbance to these species outside nesting, hunting or feeding areas. These areas used by swans and eagles occur along lakes or in riparian areas, which are also popular OSV corridors. Therefore impacts by OSVs on these species are similar and they are combined for analysis.

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Displacement, Behavioral, and Physiological Effects

OSV use in the park would be minimal and limited to administrative use only. Displacement of bald eagles and swans is possible due to this occasional administrative use or to skiers or snowshoers in the park, but such displacement would be infrequent and short term, and a 400-meter no-stopping buffer around roosting or nesting eagles would remain in place for bald eagles in the park, which would reduce the risk of disturbance to eagles. The potential for other behavioral and physiological effects that could occur due to disturbance by foot traffic and low-level administrative traffic would be low, because this traffic would be so minimal under alternative 1. For these reasons, impacts from alternative 1 would be localized, short-term negligible adverse. Long-term impacts would be beneficial because during the majority of the winter season human disturbance would be removed.

Population-level Effects

The vast majority of effects would result from a small number of skiers or snowshoers, who are only rarely expected to encounter trumpeter swans or eagles. Winter users would not be present during the active nesting season for trumpeter swans, and skiers or snowshoers rarely elicit any response from wildlife (McClure et al. 2009; McClure et al. 2008), resulting in no impacts to the critical reproductive periods, mortality, or nesting that could lead to population-level effects. Impacts from population-level effects on swans and eagles under alternative 1 would therefore be long-term negligible adverse.

Mitigation

The park would be managed as a backcountry area for skiers or snowshoers. A 400-meter no stopping buffer would remain in place for bald eagles in the park, limiting the effects of skiers or snowshoers on eagles.

Cumulative Effects

Other past, present, and foreseeable future actions in and around Yellowstone have the potential to impact swans and eagles, particularly because these species are highly mobile during the winter and year-round, and are able to fly outside Yellowstone. Any actions that reduce the ability of swans to produce viable offspring could further contribute to observed regional declines in the species population.

The Gallatin National Forest has consolidated much of its checkerboard holdings in recent years, which has been accompanied by consolidation of private lands, especially in the Big Sky area. The net

effect of these consolidations on eagles and swans is difficult to predict, because consolidated USFS lands are less likely to be developed, whereas private lands are more likely to be developed.

Road construction projects in the park, such as the recent projects at the east entrance and Madison to Norris roads, have been or are being constructed in accordance with appropriate environmental reviews and mitigation measures so as to reduce impacts on wildlife in the region. Within the park, construction is also generally designed to minimize effects on wildlife. Overall, all construction projects in the region must minimize the effects of any projects on bald eagles. Swans are similarly protected under the Migratory Bird Treaty Act. Additionally, swans and eagles are rarely killed on roads. Impacts due to road development and construction in the greater Yellowstone area would be localized, long-term negligible to moderate adverse.

The negligible to moderate impacts of these past, present, and reasonably foreseeable future actions, combined with the short- and long-term negligible adverse impacts of alternative 1, would result in long-term minor adverse cumulative impacts on trumpeter swans and bald eagles. Alternative 1 would not include visitor OSV use in the park and would contribute only a small amount to the overall cumulative impacts.

Conclusion

Alternative 1 would result in short- and long-term negligible adverse impacts on swans and eagles in the park because OSV use would be limited to minimal administrative use and there would be no observable impacts. Cumulative impacts would be long-term minor adverse, and alternative 1 would contribute a minimally to the overall cumulative impacts to eagles and swans.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Displacement, Behavioral, and Physiological Effects

Alternative 2 would allow for OSV use up to current permitted use levels under the 2009 interim rule at 318 guided snowmobiles and 78 snowcoaches per day. Recent observations of behavior demonstrate few active responses by eagles or swans when exposed to OSVs, with 80% of swans and 62% of eagles showing no reaction to OSVs, 8% of swans and 9% of eagles traveling away from disturbance, and no swans and 3% of eagles exhibiting a flight response (McClure et al. 2009). The likelihood of an active response by bald eagles and swans increase with decreased distance to the road, longer interaction time, direct approach or harassment by humans, approach by humans on foot, and, for eagles, burned forest habitat compared to open meadow (Grubb et al. 2002; Gonzalez et al. 2006; Borkowski et al. 2006; White et al. 2006). Therefore, behavioral observations under use levels during the 2009 interim rule show limited displacement and few energetically costly behavioral responses, which would also likely limit physiological responses in swans and eagles. This indicates that a majority of both swans and eagles are expected to demonstrate limited responses to OSVs under the use limits proposed for alternative 2, which includes the same limits on OSVs as the 2009 interim rule. Also, swans demonstrate some level of habituation to OSV users (Hardy 2001; White et al. 2008), and guiding requirements in alternative 2 would limit actions by humans (e.g., interaction time) that precipitate stronger responses by swans and eagles. For these reasons, impacts on swans and eagles under alternative 2 would be localized, short-term negligible to minor adverse.

Population-level Effects

For bald eagles, increased behavioral responses to OSVs may result in reproductive failure or mortality if eagles avoid accessing prime foraging areas, or are subject to such frequent flight

responses that their eggs or young fail to survive. These responses may also require increased energy due to stress and increased activity (Stalmaster and Kaiser 1998; Steidl and Anthony 2000), because their critical breeding and nesting season overlaps with OSV use in the park. Researchers have linked human disturbance to temporary and permanent nest abandonment by swans, along with movement from preferred breeding areas (Bangs et al. 1982). Although swans incubate eggs in May and hatch in June, well outside the time period of OSV use in the park, breeding pairs of swans begin choosing territories as early as February. Therefore, any increases in the frequency and duration of encounters between OSVs and swans or eagles and increases in duration of encounters heighten the probability of adverse impacts on the reproductive success of both species. However, there are successful swan breeding territories near motorized routes in the greater Yellowstone area outside the park (McEneaney 2006), and OSV have not been shown to be the primary factor in the decline of the resident swan population (Proffitt 2008). Eagle nests may fall within the 250 meter buffer distance specified for protection by the USFWS (USFWS 2008a). For example, foraging or roosting eagles near the Firehole and Madison drainages are often less than 250 meters from the road. Eagles exhibit increased behavioral response frequency and intensity with shorter distance to disturbance, number of vehicles per event, and interaction duration and rates (Gonzalez et al. 2006; White et al. 2008). However, current management protocols include a 400-meter no-stopping buffer, so OSV traffic would not be permitted to stop near any such nest when it is occupied. Thus, population-level impacts under alternative 2 to both swans and eagles would be localized, long-term negligible to minor adverse.

The impacts described above would be mitigated under this alternative in several ways. Monitoring of human-wildlife interactions would continue under all alternatives. If NPS monitoring indicates that human presence or activities have unacceptable effects on swans or eagles that cannot be otherwise mitigated, selected areas of the park (including sections of roads) may be closed to visitor use. Additionally, any area containing a nesting pair of swans would be closed by park management, and there is a mandatory no-stopping requirement in a 400-meter buffer zone from bald eagle nests. The park has the authority to close areas of the park for wildlife protection, such as to prevent disturbance of nesting eagles, or to enforce a buffer zone. Such closures would effectively limit adverse impacts of OSV use.

Cumulative Effects

Impacts on trumpeter swans and bald eagles from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The negligible to moderate adverse effects of these actions, when combined with the short- to long-term negligible to minor adverse impacts of alternative 2, would result in short- and long-term minor adverse cumulative impacts on these species. Alternative 2 would contribute a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 2 would limit impacts to swans and eagles through use-limits, guiding requirements, and little overlap of OSV use with the active swan nesting season. Given these conditions and the mitigation measures discussed above, impacts to eagles and swans under alternative 2 would be localized short- to long-term negligible to minor adverse. Cumulative impacts would be long-term minor adverse, and alternative 2 would contribute a small amount to the overall adverse cumulative impacts.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Displacement, Behavioral, and Physiological Effects

Alternative 3 would allow up to 720 guided snowmobiles and 78 snowcoaches per day, nearly double the level currently permitted. Recent wildlife behavioral observations found few active responses by eagles or swans when exposed to OSVs, as described under alternative 2. From 2004 to 2009, daily limits were up to 720 snowmobiles and 78 snowcoaches, but actual use was lower, similar to the limits proposed under alternative 3. During this time, 60% of swans and 17% of eagles showed no response to OSVs, and 10% of eagles and 10% of swans responded with travel or flight (White et al. 2006, White et al. 2008). Thus, vigilance responses appeared to increase with higher OSV use levels. There would likely be more vigilance responses by both swans and eagles with higher use levels, which may increase non-visible physiological responses and associated nesting success. However, swans demonstrate some level of habituation to OSV users, and guiding requirements would limit actions by humans (e.g., increased interaction time) that precipitate stronger responses by swans and eagles. Therefore, impacts on swans and eagles under alternative 3 would be localized short-term minor adverse.

Population-level Effects

For bald eagles and swans, increased behavioral responses to OSVs may result in reproductive failure, mortality, or nest abandonment, as described under alternative 2. However, guiding requirements would limit human activities that precipitate stronger responses by swans and eagles. Thus, due to increased frequency of OSV encounters with higher daily entrance limits and increased vigilance responses of bald eagles and swans when exposed to the OSV numbers proposed under alternative 3, population-level impacts under alternative 3 would be long-term minor adverse.

Cumulative Effects

Impacts on trumpeter swans and bald eagles from other past, present, and reasonably foreseeable future action would be the same as described for alternative 1. The negligible to moderate adverse effects of these actions, when combined with the short- to long-term minor adverse impacts of alternative 3, would result in short- and long-term minor adverse cumulative impacts on these species. Alternative 3 would contribute a noticeable amount to the overall adverse cumulative impacts.

Conclusion

Alternative 3 would limit impacts to swans and eagles as described in alternative 2, but would allow for a greater number of OSVs in the park on a daily basis and would result in short and long-term minor adverse impacts. Cumulative impacts would be long-term minor adverse, and alternative 3 would contribute a noticeable amount to the overall adverse cumulative impact.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Displacement, Behavioral, and Physiological Effects

Alternative 4 would reduce daily OSV levels to up to 110 guided snowmobiles and 30 snowcoaches per day, and would plow the park road from the west and north entrances to Old Faithful, with a limit of up to 100 guided, wheeled vehicles on these roads. Recent wildlife behavioral observations found few active responses by eagles or swans when exposed to OSVs, as described under alternative 2.

Road plowing itself would have little effect on bald eagles or swans, because they are mainly found along river drainages and lakes, and fly from one location to another. Wheeled vehicle use and plowing would take place on roads where the majority of encounters between OSVs and eagles or swans currently occur (McClure et al. 2009). Guided wheeled vehicles would have effects on swans and eagles similar to those from snowcoaches because they are of similar size. The potential for human behavior that precipitates more frequent and higher level responses, such as direct approach, stopping, or increased duration of interaction would be reduced due to the relatively low (100) wheeled vehicle limit and guiding requirements. Although buses could continue to pass within 250 meters of nests due to road location, fewer buses would pass by on a daily basis. A majority of both swans and eagles would be exposed to fewer motorized vehicles per day, and guiding requirements would limit actions by humans (e.g., interaction time) that precipitate stronger responses by swans and eagles. Also, swans demonstrate some level of habituation to OSV users. Therefore impacts on swans and eagles under alternative 4 would be localized short-term negligible adverse.

Population-level Effects

For bald eagles and swans, increased behavioral responses to OSVs may result in reproductive failure, mortality, or nest/nest site abandonment, as described under alternative 2. Therefore, the decrease in the frequency of interaction and reduction in duration of contact between OSVs and swans or eagles under alternative 4 would reduce the risk of adverse impacts on the reproductive success of both species. The 400-meter no-stopping buffer near eagle nests and regulations on group size and entrance limits would decrease the duration and frequency of encounters with OSVs. The lower daily entrance limits of wheeled buses in the area of the park where the majority of encounters between eagles or swans and OSVs currently occur would decrease the frequency of these encounters. Also, guiding requirements would limit human activities that precipitate stronger responses by swans and eagles. Thus, population-level impacts under alternative 4 would be long-term negligible adverse.

Cumulative Effects

Impacts on trumpeter swans and bald eagles from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The negligible to moderate adverse effects of these actions, when combined with the short- to long-term negligible adverse impacts of alternative 4, would result in short- and long-term minor adverse cumulative impacts on these species. Alternative 4 would contribute a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 4 would limit impacts to swans and eagles due to low use limits, reduction in overall motorized vehicle use in the winter within the park, guiding requirements, and little overlap with active swan nesting season. The low use levels and guiding requirements would result in localized short and long-term negligible adverse impacts to eagles and swans under alternative 4. Cumulative impacts would be long-term minor adverse, and alternative 4 would contribute a small amount to the overall adverse cumulative impacts.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Displacement, Behavioral, and Physiological Effects

Initially impacts under alternative 5 would be the same as alternative 2. Alternative 5 could reduce use levels to 120 guided snowcoaches per day and zero snowmobiles. Recent wildlife behavioral observations found few active responses by eagles or swans when exposed to OSVs, as described in

alternative 2. Decreasing current use levels to roughly one-third would result in reduced frequency of interactions between OSVs and eagles or swans, overall decreasing interaction duration, and resulting in fewer adverse behavioral, physiological, and displacement effects. The potential for human behavior that precipitates more frequent and higher level responses, such as direct approach, stopping, or increased duration of interaction would be reduced due to the relatively low (120) snowcoach limit, and guiding requirements. Although snowcoaches would continue to pass within 250 meters of nests due to road location, fewer overall OSVs would pass by on a daily basis. A majority of both swans and eagles would be exposed to fewer OSVs per day, and guiding requirements would limit actions by humans (e.g., increased interaction time) that precipitate stronger responses by swans and eagles. Also, swans demonstrate some level of habituation to OSVs. Therefore impacts on swans and eagles under alternative 5 would be localized short-term negligible adverse.

Population-level Effects

For bald eagles and swans, increased behavioral responses to OSVs may result in reproductive failure, mortality, or nest abandonment, as described under alternative 2. The 400-meter no-stopping buffer near eagle nests and regulations on group size and low entrance limits would decrease the duration and frequency of encounters with OSVs. Lower daily entrance limits of snowcoaches would decrease the frequency of vehicle encounters. Also, guiding requirements would limit human activities that precipitate stronger responses by swans and eagles. Thus, population-level impacts under alternative 5 would be long-term negligible adverse,

Cumulative Effects

Impacts on trumpeter swans and bald eagles from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The negligible to moderate adverse effects of these actions, when combined with the short- to long-term negligible adverse impacts of alternative 5, would result in short- and long-term minor adverse cumulative impacts on these species. Alternative 5 would contribute a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 5 would limit the impacts to swans and eagles through low use limits, guiding requirements, and little overlap between OSV use and the active swan nesting season. The low use levels and guiding requirements would limit impacts to eagles and swans under alternative 5 and result in localized short and long-term, negligible, adverse impacts. Cumulative impacts would be long-term minor adverse, and alternative 5 would contribute a small amount to the overall adverse cumulative impacts.

Impacts of Alternative 6: Implement Variable Management

Displacement, Behavioral, and Physiological Effects

Alternative 6 would increase use levels to up to 540 snowmobiles, and up to 78 snowcoaches per day, with a wide range of variability in the numbers of OSVs that could enter the park daily, with days of zero use also possible. Up to 25% of snowmobiles would be unguided or non-commercially guided, and daily entrance allocations and entrance limits would vary throughout the winter use season. From 2004 to 2009, when actual use levels (average daily use of 258 snowmobiles and 30 snowcoaches, peak daily use of 488 snowmobiles and 55 snowcoaches a year) were similar to those proposed under alternative 6, 60% of swans and 17% of eagles showed no response to OSVs, and 10% of eagles and 10% of swans responded with travel or flight. It is likely that actions by unguided snowmobile users,

including stopping near nesting or roosting eagles and direct approach, would increase the potential for higher level and more frequent behavioral responses by swans and eagles (Grubb et al. 2002). Additionally, increases in snowmobile group size to 22 under alternative 6 would increase the likelihood of stronger behavioral responses by swans and, to a lesser extent eagles (White et al. 2006). Therefore, there would likely be more vigilance responses by both swans and eagles under alternative 6 with higher use levels and the unguided user provision, which may increase non-visible physiological responses and decrease associated nesting success. Increasing current use levels would result in increased frequency and duration of interactions between OSVs and eagles or swans and more adverse behavioral, physiological, and displacement effects. The guiding requirements for the majority of snowmobiles and for all snowcoaches under this alternative would limit actions by humans that precipitate stronger responses by swans and eagles, and the larger group size could reduce the numbers of groups, but the potential for human activity that would elicit more frequent and/or higher level responses would be increased due to the inclusion of unguided tours. Both swans and eagles would be exposed to more OSVs per day, but swans demonstrate some level of habituation to OSVs. Therefore impacts on swans and eagles under alternative 6 would be localized, short-term minor to potentially moderate adverse

Population-level Effects

For bald eagles and swans, increased behavioral responses to OSVs may result in reproductive failure, mortality, or nest abandonment, as described under alternative 2. The 400-meter no-stopping buffer near eagle nests and regulations on group size and entrance limits decreases the duration and frequency of encounters with OSVs. However, the unguided user provision and relatively high use limits under alternative 6 may result in increased adverse responses by eagles and swans to OSVs, increasing energy expenditure, and possibly decreasing survival and reproductive rates of eagles and swans. Also, there would be increased frequency of vehicle encounters with higher daily entrance limits of OSVs. The OSV use season overlaps with the establishment of nesting territory by breeding pairs of swans. Increased behavioral responses by swans to OSV use under alternative 6 may result in minor to moderate impacts. There is little overlap of OSV use with the active swan nesting season, which would limit impacts to that species. Population-level impacts under alternative 6 would be long-term minor to moderate adverse.

Cumulative Effects

Impacts on trumpeter swans and bald eagles from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The negligible to moderate adverse effects of these actions, when combined with the short- to long-term minor to moderate adverse impacts of alternative 6, would result in short- and long-term minor to moderate adverse cumulative impacts on these species. Alternative 6 would contribute a noticeable amount to the overall adverse cumulative impacts.

Conclusion

Alternative 6 would limit impacts to swans and eagles due to use-limits, guiding requirements, and little overlap between OSV use and the active swan nesting season, but would increase OSV use levels on some days beyond current use levels. Impacts to eagles or swans under alternative 6 would be short- and long-term minor to moderate adverse because use levels would increase and up to 25% unguided/non-commercially guided snowmobile use would be permitted. Cumulative impacts would be long-term minor to moderate adverse, and alternative 6 would contribute a noticeable amount to the overall adverse cumulative impacts.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Displacement, Behavioral, and Physiological Effects

Alternative 7 would allow for OSV use just above the current permitted use levels under the 2009 interim rule for half the winter season, at 330 guided snowmobiles and 80 snowcoaches per day. Recent observations of behavior demonstrated few active responses by eagles or swans when exposed to OSVs, with 80% of swans and 62% of eagles showing no reaction to OSVs, 8% of swans and 9% of eagles traveling away from the disturbance, and no swans and 3% of eagles exhibiting a flight response (McClure et al. 2009). Flexible daily limits, that may result in blocks of time (weeks or days) with maximum entrance numbers, when combined with the 10:30 a.m. entrance cut-off, may result in concentrating OSV use into a shorter time period along routes, such as Madison to Old Faithful, where OSV and eagle or swan encounters occur. The likelihood of an active response by bald eagles and swans increases with decreased distance to the road, longer interaction time, direct approach or harassment by humans, approach by humans on foot, and, for eagles, burned forest habitat compared to open meadow (Grubb et al. 2002; Gonzalez et al. 2006; Borkowski et al. 2006; White et al. 2006). Even with OSV group size limits, frequent encounters with OSVs may increase the likelihood of a heightened behavioral response, because closely spaced OSV groups may have similar effects to that of larger OSV group size and longer interaction time between OSVs and wildlife.

Behavioral observations under use levels under the 2009 interim rule, show limited displacement, and few energetically costly behavioral responses which would also likely limit physiological responses in swans and eagles. Therefore a majority of both swans and eagles are expected to demonstrate limited responses to OSVs under the use limits proposed for alternative 7, which includes maximum OSV use limits similar to the 2009 interim rule, during half the winter use season. Swans demonstrate some level of habituation to OSV users (Hardy 2001; White et al. 2008), and guiding requirements in alternative 7 would limit actions by humans (e.g., increased interaction time) that precipitate stronger responses by swans and eagles. For these reasons, impacts on swans and eagles under alternative 7 would be localized, short-term negligible to minor adverse.

Population-level Effects

Because bald eagle critical breeding and nesting season overlaps with OSV use in the park, increased behavioral responses to OSVs may result in reproductive failure or mortality if eagles avoid accessing prime foraging areas or if eagles are subject to such frequent flight responses that they abandon the nest, or eggs fail to survive, or require increased energy due to stress and increased activity (Stalmaster and Kaiser 1998; Steidl and Anthony 2000). Researchers have linked human disturbance to temporary and permanent nest abandonment by swans, along with movement from preferred breeding areas (Bangs et al. 1982). Although swans incubate eggs in May and hatch in June, which is well outside the time period of OSV use in the park, breeding pairs of swans begin choosing territories as early as February. Therefore, any increases in the frequency or duration of encounters between OSVs and swans or eagles heighten the probability of adverse impacts on the reproductive success of both species. However, there are successful swan breeding territories near motorized routes in the greater Yellowstone area outside Yellowstone (McEneaney 2006), and OSV have not been shown to be the primary factor in the decline of the resident swan population (Proffitt 2008). OSVs may travel within the 250-meter buffer distance specified for protection by the USFWS (USFWS 2008a). For example, foraging or roosting eagles near the Firehole and Madison drainages are often less than 250 meters from the road. Eagles exhibit increased behavioral response frequency and intensity with shorter distance to disturbance, number of vehicles per event, and interaction duration and rates (Gonzalez et al. 2006; White et al. 2008). Current management protocols include a 400-meter no-

stopping buffer, so OSV traffic would not be permitted to stop near any such nest when it is occupied. Thus, population-level impacts under alternative 7 to both swans and eagles would be localized, long-term negligible to minor adverse.

Mitigation measures under this alternative would be the same as those described under alternative 2, with the addition of the 10:30 a.m. entrance limit for OSVs, which would concentrate OSV use. Alternative 7 also would close the east entrance to OSVs from December 15 to 21 and in the spring, from March 2 to 15, during the last two weeks of the winter use season. Early closure of the east entrance would have little impact on eagles and swans, because they are not generally found in the east sector of the park. Variable daily entrance limits would result in reduced OSV traffic during half of the winter season, but park planning would allow for annual variation that would increase limits during periods of greater visitor demand. This may mean that entrance numbers would be similar to those under alternative 2, because visitor demand fluctuates during the winter use season and periods of high demand would be filled to the maximum limit, whereas periods of low demand would remain at levels below the allowed maximum.

Cumulative Effects

Impacts on trumpeter swans and bald eagles from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The negligible to moderate adverse effects of these actions, when combined with the short- to long-term negligible to minor adverse impacts of alternative 7, would result in short- and long-term minor to moderate adverse cumulative impacts on these species. Alternative 7 would contribute minimally to the overall adverse cumulative impacts.

Conclusion

Alternative 7 would limit impacts to swans and eagles through use-limits, guiding requirements, and little overlap of OSV use with the active swan nesting season. Given these conditions and the mitigation measures discussed above, impacts to eagles and swans under alternative 7 would be localized short- to long-term negligible to minor adverse. Cumulative impacts would be long-term minor to moderate adverse, and alternative 7 would contribute minimally to the overall adverse cumulative impacts.

GRAY WOLVES

Since their reintroduction from 1995 to 1997, wolf numbers increased until 2003, when density-dependent factors unrelated to OSV use (including disease) caused declines. Wolves within the Yellowstone area are classified as a non-essential, experimental population by the USFWS, and per the ESA (10(j)), are managed within Yellowstone as a threatened population. Gray wolves rarely encounter OSV users in the park, and it would appear that wolves avoid areas of frequent OSV use (McClure et al. 2009). During winter foraging travels, gray wolves frequent ungulate winter ranges including the Yellowstone northern range and areas of geothermic influence in the park (Green et al. 1997); there are fewer wolves in the interior of the park than on the northern range because there are fewer elk in the interior (Smith et al. 2010, Sacklin pers. comm. 2010). Elk make up 83% of their diet, and other ungulates compose most of the remainder. Ungulate carcasses from winter-kill are also consumed during the spring denning season (Creel et al. 2007). During winter, wolves appear to travel primarily at night when in developed areas, with several nocturnal kills documented in these areas. Wolves den in April, after the winter use season has ended (Smith et al. 2010).

Disturbance to wolves from OSV use has been occasionally observed during wildlife monitoring surveys, and the majority of wolf responses to OSV use consisted of “look-resume” or no visible response (McClure et al. 2009). Although higher glucocorticoid levels have been documented in wolves at locations and times with increased snowmobile use, there is no evidence that this has caused population-level effects (Creel et al. 2002). Compacted OSV routes may provide low energy winter travel routes for wolves to access areas of ungulate use, or may direct the movements of wolves along roads, due to the ease of travel.

Wolves in and around Yellowstone rarely pose a threat to humans or demonstrate begging behaviors or approach humans, due in to an abundance of native prey animals, general avoidance of humans, and, in part to hazing of any wolves frequenting areas of human use or development, or observed approaching people. In 2009, the four member Canyon wolf pack were successfully hazed away from a denning site near Mammoth Hot Springs. Although the pack did not approach humans and were not food conditioned, the amount of human use in the area frequented by the wolves was an issue. After hazing, the pack moved on to its summer range in Hayden Valley. During the previous summer, prior to the hazing events of spring 2009, the wolves had approached vehicles, and frequently traveled on the Hayden Valley road. In summer 2009, following hazing, the Canyon wolves did not demonstrate these behaviors. The success of hazing with this pack and other wolf hazing in the park, indicates that hazing is a successful strategy for habituated wolves, and effectively stops unwanted behaviors (Smith et al. 2010). Due to its level of habituation, hazing was not attempted on a yearling wolf from the Gibbons pack; this wolf was lethally removed on May 19, 2009 because of apparent food conditioning and habituation to humans demonstrated by the wolf approaching humans and chasing several park visitors. This wolf had likely been fed by people (Smith et al. 2010). Guiding requirements, education on proper storage of food and behavior around wildlife, and limits to the total number of visitors a day limit the development of habituation in park wolves due to winter use. It appears that wolves generally avoid encounters with OSV users, and may preferentially choose to travel on OSV roads during times of low human activity (Smith et al. 2008, 2009, 2010).

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Displacement, Behavioral, and Physiological Effects

Though a few visitors might travel into the park on foot (skiers and snowshoers), it is unlikely that they would venture far into the park or into the winter ranges of wolves or that visitors would encounter any roaming wolves anywhere else in the park due to the scarcity and elusiveness of wolves and their propensity for night or dusk travel, when humans are generally not active in the park (Smith et al. 2009). Because no OSV use would be permitted under this alternative, OSVs would not operate in the wolves’ winter range. Encounters are possible, but wolves are likely to generally avoid interaction and effects would be short-term and rare. Therefore minimal displacement is expected to occur under this alternative and behavioral and physiological effects would be extremely rare. Displacement, behavioral, and physiological impacts on wolves under alternative 1 would be localized, short-term negligible adverse.

Population-level Effects

Under this alternative there would be minimal population-level effects such as disturbance during denning season, or disruption of hunting success. This is because there would be a nearly complete lack of interaction or encounters between winter users and wolves. Impacts would be long-term negligible adverse.

Cumulative Effects

Wolves are listed as endangered in the Northern Rockies, and are therefore covered under the ESA. This requires that the states must maintain long-term viability of wolves. Wolves are classified as experimental populations in southern Montana, Idaho south of I-90, and all of Wyoming, which allows for greater management flexibility; however, regulations are meant to limit adverse impacts. Experimental classification could lead to culling and result in both long- and short-term minor to moderate adverse impacts on wolf populations in the greater Yellowstone area.

The Gallatin National Forest Travel Plan Revision, and the Beartooth Custer National Forest Travel Management Plan are now being implemented. Actions associated with these plans could affect wolves, but negative effects would be minimized because federal and state wildlife management agencies are required to ensure the long-term viability of wolves in their planning efforts and projects. Impacts would be long-term negligible to minor adverse.

The Gallatin National Forest has recently consolidated much of its checkerboard public and private land holdings, accompanied by the consolidation of private lands, particularly in the Big Sky area. This means there are larger tracts of public land that are less likely to be developed, but also large areas of private lands that are more likely to be developed. The net effects of these actions on wolves are difficult to predict.

The Gardiner Basin and Cutler Meadows restoration (currently in progress) would likely benefit wolf prey species, because the prey species preferred browse of native plants would be favored by these restorations, with overall long-term beneficial impacts to wolves.

Any of the above actions that increase or decrease the population of prey/carcass availability for wolves would also affect their range and population in the study area.

Impacts of past, present, and foreseeable future actions would be long-term minor adverse. The impacts of these past, present, and reasonably foreseeable future actions, combined with the short and long-term negligible adverse impacts of alternative 1, would result in long-term minor adverse cumulative impacts on wolves. Alternative 1 would contribute a small amount to the overall cumulative impacts.

Conclusion

Alternative 1 would result in short- and long-term negligible adverse impacts on wolves in the park because OSV use would be limited to minimal administrative use and there would be no observable impacts. The limited human presence would have long-term beneficial impacts. Cumulative impacts would be long-term, minor, adverse, and alternative 1 would contribute a small amount to the overall cumulative impacts.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Displacement, Behavioral, and Physiological Effects

Alternative 2 would continue use levels under the 2009 interim rule of up to 318 guided snowmobiles and 78 guided snowcoaches per day. Winter road monitoring crews rarely observed behavioral responses by wolves to OSVs in Yellowstone, due to infrequent encounters, with a total of only 14 sightings of wolf-OSV interaction over the last seven winter monitoring seasons. Generally, responses by wolves are either look-resume or no visible response (McClure et al. 2009). Glucocorticoid

measurements from wolves in Yellowstone and other areas where wolves are exposed to snowmobiles were correlated between and within years during periods of higher OSV activity (Creel et al. 2002). Chronic elevated glucocorticoid levels may result in long-term adverse effects on immune function and body condition, decreasing survival and reproductive rates (Sapolsky 1992). No evidence exists for population-level effects (Creel et al. 2002). Also, frequent exposure to humans may result in habituation by wolves, resulting in possible lethal removal if wolves lose fear of humans and begin to engage in problematic behaviors such as approaching humans or chasing visitors (Smith et al. 2010).

Wolves appear to avoid interaction with OSV users, but there is no evidence from wolf territories in the park of large-scale displacement or habitat avoidance (Smith et al. 2005). Observations of habitat use by radio-collared wolves indicate that wolves frequently travel in the Madison-Firehole-Gibson basin during Winter OSV use, but avoid areas of human activity during the day. Wolf tracks were frequently observed on roads at night, suggesting that wolves travel on roads at night to conserve energy but avoid OSV activity during the day (Smith et al. 2005; Smith et al. 2006). It appears that wolves avoid encounters with OSVs and maintain normal travel activities in the park. Wolves may travel on roads to conserve energy, but they do not appear to follow roads for long distances, or to areas they would not frequent otherwise. Physiological responses would likely be increased with increased numbers of OSVs in the park, but guiding requirements and use-limits under alternative 2 would limit these responses. Therefore, impacts under alternative 2 would be localized, short-term negligible to minor adverse.

Population-level Effects

Wolf populations in the park have grown during periods of much higher OSV use than those occurring under recent conditions (with daily averages of 795 snowmobiles/day), and data suggest that inter-species aggression and natural mortality causes including diseases influence park wolf populations more than disturbance from OSV use. However, in the first few years after wolves were reintroduced to the Lamar Valley in 1995 and 1996, there was little inter-species competition due to the low total number of wolves in the park and large unoccupied territories containing ample available prey species, so it is unknown how OSV use affected population growth. Additionally, wolf hunting success data suggests that wolves are more likely to successfully bring down an elk in areas that are flat, open, and near roads (Creel and Winnie 2005). Such data suggest that avoidance of such areas by wolves during the day, due to OSV use, may limit their hunting success, in turn increasing energy expenditure and mortality and reproductive success. Also the levels of use under alternative 2 could result in some increases in glucocorticoid levels, indicating increased stress, which could eventually affect reproductive and survival rates of this species; however, chronic elevations that result in decreased reproductive survival rates of this species are unlikely. Therefore, population-level impacts under alternative 2 are predicted to be long-term negligible to minor adverse.

The impacts described above would be mitigated under this alternative through several measures. If NPS monitoring indicates that human presence or activities are having unacceptable effects on wolves that cannot be otherwise mitigated, selected areas of the park (including sections of roads) may be closed to visitor use. Additionally, areas within a 1-mile radius of a wolf den are closed to public entry and many of the wolf dens are already within grizzly bear spring closure areas, which are protected from human disturbance.

Cumulative Effects

Impacts on wolves from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The minor adverse effects of these actions, when combined with the short and long-term negligible to minor adverse impacts of alternative 2, would result in long-term

minor adverse cumulative impacts on wolves. Alternative 2 would contribute a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 2 would result in short- and long-term negligible to minor adverse impacts on wolves in the park because OSV use would be limited to current use levels, which would reduce the frequency of OSV encounters, and limit the duration of interaction and the approach distance of OSV users due to guiding requirements. Cumulative impacts would be long-term minor adverse, and alternative 2 would contribute a small amount to the overall adverse cumulative impacts.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Displacement, Behavioral, and Physiological Effects

Alternative 3 would increase OSV use levels up to 720 guided snowmobiles and 78 guided snowcoaches per day. Winter road monitoring crews rarely observed behavioral responses by wolves to OSVs in Yellowstone due to infrequent encounters, with a total of only 14 sightings of wolf-OSV interaction over the last seven winter monitoring seasons. Generally responses by wolves are either look-resume or no visible response (McClure et al. 2009), as described under alternative 2.

Wolves appear to avoid interaction with OSV users, but there is no evidence from wolf territories in the park of large-scale displacement or habitat avoidance (Smith et al. 2005). Observations of habitat use by radio-collared wolves indicate that wolves frequently travel in the Madison-Firehole-Gibson basin during Winter OSV use, but avoid areas of human activity, during the day. Wolf tracks were frequently observed on roads at night, suggesting that wolves travel on roads at night to conserve energy, but avoid OSV activity during the day (Smith et al. 2005; Smith et al. 2006). Frequent exposure to humans may result in habituation by wolves, resulting in possible lethal removal if wolves lose fear of humans and begin to engage in problematic behaviors such as approaching humans or chasing visitors (Smith et al. 2010), but such behaviors have not been attributed to winter OSV users following establishment of guiding requirements, which effectively eliminate problematic human behaviors such as feeding wolves or the dumping food scraps.

Under alternative 3 the frequency and duration of OSV presence in the park would increase, and wolves would need to spend more time avoiding encounters with OSVs, possibly affecting their normal routes of travel and causing small-scale displacement. Physiological responses would likely be increased with increased numbers of OSVs in the park. Therefore, impacts of alternative 3 would be localized short-term minor adverse.

Population-level Effects

Wolf populations in the park have grown during periods of similar OSV use similar to that which would occur under alternative 3 (daily averages of 700-800 snowmobiles/day), and data suggest that inter-species aggression and natural causes influence park wolf populations more than OSV use, as described under alternative 2. Such data suggest that avoidance of areas by wolves during the day due to OSV use may limit their hunting success, in turn increasing energy expenditure and mortality and reducing reproductive success. Also, the levels of use under alternative 3 could result in increased glucocorticoid levels, indicating increased stress, but there is no evidence of population-level effects. Therefore, population-level impacts under alternative 3 are predicted to be long-term minor adverse.

Cumulative Effects

Impacts on wolves from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The minor adverse effects of these actions, when combined with the short- and long-term minor adverse impacts of alternative 3, would result in long-term minor adverse cumulative impacts on wolves. Alternative 3 would contribute a noticeable amount to the overall adverse cumulative impacts due to the increased level of ORV use permitted.

Conclusion

Alternative 3 would result in short- and long-term minor adverse impacts on wolves in the park because OSV use would increase the frequency and duration of OSV exposure. The guiding requirement regulates the interaction time and approach distance of OSV users, limiting adverse impacts from direct interaction. Cumulative impacts would be long-term minor adverse, and alternative 3 would contribute a noticeable amount to the overall adverse cumulative impacts.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Displacement, Behavioral, and Physiological Effects

Alternative 4 would implement winter use levels of up to 110 guided snowmobiles, 30 guided snowcoaches, and 100 guided wheeled buses on the roads from the north and west entrances to Old Faithful per day. Use at these levels would result in a total of 240 motorized vehicles in the park per day, which would be lower than the total number of vehicles allowed in the park currently. Roads may adversely affect wolf movements, dispersal, and general use of an area; however, plowed roads and use of buses rather than OSVs would have similar impacts to guided snowcoaches. The lower number of motorized vehicles in the park would correlate with lower glucocorticoid levels and reduced stress and associated adverse effects. Therefore, it is expected that the lower levels of motorized vehicle use proposed under alternative 4 would minimally elevate glucocorticoid levels, potentially resulting in minor long-term adverse effects on immune function and body condition (Sapolsky 1992).

Wolves appear to avoid interaction with OSV users, and would likely also avoid wheeled commercial vehicles (such as vans and buses), but there is no evidence from wolf territories in the park of large-scale displacement or habitat avoidance (Smith et al. 2005). Observations of habitat use by radio-collared wolves indicate that wolves frequently travel in the Madison-Firehole-Gibson basin during Winter OSV use, but avoid areas of human activity during the day. Wolf tracks were frequently observed on roads at night, suggesting that wolves travel on roads at night to conserve energy, but avoid OSV activity during the day (Smith et al. 2005; Smith et al. 2006). Frequent exposure to humans may result in habituation by wolves, resulting in possible lethal removal if wolves lose fear of humans and begin to engage in problematic behaviors such as approaching humans or chasing visitors (Smith et al. 2010). Such habituation behaviors by wolves have not been attributed to OSV visitors, following establishment of guiding requirements which effectively eliminate problematic human behaviors such as feeding wolves or the dumping food scraps

Under alternative 4 the frequency and duration of motorized vehicle presence in the park would decrease, and wolves would need to spend less time avoiding encounters with OSVs, resulting in only small-scale displacement. Physiological responses would decrease with lower numbers of motorized users in the park. Therefore, impacts would be localized, short-term negligible to minor adverse.

Population-level Effects

Wolf populations in the park have grown during periods of much higher OSV use than that which would occur under alternative 4 (daily averages of 795 snowmobiles/day), and data suggest that inter-species aggression and natural causes influence park wolf populations more than OSV use, as described under alternative 2. Such data suggest that avoidance of such areas by wolves during the day, due to OSV use, may limit their hunting success, in turn increasing energy expenditure and mortality and reducing reproductive success. Also, it is likely that the levels of use under alternative 4 would result in some increases in glucocorticoid levels, indicating increased stress; however, it is unlikely that chronic elevations would eventually decrease reproductive and survival rates of this species. Therefore, population-level impacts under alternative 4 are predicted to be long-term negligible to minor adverse.

Cumulative Effects

Impacts on wolves from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The minor adverse effects of these actions, when combined with the short and long-term negligible to minor adverse impacts of alternative 4, would result in long-term minor adverse cumulative impacts on wolves. Alternative 4 would contribute a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 4 would result in short- and long-term negligible to minor adverse impacts on wolves in the park because motorized vehicle use would be limited to low use levels, which would reduce the frequency of motorized vehicle encounters with wolves, and limits duration and approach distance of OSV users when encountering wolves due to guiding requirements. Cumulative impacts would be long-term minor adverse, and alternative 4 would contribute a small amount to the overall adverse cumulative impacts.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Displacement, Behavioral, and Physiological Effects

Alternative 5 would potentially reduce OSV use levels to 120 guided snowcoaches per day, after a five-year phase out of snowmobiles. Prior to this phase out the impacts of alternative 5 would be the same as alternative 2. Depending on user-demand, the phase out may in anywhere from 78 guided snowcoaches and 318 guided snowmobiles per day to 120 snowcoaches and zero snowmobiles per day. If the five year phase out is completed, lower use levels of 120 guided snowcoaches and zero snowmobiles per day would limit the frequency and duration of OSV presence in the park, and would minimally elevate glucocorticoid levels, potentially resulting in few long-term adverse effects on immune function and body condition (Sapolsky 1992).

Wolves appear to avoid interaction with OSV users, but there is no evidence from wolf territories in the park of large-scale displacement or habitat avoidance (Smith et al. 2005). Observations of habitat use by radio-collared wolves indicate that wolves frequently travel in the Madison-Firehole-Gibson basin during Winter OSV use, but avoid areas of human activity, during the day. Wolf tracks were frequently observed on roads, suggesting that wolves travel on roads at night or when OSVs are not present to conserve energy, but avoid OSV activity during the day, indicating that displacement is short term and directly results from OSV presence (Smith et al. 2005; Smith et al. 2006). Frequent exposure to humans may result in habituation by wolves, resulting in possible lethal removal if wolves

lose fear of humans and begin to engage in problematic behaviors such as approaching humans or chasing visitors (Smith et al. 2010). Such habituation behaviors by wolves have not been attributed to OSV visitors following establishment of guiding requirements.

Under alternative 5 the frequency and duration of motorized vehicle presence in the park would decrease to relatively low levels, and wolves would need to spend less time avoiding encounters with OSVs, resulting in only small-scale, temporary displacement. Physiological responses would decrease with lower numbers of motorized users in the park. Therefore, impacts would be localized, short-term negligible to minor adverse.

Population-level Effects

Wolf populations in the park have grown during periods of much higher OSV use than that which would occur under alternative 5 (daily averages of 795 snowmobiles per day), and data suggest that inter-species aggression and natural causes influence park wolf populations more than OSV use, as described under alternative 2. Such data suggest that avoidance of such areas by wolves during the day due to OSV use may limit their hunting success, in turn increasing energy expenditure and mortality and reducing reproductive success. Also, it is likely that the levels of use under alternative 5 would result in some increases in glucocorticoid levels, indicating increased stress. However, chronic elevations that would result in decreased reproductive survival rates of this species are unlikely. Therefore, population-level impacts under alternative 5 are predicted to be long-term negligible adverse.

Cumulative Effects

Impacts on wolves from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The minor adverse effects of these actions, when combined with the short and long-term negligible to minor adverse impacts of alternative 5, would result in long-term minor adverse cumulative impacts on wolves. Alternative 5 would contribute a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 5 would result in short- and long-term negligible to minor adverse impacts on wolves in the park because OSV use would be limited to low use levels which reduces the frequency of motorized vehicle encounters with wolves, and limits duration and approach distance of OSV users when encountering wolves due to guiding requirements. Cumulative impacts would be long-term minor adverse, and alternative 5 would contribute a small amount to the overall adverse cumulative impacts.

Impacts of Alternative 6: Implement Variable Management

Displacement, Behavioral, and Physiological Effects

Alternative 6 would allow for variable use levels of up to 540 snowmobiles and 78 snowcoaches per day and variable entrance allocations, and would allow 25% of snowmobiles entering the park to be unguided. Unguided snowmobile use would increase the amount of OSV traffic in the park, and the level of behavioral responses by wolves. This is because unguided snowmobile users are more likely to engage in behaviors that cause increased behavioral responses, displacement, and associated physiological effects, such as traveling at high rates of speed and improper interactions with wildlife, as observed in unguided user interactions with other species during past winter use seasons (White et

al. 2008). Frequent exposure to humans may result in habituation by wolves, resulting in possible lethal removal if wolves lose fear of humans and begin to engage in problematic behaviors such as approaching humans or chasing visitors (Smith et al. 2010). Such habituation behaviors by wolves have not been attributed to OSV visitors, following establishment of guiding requirements which effectively eliminate problematic human behaviors such as feeding wolves or the dumping food scraps. However, the unguided/non-commercially guided alternative may increase problematic behaviors by human visitors, due to lack of trained commercial guides and regulation on proper wildlife interaction behavior, and careful storage and disposal of food. Behavioral observations of wildlife also indicate that larger OSV group sizes, such as those allowed under alternative 6, increase behavioral and associated physiological responses in wildlife. Under alternative 6 the increase in OSV use and the unguided entry provision may increase displacement of wolves from area of OSV use. Also, the increased levels of disturbance from more frequent OSV presence on snow roads, larger group sizes, and activities of unguided users (such as off-road travel or high rates of speed) may increase behavioral responses by wolves. Therefore, impacts would be localized, short-term minor to moderate adverse.

Population-level Effects

Wolf populations in the park have grown during periods of higher OSV use than those that would occur under alternative 6 (daily averages of 795 snowmobiles/day), and data suggest that inter-species aggression and natural causes influence park wolf populations more than OSV use, as described under alternative 2. Such data suggest that avoidance of such areas by wolves during the day, due to OSV use, may limit their hunting success, in turn increasing energy expenditure and mortality and reducing reproductive success. Chronic elevations that would result in decreased reproductive survival rates of this species are unlikely. Therefore, population-level impacts under alternative 6 are predicted to be long-term minor adverse.

Cumulative Effects

Impacts on wolves from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The minor adverse effects of these actions, when combined with the short and long-term minor to moderate adverse impacts of alternative 6, would result in long-term minor to moderate adverse cumulative impacts on wolves. Alternative 6 would contribute a noticeable amount to the overall adverse cumulative impacts.

Conclusion

Alternative 6 would result in long-term minor to moderate adverse impacts on wolves in the park because OSV use would increase to relatively high use levels, which would increase the frequency of OSV encounters with wolves and the duration of OSV presence. The unguided snowmobile provision may result in improper behavior and decreased approach distance of OSV users when encountering wolves. Cumulative impacts would be long-term minor to moderate adverse and alternative 6 would contribute a noticeable amount to the overall adverse cumulative.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Displacement, Behavioral, and Physiological Effects

Alternative 7 would continue use levels similar to the 2009 interim rule (330 guided snowmobiles and 80 guided snowcoaches per day). Winter road monitoring crews rarely observed behavioral responses

by wolves to OSVs in Yellowstone, due to infrequent encounters, with a total of only 14 sightings of wolf-OSV interaction over the last 7 winter monitoring seasons. Generally responses by wolves are either look-resume or no visible response (McClure et al. 2009). The levels of use under alternative 3 could result in increased glucocorticoid levels, indicating increased stress, but there is no evidence of population-level effects. Also, frequent exposure to humans may result in habituation by wolves, resulting in possible lethal removal if wolves lose fear of humans and begin to engage in problematic behaviors such as approaching humans or chasing visitors (Smith et al. 2010).

Wolves appear to avoid interaction with OSV users, but there is no evidence from wolf territories in the park of large-scale displacement or habitat avoidance (Smith et al. 2005). Observations of habitat use by radio-collared wolves indicate that wolves frequently travel in the Madison-Firehole-Gibson basin during Winter OSV use, but avoid areas of human activity during the day. Wolf tracks were frequently observed on roads at night, suggesting that wolves travel on roads at night to conserve energy but avoid OSV activity during the day (Smith et al. 2005; Smith et al. 2006). It appears that wolves avoid encounters with OSVs and maintain normal travel activities in the park. Wolves may travel on roads to conserve energy, but they do not appear to follow roads for long distances, or to areas they would not frequent otherwise. Physiological responses would likely be increased with increased numbers of OSVs in the park, but guiding requirements and use limits under alternative 7 would limit these responses. Because wolves rarely travel on OSV routes during the day, the addition of the 10:30 cut-off time, and variable use limits under alternative 7 would have minimal influence on wolves. Therefore, impacts under alternative 7 would be localized, short-term negligible to minor adverse.

Population-level Effects

Wolf populations in the park have grown during periods of much higher OSV use than that which occurs under current conditions (daily averages of 795 snowmobiles/day) and data suggest that inter-species aggression and natural causes including diseases influence park wolf populations more than disturbance from OSV use. However, in the first few years after wolves were reintroduced, there was little inter-species competition due to the low total number of wolves in the park and large unoccupied territories containing ample available prey species, so it is unknown how OSV use affected population growth. Additionally, wolf hunting success data suggests that wolves are more likely to successfully bring down an elk in areas that are flat, open, and near roads (Creel and Winnie 2005). Such data suggest that avoidance of such areas by wolves during the day, due to OSV use, may limit their hunting success, in turn increasing energy expenditure and mortality and reducing reproductive success. Also the levels of use under alternative 7 could result in some increases in glucocorticoid levels, indicating increased stress, which could eventually affect reproductive and survival rates of this species, however chronic elevations that result in decreased reproductive survival rates of this species are unlikely. Therefore, population-level impacts under alternative 7 are predicted to be long-term negligible to minor adverse.

Cumulative Effects

Impacts on wolves from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The minor adverse effects of these actions, when combined with the short and long-term negligible to minor adverse impacts of alternative 7, would result in long-term minor adverse cumulative impacts on wolves. Alternative 7 would contribute a small amount to the overall adverse cumulative impacts.

Conclusion

Alternative 7 would result in short- and long-term negligible to minor adverse impacts on wolves in the park because OSV use would be limited to current use levels, which would reduce the frequency of OSV encounters and limit the duration and approach distance of OSV users due to guiding requirements. Cumulative impacts would be long-term minor adverse, and alternative 7 would contribute a small amount to the overall adverse cumulative impacts.

AIR QUALITY

GUIDING REGULATIONS AND POLICIES

In compliance with the 1970 Clean Air Act (CAA) and the 1977 and 1990 CAA Amendments, the U.S. Environmental Protection Agency (EPA) has promulgated National Ambient Air Quality Standards (NAAQS) and regulations. The standards were enacted for the protection of the public health and welfare, allowing for an adequate margin of safety. To date, EPA has issued standards for six criteria pollutants: carbon monoxide (CO), sulfur dioxide (SO₂), particles with a diameter less than or equal to a nominal 10 micrometers (PM₁₀), particles with a diameter less than or equal to a nominal 2.5 micrometers (PM_{2.5}), ozone (O₃), nitrogen dioxide (NO₂), and lead (Pb). Each state and locality has the primary responsibility for air pollution prevention and control. Areas that do not meet national standards are called non-attainment areas. Refer to “Chapter 3: Affected Environment” for more information on each of the criteria pollutants and associated NAAQS.

In addition to the CAA, air quality is also addressed in *NPS Management Policies 2006*. The *NPS Management Policies 2006* state that 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 2006a; Section 4.7.1). *NPS Management Policies 2006* further state that the NPS will assume an aggressive role in promoting and pursuing measures to protect air quality related values from the adverse impacts of air pollution.

Pollutant concentrations at or above the NAAQS are not the expected natural condition for a park and could result in a non-attainment designation for a park unit, reflecting unacceptable and polluted air. However, pollutant concentrations below the NAAQS can also affect human health, particularly in sensitive individuals. Therefore, NPS addresses the potential for air quality impacts when pollutant concentrations are below the NAAQS through intensity definitions established in the Technical Guidance on Assessing Impacts to Air Quality in NEPA and Planning Documents (NPS 2011).

METHODOLOGY

This section provides an overview of the major components of the air quality analysis methodology. For detailed technical information on the development of emissions factors, background concentrations and other modeling assumptions, refer to appendix B.

Criteria Pollutant Concentrations

The park, in consultation with the NPS Air Resources Division, selected four locations for air quality modeling based on OSV traffic levels. To help compare and contrast different levels of OSV use, the sites were selected to include those areas where the highest pollutant concentrations would be expected and to represent a range of OSV activity levels. The four locations selected for modeling are

the west entrance, the west entrance to Madison Junction Road, the Old Faithful staging area, and the Canyon to Fishing Bridge road.

Maximum predicted ambient concentrations of CO, NO₂ and PM₁₀ and PM_{2.5} were calculated for each location using EPA-approved air quality models (CAL3QHCR and AERMOD). Impacts for each alternative were assessed with respect to the NAAQS and the 1-hour CO state standard in Montana, which is 23 parts per million (ppm) (compared to the 1-hour CO NAAQS of 35 ppm). The estimates of maximum CO, NO₂, PM₁₀ and PM_{2.5} concentrations generated by OSVs take into account emissions data, meteorological phenomena, vehicle traffic/travel conditions, and the physical configurations of roadways and staging areas.

Emissions Inventory

In addition to the modeling analysis for determining potential short-term CO, NO₂, and particulate concentrations, an emissions inventory for criteria pollutants (CO, particulate matter (PM), and NO_x) and hydrocarbons (HC) in tons per winter season was completed for each alternative. An emissions inventory of hazardous air pollutants (HAPs) (benzene; 1-3 butadiene; formaldehyde; and acetaldehyde) was also completed. Emissions were calculated using travel estimates of OSVs and on-road (wheeled) vehicles used on Yellowstone roadways, the roadway lengths, and the modes of operation of the vehicles. Emission factors were combined with daily vehicle traffic levels for each roadway segment for each alternative to determine total parkwide emissions for each pollutant. The winter season was defined as a 90-day period running from mid-December to mid-March.

Because Yellowstone is classified as a federal Class I area, PM₁₀ increment comparisons under prevention of significant deterioration (PSD) increments were assessed. PSD increments are the maximum permitted increases in pollutant concentrations over baseline levels for PM₁₀. For Class I areas, the PM₁₀ PSD increments are 4 and 8 micrograms per cubic meter for the annual and 24-hour averaging periods, respectively. Winter OSV emissions were considered increment consuming or contributing sources for this analysis. The analysis assessed PSD increments for the 24-hour averaging period only, since the sources of concern are only present during the winter season and an annual average would not be applicable. This assessment is a screening level approach and may indicate that a detailed analysis is required if concentrations are near the PM₁₀ PSD increments. Furthermore, because the methodology employed in this analysis is a screening-level analysis, it is not intended for regulatory purposes and does not constitute a regulatory PSD increment consumption analysis.

Visibility Impacts

As required by the visibility protection provision of the CAA, additional requirements apply when a proposed source has the potential to impair visibility in a Class I area (40 CFR 52.27 (d)), such as Yellowstone. Potential visibility impacts for each alternative were assessed using the EPA model VISCREEN.

Analysis Scenarios

Alternative 1 was not modeled because visitor OSV use would not be allowed under this alternative after the 2010/2011 winter season. Therefore, air quality would not be affected by visitor OSV use in the park. The air quality impacts of administrative OSV use under alternative 1 are anticipated to be negligible.

Alternatives 2, 3, and 4 were modeled based on the maximum allowed level of OSV use each day of the winter season as described in chapter 2. Under alternative 5, snowmobile use could be phased out

over a five-year period and the number of BAT snowcoaches would increase. To understand the range of possibilities, two separate conditions were analyzed for alternative 5—one representing the start of the transition to BAT snowcoaches (alternative 5a), during which time snowmobiles would be allowed, and one representing condition of all BAT snowcoaches and no snowmobiles (alternative 5b). The modeling of alternative 5a assumes a 50/50 mix of BAT and non-BAT gasoline snowcoaches for the period before the 2014/2015 season when BAT requirements for snowcoaches would be fully implemented. Alternative 5a also provides an approximation of existing conditions (a mix of BAT and non-BAT snowcoaches and BAT snowmobile) if the current allocations were met every day of the winter season.

Under alternative 6, OSV levels would vary by creating times and places for higher and lower levels of use. Maximum pollutant concentrations under alternative 6 were modeled based on the maximum level of OSV use that would be allowed per day (up to 540 snowmobiles and 78 snowcoaches). Seasonal total emissions inventories for alternative 6 were modeled based on the seasonal average daily OSV use level (355 snowmobiles and 51 snowcoaches).

Alternative 7 proposes a variety of use levels, which would establish a maximum number of snowmobiles and snowcoaches permitted in the park for specific days throughout the winter season. Three different use levels for each vehicle type would be implemented and each of these use levels was modeled for air quality impacts. Snowmobile use would range from 132 to 330 vehicles per day and snowcoach use would range from 30 to 80 vehicles per day. Alternative 7a represents the highest OSV that would be permitted. Alternative 7b provides modeling results for medium OSV use level, and alternative 7c represents the lowest limits on OSV entry to the park.

Intensity Definitions

Concentrations at or above the NAAQS are not the expected natural condition for a park and could result in a non-attainment designation for a park unit, reflecting unacceptable and polluted air. However, pollutant concentrations below the NAAQS can also affect human health, particularly in sensitive individuals. The EPA has developed an Air Quality Index (AQI) that correlates criteria pollutant concentrations to associated health concern categories. The NPS used the AQI in combination with the policy relevant background (PRB) concentration for each pollutant to develop the air quality intensity definitions shown in table 39 (NPS 2011). The PRB concentration represents the natural background plus human pollution from transport outside North America. The air quality intensity definitions reflect the importance of maintaining excellent air quality in parks, not merely complying the NAAQS. Even concentrations at 80% of the NAAQS are considered a major impact.

TABLE 39: AIR QUALITY INTENSITY DEFINITIONS

Impact level	1-hr Carbon Monoxide (ppm)	8-hr Carbon Monoxide (ppm)	24-hr PM ₁₀ (µg/m ³)	24-hr PM _{2.5} (µg/m ³)	1-hr Nitrogen Dioxide (ppm)
Negligible	0–0.2	0–0.2	0–11	0–5	0–0.001
Minor	0.3–17.5	0.3–4.4	12–77	6–20	0.002–0.049
Moderate	17.6–27.9	4.5–7.1	78–119	21–28	0.050–0.079
Major	28.0–35.0	7.2–9.0	120–150	29–35	0.079–0.100

Source: Technical Guidance on Assessing Impacts to Air Quality in NEPA and Planning Documents (NPS 2011).

A negligible impact is defined as the range of concentrations for each pollutant that is the highest estimated PRB concentration, as determined by EPA in its criteria pollutant documents and pollutant

assessments. Concentrations in this range are indistinguishable from variations in the background concentrations that are of natural and long-range transport origin. The minor impact level follows the AQI scale and corresponds to concentrations from the PRB up to an additional 50% of the difference between the PRB and the NAAQS. The moderate impact level is from 51% to 79% of the NAAQS. The major impact level in table 39 corresponds to 80% to 100% of the NAAQS for each pollutant. EPA often uses 80% as a threshold warning for approaching the NAAQS.

Qualitative visibility impact thresholds are defined separately from the air quality definitions (see table 40).

TABLE 40: VISIBILITY INTENSITY DEFINITIONS

Impact level	Description
Negligible	No perceptible visibility impacts are likely (no visible smoke, plume, or haze).
Minor	Perceptible visibility impacts occur, but are only visible from a small area of the park, are of short duration (less than one day per year) and visible to only a few park visitors on the days that they occur.
Moderate	Perceptible visibility impacts occur and are visible from several areas of the park, occur between one and several days per year, and many park visitors may observe them on the days that they occur.
Major	Perceptible visibility impacts occur and are visible from many areas of the park, occur many days over the course of a year, or are visible to a majority of park visitors on the days that they occur.

Source: Technical Guidance on Assessing Impacts to Air Quality in NEPA and Planning Documents (NPS 2011).

Study Area

The study area for the assessment of the various alternatives is the park. The study area for the cumulative impacts analysis is the park plus the lands adjacent to the park boundaries.

Criteria Pollutant Concentrations

Tables 41 and 42 show the maximum predicted 1- and 8-hour average CO concentrations for each of the action alternatives. The modeling results indicate that winter use vehicle emissions would not result in any exceedance of the CO NAAQS, or the Montana, Wyoming, or Idaho ambient air quality standards, under any of the alternatives. The maximum predicted 1-hour CO concentrations are above background levels, but less than 50% of the difference between background levels and the NAAQS, resulting in minor impacts under any of the alternatives. Under alternatives 4, 5b, and 7c, the maximum predicted 8-hour CO concentrations are indistinguishable from background levels (negligible impacts). Under alternatives 2, 3, 4, 5a, 6, 7a, and 7b, the maximum predicted 8-hour CO concentrations are above background levels, but less than 50% of the difference between background levels and the NAAQS (minor impacts).

TABLE 41: MAXIMUM PREDICTED 1-HOUR CARBON MONOXIDE (CO) CONCENTRATIONS (IN PPM)

Alternative	Site 1: West Entrance 1-Hour (ppm)	Site 2: West Entrance to Madison 1-Hour (ppm)	Site 3: Canyon to Fishing Bridge 1-Hour (ppm)	Site 4: Old Faithful Staging Area 1-Hour (ppm)	Maximum Level of Air Quality Impact
Alternative 2: 2008 Plan Limits	1.0	0.4	0.3	0.3	Minor
Alternative 3: 2004 Plan Limits	1.8	0.7	0.3	0.4	Minor
Alternative 4: Mixed-Use	0.3	0.3	0.2	0.2	Minor
Alternative 5a Start: Transition to BAT Snowcoaches Only	1.2	0.5	0.3	0.4	Minor
Alternative 5b Final: Transition to BAT Snowcoaches Only	0.2	0.3	0.3	0.2	Minor
Alternative 6: Implement Variable Management	1.5	0.4	0.3	0.4	Minor
Alternative 7a: Provide a Variety of Use Levels and Experiences for Visitors (High)	1.5	0.4	0.3	0.3	Minor
Alternative 7b: Provide a Variety of Use Levels and Experiences for Visitors (Medium)	0.7	0.3	0.3	0.3	Minor
Alternative 7c: Provide a Variety of Use Levels and Experiences for Visitors (Low)	0.4	0.3	0.2	0.2	Minor

Note: The NAAQS for CO is 35 parts per million (ppm), for the 1-hour averaging period.

TABLE 42: MAXIMUM PREDICTED 8-HOUR CARBON MONOXIDE (CO) CONCENTRATIONS (IN PPM)

Alternative	Site 1: West Entrance 8-Hour (ppm)	Site 2: West Entrance to Madison 8-Hour (ppm)	Site 3: Canyon to Fishing Bridge 8-Hour (ppm)	Site 4: Old Faithful Staging Area 8-Hour (ppm)	Maximum Level of Air Quality Impact
Alternative 2: 2008 Plan Limits	0.4	0.2	0.3	0.2	Minor
Alternative 3: 2004 Plan Limits	0.6	0.3	0.2	0.2	Minor
Alternative 4: Mixed-Use	0.2	0.2	0.2	0.2	Negligible
Alternative 5a Start: Transition to BAT Snowcoaches Only	0.5	0.3	0.2	0.2	Minor
Alternative 5b Final: Transition to BAT Snowcoaches Only	0.2	0.2	0.2	0.2	Negligible
Alternative 6: Implement Variable Management	0.5	0.3	0.2	0.2	Minor
Alternative 7a: Provide a Variety of Use Levels and Experiences for Visitors (High)	0.4	0.2	0.2	0.2	Minor
Alternative 7b: Provide a Variety of Use Levels and Experiences for Visitors (Medium)	0.3	0.2	0.2	0.2	Minor
Alternative 7c: Provide a Variety of Use Levels and Experiences for Visitors (Low)	0.2	0.2	0.2	0.2	Negligible

Note: The NAAQS for CO is 9 parts per million (ppm), for the 8-hour averaging period.

Table 43 shows the maximum predicted 1-hour NO₂ concentrations for each of the action alternatives. For all alternatives, the modeling results indicate that the maximum 1-hour NO₂ concentrations would be below the NAAQS and the Montana ambient air quality standards. For all alternatives, the predicted maximum NO₂ concentrations would fall into the minor impacts category (above background levels, but less than 50% of the difference between background levels and the NAAQS). NO₂ concentrations would be the highest at the west entrance under alternatives 6 and 7a (0.032 ppm), and the lowest overall under alternatives 4 and 7c (0.001 to 0.010 ppm depending on the location and alternative).

TABLE 43: MAXIMUM PREDICTED 1-HOUR NITROGEN DIOXIDE (NO₂) CONCENTRATIONS (IN PPM)

Alternative	Site 1: West Entrance 1-Hour (ppm)	Site 2: West Entrance to Madison 1-Hour (ppm)	Site 3: Canyon to Fishing Bridge 1-Hour (ppm)	Site 4: Old Faithful Staging Area 1-Hour (ppm)	Maximum Level of Air Quality Impact
Alternative 2: 2008 Plan Limits	0.027	0.017	0.016	0.001	Minor
Alternative 3: 2004 Plan Limits	0.027	0.030	0.017	0.001	Minor
Alternative 4: Mixed-Use	0.010	0.005	0.007	0.002	Minor
Alternative 5a Start: Transition to BAT Snowcoaches Only	0.020	0.018	0.011	0.001	Minor
Alternative 5b Final: Transition to BAT Snowcoaches Only	0.019	0.010	0.010	0.001	Minor
Alternative 6: Implement Variable Management	0.032	0.024	0.014	0.001	Minor
Alternative 7a: Provide a Variety of Use Levels and Experiences for Visitors (High)	0.032	0.018	0.011	0.001	Minor
Alternative 7b: Provide a Variety of Use Levels and Experiences for Visitors (Medium)	0.029	0.012	0.008	0.001	Minor
Alternative 7c: Provide a Variety of Use Levels and Experiences for Visitors (Low)	0.008	0.007	0.005	0.001	Minor

Note: The NAAQS for NO₂ is 0.100 parts per million (ppm), for the 1-hour averaging period.

Table 44 shows the maximum predicted 24-hour PM_{2.5} concentrations for each of the alternatives. The modeling results indicate that no winter use vehicle emissions from any of the alternatives would result in exceedances of the 24-hour PM_{2.5} NAAQS, or the Montana, Idaho or Wyoming ambient air quality standards. Under all alternatives, 24-hour PM_{2.5} concentrations would be in the range of background concentrations (negligible impacts).

TABLE 44: MAXIMUM PREDICTED 24-HOUR PM_{2.5} CONCENTRATIONS (IN µG/M³)

Alternative	Site 1: West Entrance 24-Hour µg/m ³	Site 2: West Entrance to Madison 24-Hour µg/m ³	Site 3: Canyon to Fishing Bridge 24-Hour µg/m ³	Site 4: Old Faithful Staging Area 24-Hour µg/m ³	Maximum Level of Air Quality Impact
Alternative 2: 2008 Plan Limits	1.9	1.5	1.4	1.5	Negligible
Alternative 3: 2004 Plan Limits	2.5	1.5	1.5	1.5	Negligible
Alternative 4: Mixed-Use	2.1	2.4	1.4	1.5	Negligible
Alternative 5a Start: Transition to BAT Snowcoaches Only	1.9	1.4	1.4	1.5	Negligible
Alternative 5b Final: Transition to BAT Snowcoaches Only	1.4	1.5	1.4	1.4	Negligible
Alternative 6: Implement Variable Management	2.2	1.5	1.4	1.5	Negligible
Alternative 7a: Provide a Variety of Use Levels and Experiences for Visitors (High)	1.9	1.5	1.4	1.5	Negligible
Alternative 7b: Provide a Variety of Use Levels and Experiences for Visitors (Medium)	1.6	1.4	1.4	1.4	Negligible
Alternative 7c: Provide a Variety of Use Levels and Experiences for Visitors (Low)	1.5	1.4	1.4	1.4	Negligible

Note: The NAAQS for PM_{2.5} is 35 micrograms per cubic meter (µg/m³), for the 24-hour averaging period.

Prevention of Significant Deterioration Increment Analysis

Since Yellowstone is a Class I area, PM₁₀ PSD increment consumption was assessed. For Class I areas, the PM₁₀ PSD increment is 8 micrograms per cubic meter for the 24-hour averaging period, which the EPA has determined to be the smallest “allowable” incremental increase for PM₁₀ in these areas. This increment is evaluated in reference to the previously established baseline date of 1979 for Yellowstone (NPS 2000c), which was used to determine baseline concentrations. For this study, a screening level approach was employed in comparing predicted PM₁₀ increments (no background contribution) with estimated 1979 baseline concentrations to determine the increment for the alternatives.

Snowmobile traffic in the park increased from 1979 until the early 2000s and then decreased to levels less than the late 1970s, whereas snowcoach travel has seen a steady increase, almost doubling in 10 years. It is expected that the BAT snowmobiles required by the proposed alternatives would generally result in a net decrease in 24-hour PM₁₀ levels compared to the established baseline data. The 1979 baseline levels were estimated as part of the 2007 Yellowstone Winter Use Plan FEIS. The methodology used to develop the 1979 baseline levels involved adjusting 1999 Historical Conditions

Scenario modeled PM₁₀ levels based on the maximum daily snowmobile levels (from Yellowstone entry records) for 1979 and 1999. Because the methodology employed in this study is a screening-level analysis, it is not intended for regulatory purposes and does not constitute a regulatory PSD increment consumption analysis. Typically, detailed analysis would be required if concentrations are near or “consume” the allowable Class I PM₁₀ PSD increment.

The predicted 24-hour PM₁₀ PSD increment consumption values, based on the previously described particulate modeling are shown in table 45 for each of the action alternatives. The PSD increment is below the applicable PSD increment threshold of 8 micrograms per cubic meter for all alternatives and analysis sites. Therefore, further detailed analysis of PM₁₀ increment consumption is not required.

TABLE 45: 24-HOUR PM₁₀ PSD INCREMENT CONSUMPTION IN MICROGRAMS PER CUBIC METER (µg/m³)

Alternative	Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
Alternative 2: 2008 Plan Limits	0.5	0.1	0.0	0.1
Alternative 3: 2004 Plan Limits	1.1	0.1	0.1	0.1
Alternative 4: Mixed-Use	0.7	1.0	0.0	0.1
Alternative 5a Start: Transition to BAT Snowcoaches Only	0.5	0.0	0.0	0.1
Alternative 5b Final: Transition to BAT Snowcoaches Only	0.0	0.1	0.0	0.0
Alternative 6: Implement Variable Management	0.8	0.1	0.0	0.1
Alternative 7a: Provide a Variety of Use Levels and Experiences for Visitors (High)	0.5	0.1	0.0	0.1
Alternative 7b: Provide a Variety of Use Levels and Experiences for Visitors (Medium)	0.2	0.0	0.0	0.0
Alternative 7c: Provide a Variety of Use Levels and Experiences for Visitors (Low)	0.1	0.0	0.0	0.0
1999 Historical Unregulated Scenario	191.5	40.2	5.9	3.8
PSD Baseline Year: 1979 Historical Condition	42.5	8.9	1.1	0.7

Note: Baseline Year concentrations are based on the ratio of 1979 to 1999 snowmobile levels at the modeling locations. Class I PSD Increment for 24-hour average PM₁₀ is 8 µg/m³.

Emissions Inventory

The total maximum potential winter season emissions in the park in tons per winter season are shown for each action alternative in table 46. To help put the emissions inventory in perspective, annual emissions information for the year 2000 is also presented. Over time, Yellowstone has continued to progress in a variety of non-winter-related emission areas, including more widespread use of bio-based fuels for both administrative and visitor vehicles, use of more hybrid and alternative fueled administrative vehicles, improvements in underground fuel storage tanks, and increased use of four-stroke marine engines. Also, the park has reduced residential woodstoves (often replaced by propane) and converted some stationary sources that relied on fuel oil to propane. Thus, the non-OSV emissions component is most likely lower in 2010 than the 2000 estimate (NPS 2007c).

TABLE 46: PARKWIDE TOTAL WINTER SEASON MOBILE SOURCE EMISSIONS IN POUNDS PER DAY (LB/DAY) AND TONS PER YEAR (TPY)

Alternative	Carbon Monoxide (CO)		Hydrocarbon (HC)		Nitrogen Oxide (NO _x)		Particulates (PM)	
	lb/day	tpy	lb/day	tpy	lb/day	tpy	lb/day	tpy
Alternative 2: 2008 Plan Limits	1,952	88	93	4.16	619	28	5	0.2
Alternative 3: 2004 Plan Limits	2,992	135	166	7.48	947	43	7	0.3
Alternative 4: Mixed-Use	1,177	53	64	2.90	345	16	201	9.0
Alternative 5a Start: Transition to BAT Snowcoaches Only	3,809	171	108	4.85	690	31	4	0.2
Alternative 5b Final: Transition to BAT Snowcoaches Only	1,540	69	41	1.86	489	22	4	0.2
Alternative 6: Implement Variable Management	1,663	75	88	3.94	527	24	4	0.2
Alternative 7 Provide a Variety of Use Levels and Experiences for Visitors	1,998	73	95	3.53	633	23	5	0.2
Yellowstone Annual Emissions (circa 2000)		6,662		-----		297		212

Notes: Annual Emissions for 2000 are from the 2000 Air Emissions Inventory, Yellowstone National Park (final March 2003) (NPS 2003b). Includes summer and winter point, area, and mobile sources (excluding wildfire).

The report inventoried volatile organic compounds (VOCs) but not HC. The report is available at <http://www2.nature.nps.gov/air/AQBasics/inparkemissions.cfm>.

Alternative 7 daily emissions based on the maximum use level (alternative 7a).

Total CO emissions are estimated to be the highest under alternative 5a, which includes some non-BAT snowcoaches. HC and NO_x emissions would be the highest under alternative 3, the alternative with the highest OSV entrance volumes. PM emissions would be substantially higher under alternative 4 compared to other alternatives because of the emissions associated with fugitive dust on plowed roads.

Hazardous Air Pollutant Emissions

Total winter season mobile source emissions of HAPs for the action alternatives are summarized in table 47. HAP emissions, such as benzene, would be highest under alternative 3 and lowest under alternative 5b.

TABLE 47: PARKWIDE TOTAL WINTER SEASON MOBILE SOURCES HAPs EMISSIONS (TONS PER YEAR)

Alternative	Benzene (tpy)	1-3 Butadiene (tpy)	Formaldehyde (tpy)	Acetaldehyde (tpy)
Alternative 2: 2008 Plan Limits	0.11	0.00	0.12	0.04
Alternative 3: 2004 Plan Limits	0.20	0.00	0.21	0.08
Alternative 4: Mixed-Use	0.08	0.01	0.09	0.03
Alternative 5a Start: Transition to BAT Snowcoaches Only	0.14	0.01	0.12	0.04
Alternative 5b Final: Transition to BAT Snowcoaches Only	0.06	0.01	0.05	0.02
Alternative 6: Implement Variable Management	0.11	0.00	0.11	0.04
Alternative 7 Provide a Variety of Use Levels and Experiences for Visitors	0.10	0.00	0.10	0.04

Notes: Four-stroke snowmobile HAPs estimated as a fraction of measured HC emissions based on data reported in SwRI's Laboratory Testing of Snowmobile Emissions, Lela and White, July 2002.

Snowcoach and on-road vehicle HAPs estimated as a fraction of HC emissions based on MOBILE6.2 modeling of HC and air toxics emission factors for light- and heavy-duty vehicles.

Visibility

The results of the VISCSCREEN modeling are shown in table 48. No potential localized, perceptible, visibility impacts are predicted for any of the action alternatives.

TABLE 48: VISIBILITY SCREENING IMPACTS

Alternative	Screening Criteria Exceedance			
	Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
Alternative 2: 2008 Plan Limits	No	No	No	No
Alternative 3: 2004 Plan Limits	No	No	No	No
Alternative 4: Mixed-Use	No	No	No	No
Alternative 5a Start: Transition to BAT Snowcoaches Only	No	No	No	No
Alternative 5b Final: Transition to BAT Snowcoaches Only	No	No	No	No
Alternative 6: Implement Variable Management	No	No	No	No
Alternative 7a: Provide a Variety of Use Levels and Experiences for Visitors (High)	No	No	No	No
Alternative 7b: Provide a Variety of Use Levels and Experiences for Visitors (Medium)	No	No	No	No
Alternative 7c: Provide a Variety of Use Levels and Experiences for Visitors (Low)	No	No	No	No

SUMMARY OF IMPACTS

This section summarizes the impact analysis results for each alternative, discusses cumulative effects, and provides conclusions regarding the effects of each alternative on air quality and visibility. The air quality impacts for each alternative are representative of the maximum level of impact that could occur from emissions of CO, NO₂ and PM_{2.5}. This section is followed by the detailed impact analysis of each alternative.

Alternative 1 would have long-term negligible adverse impacts to air quality and visibility because OSV use by visitors would not be allowed. OSV traffic levels would be zero into the future and the only emissions would be from minimal administrative OSV use.

- Alternative 2 would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.0 ppm, 0.4 ppm, and 0.027 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely, resulting in long-term negligible adverse impacts.
- Alternative 3 would result in long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.8 ppm, 0.6 ppm, and 0.027 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely, resulting in long-term negligible adverse impacts.
- Alternative 4 would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO and NO₂ concentrations of 0.3 ppm and 0.010 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely, resulting in long-term negligible adverse impacts.
- Alternatives 5a and 5b would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.2 ppm, 0.5 ppm, and 0.020 ppm, respectively (5a) and predicted maximum 1-hour CO and NO₂ concentrations of 0.3 ppm and 0.019 ppm, respectively (5b). Air quality would improve with the completion of the transition to BAT snowcoaches. No perceptible visibility impacts would be likely under alternative 5 before, during, or after the transition to BAT snowcoaches.
- Alternative 6 would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.5 ppm, 0.5 ppm, and 0.032 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely, resulting in long-term negligible adverse impacts. These indicators were based on the highest use day, 540 snowmobiles and 78 snowcoaches; therefore, days when OSV use levels are lower, these impacts would be expected to decrease.
- Impacts to air quality under alternative 7 would vary day-to-day based on the level of OSV use allowed. However, the overall air quality impact conclusion for alternative 7 is the same regardless of the level of use—long-term minor adverse impacts. Under alternative 7a, the minor adverse impacts would be due to the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.5 ppm, 0.4 ppm, and 0.032 ppm, respectively. Under alternative 7b, the minor adverse impacts would be due to the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 0.7 ppm, 0.3 ppm, and 0.029 ppm, respectively. Under alternative 7c, the minor adverse impacts would be due to the predicted maximum 1-hour CO and NO₂ concentrations of 0.4 ppm and 0.008 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely.

DETAILED IMPACT ANALYSIS

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Under alternative 1, air quality and visibility impacts would be long-term negligible adverse because OSV use by visitors would not be allowed. The current visitor OSV traffic levels under the 2009 interim rule would be zero into the future and the only emissions would be from administrative OSV use.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that have the potential to impact air quality are summarized below. Substantial impacts to air quality and visibility in the park are not expected due to the protections granted under the CAA as a Class I area. The impacts of past, present, and reasonably foreseeable future actions, combined with the long-term negligible impacts of alternative 1, would result in long-term minor adverse impacts on air quality. Under alternative 1, the past, present, and reasonably foreseeable future actions would be the primary contributors to the cumulative impacts. The contribution of the low levels of administrative OSV use under this alternative to overall cumulative impacts would be minimal.

Wheeled vehicle and OSV use outside the boundaries of the park has the potential to impact regional winter season air quality, including the background pollutant levels in the park. Unlike in Yellowstone, the use of BAT snowmobiles (which result in lower CO and HC emissions) is not required on adjacent federal lands. Future trends in the emissions from wheeled vehicles and OSVs operating outside the park will be influenced by the travel management plans of the adjacent national forests. The potential implications of two such travel plans are summarized below—the Gallatin National Forest Travel Plan Revision and the Beartooth District of Custer National Forest Travel Management Plan.

Gallatin National Forest is adjacent to Yellowstone's northern border and part of its western border. The 2006 Record of Decision for the Gallatin National Forest Travel Plan Revision decreased the area of the Gallatin National Forest open to snowmobile use (outside of wilderness areas) from 84% to about 55% (USFS 2006). Snowmobile routes would be concentrated in the areas surrounding West Yellowstone and Cooke City. The FEIS for the Gallatin National Forest Travel Plan Revision concluded that air quality was not a significant issue for the evaluation of the travel plan alternatives and that no violations of the Montana ambient air quality standards or NAAQS would occur (USFS 2006). Therefore, it can be concluded that the impacts of the Gallatin Travel Plan on air quality in Yellowstone would be long-term negligible adverse because it would be less than the effect within Gallatin National Forest itself.

The Beartooth District of Custer National Forest is adjacent to the northeast corner of Yellowstone. A Record of Decision for the Beartooth District Travel Management Plan was issued in 2008 (USFS 2008b). The travel management plan addressed motorized vehicle routes, but OSV regulations were explicitly excluded from the scope of the plan. As a result, OSV use in the Beartooth District remains regulated by a 1986 Forest Plan. OSV use in the small portion of the Beartooth District around Cooke City is administered by the Gallatin National Forest Travel Plan Revision described previously. The 2008 FEIS for the travel management plan concluded that air quality in the Beartooth District would continue to be well under the NAAQS for the following reasons: "(1) good dispersion characteristics across the District, (2) low inversion potential across the District, (3) low emissions from vehicles relative to other potential sources, and 4) reduced or equivalent route miles open to motorized vehicles under all alternatives compared to the existing condition." (USFS 2008b). In addition, the park is

generally upwind from the Beartooth District. Therefore, it can be concluded that the impact of the Beartooth District Travel Management Plan on air quality in the park would be long-term negligible adverse because it would be less than the effect within the Beartooth District itself.

Parts of Wyoming and Montana are experiencing record amounts of oil and gas leasing. The pollutant emissions generated by oil and gas drilling include NO_x and SO₂. The emissions from oil and gas drilling can contribute to ozone formation and visibility impacts. Long-term minor adverse impacts to air quality and visibility from oil and gas development in the region can reasonably be expected. Oil and gas development is considered the largest “threat” to air quality in the Greater Yellowstone Area by the Greater Yellowstone Clean Air Partnership (GYC 2005). Specific areas where oil and gas development is concentrated include the Pinedale Anticline and Jonah II natural gas fields near Pinedale, Wyoming (GYC 2005).

The most recent environmental analyses conducted by the Bureau of Land Management (BLM) for oil and gas development in the Pinedale Anticline is provided in the 2008 Pinedale Anticline Project Area Supplemental Environmental Impact Statement (SEIS) (BLM 2008a). BLM approved up to 600 additional well pads and 4,399 wells in the Pinedale Anticline (BLM 2008b). The air quality analyses conducted for the Pinedale Anticline SEIS concluded that there would be no exceedances of the NAAQS or the applicable PSD increments in the analyzed Class I areas, including Yellowstone. This conclusion remained true even in modeling of a cumulative impacts scenario that included other major industrial sources in the region (BLM 2008c).

In terms of visibility impacts, the Pinedale Anticline SEIS analysis predicted a maximum of three days per year where visibility in Yellowstone would change by 0.5 deciview (approximately a 5% change in light extinction) or more taking into account the cumulative emissions of the Pinedale Anticline development, other emissions sources and IMPROVE network background levels. Based on the direct impacts of the Pinedale Anticline development alone, no exceedances of 0.5 deciview were predicted. The analysis is based on 98th percentile values in accordance with Federal Land Managers’ Air Quality Related Values Work Group (FLAG) guidance. The BLM analysis results show that the Pinedale Anticline development would not result in adverse visibility impacts in Yellowstone based on the FLAG thresholds for Class I areas (0.5 deciview change for direct impacts and 1.0 deciview change for cumulative impacts).

Another trend with the potential to result in more development is the consolidation of lands in the Gallatin National Forest. In the last ten years, the Gallatin National Forest has negotiated several land exchanges that have consolidated some previously checkerboarded holdings. Although this has generally positive effects for most wildlife (because consolidated lands are less subject to development), it has the negative side-effect of private land consolidation (especially in the Big Sky area), which has allowed more land subdivision and rural growth to occur there, with consequent effects on traffic and air quality (NPS 2007c). Population and employment growth in the Yellowstone region affects winter season air quality through emissions from woodstoves, furnaces, industrial point sources (including power plants and oil refineries), on-road vehicles, and off-road recreational vehicles. The major emissions from woodstoves include PM, CO, VOC and NO_x (USEPA 1995). These same pollutants are also emitted by on-road vehicles and off-road recreational vehicles in the winter. Daily vehicle miles travelled on state highways in Park County and Teton County, Wyoming for 2008 were estimated at 587,627 and 622,770, respectively (WDOT 2008). There is insufficient information available to develop a cumulative emissions scenario taking into account all future emissions from population and employment growth in the region. However, given the existing air quality in the area and increasing emissions standards for both mobile and point sources that will lower pollutant emissions, the impacts of these actions on air quality in the park are considered to be long-term minor adverse.

Conclusion

The effects of alternative 1 on air quality and visibility would be long-term negligible adverse. Cumulative impacts would result in long-term minor adverse impacts on air quality.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Alternative 2 would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.0 ppm, 0.4 ppm, and 0.027 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely, resulting in long-term negligible adverse impacts.

Cumulative Impacts

Impacts on air quality from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term minor adverse impacts of alternative 2, would result in long-term minor adverse cumulative impacts on air quality.

Conclusion

The effect of alternative 2 on air quality would be long-term minor adverse. The effect of alternative 2 on visibility would be long-term negligible adverse. Cumulative impacts to air quality and visibility would be long-term minor adverse.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Alternative 3 would result in long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.8 ppm, 0.6 ppm, and 0.027 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely, resulting in long-term negligible adverse impacts.

Cumulative Impacts

Impacts on air quality from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term minor adverse impacts of alternative 3, would result in long-term minor adverse cumulative impacts on air quality.

Conclusion

The effect of alternative 3 on air quality would be long-term minor adverse. The effect of alternative 3 on visibility would be long-term negligible adverse. Cumulative impacts to air quality and visibility would be long-term minor adverse.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Alternative 4 would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO and NO₂ concentrations of 0.3 ppm and 0.010 ppm, respectively. No exceedance

of the NAAQS would occur. No perceptible visibility impacts would be likely, resulting in long-term negligible adverse impacts.

Cumulative Impacts

Impacts on air quality from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term minor adverse impacts of alternative 4, would result in long-term minor adverse cumulative impacts on air quality.

Conclusion

The effect of alternative 4 on air quality would be long-term minor adverse. The effect of alternative 4 on visibility would be long-term minor adverse. Cumulative impacts to air quality and visibility would be long-term, minor adverse.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Alternative 5a would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.2 ppm, 0.5 ppm, and 0.020 ppm, respectively. Air quality would improve with the completion of the transition to BAT snowcoaches. Alternative 5b would have long-term minor adverse impacts to air quality as a result of the predicted maximum 1-hour CO and NO₂ concentrations of 0.3 ppm and 0.019 ppm, respectively. No perceptible visibility impacts would be likely under alternative 5 before, during or after the transition to BAT snowcoaches.

Cumulative Impacts

Impacts on air quality from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term minor adverse impacts of alternative 5, would result in long-term minor adverse cumulative impacts on air quality.

Conclusion

The effects of alternative 5 on air quality would be long-term minor adverse. The effect of alternative 5 on visibility would be long-term negligible adverse. Cumulative impacts to air quality and visibility would be long-term minor adverse.

Impacts of Alternative 6: Implement Variable Management

Alternative 6 would have long-term minor adverse impacts on air quality as a result of the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.5 ppm, 0.5 ppm, and 0.032 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely. These indicators were based on the highest use day, 540 snowmobiles and 78 snowcoaches; therefore, days when OSV use levels are lower, these impacts would be expected to decrease. One example (from chapter 2) would have 22 days of the winter at the maximum use levels, and 15 days at minimum use levels, with the remaining days at levels in between the minimum and maximum. The example provided in chapter 2 could change from year to year. Also, under this alternative, some areas of the park would have no OSV use for portions of the winter season.

Cumulative Impacts

Impacts on air quality from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term minor adverse impacts of alternative 6, would result in long-term minor adverse cumulative impacts on air quality.

Conclusion

The effect of alternative 6 on air quality would be long-term minor adverse. The effect of alternative 6 on visibility would be long-term negligible adverse. Cumulative impacts to air quality and visibility would be long-term minor adverse.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Impacts to air quality under alternative 7 would vary day-to-day based on the level of OSV use allowed. However, the overall air quality impact conclusion for alternative 7 is the same regardless of the level of use—long-term minor adverse impacts. Under alternative 7a, the minor adverse impacts would be due to the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.5 ppm, 0.4 ppm, and 0.032 ppm, respectively. Under alternative 7b, the minor adverse impacts are due to the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 0.7 ppm, 0.3 ppm, and 0.029 ppm, respectively. Under alternative 7c, the minor adverse impacts would be due to the predicted maximum 1-hour CO and NO₂ concentrations of 0.4 ppm and 0.008 ppm, respectively. No exceedance of the NAAQS would occur. No perceptible visibility impacts would be likely.

Cumulative Impacts

Impacts on air quality from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term minor adverse impacts of alternative 7, would result in long-term minor adverse cumulative impacts on air quality.

Conclusion

The effect of alternative 7 on air quality would be long-term minor adverse. The effect of alternative 7 on visibility would be long-term negligible adverse. Cumulative impacts to air quality and visibility would be long-term minor adverse.

SOUNDSCAPES AND THE ACOUSTIC ENVIRONMENT

GUIDING REGULATIONS AND POLICIES

The NPS Organic Act (16 USC 1) establishes and authorizes the NPS “to conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (NPS Organic Act (16 USC 1)). An intact natural soundscape enhances visitor experience and allows for natural functioning of wildlife communication.

Regarding general park soundscape management, NPS *Management Policies 2006*, Section 4.9 “Soundscape Management,” requires that the NPS “preserve, to the greatest extent possible, the

natural soundscapes of parks.” Additionally, the NPS “will restore to the natural condition wherever possible those park soundscapes that have become degraded by the unnatural sounds (noise), and will protect natural soundscapes from unacceptable impacts” (NPS *Management Policies 2006* (NPS 2006a, sec 4.9)). Director’s Order 47: Soundscape Preservation and Management, was developed to emphasize NPS policies “that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources.” This Director’s Order also directs park managers to measure acoustic conditions, differentiate existing or proposed human-made sounds that are consistent with park purposes, set acoustic goals based on the sounds deemed consistent with the park purpose, and determine which noise sources are impacting the parks (NPS 2000d).

SOUNDSCAPES TERMINOLOGY

Refer to “Chapter 3: Affected Environment” for background information on the units used to measure sounds (dBA) and metrics such as percent time audible and L_{eq} (the constant sound level that conveys the same energy as the variable sound levels during the analysis period). Several examples of sound pressure levels in the dBA scale are listed in table 20, including typical sounds found in Yellowstone.

METHODOLOGY

The NPS Natural Sounds Program conducted acoustic modeling to evaluate the potential impacts of the alternatives on natural soundscapes. A brief overview of the modeling methodology and assumptions is provided below. For additional detailed technical information, refer to the soundscapes modeling report (appendix C).

The acoustics modeling conducted by the Volpe National Transportation Systems Center for the 2007 Winter Use Plan FEIS used an adapted version of the Federal Aviation Administration’s Integrated Noise Model. For this draft plan/EIS, the NPS adapted the Noise Model Simulation (NMSim) model, primarily used in aviation applications, for analysis of OSVs. NMSim computes the time history of noise as a mobile noise source passes by a receptor location.

Several basic model inputs developed for the 2007 Winter Use Plan FEIS were used for the NMSim analysis, including temperature, relative humidity, snow cover, and natural ambient sound levels. The modeling accounts for the acoustic effects of topography, OSV speeds, and OSV group size. Under the action alternatives, all snowmobiles and snowcoaches were assumed to meet BAT requirements. The maximum number of snowmobiles and snowcoaches allowed under each alternative were allocated to specific link segments throughout the day. The modeling conducted includes the noise generated by administrative vehicles (e.g., road grooming, NPS and concessioner OSVs,). The modeling framework excludes certain factors such as the minor effects of vegetation on sound propagation, inversions, snow cover and the structure of the snow. These modeling limitations are further described in appendix C.

The NMSim outputs were processed with statistical software to generate maps and summary data for the approximately 40,000 grid cells representing the park area. The analysis focused on four key indicators of OSV noise effects:

Percent Time Audible. Percent time audible is a measure of the length of time during an eight-hour day (8:00 a.m. to 4:00 p.m.) that OSV vehicles would be audible to humans with normal hearing in a given grid cell (regardless of the sound level). As discussed in “Chapter 3: Affected Environment,” percent time audible constantly varies over time. However, the percent time audible over an 8-hour day provides a useful metric for comparing the alternatives.

Audible Equivalent Sound Level (L_{eq}). Audible L_{eq} measures sound levels experienced in a grid cell during the time that OSVs are audible. L_{eq} is the constant sound level that conveys the same energy as the variable sound levels during the analysis period. Audible L_{eq} differs from the typical calculation of L_{eq} in that it excludes from the analysis period the time during which OSVs are not audible.

Peak 4. Peak 4 is the mean of the four loudest sustained sound levels (at least 15 seconds long) experienced by a grid cell during the day and replaces the maximum sound level (L_{max}) indicator used in previous studies. The modeling interval was 5 seconds, so four values collectively comprise at least 15 seconds of exposure. Peak 4 provides a robust indicator of the loudest events, while avoiding modeling anomalies.

8-hour Equivalent Sound Level (L_{eq}). The 8-hour L_{eq} accounts for the magnitude and duration of OSV sound over the 8:00 a.m. to 4:00 p.m. analysis period (including times when no OSV sounds are audible). This measure differs from percent time audible; L_{eq} provides a measure for magnitude in addition to duration.

Study Area

The study area for assessment of the various alternatives is the park. The study area for the cumulative impacts analysis is the park plus the lands adjacent to the park boundaries.

Analysis Scenarios

Table 49 provides a summary of the alternatives/analysis scenarios modeled for soundscapes impacts. Alternative 1 was modeled based on administrative OSV use only (no visitor OSV use).

Under alternative 5, snowmobile use would be phased out over a five-year period and the number of BAT snowcoaches would be allowed to increase. Two separate analysis conditions were assessed for alternative 5: one representing the start of the transition to BAT snowcoaches (alternative 5a), during which time snowmobiles would be allowed, and one representing all BAT snowcoaches and no snowmobiles (alternative 5b).

Under alternative 6, OSV levels would vary by creating times and places for higher and lower levels of use. Two analysis conditions were assessed for alternative 6. Alternative 6a represents the maximum level of OSV use that would be allowed per day (up to 540 snowmobiles and 78 snowcoaches). Alternative 6b represents the seasonal average daily OSV use level (up to 355 snowmobiles and 51 snowcoaches).

TABLE 49: SOUNDSCAPES ANALYSIS SCENARIOS

Analysis Scenario	Daily Visitor Snowmobile Entries	Daily Visitor Snowcoach Entries	Daily Administrative Snowmobile Trips	Daily Administrative Snowcoach Trips	Daily Commercial Multi-Passenger Wheeled Vehicle Entries
Current Condition ¹	252	28	110	13	0
Alternative 1: No-Action—No Visitor Snowmobile or Snowcoach Use (Administrative Use Only)	0	0			0
Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits	318	78	110	13	0
Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits	720	78	110	13	0
Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles	110	30	110	13	100
Alternative 5a Start: Transition to Snowcoaches meeting BAT Requirements Only	318	78	110	13	0
Alternative 5b Final: Transition to Snowcoaches meeting BAT Requirements Only	0	120	110	13	0
Alternative 6a Maximum: Implement Variable Management	540	78	110	13	0
Alternative 6b Seasonal Average: Implement Variable Management	355	51	110	13	0
Alternative 7a: Provide a Variety of Use Levels and Experiences for Visitors (High)	330	80	110	13	0
Alternative 7b: Provide a Variety of Use Levels and Experiences for Visitors (Medium)	220	50	110	13	0
Alternative 7c: Provide a Variety of Use Levels and Experiences for Visitors (Low)	132	30	110	13	0

¹ Based on the average of the actual OSV entrance volumes from the 2003/2004 winter season through the 2008/2009 winter season.

Alternative 7 proposes a variety of use levels, which would establish a maximum number of snowmobiles and snowcoaches permitted in the park for specific days throughout the winter season. Three different use levels for each vehicle type would be implemented. Snowmobile use would range from 132 to 330 vehicles per day and snowcoach use would range from 30 to 80 vehicles per day. Alternative 7a represents the highest number of OSVs that would be permitted. Alternative 7b provides modeling results for medium OSV use level, and alternative 7c represents the lowest limit on OSV entry to the park.

INTENSITY DEFINITIONS

Separate intensity definitions based on the 8-hour L_{eq} metric are established for travel corridors and backcountry areas (table 50). Although natural quiet is important in both settings, the backcountry intensity definitions are more protective than the intensity definitions for the travel corridor. The intensity definitions are based on accepted noise standards and dose-response studies measuring visitor annoyance with vehicle noise in park settings. For a detailed discussion of the rationale for the soundscapes intensity definitions, refer to appendix C.

TABLE 50: INTENSITY DEFINITIONS FOR SOUNDSCAPES

Impact Level	Travel Corridors	Backcountry
Negligible	8-hour $L_{eq} < 15$ dBA	8-hour $L_{eq} < 5$ dBA
Minor	8-hour $L_{eq} \geq 15$ dBA and < 25 dBA	8-hour $L_{eq} \geq 5$ dBA and < 15 dBA
Moderate	8-hour $L_{eq} \geq 25$ dBA and 8-hour $L_{eq} < 35$ dBA or 8-hour $L_{eq} \leq 35$ dBA in 90% of the travel corridor area	8-hour $L_{eq} \geq 15$ dBA and 8-hour $L_{eq} < 25$ dBA or 8-hour $L_{eq} \leq 25$ dBA in 90% of the backcountry area
Major	8-hour $L_{eq} \geq 35$ dBA for greater than 10 percent of the total travel corridor area	8-hour $L_{eq} \geq 25$ dBA for greater than 10 percent of the total backcountry area

SUMMARY OF MODELING RESULTS

This section provides an overview of the soundscapes analysis results, including summary comparison tables for the action alternatives. Alternative-specific impact descriptions are provided in subsequent sections and include discussion of cumulative effects and the conclusions for each alternative. For all of the following tables (showing modeling results), the current condition column represents use levels under the 2009 interim rule that was in effect for the 2009/2010 and 2010/2011 winter seasons.

Percent Time Audible

Percent time audible is a measure of the length of time during an eight-hour day (8:00 a.m. to 4:00 p.m.) that OSV vehicles would be audible to humans with normal hearing (regardless of the sound level). For example, 50 percent time audible means OSV sounds could potentially be heard in specified areas for 50 percent of the day, or four hours during an eight-hour day – not necessarily consecutive hours, but spaced throughout the day. Tables 51 and 52 summarize the percent time audible results for the travel corridor and backcountry areas, respectively. Mapping of the percent time audible results for each alternative is provided in appendix C.

TABLE 51: TRAVEL CORRIDOR PERCENT TIME AUDIBLE MODELING RESULTS

Percent Time Audible	Percent of Travel Corridor Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
0	8.4	9.0	8.4	8.4	8.2	8.4	8.7	8.4	8.4	8.4	8.5	8.5
1 to 20	23.5	40.2	17.2	14.2	21.9	17.4	15.0	15.2	18.9	18.0	23.1	28.9
21 to 50	36.3	41.7	29.6	26.3	25.3	30.0	29.3	28.0	32.9	30.7	36.7	39.7
51 to 80	26.2	8.6	29.6	30.2	30.9	30.1	30.1	30.3	29.3	30.4	24.0	19.7
Over 80	5.6	0.5	15.2	20.9	13.7	14.1	16.9	18.1	10.5	12.5	7.7	3.2

Notes: Percent time audible calculated for the 8-hour period from 8:00 a.m. to 4:00 p.m.

TABLE 52: BACKCOUNTRY PERCENT TIME AUDIBLE MODELING RESULTS

Percent Time Audible	Percent of Backcountry Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
0	89.2	89.7	89.1	89.1	89.2	89.1	89.3	89.1	89.2	89.1	89.2	89.3
1 to 20	6.7	8.2	5.7	5.4	6.3	5.8	5.3	5.5	6.0	5.9	6.8	7.3
21 to 50	2.9	2.0	3.1	3.0	2.7	3.1	3.2	3.1	3.1	3.2	2.8	2.7
51 to 80	1.1	0.1	1.6	1.6	1.5	1.6	1.5	1.6	1.4	1.4	1.0	0.7
Over 80	0.1	0.0	0.5	0.9	0.3	0.4	0.7	0.7	0.3	0.4	0.2	0.0

Notes: Percent time audible calculated for the 8-hour period from 8:00 a.m. to 4:00 p.m.

Under use levels that occurred during the interim rule, OSV sounds are audible to a human with normal hearing between 51% and 80% of the time in 26.2% of the travel corridor area (table 51). In 5.6% of the travel corridor area, OSV sounds are audible over 80% of the time. The areas with longest percent time audible are on and adjacent to roadways. Alternative 1 would reduce the area of the travel corridor OSVs audible over 80 percent of the time to 0.5%. The OSV use levels modeled under all the action alternatives would increase the area of the travel corridor where OSV sounds are audible over 80% of the time, relative to alternative 1. The largest increase in OSV time audible would be under alternative 3 (the alternative with the highest OSV use levels). Alternative 7c is the action alternative with the smallest increase in OSV audibility relative to the no-action alternative and would reduce OSV audibility compared to the current condition.

As shown in table 52, OSVs are not audible in approximately 89-90% of the backcountry area under the current conditions and any of the alternatives. As would be expected, the primary influence of the alternatives on OSV audibility is within the travel corridors. However, some changes in the area of the backcountry with OSVs audible more than 80% of the time do occur. For example, the area of the backcountry with OSVs audible more than 80% of the time would increase from 0% under alternative 1 to 0.9% under alternative 3. The areas of the backcountry where the audibility of OSVs would increase are generally adjacent to the boundary between the travel corridor and backcountry management zones.

Audible L_{eq}

Whereas percent time audible describes whether or not OSVs are audible, audible L_{eq} describes how high the sound levels are during those times that OSVs are audible. Audible L_{eq} is expressed as an equivalent sound level—the constant sound level conveying the same energy as all the varying sound levels over the 8:00 a.m. to 4:00 p.m. analysis period (excluding those times when OSVs are not audible). Tables 53 and 54 summarize the audible L_{eq} results for the travel corridor and backcountry areas, respectively. Mapping of the audible L_{eq} results for each alternative is provided in appendix C.

TABLE 53: TRAVEL CORRIDOR AUDIBLE L_{eq} MODELING RESULTS

Audible L_{eq} (dBA)	Percent of Travel Corridor Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
0 or less	8.5	9.0	8.5	8.5	8.3	8.5	8.9	8.5	8.5	8.5	8.5	8.6
1 to 20	42.6	55.0	40.1	34.5	44.5	40.0	48.8	36.2	39.0	40.5	42.9	44.4
21 to 35	38.4	29.3	39.2	41.4	36.6	39.3	34.6	40.8	39.6	38.9	37.6	37.7
36 to 60	10.3	6.6	11.9	15.1	10.3	11.9	7.6	14.1	12.6	11.9	10.8	9.1
Over 60	0.2	0.1	0.3	0.5	0.3	0.3	0.1	0.4	0.3	0.2	0.2	0.2

TABLE 54: BACKCOUNTRY AUDIBLE L_{eq} MODELING RESULTS

Audible L_{eq}	Percent of Backcountry Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
0 or less	89.2	89.7	89.2	89.2	89.3	89.2	89.7	89.2	89.2	89.2	89.2	89.3
1 to 10	10.5	10.3	10.5	10.2	10.5	10.5	10.2	10.3	10.5	10.5	10.6	10.5
11 to 20	0.3	0.0	0.3	0.6	0.2	0.3	0.1	0.5	0.3	0.3	0.2	0.2
Over 20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Under use levels that occurred under the 2009 interim rule, audible L_{eq} is between 1 and 35 dBA in approximately 81% of the travel corridor. American National Standards Institute (ANSI) standard 2.12 specifies 35 dBA as the desired background condition for many indoor spaces where quiet and outstanding listening conditions are important (bedrooms, auditoria, theaters, conference rooms). Only 10.3% of the travel corridor area has an audible L_{eq} between 36 and 60 dBA, and 0.2% exceeds 60 dBA. Sound levels of 50 to 60 dBA are common in environments with human conversations, such as an office. Under alternative 1, 6.7% of the travel corridor would have an audible L_{eq} over 35 dBA and 0.1% exceeds 60 dBA. The OSV use levels modeled under all of the action alternatives would increase the percentage of the travel corridor with an audible L_{eq} over 35 dBA compared to the no-action alternative. Alternatives 4, 5b, and 7c (the conditions with the lowest OSV use levels modeled) would reduce the area of the travel corridor with an audible L_{eq} over 35 dBA relative to the current condition.

Table 54 shows that OSV audible L_{eq} sound levels in nearly 90 percent of the backcountry area are very low under current conditions, the no-action alternative, and any of the action alternatives. Small differences in backcountry audible L_{eq} are shown in the range of 11 to 20 dBA. Under any of the alternatives, backcountry audible L_{eq} would not exceed 20 dBA.

Peak 4

Percent time audible and audible L_{eq} do not provide information on short-duration peaks in OSV sound levels that can be important to understanding impacts on natural soundscapes. Peak 4 is the mean of the four loudest sustained sound levels (at least 15 seconds in duration) during the 8:00 a.m. to 4:00 p.m. analysis period. The peak 4 results are influenced mainly by the loudest vehicle in use, rather than the total traffic. Tables 55 and 56 summarize the peak 4 results for the travel corridor and backcountry areas, respectively. Mapping of the peak 4 results for each alternative is provided in appendix C.

TABLE 55: TRAVEL CORRIDOR PEAK 4 MODELING RESULTS

Peak 4 (dBA)	Percent of Travel Corridor Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
0 or less	5.3	9.4	5.3	5.3	6.8	5.3	9.4	5.3	5.3	5.3	5.3	5.8
1 to 20	19.7	31.6	19.7	19.7	22.7	19.7	31.6	19.7	19.7	19.7	19.7	21.0
21 to 35	36.5	40.8	36.5	36.5	39.4	36.5	40.8	36.5	36.5	36.5	36.5	37.6
36 to 60	35.2	16.9	35.2	35.2	28.3	35.2	16.9	35.2	35.2	35.2	35.2	32.7
61 to 80	3.2	1.3	3.2	3.2	2.8	3.2	1.3	3.2	3.2	3.2	3.2	2.9
Over 80	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.0

TABLE 56: BACKCOUNTRY PEAK 4 MODELING RESULTS

Peak 4 (dBA)	Percent of Backcountry Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
0 or less	83.4	90.2	83.4	83.4	86.3	83.4	90.2	83.4	83.4	83.4	83.4	84.3
1 to 10	8.4	6.4	8.4	8.4	7.3	8.4	6.4	8.4	8.4	8.4	8.4	8.2
11 to 20	5.6	3.2	5.6	5.6	4.7	5.6	3.2	5.6	5.6	5.6	5.6	5.3
21 to 30	2.4	0.2	2.4	2.4	1.6	2.4	0.2	2.4	2.4	2.4	2.4	2.0
31 to 35	0.2	0.0	0.2	0.2	0.1	0.2	0.0	0.2	0.2	0.2	0.2	0.2
Over 35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Under use levels that occurred during the 2009 interim rule, 61.5% of the travel corridor area experiences peak 4 levels of 35 dBA or less (table 55). In 35.2% of the travel corridor, peak 4 sound levels are between 36 and 60 dBA and in 3.2% of the travel corridor peak 4 sound levels are between 61 and 80 dBA. Only 0.1% of the travel corridor experiences peak 4 sound levels over 80 dBA under the current conditions. A sound level of 80 dBA is roughly equivalent to average city traffic (see table 20 in chapter 3). Alternatives 2, 3, 5a, 6a, and 6b would not substantially change the area of the travel corridor in each of the peak 4 categories. The area of the travel corridor in the higher peak 4 categories (over 60 dBA) would be reduced under alternatives 4 and 5b relative to the current conditions. Both of these alternatives would eliminate peak 4 levels over 80 dBA.

Under alternative 1, 81.8% of the travel corridor area experiences peak 4 levels of 35 dBA or less. In 16.9% of the travel corridor, peak 4 sound levels are between 36 and 60 dBA and in 1.3% of the travel

corridor peak 4 sound levels are between 61 and 80 dBA. Under alternative 1, peak 4 sound levels would not exceed 80 dBA.

All the action alternatives (except for alternative 5b) increase the area of the travel corridor with peak 4 sound levels over 60 dBA compared to alternative 1. Alternatives 4, 5b, and 7c reduce the area of the travel corridor with peak 4 sound levels over 60 dBA compared to the current condition and eliminate peak 4 sound levels over 80 dBA.

Table 56 shows that even peak sound levels in the backcountry are relatively quiet. Peak 4 sound levels in the backcountry do not exceed 35 dBA under the current condition, the no-action alternative, or any of the action alternatives. All of the action alternatives (except for alternative 5b) would increase the area of the backcountry with peak 4 sound levels over 30 dBA compared to alternative 1. Alternatives 4 and 5b would reduce the area of the backcountry with peak 4 sound levels over 30 dBA compared to the current condition.

8-Hour L_{eq}

The 8-hour L_{eq} analysis results for the travel corridor and backcountry areas are provided in tables 57 and 58, respectively. The 8-hour L_{eq} results are presented graphically in appendix C.

TABLE 57: TRAVEL CORRIDOR 8-HOUR L_{eq} MODELING RESULTS

8-hour L_{eq} (dBA)	Percent of Travel Corridor Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
< 15 (Negligible)	48.7	65.5	43.7	38.7	48.4	43.8	51.1	40.3	44.0	45.1	48.9	52.3
≥ 15 and < 25 (Minor)	27.4	23.1	27.3	26.1	26.9	27.4	27.1	26.5	27.3	26.8	26.3	26.8
≥ 25 and < 35 (Moderate)	16.9	7.8	20.1	22.9	16.8	20.0	16.0	22.1	19.8	19.3	17.4	14.8
≥ 35 (Major)*	7.0	3.6	8.9	12.2	7.8	8.9	5.9	11.0	8.9	8.9	7.4	6.0

*Overall impacts of an alternative were considered to be moderate if less than 10 percent of the travel corridor area had an 8-hour L_{eq} ≥ 35 dBA, see table 50 for the intensity definitions.

TABLE 58: BACKCOUNTRY 8-HOUR L_{eq} MODELING RESULTS

8-hour L_{eq} (dBA)	Percent of Backcountry Area											
	Current Condition	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5a	Alt. 5b	Alt. 6a	Alt. 6b	Alt. 7a	Alt. 7b	Alt. 7c
< 5 (Negligible)	97.1	99.1	96.3	95.5	97.3	96.4	97.5	95.8	96.4	96.5	97.1	97.6
≥ 5 and < 15 (Minor)	2.4	0.9	3.0	3.4	2.3	3.0	2.2	3.2	3.0	2.8	2.4	2.1
≥ 15 and < 25 (Moderate)	0.5	0.0	0.7	1.1	0.4	0.7	0.3	0.9	0.7	0.7	0.5	0.3
≥ 25 (Major)*	0.0	0.0	0.0	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*Overall impacts of an alternative were considered to be moderate if less than 10 percent of the backcountry area had an 8-hour L_{eq} ≥ 25 dBA, see table 50 for the intensity definitions.

Within the travel corridors, the highest 8-hour L_{eq} levels (≥ 35 dBA) occur on and adjacent to roadways. Under current conditions, approximately 7% of the travel corridor area experiences 8-hour L_{eq} sound levels greater than or equal to 35 dBA (table 57). Under alternative 1, the area of the travel corridor with 8-hour L_{eq} sound levels greater than or equal to 35 dBA would be reduced to 3.6%. Sound levels decrease with increasing distance from roadways and are generally less than 15 dBA near the edges of the boundary between the travel corridor and the backcountry. All the action alternatives increase the area of travel corridor with 8-hour L_{eq} sound levels greater than or equal to 35 dBA compared to the no-action alternative. The alternatives with the largest impact are alternative 3 (12.2% ≥ 35 dBA) and alternative 6a (11.0% ≥ 35 dBA).

Under alternative 1, all of the backcountry area would have 8-hour L_{eq} sound levels less than 15 dBA. All the action alternatives would increase 8-hour sound levels in the 15 to 25 dBA range in 1.1% or less of the backcountry. The 8-hour L_{eq} sound level in the backcountry would not exceed 25 dBA, except under alternative 3, where 0.1% of the backcountry would be at or exceeding 25 dBA. Under all alternatives, 96% or more of the backcountry area would have an 8-hour L_{eq} of less than 5 dBA.

SUMMARY OF IMPACTS

This section summarizes the impact analysis results for each alternative, discusses cumulative effects and draws conclusions regarding the effect of each alternative on soundscapes. A detailed discussion of each alternative follows.

- Alternative 1 would have long-term moderate adverse impacts on soundscapes in travel corridors and long-term minor adverse impacts in backcountry areas.
- Alternative 2 would have long-term moderate adverse impacts on soundscapes in both the travel corridor and backcountry areas.
- Alternative 3 would have long-term major adverse impacts on soundscapes in travel corridors and long-term moderate adverse impacts in backcountry areas. Therefore, alternative 3 would result in greater impacts on natural soundscapes than the current conditions (use levels under the 2009 interim rule).
- Alternative 4 would have long-term moderate adverse impacts on soundscapes in both the travel corridor and backcountry areas.
- Alternative 5a would result in greater impacts on natural soundscapes than the current condition. Although OSVs would be audible over a larger area than the current condition under alternative 5b, the overall impact of alternative 5b on soundscapes would be less than the current condition based on consideration of other metrics (e.g., 8-hour L_{eq} , audible L_{eq} , peak 4).
- Alternative 6a (maximum OSV use level) would have long-term major adverse impacts on soundscapes in travel corridors and long-term moderate adverse impacts in backcountry areas. Alternative 6b (seasonal average OSV use level) would result in long-term moderate adverse impacts in the travel corridors and backcountry areas.
- Alternatives 7a, 7b, and 7c would all have long-term moderate adverse impacts on soundscapes in the travel corridors and backcountry areas. The impact conclusion is the same, the soundscapes impact under these alternatives would vary, and the greatest impact occurring under alternative 7a (highest OSV use) and smallest impact occurring under alternative 7c (lowest OSV use).

DETAILED IMPACT ANALYSIS

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Under alternative 1, within the travel corridors, 3.6% of the area would have an 8-hour L_{eq} greater than or equal to 35 dBA (compared to 7% in the current condition). In the backcountry, 0% of the area would have an 8-hour L_{eq} greater than or equal to 15 dBA (compared to 0.5% in the current condition). Administrative OSVs would be audible over 50% of the time in approximately 9.1% of the travel corridor area, compared to 31.8% of the travel corridor area under current conditions. Alternative 1 would have long-term moderate adverse impacts on soundscapes in travel corridors and long-term minor adverse impacts backcountry areas.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions both outside and within the park have the potential to impact soundscapes in the park. Aircraft overflights (including commercial jets, research flights in low-flying propeller planes, corporate and general aviation aircraft, and medical rescue helicopters) cause motorized sounds that are audible at sound levels which range from very quiet to levels that mask other sounds. Relative to snowmobile- and snowcoach-related sounds, the duration of audible aircraft overflights is short. The 2005-2010 observational study found that in total, motorized sounds were audible 56% of the time. Aircraft accounted for 6.7% of the duration of motorized sounds (Burson 2010a). As shown in table 59, jets are responsible for the majority of the duration of audible aircraft sounds.

TABLE 59: AIRCRAFT TIME AUDIBLE, 2005-2010 OBSERVATIONAL STUDY

	Time Audible (Hours: Minutes: Seconds)	Percent out of the Total Duration of Motorized Sounds	Percent out of the Total Duration of the Observational Study
Jets	6:30:41	4.5%	2.5%
Propeller aircraft	2:39:10	1.8%	1.0%
Helicopters	0:32:43	0.4%	0.2%
Total	9:42:34	6.7%	3.8%

The observational study results reported above are based on monitoring in developed and travel corridor locations. Aircraft overflights are audible approximately 6% of the average day in backcountry areas such as Fern Lake (Burson 2007). Taking into account both natural and non-natural sounds, hourly L_{eq} sound levels were generally between 20 and 30 dBA at Fern Lake and maximum hourly sound levels were 60 dBA. No OSV sounds were audible at Fern Lake, which is 8 miles from the nearest OSV corridor (the road between Fishing Bridge and Canyon). In the winter, aircraft are about the only source of non-natural sounds in backcountry areas far from roadways.

Despite recent slowing in the growth in air travel mirroring the recession-related slow down in overall economic activity, long-term growth is still expected according to Federal Aviation Administration forecasts (FAA 2010). As a result, aircraft overflights are expected to continue to result in short and long-term minor adverse impacts, particularly in backcountry areas and on days with low wind levels.

Due to the attenuation of sound with increasing distance from the source, OSV use outside the park boundaries is unlikely to affect substantial portions of the interior of the park. However, in some areas within a few miles of the park boundary, OSV use outside the park is a major source of non-natural

sounds. For example, snowmobiles operating outside Yellowstone's western boundary in Gallatin National Forest and possibly in West Yellowstone, Montana were commonly audible at the West Yellowstone 3.1 site (three miles from the park boundary) during 2004/2005 monitoring (Burson 2005). The distinctive sounds of two-stroke snowmobiles over three miles away were clearly distinguishable in recordings and while visiting the site. The percent time audible at West Yellowstone of OSVs traveling only on the groomed road between the west entrance and Madison Junction was estimated to be 36%. However, OSV use outside the park raised the total percent time audible at West Yellowstone 3.1 to 66% (Burson 2005).

There is insufficient monitoring information available to quantify the audibility of OSVs outside the park in locations other than West Yellowstone 3.1. The audibility of OSVs outside the park has not been specifically noted at any monitoring site other than West Yellowstone 3.1 (Burson 2004-2010). One trend with the potential to result in more OSV activity outside the park is the consolidation of lands in the Gallatin National Forest. In the last 10 years, the Gallatin National Forest has negotiated several land exchanges that have consolidated some previously checkerboarded holdings. Although this has generally positive effects for most wildlife (because consolidated lands are less subject to development), it has the negative side-effect of private land consolidation (especially in the Big Sky area), which has allowed more land subdivision and rural growth to occur there, with consequent effects on traffic and natural soundscapes (NPS 2007c).

Future trends in the audibility of OSVs operating outside the park will be influenced by the travel management plans of the adjacent national forests. The potential implications of two such travel plans are summarized below—the Gallatin National Forest Travel Plan Revision and the Beartooth District of Custer National Forest Travel Management Plan.

Gallatin National Forest is adjacent to Yellowstone's northern border and part of its western border. The 2006 Record of Decision for the Gallatin National Forest Travel Plan Revision decreased the area of the Gallatin National Forest open to snowmobile use (outside of wilderness areas) from 84% to about 55% (USFS 2006). The travel plan was designed to cluster motorized use areas to reduce the total area potentially affected by noise from snowmobiles. As a result, the USFS expected noise levels would increase in those concentrated use zones and decrease elsewhere. The largest concentration of designated snowmobile trails in the Gallatin National Forest in the vicinity of the park is around West Yellowstone. There is a smaller number and length of snowmobile trails around Cooke City. Snowmobile use is prohibited in most of the remaining areas along the border between Gallatin National Forest and Yellowstone National Park (e.g., the Lee Metcalf Wilderness Area to the west and the Absaroka Beartooth Wilderness to the north). It can be reasonably expected that the audibility of OSVs in use outside the park will increase in the future within a few miles of the trails around West Yellowstone and Cooke City. Other areas of Yellowstone adjacent to wilderness areas would not be affected by OSV use.

The Beartooth District of Custer National Forest is adjacent to the northeast corner of Yellowstone. A Record of Decision for the Beartooth District Travel Management Plan was issued in 2008 (USFS 2008b). The travel management plan addressed motorized vehicle routes, but OSV regulations were explicitly excluded from the scope of the plan. As a result, OSV use in the Beartooth District remains regulated by a 1986 Forest Plan. OSV use in the small portion of the Beartooth District around Cooke City is administered by the Gallatin National Forest Travel Plan Revision described previously. The motorized routes allowed by the 2008 Travel Management Plan are all at least 15 miles from the boundary of Yellowstone. As a result, it can be concluded that motorized vehicle routes in the Beartooth District would have no effect on natural soundscapes in Yellowstone. Motorized vehicle use (including OSVs) is prohibited in the Absaroka Beartooth Wilderness Area, which covers much of the Beartooth District where it is adjacent to the park.

The impacts of past, present, and reasonably foreseeable future actions, combined with the long-term negligible impacts of alternative 1, would result in long-term minor adverse cumulative impacts on natural soundscapes. Under alternative 1, other past, present, and reasonably foreseeable future actions (e.g., airplanes, OSV use outside the park) would be the primary contributors to the cumulative impacts. The contribution of the low levels of administrative OSV use under this alternative to overall cumulative impacts in both the travel corridors and backcountry would be minimal.

Conclusion

The effects of alternative 1 on soundscapes would be long-term, minor to moderate, and adverse due to administrative OSV use. Moderate impacts would be limited to travel corridors. Cumulative impacts to soundscapes would be long-term, minor and adverse.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Under alternative 2, within the travel corridors, 8.9% of the area would have an 8-hour L_{eq} greater than or equal to 35 dBA (compared to 7% under current conditions). In the backcountry, 0.7% of the area would have an 8-hour L_{eq} greater than or equal to 15 dBA (compared to 0.5% in the current condition). Assuming the maximum allowed use levels, OSVs would be audible over 50% of the time in approximately 44.8% of the travel corridor area, compared to 31.8% of the travel corridor area under current conditions. Alternative 2 would have long-term moderate adverse impacts on soundscapes in both the travel corridor and backcountry areas.

Cumulative Impacts

Impacts on soundscapes from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor adverse effects of these actions, when combined with the long-term moderate adverse impacts of alternative 2, would result in long-term moderate adverse cumulative impacts on natural soundscapes.

Conclusion

The effects of alternative 2 on soundscapes would be long-term, moderate and adverse due to the level of OSV use permitted. Cumulative impacts to soundscapes would be long-term, moderate and adverse.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Under alternative 3, within the travel corridors, 12.2% of the area would have an 8-hour L_{eq} greater than or equal to 35 dBA (compared to 7% under current conditions). In the backcountry, 1.2% of the area would have an 8-hour L_{eq} greater than or equal to 15 dBA (compared to 0.5% under current conditions). Assuming the maximum allowed use levels, OSVs would be audible over 50% of the time in approximately 51.1% of the travel corridor area, compared to 31.8% of the travel corridor area under current conditions. Alternative 3 would have long-term major adverse impacts on soundscapes in the travel corridor areas and long-term moderate adverse impacts in the backcountry areas. As a result, alternative 3 would result in greater impacts on natural soundscapes than the current conditions.

Cumulative Impacts

Impacts on soundscapes from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor adverse effects of these actions, when

combined with the long-term moderate to major adverse impacts of alternative 3, would result in long-term moderate to major adverse cumulative impacts on natural soundscapes.

Conclusion

The effects of alternative 3 on soundscapes would be long-term, moderate to major and adverse. Major impacts would be limited to the travel corridor, due to the increased level of OSV use. Cumulative impacts to soundscapes would be long-term, moderate to major and adverse.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Under alternative 4, within the travel corridors 7.8% of the area would have an 8-hour L_{eq} greater than or equal to 35 dBA (compared to 7% under current conditions). In the backcountry, 0.4% of the area would have an 8-hour L_{eq} greater than or equal to 15 dBA (compared to 0.4% in the current condition). Assuming the maximum allowed use levels, OSVs and/or wheeled vehicles would be audible more than 50% of the time in approximately 44.6% of the travel corridor area, compared to 31.8% of the travel corridor area under current conditions. Alternative 4 would have long-term moderate adverse impacts on soundscapes in both the travel corridor and backcountry areas.

Cumulative Impacts

Impacts on soundscapes from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor adverse impacts of these actions, when combined with the long-term moderate adverse impacts of alternative 4, would result in long-term moderate adverse cumulative impacts on natural soundscapes.

Conclusion

The effects of alternative 4 on soundscapes would be long-term, moderate and adverse, due to the permitted level of OSV use. Cumulative impacts to soundscapes would be long-term, moderate and adverse.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Alternative 5 would have long-term moderate adverse impacts on soundscapes in both the travel corridor and backcountry areas. This moderate impact conclusion is the same for alternative 5a (start of the transition to BAT snowcoaches) and alternative 5b (completion of the transition to BAT snowcoaches only). When compared to each other, alternative 5b shows slightly lower impacts on soundscapes than alternative 5a. Within the travel corridors, 8.9% and 5.9% of the area would have an 8-hour L_{eq} greater than or equal to 35 dBA under alternative 5a and alternative 5b, respectively (compared to 7% under current conditions). In the backcountry, 0.7% and 0.3% of the area would have an 8-hour L_{eq} greater than or equal to 15 dBA under alternative 5a and 5b, respectively (compared to 0.5% under current conditions). Assuming the maximum allowed use levels, OSVs would be audible over 50% of the time in approximately 44.2% of the travel corridor area under alternative 5a, compared to 31.8% of the travel corridor area under current conditions. Under alternative 5b, OSVs would be audible in 47% the travel corridor area over 50% of the time. Overall, impacts under alternative 5 (before and after the phase out to snowcoaches only) would be long-term, moderate, adverse. Alternative 5a would result in greater impacts on natural soundscapes than the current condition. Although OSVs would be audible over a larger area than the current condition

under alternative 5b, the overall impact of alternative 5b on soundscapes would be less than the current condition based on consideration of other metrics (e.g., 8-hour L_{eq} , audible L_{eq} , peak 4).

Cumulative Impacts

Impacts on soundscapes from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor adverse impacts of these actions, when combined with the long-term moderate adverse impacts of alternative 5, would result in long-term moderate adverse cumulative impacts on natural soundscapes.

Conclusion

The effects of alternative 5 on soundscapes would be long-term, moderate and adverse, both before and after the phase out to snowmobiles only. Cumulative impacts to soundscapes would be long-term, moderate and adverse.

Alternative 6: Implement Variable Management

Alternative 6a (maximum OSV use level) would have long-term major adverse impacts on soundscapes in the travel corridors and long-term moderate adverse impacts in backcountry areas. Alternative 6b (seasonal average OSV use level) would result in long-term moderate adverse impacts in both the travel corridors and backcountry areas. There are many different scenarios; one example (from chapter 2) would have 22 days of the winter at the maximum use levels, and 15 days at minimum use levels, with the remaining days at levels in between the minimum and maximum. The example provided in chapter 2 could change from year to year. Also, under this alternative, some areas of the park would have no OSV use for parts of the winter season.

Within the travel corridors, 11% and 8.9% of the area would have an 8-hour L_{eq} greater than or equal to 35 dBA under alternative 6a and alternative 6b, respectively (compared to 7% under current conditions). In the backcountry, 0.7% and 0.3% of the area would have an 8-hour L_{eq} greater than or equal to 15 dBA under alternative 6a and alternative 6b, respectively (compared to 0.5% in the current condition) OSVs would be audible over 50% of the time in approximately 48.4% of the travel corridor area under alternative 6a, compared to 31.8% of the travel corridor area under current conditions and 39.8% under alternative 6b.

Cumulative Impacts

Impacts on soundscapes from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor adverse impacts of these actions, when combined with the long-term moderate to major adverse impacts of alternative 6, would result in long-term moderate to major adverse cumulative impacts on natural soundscapes.

Conclusion

The effects of alternative 6 on soundscapes would be long-term, moderate to major, adverse representing the range between low and high use days under alternative 6. Cumulative impacts to soundscapes would be long-term, moderate to major and adverse.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Alternatives 7a, 7b, and 7c would all have long-term moderate adverse impacts on soundscapes in the travel corridors and backcountry areas. Although the impact conclusion is the same, the soundscapes impact under these alternatives would vary, with the greatest impact occurring under alternative 7a (highest OSV use) and smallest impact occurring under alternative 7c (lowest OSV use).

Under alternative 7a, within the travel corridors, 8.9% of the area would have an 8-hour L_{eq} greater than or equal to 35 dBA (compared to 7% in the current condition). Under alternatives 7b and 7c, the area of the travel corridor with an 8-hour L_{eq} greater than or equal to 35 dBA would be 7.4% and 6.0%, respectively.

In the backcountry, 0.7% of the area would have an 8-hour L_{eq} greater than or equal to 15 dBA under alternative 7a (compared to 0.5% in the current condition). Under alternatives 7b and 7c, the area of the backcountry with an 8-hour L_{eq} greater than or equal to 15 dBA would be 0.7% and -0.5%, respectively.

Assuming the maximum allowed use levels, OSVs would be audible over 50% of the time in approximately 42.9% of the travel corridor area under alternative 7a, compared to 31.8% of the travel corridor area under current conditions. Under alternatives 7b and 7c, the area of the travel corridor with OSVs audible over 50% of the time would be 31.7% and 22.9%, respectively.

Cumulative Impacts

Impacts on soundscapes from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The long-term minor adverse impacts of these actions, when combined with the long-term moderate adverse impacts of alternative 7, would result in long-term moderate adverse cumulative impacts on natural soundscapes.

Conclusion

The effect of alternative 7 on soundscapes would be long-term, moderate adverse. Cumulative impacts to soundscapes would be long-term, moderate and adverse.

VISITOR USE AND EXPERIENCE

Current laws and NPS policies indicate the following desired conditions in the park with regard to visitor use and experience relative to the presence and operation of OSVs in the park. Under the Organic Act, General Authorities Act, and NPS *Management Policies 2006*, opportunities are and should continue to be provided for appropriate, high-quality public enjoyment. Visitors will have the opportunity to enjoy the superlative natural resources found in the park. Such opportunities will create ample opportunity for inspiration, appreciation, and enjoyment through personalized experiences.

ASSUMPTIONS, METHODOLOGY, AND INTENSITY DEFINITIONS

This section includes an analysis of the opportunities to view and experience park resources in the winter. Such opportunities are different than those experienced in the summer. Resources considered in the analysis include opportunities to view wildlife and scenery, behavior of other visitors with regards to safety, quality of road surfaces, availability of information, quiet and solitude, air quality, and stakeholder values.

To evaluate the level of impact to the visitor experience under each alternative, the following types of information were referenced:

- Visitor surveys
- Assessment of visitation patterns
- Assessment of opportunities historically available.

The following definitions for evaluating impacts to visitor use and experience were used for assessing the potential impacts of each alternative.

Negligible: Visitors would be able to experience a wide range of park resources and participate in a wide range of winter use activities, although may be prevented from a few experiences and/or activities because of limited access, technical difficulty, and/or cost. Visitors would typically be able to fulfill the purpose of their visit.

Minor: Visitors would be able to experience a range of park resources and participate in a range of winter use activities, but would be prevented from some experiences and/or activities because of limited access, technical difficulty, and/or cost. Most visitors would be able to fulfill the purpose of their visit.

Moderate: Visitors would be able to experience some park resources and participate in some winter use activities, but would be prevented from some experiences and/or activities because of limited access, technical difficulty, and/or cost. Some visitors may not be able to fulfill the purpose of their visit.

Major: Visitors would be able to experience some park resources and participate in some winter use activities, but would be prevented from most experiences and/or activities because of limited access, technical difficulty, and/or cost. Few visitors would be able to fulfill the purpose of their visit.

Study Area

The geographic study area for the visitor use and experience analysis includes the entire area within the park boundary.

SUMMARY OF IMPACTS

Impacts to visitor use and experience under the alternatives ranged from long-term major adverse under the no-action alternative, to long-term beneficial under the action alternatives because the levels and types of OSV use permitted in the park would be increased, when compared to the no-action alternative. Impacts under each alternative were as follows:

- Alternative 1 would have long-term major adverse impacts on visitor use and experience because winter access to the interior of the park would not be provided for visitors. Non-motorized visitors would be permitted, but due to the distance into the park and harsh weather conditions, very few visitors would be able to reach features in the interior such as Old Faithful. Winter visitors desiring either or both non-motorized and motorized experiences would be affected by this loss of access.

- Alternative 2 would have long-term beneficial impacts to visitor use and experience because permitted use levels would be similar to those under 2009 interim rule conditions (2009/2010 winter season) and would provide for both motorized and non-motorized (accessing trail heads by motorized means) access into the interior of the park. This use level would meet the level of demand for winter visitation that has occurred for the 2009/2010 winter season and it would provide limited opportunities for growth. Resource conditions (i.e., wildlife, soundscapes, and air quality) that support a quality visitor experience would experience limited effects.
- Alternative 3 would have long-term beneficial impacts to visitor use and experience in terms of access and long-term minor adverse impacts occurring from any decrease in visitor satisfaction. The opportunity for OSV access to the interior of the park would increase due to higher use limits, but the higher number of OSVs in the park may affect resource conditions (i.e., wildlife and soundscapes) to a greater extent than in recent years and may affect the ability to view wildlife and experience natural sounds. Also, some non-motorized users may be adversely impacted by an increase in OSV use.
- Alternative 4 would have long-term beneficial impacts to visitor use and experience, because motorized access to the interior of the park would continue and would be expanded to include commercial wheeled vehicles. However, because the number of snowmobiles and snowcoaches permitted would decrease from 2009 interim rule (2009/2010 winter season) levels, the demand for OSV use may not be met and those visitors that cannot obtain their desired experience would have long-term moderate adverse impacts for this user group.
- Alternative 5 would have long-term beneficial impacts to visitor use and experience because motorized access to the interior of the park would continue and until the transition to snowcoaches only, would be the same as 2009 interim rule (2009/2010 winter season) use limits. After the transition, those desiring snowcoach access would still experience long-term beneficial impacts, whereas those desiring snowmobile access would experience long-term moderate adverse impacts, because this experience may not be available.
- Alternative 6 would have long-term beneficial impacts to visitor use and experience because motorized access to the interior of the park would continue and would provide additional flexibility, including days of higher or lower OSV use, and the ability to share daily OSV allocations between entrance gates. Potential long-term negligible to minor adverse impacts could occur if the visitors' desired activity is not available at the desired time, or if a high use day prevents them from experiencing the desired resource condition (the ability to see wildlife or hear natural quiet).
- Alternative 7 would have long-term beneficial impacts to visitor use and experience because motorized access to the interior of the park would continue and variable use levels would allow visitors to plan their trip around their desired experience. Use levels would be similar to or lower than permitted under the 2009 interim rule, and would result in potential long-term minor to moderate adverse impacts if the visitors' desired activity is not available at the desired time. However, lower use levels should provide for improved resource conditions, and visitor enjoyment of those conditions, throughout the winter season.

DETAILED IMPACT ANALYSIS

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Under alternative 1, all snowmobile and snowcoach use in the park would end. Vehicle access would continue along the route from Cooke City to Gardiner (U.S. Highways 212 and 89), which is plowed during the winter months; however, other roadways in the park would be closed to vehicular traffic.

Two separate groups of park visitors would be affected by the change in management policies – motorized OSV users and non-motorized winter users.

Under alternative 1, opportunities to experience the park’s interior by either snowmobile or snowcoach, an opportunity that has existed at various levels since the 1950s, would cease. For these visitors—who average more than 60,000 people per year— their desired winter visitor experience would no longer be available. Facilities in the interior of the park would be expected to close because reduced visitation would not be able to support the operation of lodges and the provision of other services. Guides would no longer be needed, the Visitor Center at Old Faithful would be closed, and there would be no need for warming huts to support visitor safety and experience.

Some visitors may choose to use a vehicle to access northern areas of the park for backcountry uses, such as snowshoeing and cross-country skiing. However, since the two uses differ greatly, the percentage of winter visitors likely to adapt to such a change in management policies is unknown. For the majority of Yellowstone winter visitors, ending access via snowmobile and snowcoach would result in parkwide, long-term major adverse impacts on the visitor use and experience.

Non-motorized users would likely experience both adverse and beneficial effects under alternative 1. By eliminating OSV access to the interior of the park, it is anticipated that the experiences of skiers and snowshoers would generally be focused on the fringes of the park or along the highway corridor in the northern part of the park. This reduced access would restrict opportunities to experience the park’s geyser field, the Yellowstone River and Yellowstone Falls, iconic wildlife, and peace and solitude associated with the winter season. This would result in parkwide, long-term moderate to major adverse effects on visitor use and experience.

Benefits to non-motorized users may include increased opportunities to enjoy natural sounds and view wildlife. Noise and disturbance generated by snowmobile and snowcoach activities would be limited to those associated with park management and administration personnel. Therefore, such effects would generally be eliminated from the majority of the park and increase the chance to experience natural sounds. However, non-motorized visitors do not generally concentrate their activities in areas frequented by snowmobiles and snowcoaches, but rather in the backcountry where they can experience the natural sights and sounds of the park. Therefore, the benefits of reduced motorized use for non-motorized users would be limited, localized, and long-term.

The displacement of animals, in particular bison and elk, as a result of OSV-related noise and intrusion would be reduced to nearly zero by limiting OSV use to that associated with the management and administration of the park. Since access to the winter range would require long treks on skis or snowshoes, the frequency of human intrusion into this area would be infrequent. Visitors capable of making the trip to the winter range may have an increased wildlife experience, which would result in limited long-term benefits to their visitor experience.

Under alternative 1, the interior of the park would be closed to vehicular movements, thereby eliminating possible experiences for most visitors (though skiers and snowshoers could still access northern areas of the park but would have difficulty accessing the interior). This would result in a long-term major adverse effects on visitor use and experience.

Cumulative Impacts

Winter visitors to the park often enjoy a variety of experiences and include other destinations in their plans for visiting the area. In the greater Yellowstone area, there are numerous opportunities for winter users to recreate in national forests, view wildlife in wildlife refuges, and visit local

communities such as Jackson and Cody, Wyoming, West Yellowstone, Gardiner, and Cooke City Montana, and Island Park and Ashton, Idaho.

Although such destinations may be included in a visitor's itinerary, the experiences inside Yellowstone are not available elsewhere. A wide range of activities exist in Yellowstone in the winter that includes photography, wildlife viewing, walking, skiing, and snowshoeing. Yellowstone has 35 miles of groomed trails, or for the adventurous, many miles of backcountry trails available for skiing or snowshoeing. Park concessioners operate lodging accommodations at Mammoth Hot Springs and Old Faithful and provide other services, including evening programs, snowmobile and snowcoach tours, guided ski and snowshoe tours, wildlife tours, a ski shop and repair center, massage therapy, hot tub rentals, and ice skating rinks. In addition, a yurt camp is available at Canyon, which is operated by one of the park's snowcoach outfitters. The NPS also provides ranger-led winter programs that offer insight into the history, culture, and geography of Yellowstone National Park. Winter programs begin when the park opens for the winter season December 15 and end on March 15. Until expiration of the 2009 interim rule, the availability of these services and experiences supported long-term benefits to winter visitor understanding and appreciation of park resources and values. These experiences have provided long-term beneficial impacts to visitors and would continue to provide beneficial impacts if continued into the future.

However, under alternative 1, only the northern portions of the park—Mammoth Hot Springs and Highways 212 and 89—would be accessible by motorized methods, and all OSV access would end. Visitor services at Old Faithful, Canyon, and other interior park locations would be closed, because OSVs serve as the conduit to these experiences. Thus, under alternative 1, because access would be limited, the availability of the experiences would be eliminated. The impacts of past, present, and reasonably foreseeable future winter experiences, combined with the long-term major adverse impacts of alternative 1, would result in long-term major adverse cumulative impacts on visitor use and experience, of which alternative 1 would constitute a large part.

Conclusion

Restricting winter access to the interior of the park by non-motorized means would result in long-term major adverse impacts on the visitor use and experience. Winter visitors desiring either or both non-motorized and motorized experiences would be affected by loss of access. Overall cumulative effects would be long-term major adverse.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Under alternative 2, the level of winter access permitted would remain the same under the 2009 interim rule. Primary park roads would continue to be used for motorized access with up to 318 snowmobiles and 78 snowcoaches permitted per day, the level of use permitted under the 2009 interim rule. Assuming an average of 1.3 riders per snowmobile and 8 visitors per snowcoach (based on past visitation numbers), the maximum number of visitors entering the park per day would be approximately 1,000. Guides and BAT OSVs would be required. Because visitor use in the interior of the park would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities that help support a safe and high-quality visitor experience would continue to be offered.

Compared to alternative 1, alternative 2 would offer a markedly improved visitor experience—with the exception of the small group of people who could ski the long distances between park entrances and attractions—because it would allow motorized access in the park to continue, which would increase the number of visitors able to access the park's interior features in the winter. The ability to tour the park by OSV would offer a variety of opportunities to enhance visitor experience, particularly

where many park attractions would not otherwise be accessible. Requirements for using commercial guides and BAT snowmobiles under this alternative would support opportunities to view wildlife and scenery, generally safe touring conditions, access to park information, opportunities for quiet and solitude, and clean air, similar to the conditions that have prevailed in the park since the 2004 winter season.

Commercial guides are familiar with those areas where wildlife viewing is particularly good and routinely make impromptu stops to view wildlife and park scenery. They enforce proper touring behavior and usually provide informative commentary to their clients. Other information would continue to be available at warming huts, contact stations, visitor centers and entrance stations. Because commercially guided groups travel together and many such groups adhere to schedules that leave large periods of time free from OSV noise, periods of quiet and opportunities for solitude would continue. The requirement for using BAT technology would mean that good air quality in the park would also continue. For the majority of winter visitors, alternative 2 would provide long-term beneficial effects for visitor use and experience.

The presence of OSVs could cause wildlife to retreat from corridors where OSVs are used with the possibility of slightly reducing viewing opportunities. However, as described above under “Wildlife and Wildlife Habitat” the level of mechanized access proposed under alternative 2 would not be expected to result in large-scale changes in winter range use by park wildlife, and viewing opportunities would continue.

Visitors seeking non-motorized uses in the park would experience both beneficial and adverse effects. Users would benefit from continued access to the park’s interior, maintenance of 35 miles of trails, and use of visitor services and amenities resulting in long-term beneficial effects on visitor experience and access. Localized adverse effects would occur from periodic exposure to OSV sounds and sights. As described in “Chapter 3: Affected Environment” (see “Soundscapes and Visitor Use and Experience”), these intrusions would not be expected to result in measurable reductions in visitor satisfaction or understanding and appreciation of park resources and values. Therefore, impacts to visitor use and experience for those seeking a non-motorized experience would be long-term, negligible to minor adverse.

The daily allocation of OSVs would be fixed under alternative 2. Although the daily allocations for snowmobiles and snowcoaches may not be met on a daily basis, capacity may be reached during traditionally busy periods. Fixed use limits could affect peak season winter visitors, especially on holidays and weekends. During periods of high visitation, some visitors may not be able to enter the park or have the experience they desire at a particular entrance, whereas capacity may be available at another entrance that they cannot access. This could occasionally diminish benefits associated with alternative 2.

Although some visitor expectations for OSV access to the park may not be met under alternative 2, implementation of this alternative would provide adequate access to meet OSV demand because permitted use levels would be the same as those maintained under the 2009 interim rule, which have not been met on a parkwide basis. Resource conditions on which visitor experience is in part dependent, including air quality and natural sounds, would largely be protected (see the “Air Quality” and “Soundscapes” sections). Although long-term minor adverse impacts associated with unmet expectations for some visitor groups during high visitation periods would persist, alternative 2 would result in long-term benefits to visitor use and experience.

Cumulative Impacts

Impacts on visitor use and experience from other past, present, and reasonably foreseeable future winter visitor experiences would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term beneficial impacts of alternative 2 would result in long-term beneficial cumulative impacts to visitor use and experience. Alternative 2 would make a large contribution to these impacts by offering traditional winter visitor use and experience opportunities in Yellowstone, a unique recreational opportunity in the area.

Conclusion

Under alternative 2, continuing OSV use and access in accordance with the 2009 interim rule limits would meet recent demand for winter visitation and provide limited opportunities for growth. Both motorized and non-motorized winter users would experience the benefits of continued access to the park's interior. Resource conditions (i.e., wildlife, soundscapes, and air quality), which support a quality visitor experience, would experience long-term negligible to moderate adverse effects. Therefore, alternative 2 would result in long-term benefits to visitor use and experience. Cumulative impacts to visitor use and experience under alternative 2 would be long-term and beneficial.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Under alternative 3, the level of OSV use permitted would be the same as described in the 2004 Winter Use Plan. Snowmobile use would increase over the levels allowed in the 2009 interim rule to up to 720 vehicles per day and snowcoach access would remain unchanged at 78 vehicles per day. Under this alternative, up to approximately 1,500 (an average of 1.3 per snowmobile and 8 per snowcoach) visitors could be expected to enter the park daily. Primary park roads would be used for motorized access. Commercial guides and BAT snowmobiles would be required. Since visitor use in the park's interior would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities supporting a safe, high-quality visitor experience would continue to be offered.

Alternative 3 would allow OSV access to the park's interior. The increase in the number of permitted snow vehicles would allow for a substantial increase in visitation during the winter season. OSVs would access the park's interior on groomed roadways and would have opportunities to experience a variety of winter activities, both motorized and non-motorized. The requirements for using commercial guides and BAT snowmobiles under this alternative would support opportunities to view wildlife and scenery, generally safe touring conditions, ready availability of information, and clean air. Overall, effects on visitor experience and access under alternative 3 would be long-term and beneficial.

Commercial guides are familiar with those areas that are particularly good for wildlife viewing and routinely make impromptu stops to visitors to view wildlife and park scenery. They enforce proper touring behavior and usually provide informative commentary to their clients. Additional information would continue to be available at warming huts, contact stations, visitor centers, and entrance stations. Since commercially guided groups travel together and many such groups adhere to schedules leaving large periods of time free from OSV noise, opportunities for quiet and solitude would remain. Additionally, the requirement for using BAT technology would limit impacts to air quality. OSV travel may degrade the quality of groomed surfaces somewhat (creating ruts and bumps on the surface of the snow); however, most visitors would experience the park on roads groomed on a regular basis.

As described above under "Wildlife and Wildlife Habitat," bison and elk may move away from OSV routes as OSV use levels increase due to the increased level of disturbance, thereby reducing wildlife

viewing opportunities. A 2008 study that occurred during the time that up to 720 snowmobiles were permitted in the park, found that the opportunity to view bison was a large component of the winter experience, with 71% of respondents stating it was very important. Of those visitors that saw bison on their way to Old Faithful (99% of respondents), 21% indicated witnessing an encounter when the vision appeared hurried, took flight or was defensive (Freimund et al. 2009). However, the majority of visitors (72% to 78%) that witnessed these responses described them as acceptable/appropriate (Freimund et al. 2009). Additionally, the increased presence of OSVs would reduce opportunities for quiet and solitude – for both motorized and non-motorized users – as compared to alternative 1 and conditions that have been present for the past two winter seasons under the 2009 interim rule. The Freimund et al. study found that the opportunity to experience natural sounds at Yellowstone in the winter is important to the visitor experience. At use levels that would be similar to those under alternative 3, visitor satisfaction with natural sounds was high; 87% of respondents were “very satisfied” with their overall park experience and the remaining 13% were “satisfied” (Freimund et al. 2009). These incremental decreases in resource conditions, as well as past studies at similar use levels that show these resources conditions would be considered acceptable/appropriate, would result in long-term negligible to minor adverse effects to the visitor use and experience.

Visitors seeking non-motorized uses inside the park would experience both beneficial and adverse effects. Users would benefit from continued access to the park’s interior, maintenance of 35 miles of trails, and the use of visitor services and amenities. Limited adverse effects would occur from periodic exposure to OSV sounds and sights. With periods of noise intrusion over 35 dBA, and permitted use levels more than doubling compared to what has occurred the past two winter seasons, the ability to appreciate park resources and values would be impacted for these visitors and could result in long-term minor adverse effects.

The daily allocation of OSVs would be fixed under alternative 3. Although the daily allocations for snowmobiles and snowcoaches may not be met on a daily basis, capacity could be reached during traditionally busy periods. This would affect peak season winter visitors, particularly on holidays and weekends. Some visitors may not be able to enter the park or have the experience they desire. This could diminish overall visitor access benefits associated with alternative 3.

Visitors would experience long-term minor adverse impacts under alternative 3. These impacts would result from increased use levels that could adversely affect park resources, and in turn, diminish the visitor experience. Non-motorized users may experience decreased satisfaction with increased OSV use. However, due to the high levels of use permitted and the ability of visitor to experience Yellowstone in the winter in a variety of ways, long-term beneficial impacts would also occur.

Cumulative Impacts

Impacts on visitor use and experience from other past, present, and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term minor adverse impacts and long-term beneficial impacts of alternative 3, would result in long-term beneficial cumulative impacts to visitor use and experience. Alternative 3 would make a large contribution to these impacts by supporting traditional winter visitor use and experience opportunities in Yellowstone, a unique recreational opportunity in the area.

Conclusion

Under alternative 3, increasing OSV numbers and allowing access in accordance with the 2004 plan limits would provide opportunities for OSV users to experience Yellowstone in the winter, and would allow for some growth in OSV use as compared to what was observed between 2004 and 2009. Both

motorized and non-motorized winter users would experience the benefits of continued access to the park's interior, but all users could experience a decrease in satisfaction because resources could be impacted by increased OSV use. Resource conditions (i.e., wildlife and soundscapes) would be affected to a greater extent than in recent years and may affect the ability to view wildlife and experience natural sounds. Overall, alternative 3 would result in long-term benefits to visitor experience and access, with long-term minor adverse impacts occurring from any decrease in visitor satisfaction. Cumulative impacts to visitor use and experience under alternative 3 would be long-term and beneficial.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Under alternative 4, winter access would be managed differently for different vehicle types to various parts of the park. A portion of the main park road system from Mammoth to Madison and from the west entrance to Old Faithful would be plowed to allow commercial wheeled-vehicle access. From the south entrance to Old Faithful and from West Thumb to Norris would be groomed for OSV use. Up to 66 snowmobiles and 20 snowcoaches could enter from the south each day. Up to 100 multi-passenger, commercial vehicles would be allowed to enter from the north and west; no private wheeled vehicles would be permitted. Limited snowmobile use (22 per day) would be allowed at Old Faithful and Norris. The east entrance would be closed to motorized use.

Because visitor use in the park's interior would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities that help support a safe and high-quality visitor experience would continue to be offered. Under this alternative, the total number of visitors inside the park could increase. Vans and buses could easily transport up to 2,000 visitors into the park each day. Including OSV users, total visitation could be expected to range up to over 2,300 per day. It is anticipated that commercial providers would provide wheeled-vehicle visitor experiences along the plowed roadways. This could include experiences in geologically active areas from Old Faithful and north through the Geyser Basin to Norris. Overnight stays at Old Faithful Snow Lodge would also be expected to increase should visitation to the park increase. For those entering in wheeled vehicles, once inside the park, access to sites beyond plowed roads and developed visitor areas would be restricted to backcountry methods on snowshoes and skis (as under the 2009 interim rule) and limited availability of OSVs from Norris or Old Faithful.

Under alternative 4, visitors seeking OSV and non-motorized would likely experience mixed beneficial and adverse effects. OSV use would continue, but reduced capacity numbers from under 2009 interim rule use levels would impact the ability to access a variety of experiences in the park as compared to historical levels. Commercial guides and BAT OSVs would be required. Snowmobiles (up to 110 per day) and snowcoaches (up to 30 per day) may not meet demand (based on use levels for the 2009/2010 winter season) and would not be able accommodate any growth in demand for OSV use in the park. Under this alternative, OSV routes would be reduced and "loop tour" experiences eliminated. Such a change would be beneficial as compared to alternative 1 but would not provide a level of visitor access consistent with those in place under the 2009 interim rule and historical use rates (see table 37). As a result, it is not anticipated that the user levels permitted under this alternatives would meet expectations for the majority of winter visitors.

As described above under "Wildlife and Wildlife Habitat," opportunities to view bison and elk would continue along plowed roadways, because these species do not generally disperse as a result of the presence of wheeled vehicles. However, the frequent presence and operation of snowplows to maintain road access could degrade natural quiet for both animals and visitors.

Winter visitors seeking non-motorized recreation could access the park by both wheeled vehicles and OSVs. Accessing the park by these different vehicle types would lead to distinctive experiences; each type of vehicle would be able to access distinct park environments and settings. Further, the addition of wheeled vehicle access would add an access opportunity that would likely be more financially affordable to visitors than OSV use. For the areas east of Old Faithful and Norris, backcountry visitors would likely experience increased quiet because the total number of OSVs would be dramatically reduced. This may improve wildlife viewing and increase opportunities to appreciate solitude and the park's winter resources. Cross-country skiers and snowshoers visiting areas west of Old Faithful and Norris would access trailheads via wheeled vehicles on plowed roads. The park would continue to maintain 35 miles of backcountry trails and would add 10 miles of trails made accessible from the plowed roads.

Compared to alternative 1, alternative 4 would offer a distinctively different visitor experience. The addition of wheeled-vehicle access combined with continued but limited ability to tour the park by OSV would create opportunities to have an enjoyable visitor experience. However, this may not meet visitor expectations for exploring the park by OSV, resulting in long-term minor to moderate adverse impacts, because the difference in experience would be noticeable and measureable for this specific group of visitors. The requirements to use commercial vehicles, guides, and BAT snowmobiles under this alternative would support opportunities to view wildlife and scenery, generally safe touring conditions, ready availability of information, and clean air. OSV noise would decrease to approximately half of that under the 2009 interim rule on and near travel corridors.

Adverse impacts to visitor use and experience would continue under alternative 4 because the expectation for OSV access to the park would likely not be met. However, a new winter visitor experience would be added with wheeled vehicle use, creating beneficial effects. Although adverse impacts would persist, compared to alternative 1, overall impacts on visitor use and experience would be long-term beneficial, with long-term minor to moderate adverse impacts to those visitors impacted by the limited availability of OSV.

Cumulative Impacts

Impacts on visitor use and experience from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term minor to moderate adverse impacts and long-term beneficial impacts of alternative 4, would result in long-term minor to moderate adverse impacts and long-term beneficial cumulative impacts to visitor use and experience. Alternative 4 would make a large contribution to these impacts by supporting traditional winter visitor use and experience opportunities in Yellowstone, a unique recreational opportunity in the area.

Conclusion

Under alternative 4, changes in visitor access and experience created by introducing wheeled vehicles access and limiting OSV access would result in a distinctively different winter visitor experience. Parkwide, long-term beneficial impacts would result compared with alternative 1. Both motorized and non-motorized winter users would experience the benefits of continued access to the park's interior. However, expectations for OSV access and experience would not likely be met because of the decrease in the number of snowmobiles and snowcoaches permitted in the park on any given day, resulting in long-term moderate adverse impacts for this user group. Overall, alternative 4 would result in long-term beneficial impact and long-term minor to moderate adverse impacts to visitor experience and access. Cumulative impacts to visitor use and experience would be long-term minor to moderate adverse and long-term beneficial.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

At the implementation of this alternative, this alternative would have the same use levels as under alternative 2 (up to 318 snowmobiles and 78 snowcoaches) and therefore the impacts would be the same. Beginning in the 2014/2015 winter season, BAT snowcoach access would be allowed to increase over a 5-year period from the 2009 interim rule level of up to 78 vehicles per day to 120 vehicles per day. Snowmobile use would correspondingly decrease from the 2009 interim rule use level of up to 318 vehicles per day to zero over the 5-year period; the decrease in snowmobiles would be based on the demand for snowcoaches or at the Superintendents discretion. Assuming eight visitors per snowcoach, a total daily visitation rate of 960 visitors could be expected if a full phase out were to occur. Requirements for BAT snowmobiles and guided activities would continue throughout the transition period with all new snowcoaches required to have BAT. Primary park roads would be groomed for OSV use. Since visitor use in the park's interior would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities that help support a safe, high-quality visitor experience would continue to be offered.

Compared to the alternative 1, alternative 5 would offer an improved visitor experience. However, a specific, individual winter experience in the park, one that has been available for many years, would be phased out and replaced by a group experience. Although attractions and destinations would remain accessible and interpretation provided through guides, the sense of adventure associated with riding a snowmobile, which includes being exposed to the winter weather with no barrier between the visitor and the environment, would be lost. For those visitors seeking this type of experience, the removal of snowmobile use from the park would result in long-term, moderate, adverse effects on visitor experience.

During the 5-year transition period, the requirements for using commercial guides and BAT snowmobiles would support opportunities to view wildlife and scenery, generally safe touring conditions, ready availability of information, good opportunities for quiet and solitude, and clean air. This would be similar to the conditions that have prevailed in the park since the 2004 winter season. Commercial guides are familiar with typical wildlife viewing locations and routinely make impromptu stops to view wildlife and park scenery. They enforce proper touring behavior and usually provide informative commentary to their clients. Other information would continue to be available at warming huts, contact stations, visitor centers, and entrance stations. Requirements for BAT technology for snowcoaches would support good air quality.

Visitors seeking non-motorized uses inside the park would experience limited beneficial effects. The total number of OSVs in the park would be reduced to the number of snowcoaches permitted in the park on a given day. It is anticipated that this would result in a small reduction in OSV sounds exceeding 35 dBA in the travel corridor (from approximately 9 percent to 6 percent of the day) as compared to the combined presence of snowmobiles and snowcoaches. As a result, backcountry visitors may experience an increment of improved opportunities to experience quiet and solitude. These visitors would continue to benefit from continued access to the park's interior, maintenance of 35 miles of trails, and use of visitor services and amenities such as warming huts. Limited adverse effects would continue to occur from periodic exposure to snowcoach sounds and sights. As described in the Affected Environment (see "Soundscapes" and "Wildlife and Wildlife Habitat"), these intrusions would be considered minimal.

The daily allocation of snowcoaches provided under alternative 5 would be fixed and the 120 snowcoach maximum should a full phase out occur and may not meet demand during traditionally busy periods or allow for increased visitation. This could affect peak season winter visitors, particularly on holidays and weekends. As a result, some potential visitors may not be able to enter the

park or have the experience they desire, possibly diminishing overall benefits associated with alternative 5 for those potential visitors. Visitors would be able to engage in OSV use in other areas in the region, but the specific experience of OSV use in Yellowstone would be more limited.

Some visitor expectations for the type and amount of OSV access to the park may not be met under alternative 5. Additionally, the implementation of this alternative may not meet demand (based on use levels for the 2009/2010 winter season) or allow for increased winter visitation to the park. Resource conditions that contribute to visitor experience (e.g., air quality and natural sounds) would largely be protected under this alternative. Although minor adverse impacts associated with unmet expectations of some visitor groups would continue or increase with the elimination of snowmobile use, when compared to alternative 1, alternative 5 would result in long-term benefits to visitor use and experience with long-term moderate adverse impacts to users who can no longer have an individual OSV (snowmobile) experience in the park.

Cumulative Impacts

Impacts on visitor use and experience from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term moderate adverse impacts and long-term beneficial impacts of alternative 5 would result in long-term moderate adverse impacts and long-term beneficial cumulative impacts to visitor use and experience. Alternative 5 would make a large contribution to these impacts by supporting traditional winter visitor use and experience opportunities in Yellowstone, a unique recreational opportunity in the area.

Conclusion

Under alternative 5, changes in visitor experience created by the potential transition to snowcoach access only would result in parkwide, long-term benefits compared to the no-action alternative. Both motorized and non-motorized winter users would experience the benefits of continued access to the park's interior. However, the opportunity to experience a specific, individual snowmobile experience as offered in the past would be lost. This would result in the potential for visitors' expectations not to be met. Overall, alternative 5 would result in long-term beneficial impacts to visitor experience and access, with long-term moderate adverse impacts to those wishing to engage in snowmobile use. Cumulative impacts to visitor use and experience would be long-term beneficial and long-term moderate adverse.

Impacts of Alternative 6: Implement Variable Management

Under alternative 6, winter access would be managed to increase a variety of winter experiences, create flexibility in use levels, and add opportunities for backcountry skiing and snowshoeing. Up to 540 snowmobiles and 78 snowcoaches would be permitted in the park daily, but this number could vary on a daily basis, based on a per-determined winter use schedule. Approximately 1300 visitors per day could be expected under this alternative. Entrance gate allocations would be flexible and incentives for use of new technology would be developed. Up to 25% of snowmobile use would be unguided or non-commercially guided, with requirements for completing a snowmobile education and safety course, with the remaining OSV allocations being commercially guided. In addition, a variety of additional snowmobile routes would be made available based on a seasonal schedule. Since visitor use in the park's interior would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities that help support a safe and high-quality visitor experience would continue to be offered. Under this alternative, visitors would have increased opportunities for exploring Yellowstone using OSVs with use limits that would increase use from 2009/2010 winter season levels. Depending

on snow conditions, availability of alternate routes, and service provider capacities, visitors would have increased flexibility in visiting the park during winter. Traditional vacation /holiday periods and long weekends would likely see higher demand with the potential to meet maximum OSV capacity in some years, and lower OSV levels in other years. However, the use of alternate routes, availability of unguided/non-commercially guided snowmobiling, and the ability of operators to exchange permits would alleviate potential crowding by allocating use based on visitor demand and defined capacities in various areas.

Depending on demand, the total number of visitors inside the park could potentially increase. Peak season visitation during holidays could reach capacity. Visitors seeking OSV experiences would likely experience beneficial effects from alternative 6. Availability of snowmobile tours would be increased, visitors with their own snowmobiles that meet BAT requirements would have access to the park under the unguided/non-commercially guided system, and snowcoach access would continue. Commercial guides and BAT snowmobiles would be required for all other OSV use. This would be beneficial and would provide a level of visitor access consistent with historical use rates and would allow the flexibility to meet changing demands. It is anticipated that this alternative would meet the expectation of most OSV visitors.

As described under “Wildlife and Wildlife Habitat,” bison and elk may move away from OSV routes as OSV use levels increase should they find the sound of OSVs or human interaction bothersome, possibly reducing wildlife viewing opportunities. A 2008 study that occurred during the time that up to 720 snowmobiles were permitted in the park found that the opportunity to view bison was a large component of the winter experience, with 71% of respondents stating it was very important. Of those visitors that saw bison on their way to Old Faithful (99% of respondents), 21% indicated witnessing an encounter when the bison appeared hurried, took flight or was defensive. However, the majority of visitors (72% to 78%) that witnessed these responses described them as acceptable/appropriate (Freimund et al. 2009). In addition, the increased presence of OSVs would reduce opportunities for quiet and solitude—for both motorized and non-motorized users—as compared to alternative 1 and conditions that have been present for the past two winter seasons. At use levels that would be similar to those under alternative 3, Freimund et al. (2009) found that the opportunity to experience natural sounds at Yellowstone in the winter is important to the visitor experience and satisfaction with natural sounds was high, with 87% of respondents being “very satisfied” with their overall park experience and the remaining 13% were “satisfied” (Freimund et al. 2009). OSV noise would exceed 35 dBA in travel corridors for approximately 13 to 14 percent of the day – more than double that of the 2009 interim rule conditions. For backcountry visitors, the increase in the total number of OSVs allowed in the park from 396 vehicles per day to 618 vehicles per day (on a high use day) could result in a modest reduction in opportunities to experience natural sounds and solitude. However, alternative 6 provides for variability in use throughout the season. This variability would allow users to plan their trip around their desired experience. If OSV noise would detract from a visitor experience, that visitor can plan a visit for a time with lower OSV use. If OSV use is a critical part of a visitor experience, the visitor can plan for a day with higher OSV use; past studies have found that although high level of use may have some adverse impact to the visitor experience, there is a high level of visitor satisfaction, as described above (Freimund et al. 2009). This flexibility would result in long-term beneficial impacts, with the potential for long-term negligible to minor adverse impacts if these individual desires cannot be accommodated.

Alternative 6 has the greatest potential to meet expectations of OSV visitors to the park. Also associated with this alternative would be a small increase in adverse impacts to other visitors and park resources. Compared to alternative 1, overall impacts on visitor use and experience would be long-term beneficial, with long-term negligible to minor adverse impacts to those who would not be able to achieve their desired visitor experience because of increased use levels, although these users could

plan for days where the desired experience is provided. These impacts to visitor use and experience would be similar to greater than those under the 2009 interim rule.

Cumulative Impacts

Impacts on visitor use and experience from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term negligible to minor adverse impacts and long-term beneficial impacts of alternative 6 would result in long-term minor adverse impacts and long-term beneficial cumulative impacts to visitor use and experience. Alternative 6 would make a large contribution to these impacts by supporting traditional winter visitor use and experience opportunities in Yellowstone, a unique recreational opportunity in the area.

Conclusion

Under alternative 6, increases in OSV allocations and flexibility in daily use would result in parkwide, long-term beneficial impacts compared to the no-action alternative. Both motorized and non-motorized winter users would experience the benefits of continued access to the park's interior, and visitors could plan their trip around the use level for that day and their desired experience. Resource conditions (e.g., wildlife and soundscapes) would be affected to a greater extent than in recent years, somewhat affecting the visitors' ability to view wildlife and experience natural sounds. Overall, alternative 6 would result in long-term benefits to visitor experience and access, with potential negligible to minor impacts for visitors that cannot accommodate their desired experience. Cumulative impacts would be long-term minor adverse as well as long-term beneficial.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Under alternative 7, the number of snowmobiles and snowcoaches permitted in the park would vary, allowing higher use during peak demand periods. Up to 330 snowmobiles and 80 snowcoaches could enter the park during the winter season. During times when the permitted use levels are lower, up to 220 and 143 snowmobiles, and 50 and 30 snowcoaches, respectively, could enter the park to allow for variation in use. All snowmobile and snowcoach use in the park would be commercially guided. Under this alternative, all OSVs would be required to enter the park before 10:30 a.m. each day. A maximum of approximately 1,070 OSV visitors per day (on a high use day) could be expected under this alternative. All entrance gate allocations would be flexible and could be transferred between gate locations. BAT would be required for all OSVs by the 2014/2015 winter use season, with additional BAT requirements for NO_x to be developed. Because visitor use in the park's interior would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities that help support a safe and high-quality visitor experience would continue to be offered. Increased access would be provided to cross country skiers and snowshoers by conversion of several OSV routes to non-motorized use. These routes include Firehole Canyon, North Canyon Rim Drive, and Riverside Drive.

Under this alternative, the variety of available winter use experiences would be expanded, and OSV numbers permitted and access locations would be flexible. It is anticipated that current OSV demand would be met, and limited growth could be accommodated. Thus, alternative 7 would provide long-term, parkwide benefits for OSV visitors. However, the OSV visitor experience would be altered from that available in past winter seasons, especially for lower use days. OSVs would have limited access in the beginning and end of the winter season, potentially reducing available visitation dates. OSV visitors would have only commercially guided touring opportunities, and would have reduced ability to view high-value features seen along routes converted to non-motorized use. Some visitors may not

be able to visit at the desired time or experience a specific park landscape and resource. For OSV users, the benefits of alternative 7 would be offset somewhat by long-term, localized, minor to moderate, adverse effects of these restrictions.

Alternative 7 has the greatest potential to meet expectations of non-motorized winter users of the park. Cross-country skiers and snowshoers would gain access to routes previously shared with OSVs, and would have the new opportunities to experience park resources and values with low levels of OSV noise and intrusion. Alternative 7 would result in long-term, parkwide, benefits for park visitors pursuing non-motorized means of recreation.

The overall reduction in the number of OSVs, compared to historical numbers, and reduced access to portions of the park would increase opportunities for quiet and solitude for both motorized and non-motorized users for half of the winter use season. OSV noise would exceed 35 dBA in travel corridors for approximately 12% to 9% of the day, similar to those levels experienced in the winter of 2009/2010. The variability in numbers of OSVs in the park would allow users to plan their trip around their desired experience. If OSV noise would detract from a visitor's experience, that visitor can plan a visit for a time with lower OSV use; if OSV use is a critical part of a visitor's experience, they can plan for a day with higher OSV use. This flexibility could result in long-term beneficial impacts, with the potential for long-term negligible to minor adverse impacts if these individual desires cannot be accommodated.

Also associated with alternative 7 are somewhat reduced impacts to wildlife from reduced OSV numbers for half of the winter use season, elimination of OSVs on some routes, and requiring all OSVs to enter the park by 10:30 a.m. (clumping use). In combination with reduced OSV noise, it is anticipated that wildlife would be affected to a lesser extent than in recent years, and opportunities for viewing may be improved.

Compared to alternative 1, overall impacts on visitor use and experience would be long-term beneficial, with long-term, minor to moderate, adverse impacts for those visitors unable to achieve their desired visitor experience because of reduced OSV availability and route changes.

Cumulative Impacts

Impacts on visitor use and experience from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term minor to moderate adverse impacts and long-term beneficial impacts of alternative 7 would result in long-term minor to moderate adverse impacts and long-term beneficial cumulative impacts to visitor use and experience. Alternative 7 would make a large contribution to these impacts by supporting traditional winter visitor use and experience opportunities in Yellowstone, a unique recreational opportunity in the area.

Conclusion

Under alternative 7, varying OSV allocations and flexibility in daily use would result in parkwide, long-term beneficial impacts compared to the no-action alternative. Visitors could plan their trip around desired use and experiences, but limited OSV availability early and later in the winter season may result in unmet expectations for OSV visitors. Resource conditions (soundscapes and wildlife) would be affected to a lesser extent than in recent years, somewhat improving visitors' ability to view experience natural sounds and view wildlife. Overall, alternative 7 would result in long-term benefits to visitor experience and access, with potential minor to moderate adverse impacts for visitors that

cannot obtain their desired experience. Cumulative impacts would be long-term, minor to moderate, adverse, as well as long-term beneficial.

VISITOR ACCESSIBILITY

GUIDING REGULATIONS AND POLICIES

It is NPS policy to ensure that all people, including those with disabilities, have the highest reasonable level of accessibility to NPS programs, facilities and services. *NPS Management Policies 2006* emphasize the need to comply with the Americans with Disabilities Act (ADA) and Architectural Barriers Act in Section 5.3.2, “Physical Access for Persons with Disabilities” and Sections 1.9.3, 8.4.2, and 9.1.2 “Accessibility for Persons with Disabilities.” Other mandates include the requirement for providing reasonable accommodation for known disabilities of qualified applicants and employees (Director’s Order 16A, Reasonable Accommodation for Applicants and Employees with Disabilities) and to ensure that facilities are readily accessible to and usable by individuals with disabilities, including individuals who use wheelchairs (Director’s Order 42, Accessibility for Visitors with Disabilities in National Park Service Programs and Services).

In addition, the NPS requires that those providing commercial services in the parks share the NPS responsibility to provide employees and visitors with the greatest degree of access to programs, facilities, and services that is reasonable, within the terms of existing contracts and agreements (see *NPS Management Policies 2006*, sec. 10.2.6.2 “Accessibility of Commercial Services”).

ASSUMPTIONS, METHODOLOGY, AND INTENSITY DEFINITIONS

This section includes an analysis of changes to accessibility for the very young, the elderly, and those with mobility impairments. For the very young and the elderly, mobility issues were not considered to be of primary concern; rather, exposure to winter weather, including cold temperatures and high winds, and the need for protection from these elements were considered. Resources considered in the analysis include opportunities to view wildlife and scenery in a safe environment.

For this analysis, it is assumed that the experience of visiting Yellowstone by snowcoach would be available for the very young, elderly, and mobility impaired visitors. In addition, snowmobile use would be possible for some portion of those visitors with disabilities. Therefore, snowcoach and snowmobile use are considered in this analysis. It is also assumed that those providing commercial tours in the park are in compliance with NPS accessibility requirements as mentioned above. This includes larger capacity snowcoaches offering wheelchair accessibility and/or ramps.

The following definitions for evaluating impacts on visitor accessibility were defined.

Negligible: Accessibility for the very young, the elderly, and individuals with disabilities would not be affected, or effects would not be noticeable or measurable. There would be minimal effects on safe opportunities to view wildlife and scenery.

Minor: Changes in accessibility would be noticeable, but would affect only a small portion of the very young, the elderly, and individuals with mobility-related disabilities who visit the park. Impacts would be slight without appreciably limiting or enhancing critical characteristics of opportunities to safely view wildlife and scenery.

Moderate: Changes in accessibility would be readily apparent to many of the very young, the elderly, and individuals with mobility-related disabilities who use the park. Visitors would have some difficulty finding available, safe opportunities to view wildlife and scenery.

Major: The effects on accessibility would be readily apparent to most of the very young, the elderly, and individuals with mobility-related disabilities who use the park and would substantially change their ability to access park features. Visitors would frequently have substantial difficulty finding available, safe opportunities to view wildlife and scenery.

Study Area

The geographic study area for visitor accessibility analysis includes the entire area within the park boundary.

SUMMARY OF IMPACTS

Impacts to visitor access under the alternatives ranged from long-term major adverse under the no-action alternative to long-term and beneficial under the action alternatives because the levels and types of OSV use allowed for greater access into the interior of the park. Impacts under each alternative were as follows:

- Alternative 1 would have long-term major adverse impacts by restricting winter access to the interior of the park to non-motorized methods.
- Alternatives 2, 3, 4, 5, 6, and 7 would have long-term beneficial impacts because allowing OSV into the interior of the park would provide opportunities for accessibility. However, under alternative 4, the potential for long-term minor adverse impacts would exist because the number of OSVs would be limited, thereby potentially limiting the number of accessible OSVs.

DETAILED IMPACT ANALYSIS

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Under alternative 1, no public OSV use would be allowed in the park. Vehicle access would continue along the route from Cooke City to Gardiner (U.S. Highways 212 and 89), which is plowed during the winter months (NPS 2010c).

Under alternative 1, access for all visitors—both those with and without accessibility needs—to the park's interior would be limited to those capable of snowshoeing or cross-country skiing into the park. In addition, visitor services and amenities within the park would be severely reduced or eliminated. For the very young, elderly, and those that are mobility impaired, this would result in a loss of opportunity to experience the park's iconic features of Old Faithful, the Geyser Basin, and Yellowstone River and Yellowstone Falls, among others. This would result in long-term, major adverse impacts for those users with accessibility needs.

Cumulative Impacts

As described in the section “Visitor Use and Experience,” Yellowstone offers a range of accessible winter visitor experiences, including snowcoach access to photography opportunities and wildlife viewing. Park concessioners operate lodging accommodations at Mammoth Hot Springs and Old Faithful and provide other services, including evening programs, snowcoach tours, wildlife tours, massage therapy, and hot tub rentals. In addition, a yurt camp is available at Canyon, which is operated by one of the park’s snowcoach outfitters. The NPS also provides ranger-led winter programs that offer insight into the history, culture, and geography of Yellowstone National Park. Winter programs begin when the park opens for the winter season on December 15 and end on March 15. Until expiration of the 2009 interim rule, the availability of these services and experiences supported long-term benefits to winter visitor understanding and appreciation of park resources and values.

The long-term beneficial impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term major adverse impacts of alternative 1, would result in long-term major adverse cumulative impacts on visitor accessibility. Alternative 1 would constitute a large part of these impacts because access to the interior of the park would impact all visitors to Yellowstone.

Conclusion

Restricting winter access to the interior of the park to non-motorized methods would result in long-term major adverse impacts to visitor accessibility; including the very young, the elderly, and the mobility-impaired visitors. Accessible regional opportunities for winter recreation would offset these adverse impacts somewhat. Cumulative impacts to visitor accessibility would be long-term major adverse, to which alternative 1 would contribute a large part.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Under alternative 2, the level of winter access permitted would be similar to the 2009 interim rule. The main park roads would be groomed for OSV access, which includes a daily limit of up to 78 snowcoaches per day. This would also provide access for snowcoaches equipped with ramps/lifts to accommodate wheelchairs. Mobility impaired visitors capable of operating snowmobiles would have access to this traditional winter activity, and wheelchairs can be transported via snowmobile. In addition, small children could be accommodated on snowmobiles with their parents, providing an exciting and cost effective way for families to experience Yellowstone in winter. Accessible facilities in the park would continue to be available to support a safe and, informative park experience for the very young, the elderly, and the mobility impaired. Once in the park, a variety of accessible facilities would be available to support the traditional winter use experience for those with accessibility needs; including facilities near Old Faithful found at the Snow Lodge and the visitor center. While touring by snowcoach and snowmobile, the Canyon can be viewed from accessible locations on the South Rim Drive at Artist Point and at Uncle Tom’s Overlook. In addition, Fishing Bridge is partially wheelchair accessible.

Compared to alternative 1, alternative 2 would offer a markedly better experience for those with accessibility needs. The continued ability to tour the park by OSV would offer a variety of opportunities to have a safe, informative, and enjoyable experience. This alternative would support guided opportunities to view wildlife and scenery, ready availability of information, opportunities for quiet and solitude, and clean air, similar to the conditions that have prevailed in the park over the last four winters. As of December 2010, the demand for snowcoach ramp/lift capabilities was being met by service providers with equipment suitable to meet these needs. It is anticipated that service

providers would expand equipment capabilities to meet an increase in demand should it be necessary in the future.

For the very young, the elderly, and the mobility-impaired winter visitors, alternative 2 would provide parkwide, long-term beneficial impacts on accessibility.

Cumulative Impacts

Impacts on visitor accessibility from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term beneficial impacts of alternative 2 would result in long-term beneficial cumulative impacts to visitor accessibility. Alternative 2 would make a large contribution to these impacts by supporting accessible winter visitor use and experience opportunities in the park, a unique recreational opportunity in the area.

Conclusion

Under alternative 2, continuing OSV numbers and routes in accordance with the 2009 interim rule limits would meet demand (based on use levels for the 2009/2010 winter season) for accessible winter visitation for the very young, the elderly, and the mobility impaired. Opportunities for increased visitation for those with mobility needs would also be accommodated. Thus, alternative 2 would result in long-term beneficial impacts to visitor accessibility. Cumulative impacts under alternative 2 would be long-term and beneficial.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Under alternative 3, winter use levels as described in the 2004 Winter Use Plan would continue, permitting up to 78 snowcoaches per day in the park. As described for alternative 2, snowmobile touring would also be available for those seeking this specific winter use experience. Primary park roads would be groomed for OSV access, including those suitable for wheelchair use and those with ramps/lifts. Accessible facilities in the park would continue to be available to support a comfortable and informative park experience for the very young, the elderly, and mobility impaired. As described for alternative 2, the park's accessible facilities would support a safe and educational experience for those with mobility needs. It is anticipated that existing demand would be met with additional capacity for an increase in accessible services. Within the park, accessible facilities at a variety of locations would support traditional winter experiences for those with accessibility needs. Alternative 3 would result in parkwide long-term benefits for visitor accessibility.

Cumulative Impacts

Impacts on visitor accessibility from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These and long-term beneficial impacts, when combined with the long-term beneficial impacts of alternative 3 would result in long-term beneficial cumulative impacts to visitor accessibility. Alternative 3 would make a large contribution to these impacts by supporting accessible winter visitor use and experience opportunities in the park, a unique recreational opportunity in the area.

Conclusion

Under alternative 3, OSV numbers and routes in accordance with the 2004 Winter Use Plan limits would meet the demand (based on use levels for the 2009/2010 winter season) for a winter experience

that can be enjoyed by the very young, the elderly, and the mobility impaired. Opportunities for increased accessible visitation would also be accommodated. Therefore, alternative 3 would result in long-term benefits to visitor accessibility. Cumulative impacts under alternative 3 would be long-term and beneficial.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Under alternative 4, winter access would be managed for different vehicle types with different regulations by section of the park. Part of the main park road system from Mammoth to Madison and from the west entrance to Old Faithful would be plowed to allow commercial wheeled-vehicle access. The area from the south entrance to Old Faithful and from West Thumb to Norris would be groomed for OSV use. Up to 20 snowcoaches, along with up to 66 snowmobiles per day could enter from the south each day. Up to 100 multi-passenger, wheeled, commercial vehicles would be allowed to enter the park from the north and west (no private wheeled vehicles would be permitted). The east entrance would be closed to motorized use. Accessible facilities in the park would continue to be available to support a comfortable and informative park experience for the very young, the elderly, and the mobility impaired. This alternative provides the greatest potential for including a variety of accessible experiences for winter visitors. Allowing for wheeled access to portions of the park would expand the variety of vehicles that provide safe, ADA-compliant visitor transportation and guided tour services within the park. Commercial service providers could employ vans and shuttle buses used during the summer season for a portion of their winter services, avoiding the expense of converting other vehicles to meet ADA compliance requirements. Wheeled vehicle experiences could include the geologically active areas from Old Faithful north through the Geyser Basin to Norris. From the west entrance, visitors would travel along the Madison River introducing a new accessible winter experience that does not require OSV travel.

However, for those seeking accessible snowcoach and snowmobile touring, availability could be limited as compared to other alternatives. Although OSV use would continue, available experiences would be dramatically reduced compared to historical levels. Allowing OSV entry only from the south would localize availability, may not meet current overall demand, and is not anticipated to accommodate an increased demand for such services. Therefore, it could be more difficult for those with accessibility needs to have an OSV experience in the park. In addition, OSV routes would be reduced and “loop tour” experiences eliminated. This alternative would be beneficial for accessibility compared to alternative 1, but may not provide accessible visitor experiences consistent with historical use. Such effects would be experienced by all park users – both those with and without accessibility needs. As described for alternative 2, within the park, accessible facilities at a variety of locations would support a safe and informative winter experience for those with accessibility needs.

Compared to alternative 1, alternative 4 would offer distinctive accessibility options providing long-term beneficial impacts. The addition of wheeled-vehicle access combined with the continued but limited ability to tour the park by OSV would create opportunities to have an enjoyable accessible experience; however, it may not meet expectations for exploring the park by snowcoach or snowmobile and could also result in long-term minor adverse impacts if accessible OSV demand cannot be met.

Cumulative Impacts

Impacts on visitor accessibility from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term beneficial impacts and long-term minor adverse impacts of alternative 4 would result in

long-term beneficial cumulative impacts to visitor use and experience. Alternative 4 would make a large contribution to these impacts by supporting accessible winter visitor use and experience opportunities in the park, a unique recreational opportunity in the area.

Conclusion

Under alternative 4, distinct accessibility options of snowcoaches, snowmobiles, and wheeled vehicles would be available for exploring Yellowstone in winter. However, accessible snowcoach experiences may not be available to all seeking them. Nonetheless, the availability of wheeled, accessible vehicles would potentially provide the greatest degree of accessibility of the proposed alternatives. This would result in parkwide, long-term beneficial impacts to accessibility when compared to the no-action alternative, with the potential for long-term minor adverse impacts due to the limited availability of snowcoach access. Cumulative impacts would be long-term beneficial.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Impacts under alternative 5 upon plan implementation would be the same as alternative 2. Beginning in the 2014/2015 winter season, BAT snowcoach access would increase over a 5-year period from the 2009 interim rule level of up to 78 vehicles per day to 120 vehicles per day, based on user demand. Snowmobile use would correspondingly decrease to zero over the 5-year period if user demand for snowcoaches exists or at the discretion of the Superintendent. The main park roads would be groomed for OSV use. Accessible facilities in the park would continue to be available to support safe and informative park experiences for the very young, the elderly, and the mobility impaired. Following the 5-year transition period, the daily allocation of snowcoaches provided under alternative 5 would be fixed. Snowcoaches would enter the park from a variety of locations. Given that there had been unused capacity under the 2009 interim rule for accessible snowcoach tours, the increase would allow for substantial growth in services of ADA-compliant snowcoaches, if demand increases.

However, with elimination of snowmobile use in the park, the opportunity for this experience would be lost. In addition, with only the option of snowcoach touring, alternative 5 would have the potential to increase the cost of winter use experiences for families with small children. This would result in long-term, minor to moderate adverse effects to this specific group of visitors with accessibility needs. As described for alternative 2, within the park, accessible facilities at a variety of locations would support a safe and comfortable experience for those with accessibility needs.

Alternative 5 offers the greatest potential for the very young, the elderly, and the mobility impaired to experience an informative “over the snow” adventure in the winter landscape of the park via snowcoach. However, the opportunity to use snowmobiles would be eliminated over the long term. Although there would be minor to moderate adverse effects to accessibility for those seeking snowmobile experiences in the park, alternative 5 would result in parkwide, long-term beneficial impacts to accessibility when compared to the no-action alternative.

Cumulative Impacts

Impacts on visitor accessibility from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These and long-term beneficial impacts, when combined with the long-term beneficial impacts of alternative 5 would result in long-term beneficial cumulative impacts to visitor use and experience. Alternative 5 would make a large contribution to these impacts by supporting accessible winter visitor use and experience opportunities in the park, a unique recreational opportunity in the area.

Conclusion

Under alternative 5, changes in visitor experience created by the potential transition to snowcoach access only would result in parkwide, long-term beneficial impacts compared to the no-action alternative. For those seeking snowmobile experiences, impacts would be long-term, minor to moderate adverse. Cumulative impacts would be long-term and beneficial.

Impacts of Alternative 6: Implement Variable Management

Under alternative 6, winter access would be managed to increase the variety of winter experiences and also create flexibility in use levels. Primary park roads would be groomed for OSV access, including up to 78 snowcoaches per day, but the number of snowcoaches and snowmobiles would vary throughout the winter season. Accessible facilities in the park would continue to be available to support a comfortable and informative park experience for the very young, the elderly, and the mobility impaired. Entrance gate allocations would be flexible and incentives for use of new technology would be developed. Because visitor use in the park's interior would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities that support a safe and high-quality visitor experience would continue to be offered. As described for alternative 2, the park's accessible facilities would support an comfortable and educational experience. The existing fleet of snowcoaches is able to accommodate demand and would likely be able to meet the increased need for such services, as necessary. Those seeking snowmobile experiences would have access to this activity. Depending on snow conditions, availability of alternate routes, and service provider capacities, the very young, the elderly, and the mobility-impaired visitors could have increased flexibility in visiting the park during winter. The ability of operators to exchange permits would potentially provide accessibility based on demand. Alternative 6 would result in parkwide, long-term beneficial impacts for visitor accessibility.

Cumulative Impacts

Impacts on visitor accessibility from other past, present, and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term beneficial impacts of alternative 6 would result in long-term beneficial cumulative impacts to visitor use and experience. Alternative 6 would make a large contribution to these impacts by supporting accessible winter visitor use and experience opportunities in the park, a unique recreational opportunity in the area.

Conclusion

Under alternative 6, total snowcoach allocations would be similar to those in the 2009/2010 winter season. Flexibility in routes and gate entry numbers would potentially increase accessible snowcoach use. This would result in parkwide, long-term beneficial impacts to accessibility compared to the no-action alternative. Cumulative impacts would be long-term and beneficial.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Under alternative 7, winter access would be managed to provide varying use levels around the park and across the winter use season. Primary park roads would be groomed for OSV access, and snowcoach and snowmobile access would vary per day throughout the season. As described above, snowcoaches are suitable for wheelchair use or have ramps/lifts. Accessible facilities in the park would continue to support a comfortable and informative park experience for the very young, the elderly, and the mobility impaired. Snowmobile access would continue to be available for those

seeking this experience. Because visitor use in the park's interior would continue, the Old Faithful Snow Lodge, warming huts, and other winter amenities supporting a safe and high-quality visitor experience would continue to be open. However, several existing OSV routes would be converted to non-motorized use, including the Firehole Canyon, North Canyon Rim, and Riverside Drive. As described for alternative 2, the park's accessible facilities would support a comfortable and educational experience those with accessibility needs. The existing fleet of snowcoaches would accommodate existing demand and would likely be able to meet the increased need for such services, as necessary. In addition, the ability of operators to exchange permits would potentially provide accessibility based on demand. Alternative 7 would provide long-term, parkwide, benefits to visitor accessibility.

Cumulative Impacts

Impacts on visitor accessibility from other past, present and reasonably foreseeable future actions would be as described for alternative 1. These long-term beneficial impacts, when combined with the long-term, parkwide, beneficial impacts of alternative 7 would result in long-term beneficial cumulative impacts to visitor accessibility. Alternative 7 would make a large contribution to these impacts by supporting accessible winter visitor use and experience opportunities in the park, a unique recreational opportunity in the area.

Conclusion

Under alternative 7, OSV allocations would vary within the winter use season, and would be expected to support current and future accessibility demands. This would result in parkwide, long-term beneficial impacts to accessibility compared to the no-action alternative. Cumulative impacts would be long-term and beneficial.

HEALTH AND SAFETY

GUIDING REGULATIONS AND POLICIES

NPS Management Policies 2006 state, "While recognizing that there are limitations on its capability to totally eliminate all hazards, the Service ... will seek to provide a safe and healthful environment for visitors and employees." *Management Policies 2006* also state, "the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education" (NPS 2006a, section 8.2.5.1). For Yellowstone winter use, this would relate to the air and sound emissions, avalanche danger, and safety concerns between different modes of winter transportation (including conflicts between users and safety concerns related to motorized use in winter driving conditions) experienced by staff and visitors.

Air Emissions. The Occupational Safety and Health Administration (OSHA) sets enforceable permissible exposure limits (PELs) to protect workers against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air, and are based on an 8-hour time weighted average exposure (OSHA 2006). Table 60 shows the PELs established by OSHA. In addition to these standards, studies at Yellowstone also consider the limits of the American Conference of Industrial Hygienists (ACGIH), which is an industry standard setting organization. ACGIH details threshold limit values (TLVs) for various air emissions, which are also presented in table 60.

TABLE 60: OSHA AND ACGIH LIMITS FOR AIR CONTAMINANTS

Substance	8-hour time weighted average – OSHA PEL	ACGIH Threshold Limit Value
Acetone	1000 ppm	500 ppm
Benzene	1.0 ppm	0.5 ppm
Carbon Monoxide	50 ppm	25 ppm
Ethyl Alcohol	1000 ppm	1000 ppm
Ethyl Benzene	100 ppm	100 ppm
Formaldehyde	0.75 ppm/2.0 ppm ^a	0.3 ppm ^b
Isopropyl Alcohol	400 ppm	400 ppm
Naphtha	100 ppm	—
Petroleum Distillates	500 ppm	—
Toluene	200 ppm	50 ppm
Xylene	100 ppm	100 ppm

^aShort-term exposure limit^bCeiling limits

Source: 29 CFR § 1910, Radtke 2008 and 2009

— Data not available

Noise Emissions. Various standards exist for occupational exposure to noise including the OSHA permissible exposure levels (PELs), EPA standards, and the National Institute for Occupational Safety and Health (NIOSH) standards, each discussed below.

In order to protect the hearing of employees, OSHA has established maximum noise levels for occupational exposure, beyond which mitigation measures or personal protective equipment is required. Table 61 shows the permissible noise exposures established by OSHA. The action level at which a hearing conservation program for employees is warranted, has been identified by OSHA as 85 dBA. The PEL for noise exposure as identified by OSHA is 90 dBA. The below analysis considers the 8-hour standard for all agencies, for purposes of comparison.

TABLE 61: OSHA PERMISSIBLE NOISE EXPOSURES

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

Source: OSHA 2006

Although primary responsibility for control of noise rests with state and local governments, federal action is essential to deal with major noise sources in commerce, control of which requires national uniformity of treatment (EPA 2010m). Directed by Congress, the EPA retains authority to investigate and study noise and its effects, disseminate information to the public regarding noise pollution and its adverse health effects, respond to inquiries on matters related to noise, and evaluate the effectiveness of existing regulations for protecting the public health and welfare, pursuant to the Noise Control Act of 1972 and the Quiet Communities Act of 1978 (EPA 2010n). Noise levels necessary to protect public health and welfare against hearing loss, annoyance, and activity interference have been identified and published in a new EPA document, “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.” The document identifies a 24-hour exposure level of 70 decibels as the level of environmental noise which will prevent any measurable hearing loss over a lifetime. Likewise, a level of 55 decibels outdoors is identified as preventing activity interference and annoyance (EPA 2010o).

In the Occupational Safety and Health Act of 1970, NIOSH is charged with recommending occupational safety and health standards, including noise exposure, and describing exposure concentrations that are safe for various periods of employment. By means of criteria documents, NIOSH communicates these recommended standards to regulatory agencies, including OSHA and others in the occupational health and safety community. In 1972, NIOSH published *Criteria for a Recommended Standard: Occupational Exposure to Noise*, which provided the basis for a recommended standard to reduce the risk of developing permanent hearing loss as a result of occupational noise exposure. NIOSH revised its previous recommendations in 1998, which go beyond attempting to conserve hearing by focusing on preventing occupational noise-induced hearing loss (NIOSH 1998). ANSI is a private, non-profit membership organization that serves as administrator and coordinator of the U.S. private sector voluntary standardization system. It facilitates the development of American National Standards by accrediting the procedures of organizations that develop standards. These groups work cooperatively to develop voluntary national consensus standards. ANSI empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment (ANSI n.d.). The NIOSH and ANSI recommended exposure limit for occupational noise exposure is 85 decibels as an 8-hour time-weighted average (Noise Pollution Clearing House n.d.). With a 40-year lifetime exposure at the 85 decibel recommended exposure limit, the excess risk of developing occupational noise-induced hearing loss is eight percent, which is considerably lower than the 25% excess risk at the 90 decibel PEL currently enforced by OSHA (NIOSH 1998). Table 62 shows a comparison of noise exposure standards set by OSHA, EPA, NIOSH, and ANSI.

TABLE 62: COMPARISON OF NOISE EXPOSURE STANDARDS SET BY DIFFERENT ORGANIZATIONS

dBA	EPA	ANSI and NIOSH	OSHA
	Hours	Hours	Hours
70	24		
73	12		
76	6		
79	3		
82	1		
85		8	
88		4	
90			8
91		2	
92			6
94		1	
95			4
97			3
100			2
102			1

Source: Noise Pollution Clearinghouse n.d.

Avalanche Danger. On August 10, 11 and 12, 2010, seven internal NPS and external avalanche control experts and observers undertook a detailed, systematic review of agency winter operations on Sylvan Pass at Yellowstone, called an Operational Risk Management Assessment (ORMA). This review was a secondary follow-up to the initial ORMA conducted in 2007. The ORMA focused on the following four principles:

1. Accept no unnecessary risk.
2. Accept risk when benefits outweigh the cost.
3. Anticipate and manage risk by planning.
4. Make risk decisions at the right level.

A key feature is that ORMA does NOT tell you what to do, it gives you an accurate assessment of all risks and asks the question: “What is acceptable to you?” As part of the ORMA, the panel assessed possible operating conditions for Sylvan Pass, including current operations, and scored these various scenarios under the green-amber-red scale. The green-amber-red scale is shown in figure 24. For reference, current Sylvan Pass operations received a green-amber-red score of 34.67, or approximately 35, the high end of green.

RED (High Risk)	80
AMBER (Caution)	60
GREEN (Low Risk)	35
	0

FIGURE 24: GREEN-AMBER-RED SCALE FOR THE ORMA PROCESS

Visitor Use Conflict/Exposure to the Elements. NPS *Management Policies 2006* address health and safety for both NPS staff and visitors. For NPS staff, section 1.9.1.4 “Employee Safety and Health” states,

The safety and health of employees, contractors, volunteers, and the public are core Service values. In making decisions on matters concerning employee safety and health, NPS managers must exercise good judgment and discretion and, above all, keep in mind that the safeguarding of human life must not be compromised. The Service must ensure that all employees are trained and informed on how to do their jobs safely, and that they have the necessary clothing, materials, and equipment to perform their duties with minimal personal risk.”

In relation to visitor safety, section 8.2.5.1, in part, states in part that

While recognizing that there are limitations on its capability to totally eliminate all hazards, the Service and its concessioners, contractors, and cooperators will seek to provide a safe and healthful environment for visitors and employees. The Service will work cooperatively with other federal, tribal, state, and local agencies; organizations; and individuals to carry out this responsibility. The Service will strive to identify and prevent injuries from recognizable threats to the safety and health of persons and to the protection of property by applying nationally accepted codes, standards, engineering principles, and the guidance contained in Director’s Orders #50B, #50C, #58, and #83 and their associated reference manuals. When practicable and consistent with congressionally designated purposes and mandates, the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education. In doing so, the Service’s preferred actions will be those that have the least impact on park resources and values.

The Service recognizes that the park resources it protects are not only visitor attractions, but that they may also be potentially hazardous. In addition, the recreational activities of some visitors may be of especially high-risk, high-adventure types, which pose a significant personal risk to participants and which the Service cannot totally control. Park visitors must assume a substantial degree of risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments.

ASSUMPTIONS, METHODOLOGY, AND INTENSITY DEFINITIONS

The area of analysis is the park. To assess the level of impact to employee and public health and safety for each alternative, the following types of information were used:

- Safety policies and guidelines.
- Results of air monitoring near the west entrance in Yellowstone.
- Results of personal exposure and sound monitoring.
- Reports from employees and commercial guides.
- Past and current avalanche analyses and the result of recent ORMA proceedings.

Overall impacts to health and safety, including impacts for avalanche control in the Sylvan Pass area of Yellowstone, are defined below. Because personal and occupational exposure to air quality and noise contaminants has been monitored in Yellowstone, the alternatives are compared qualitatively, using the monitored data (Jensen and Meyer 2006; Spear et al. 2006; Radtke 2008; Radtke 2009).

The following intensity definitions for evaluating impacts on health and safety were defined.

- Negligible:* Air and noise emissions would be well below applicable standards. There would be limited risk to employees conducting avalanche control activities during the winter use season at Sylvan Pass (green as defined by the ORMA). There would be no to minimal risks to visitors as a result of conflicts with other uses, as well as from the harsh winter elements.
- Minor:* Air and noise emissions would remain below applicable standards. If mitigation were needed, it would be relatively simple and would likely be successful. There would be limited to moderate risk to employees conducting avalanche control activities during the winter use season at Sylvan Pass (green as defined by ORMA). There could be occasional risks to visitors as a result of conflicts with other uses, as well as from the harsh winter elements, but reported incidents of these conflicts to law enforcement would remain infrequent.
- Moderate:* Applicable air and noise standards may be approached occasionally. Mitigation measures would probably be necessary and would likely be successful. There would be a moderate to high risk to employees conducting avalanche control activities during the winter use season at Sylvan Pass (amber as defined by ORMA). There could be occasional to frequent risks to visitors, reported to law enforcement, as a result of conflicts with other uses, as well as from the harsh winter elements.
- Major:* Applicable standards for air and noise would be exceeded rarely, and could be mitigated with simple measures. Extensive mitigation measures would be needed, and their success would not be guaranteed. There would be a high risk to employees conducting avalanche control activities during the winter use season at Sylvan Pass (red as defined by ORMA). There could be frequent risks to visitors, reported to law enforcement, as a result of conflicts with other uses, as well as from the harsh winter elements.

Study Area

The geographic study area for health and safety for the impact analysis and cumulative impact analysis is within the boundary of the park.

SUMMARY OF IMPACTS

Impacts to health and safety under the alternatives ranged from long-term moderate adverse, under alternatives 2, 3, 5, and 7 from potential use conflicts and the operation of Sylvan Pass, to long-term and beneficial for alternatives that include the closure of Sylvan Pass (alternatives 1 and 4). Impacts under each alternative were as follows:

- Alternative 1 would have long-term negligible adverse impacts to health and safety from noise and air emissions, because air pollution and noise levels would be limited to administrative OSV use and would be minimal. There would also be long-term beneficial impacts to health and safety from the closure of Sylvan Pass. Long-term minor adverse impacts would occur from the possibility of non-motorized users being out in harsh winter conditions with minimal support facilities.
- Alternatives 2, 3, 5, and 7 would have long-term negligible adverse impacts to health and safety from air and noise emissions, because levels would be well below all regulatory standards for human health. Because all of these alternatives would include the operation of Sylvan Pass, there would long-term moderate adverse impacts due to the inherent risk of staff working in a known avalanche zone. Use levels and types (both snowmobile and snowcoach use) under these alternatives would result in long-term minor to moderate adverse impacts from user conflicts and exposure to the elements. Impacts to health and safety would be similar to current conditions.
- Alternative 4 would have long-term negligible adverse impacts to health and safety from air and noise emissions because levels would be well below all regulatory standards for human health. The closure of Sylvan Pass would have long-term beneficial impacts because staff would not be working in a known avalanche zone. Because more users would be in commercial wheeled vehicles or snowcoaches, exposure to the elements would be reduced and long-term minor adverse impacts from user conflicts and exposure to the elements would occur.
- Alternative 6 would have long-term negligible adverse impacts to health and safety from air and noise emissions because levels would be well below all regulatory standards for human health. Because this alternative would include the operation of Sylvan Pass, there would long-term moderate adverse impacts due to the inherent risk of staff working in a known avalanche zone. Use levels would be higher than current conditions and would result in long-term minor to moderate adverse impacts from user conflicts and exposure to the elements.

DETAILED IMPACT ANALYSIS

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Under alternative 1, snowmobile use would be limited to administrative uses. The few administrative snowmobiles used in the park would meet BAT guidelines, with road grooming being completed on an as-needed basis (greatly reduced from current operations). Non-motorized uses would continue in the park, but would likely be limited to the outer edges due to the distance between the park entrance and Old Faithful, because many park visitors would not have the physical ability to cover this distance. Because no recreational or administrative OSV use would occur, Sylvan Pass would be closed to visitor use and would not require staff for daily avalanche control operations.

With this minimal level of use, exposure to air pollutants would be limited. As noted above under “Air Quality,” emissions levels would be well below OSHA PELs and ACGIH TLVs when limited to administrative travel. Likewise, employees at the entrances would not be exposed to benzene or formaldehyde since recreational OSVs would no longer be going through the park entrances. As a result, there would be long-term negligible adverse impacts to health and safety in terms of air emissions.

Under the no-action alternative, noise would also be limited to administrative use. As described above under “Soundscapes and the Acoustic Environment,” these noise levels would be minimal and well below OSHA, NIOSH, and EPA noise standards. As a result, there would be long-term negligible adverse impacts to health and safety in terms of sound emissions and there would be an improvement in air emissions over the current conditions.

With the closure of Sylvan Pass, avalanche control operations would not be necessary and park employees would not be exposed to the inherent risks of avalanche control operations (as described in chapter 3). During the 2010 ORMA, existing operations were considered, with the panel ranking them in the amber category. With the closure of Sylvan Pass, these operations would no longer be required, resulting in long-term beneficial impacts to staff health and safety, because they would no longer be forecasting in this area on a daily basis, reducing the amount of risk they would encounter. The 2010 ORMA also addressed the spring opening of Sylvan Pass in the context of winter avalanche management at Sylvan Pass, and additional challenges were identified for the spring opening of Sylvan Pass if avalanche forecasting and control operations did not occur in the winter.

Visitor use in the park would be limited to non-motorized use, the majority of which would occur on the periphery of the park. Non-motorized users may encounter administrative OSV use, but this use would be limited to a few trips a day and these encounters would be infrequent. In general, there would be long-term negligible adverse impacts, because the potential for conflict between uses would be minimal. However, non-motorized users could face increased risks in the interior of the park, because there would be limited facilities or other users to assist should weather conditions change, resulting in long-term minor adverse impacts. In addition, the limited staff that would be in the park during the winter season would not have back up should an emergency occur, because staffing within the park would be extremely limited.

Overall, air pollution and noise levels would be limited to administrative OSV use and would be minimal, and the closure of Sylvan Pass would reduce the avalanche risk to staff. Therefore, impacts would be long-term negligible adverse and long-term beneficial to health and safety, with the potential for long-term minor adverse impacts from the possibility of non-motorized users being out in harsh winter conditions with minimal support facilities.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that could impact health and safety include recreation occurring on adjacent lands (including use in consolidated forest lands). This recreation would require the use of vehicles or other equipment which create air and/or noise emissions in the region, but would not create any avalanche danger to be mitigated. All of these actions occur on lands outside of the park and do not extend into the park, except for OSV use, which is managed in the park to minimize impacts to health and safety and would result in long-term negligible adverse impacts.

Multiple construction projects currently occurring or planned in the park would also contribute to impacts on health and safety. These projects would include construction of the new west entrance and reconstruction of the east entrance road (underway). Overall, although construction sites could have

temporary adverse impacts to park visitors related to health and safety, construction would not be occurring during the winter months and would not impact park staff and visitors during this time. Some of these projects would have beneficial impacts related to winter use because the reconstruction of the east entrance road has moved the road farther away from avalanche slide areas, and construction of new facilities at the west entrance has included new staff kiosks with improved ventilation systems, if needed. Overall, these construction projects would have long-term beneficial impacts to health and safety.

The long-term negligible adverse impacts and long-term beneficial impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible to minor adverse impacts and long-term beneficial impacts of alternative 1, would result in long-term negligible adverse cumulative impacts on health and safety. Alternative 1 would contribute a minimal amount to the overall cumulative impacts because many of these actions occur across a larger region of which Yellowstone is a part.

Conclusion

Overall, air pollution and noise levels would be limited to administrative OSV use and would be minimal, and the closure of Sylvan Pass would reduce the avalanche risk to staff. Therefore, impacts to health and safety would be long-term negligible adverse and long-term beneficial to health and safety, with the potential for long-term minor adverse impacts from the possibility of non-motorized users being out in harsh winter conditions with minimal support facilities. Cumulative impacts would be long-term, negligible adverse.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Under alternative 2, use levels in the park would allow for up to 318 snowmobiles per day and 78 snowcoaches, the level of use permitted under the 2009 interim rule. Existing OSV management measures that include BAT guidelines for snowmobiles, commercial guiding requirements, and hour of operation restrictions would continue. In addition to the current management measures employed, BAT guidelines would be developed and implemented for snowcoaches by the 2014/2015 season. Further, if the EPA adopts standards for any class of OSV that are more stringent than the requirements resulting from this draft plan/EIS, the EPA standards would become the NPS standards. Non-motorized uses would continue in the park, throughout the interior as currently occurring. Under alternative 2, Sylvan Pass would be open to visitor use and would require staff for daily avalanche control operations.

Staff exposure to air and noise emissions in the winter was measured during an exposure assessment conducted at the entrance stations during Presidents' Day weekend of 2008 (a peak use period). Use volume over the three-day weekend was 691 snowmobiles and 71 snowcoaches total (Radtke 2008). A similar exposure assessment was again conducted during President's Day weekend of 2009. During the 2009 assessment, use volumes were 635 snowmobiles and 64 snowcoaches total for the three-day weekend. In addition to a slightly lower level of use, the 2009 study differed from the 2008 study with a new entrance station configuration and during one day of the assessment (February 15), the emissions from snowcoaches were separated from snowmobiles to determine whether exposure levels would differ (Radtke 2009).

The 2008 and 2009 exposure assessments looked at air emissions through the measurement of carbon monoxide, hydrocarbons, and aldehydes. At these use levels, the exposure assessments found that results for all VOCs, aldehydes, and carbon monoxide were well below the occupational exposure limits (for OSHA and ACGIH) and in most cases were below the detection limits of the analytical

method (Radtke 2008). In the 2008 assessment, results for VOCs showed that most were below the detection limit, with the relative highest exposure being to benzenes, which was approximately 2% of the PEL. Employees on snowmobiles did show measurable carbon monoxide exposures, but those levels were still below applicable standards (approximately 10% of the PEL). During this survey, three of nine aldehyde had detectable levels of formaldehyde (limit of detection was 1 ug/sample). Although detectable, these measurements were still only 2%-3% of the PEL and 5%-7% of the ACGIH TLV. No other aldehydes, such as acrolein or acetaldehyde were above the detection limit (Radtke 2008). In the 2009 assessment, similar results occurred with personal exposures to these contaminants well below OSHA PELs and ACGIH TLVs, with most being below detectable limits. In looking at the separation of snowcoaches and snowmobiles in 2009, these vehicles were separated by lane at the west entrance with 19 snowcoaches in lane B and 241 snowmobiles in lane A over the three-day weekend. Results of this separation showed that carbon monoxide was slightly higher over the sampling period for the snowmobile lane, but the peak reading was higher for snowcoaches (although the peak reading did not reach the NIOSH ceiling of 200 ppm). There was no difference evident in aldehydes or VOCs between the two vehicle types.

Results showing that air emissions were well within all applicable standards from the 2008 and 2009 assessments are due, in part, to the OSV management occurring in Yellowstone. Requirements for BAT, as well as required guides and limits on the number of OSVs in the park, contribute to keeping emissions well within regulatory levels. Also contributing to these low levels are the kiosk ventilation systems, where the employees work. Under alternative 2, use levels would be lower than those assessed in the 2008 and 2009 exposure assessments and management measures that have kept emissions low, described above, would be continued. With lower levels of use (up to 318 snowmobiles and 78 snowcoaches, compared to over 600 snowmobiles and a similar level of snowcoach use), it is expected that air emissions under alternative 2 would continue to be well below the detection limit and within OSHA PELs and ACGIH TLVs. As shown in the 2009 study, peak levels of carbon monoxide would likely be higher for snowmobiles than snowcoaches, but still within established levels. Because use would likely be within OSHA PELs and ACGIH TLVs with no exceedences, based on past monitoring, impacts on health and safety from air emissions would be long-term negligible adverse.

The 2008 and 2009 assessments looked at noise emissions at the west entrance as well as for employees using OSVs on a daily basis. In both 2008 and 2009, personal noise exposures in the two kiosks at the west entrance ranged from 67.1 dBA to 70.6 dBA. These levels are below the OSHA action level/PEL as well as EPA and NIOSH standards (Radtke 2008, 2009). The 2008 assessment also monitored a maintenance employee riding a four-stroke snowmobile for a full shift, and found that the full shift exposure was close to the OSHA action level (85 dBA) (Radtke 2008). Under alternative 2, use levels would be lower than those assessed in the 2008 and 2009 exposure assessments, and management measures that have kept noise emissions low, such as BAT and set use levels, would be continued. With lower levels of use, it is expected that noise emissions under alternative 2 would continue to be below the OSHA action level, and impacts on health and safety from noise emissions would be long-term negligible adverse.

Alternative 2 would provide for the continued operation of Sylvan Pass, with avalanche control operations continuing at their current levels. As described in the "Affected Environment" chapter, avalanche work is inherently dangerous and risks to employees may be greater than those generally posed to visitors because (1) employees conducting avalanche hazard mitigation spend more time in the pass, and (2) avalanche control work, by its very nature, is hazardous. Under alternative 2, the risk would be addressed through implementation of a strict safety-based, risk reduction program, continuing the program that is currently in place and was rated in a recent ORMA on the high end of green and the low end of amber (caution). The pass would not be open unless safety criteria are met

and, in the professional judgment of park managers, operations can be conducted within acceptable levels of risk.

When park staff perform avalanche mitigation, a combination of avalanche mitigation techniques could be used, including risk assessment analyses as well as forecasting and helicopter and howitzer dispensed explosives. Area staff would use whichever tool is the safest and most appropriate for a given situation, with the full understanding that safety of employees and visitors comes first. Employees in the field would make the operational determination of when safety criteria have been met, and operations can be conducted with acceptable levels of risk. The NPS would not take unacceptable risks. When safety criteria have been met, the pass would be open; when they have not been met, the pass would remain closed. As with past winters, extended closures of the pass may occur. Also, during the winter season, the pass would not be open for administrative travel unless it is also open to public travel, further reducing employee exposure to risk. Because current operations were rated by the ORMA as green/amber (NPS 2010n), impacts to NPS staff from avalanche operations would be long-term moderate adverse.

Visitor use in the park would include both motorized and to non-motorized use. As noted in chapter 3 (figure 16), since OSV management that has included commercial guiding requirements was implemented, the number of OSV moving violations and arrests has continued to decline. Alternative 2 would continue OSV management measures put in place since 2004, including requiring commercially guided use of all OSVs. Guided use also ensures that guides have been trained (as part of their agreement with the NPS) in operation in winter conditions and in avoiding conflict with non-motorized users. The continuation of guiding requirements would have long-term beneficial impacts to health and safety. Alternative 2, as with all action alternatives, would not advise non-essential work/OSVs travel at below -20°F , which would reduce the amount of time both visitors and staff would spend in harsh winter conditions. Because OSV use would still occur, and staff and visitors would still be exposed to the winter elements, impacts would be long-term minor adverse, because OSV management and park practices would minimize both user conflict and risk from the elements.

Overall air pollution and noise levels would be below applicable standards, and conflicts between users and exposure to harsh winter conditions would be minimized through OSV management measures under alternative 2. NPS employees working in Sylvan Pass would still be exposed to avalanche risk, which has been rated at an amber (caution) level in a recent ORMA process (NPS 2010n). Under alternative 2, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass, and long-term minor adverse from user conflicts and exposure to the elements.

Cumulative Impacts

The long-term negligible adverse impacts and long-term beneficial impacts on the health and safety of NPS staff and visitors from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term negligible to moderate adverse impacts of alternative 2, would result in long-term minor adverse cumulative impacts on health and safety. Alternative 2 would contribute a minimal amount to the overall cumulative impacts because many of these actions occur across a larger region of which Yellowstone is a part.

Conclusion

Under alternative 2, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass, and long-term

minor adverse from user conflicts and exposure to the elements. Cumulative impacts under alternative 2 would be long-term minor adverse.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Under alternative 3, use levels in the park would allow for up to 720 snowmobiles per day and 78 snowcoaches, the level that was permitted under the 2004 plan limits. Existing OSV management measures would continue that include BAT guidelines for snowmobiles, commercial guiding requirements, and hour of operation restrictions would continue. In addition to the current management measures employed, BAT guidelines would be developed and implemented for snowcoaches by the 2014/2015 season. Further, if the EPA adopts standards for any class of OSV that are more stringent than the requirements resulting from this draft plan/EIS, the EPA standards would become the NPS standards. Non-motorized uses would continue in the park, throughout the interior as currently occurring. Under alternative 3, Sylvan Pass would be open to visitor use and would require staff for daily avalanche control operations.

As described above under alternative 2, exposure assessments were conducted over Presidents' Day weekend 2008 and 2009. These assessments found that at use levels between 635 and 691 snowmobiles and 64 and 71 snowcoaches (totals for the entire three-day weekend), exposures to air emissions were below all occupational exposure limits (Radtke 2008 and 2009). In addition, a study conducted by OSHA in 2000 considered 976 two-stroke snowmobiles (a daily average) and showed levels below applicable standards in two out of three entry kiosks. At the third, the exposure level was at the OSHA threshold (OSHA 2000). In 2001, benzene levels from a daily average of 666 two-stroke sleds were considered and found to be below all applicable standards at all three kiosks (Kado et al. 2001). Studies done in 2004, 2005, and 2006 also looked at benzene levels, with mostly four-stroke engines, with levels greatly decreasing from the 2000 and 2001 levels. Based on these data, it can be assumed that the use level proposed under alternative 3 (720 four-stroke sleds) would result in benzene levels that are below regulatory standards because at a daily average of 976 two-stroke sleds, the standards were just being met and with four-stroke engines, this would be expected to fall below the regulated level.

As with alternative 2, requirements for BAT, as well as required guides and limits on the number of OSVs in the park, would contribute to keeping emissions well within regulatory levels as shown in the studies noted above. Also contributing to these low levels are the kiosk ventilation systems, where the employees work. Under alternative 3, use levels would be higher than those assessed in the 2008 and 2009 exposure assessments but lower than those assessed in the 2000 OSHA study. Management measures employed since 2004 (BAT, guided use, and use limits) have kept emissions within the regulatory standards described above, and would be continued under alternative 3. Based on this, it is expected that air emissions under alternative 3 would continue to be below the detection limit and within OSHA PELs and ACGIH TLVs. As shown in the 2009 study, peak levels of carbon monoxide would likely be higher for snowmobiles than snowcoaches, but still within established levels. Because use would likely be within OSHA PELs and ACGIH TLVs with no exceedences, based on past monitoring, impacts on health and safety from air emissions would be long-term negligible adverse.

The 2008 and 2009 assessments also looked at noise emissions at the west entrance as well as for employees using OSVs on a daily basis. As described in alternative 2, personal noise exposures in the two kiosks at the west entrance were below the OSHA action level/PEL as well as EPA and NIOSH standards (Radtke 2008, 2009). As described under "Soundscapes and the Acoustic Environment," a use level of up to 720 snowmobiles and 78 snowcoaches would result in noise levels of over 35 dBA approximately 15% of the time. Although use levels would be higher under alternative 3 than the levels studied in 2008 and 2009, these levels do not have the potential to be much higher (a high of

691 snowmobiles vs. a potential high of 720 snowmobiles) and noise levels would still be expected to be below the OSHA action level. Under alternative 3, use levels would be similar to those in the 2008 and 2009 exposure assessments and management measures that have kept noise emissions below the standards, such as BAT and set use levels, would be continued. With similar levels of use, it is expected that noise emissions under alternative 3 would continue to be below the OSHA action level and impacts on health and safety from noise emissions would be long-term negligible adverse.

Alternative 3 would provide for the continued operation of Sylvan Pass, with avalanche control operations continuing at their current levels, as described in detail under alternative 2. These operations were rated by the recent ORMA as amber, or caution, in terms of the risk to NPS staff (NPS 2010n), therefore impacts to NPS staff from avalanche operations would be long-term moderate adverse.

Visitor use in the park would include both motorized and to non-motorized use. As noted in chapter 3 (figure 16), since OSV management that includes commercial guiding requirements has been implemented, the number of OSV moving violations and arrests has continued to decline. Alternative 3 would continue OSV management measures put in place since 2004 including requiring guided use of all OSV. Commercially guided use also ensures that guides have been trained (as part of their agreement with the NPS) in operation in winter conditions and in avoiding conflict with non-motorized users. The continuation of guiding requirements would have long-term beneficial impacts to health and safety. Alternative 3, as with all action alternatives, would not advise non-essential work/OSVs travel at below -20°F , which would reduce the amount of time both visitors and staff would spend in harsh winter conditions. Because OSV use would still occur, and staff and visitors would still be exposed to the winter elements, impacts would be long-term minor adverse, because OSV management and park practices would minimize both user conflict and risk from the elements.

Overall air pollution and noise levels are expected to be below applicable standards and conflicts between users and exposure to harsh winter conditions would be minimized through OSV management measures under alternative 3. NPS employees working in Sylvan Pass would still be exposed to avalanche risk, which has been rated at an amber (caution) level in a recent ORMA process (NPS 2010n). Under alternative 3, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass, and long-term minor adverse from user conflicts and exposure to the elements.

Cumulative Impacts

The long-term negligible adverse impacts and long-term beneficial impacts on the health and safety of NPS staff and visitors from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term negligible to moderate adverse impacts of alternative 3, would result in long-term minor adverse cumulative impacts on health and safety. Alternative 3 would contribute a minimal amount to the overall cumulative impacts, because many of these actions occur across a larger region, of which Yellowstone is a part.

Conclusion

Under alternative 3, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass, and long-term minor adverse from user conflicts and exposure to the elements. Cumulative impacts would be long-term minor adverse.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Under alternative 4, use levels in the park would allow for up to 110 snowmobiles per day and 30 snowcoaches per day, along with up to 100 wheeled commercial vehicles. Existing regulations on OSV use would continue that include BAT guidelines for snowmobiles, commercial guiding requirements, and hour of operation restrictions would continue. In addition to the current management measures employed, BAT guidelines would be developed and implemented for snowcoaches by the 2014/2015 season. Further, if the EPA adopts standards for any class of OSV that are more stringent than the requirements resulting from this draft plan/EIS, the EPA standards would become the NPS standards. For wheeled vehicles, EPA tier II guidelines would be followed, providing emissions reduction. Non-motorized uses would continue in the park, throughout the interior as currently occurring. Under alternative 4, Sylvan Pass would not be open to visitor use and would not require staff for daily avalanche control operations.

As described above under alternative 2, exposure assessments were conducted over Presidents' Day weekend 2008 and 2009. These assessments found that at use levels between 635 and 691 snowmobiles and 64 and 71 snowcoaches over a three-day weekend, exposures to air emissions were below all occupational exposure limits (Radtke 2008, 2009). Because use levels for OSVs would be lower (1/6 less than the measured use), it is expected that air emissions exposure from OSVs for alternative 4 would continue to be below all occupational exposure limits. The addition of commercial wheeled vehicles would occur under this alternative; however, by meeting tier II standards, their contribution to these pollutants would not be expected to result in a violation of exposure limits. As shown in the 2009 study, peak levels of carbon monoxide would likely be higher for snowmobiles than snowcoaches, but still within established levels. Because use would likely be within OSHA PELs and ACGIH TLVs with no exceedences, based on past monitoring, impacts from air emissions on health and safety would be long-term negligible adverse.

The 2008 and 2009 assessments also looked at noise emissions at the west entrance as well as for employees using OSVs on a daily basis. As described in alternative 2, personal noise exposures in the two kiosks at the west entrance were below the OSHA action level/PEL as well as EPA and NIOSH standards (Radtke 2008, 2009). With lower levels of use proposed than those assessed in 2008 and 2009, it is expected that noise emissions under alternative 4 would continue to be below the OSHA action level and impacts on health and safety from noise emissions would be long-term negligible adverse.

With the closure of Sylvan Pass under alternative 4, avalanche control operations would not be necessary and park employees would not be exposed to the inherent risks of avalanche control operations (as described in chapter 3). During the 2010 ORMA, existing operations were considered, with the panel ranking them in the amber category, or caution (NPS 2010n). With the closure of Sylvan Pass, these operations would no longer be required, resulting in long-term beneficial impacts to staff health and safety, because they would no longer be forecasting in this area on a daily basis reducing the amount of risk they encounter. The 2010 ORMA also addressed the spring opening of Sylvan Pass in the context of winter avalanche management at Sylvan Pass, and additional challenges were identified for the spring opening at Sylvan Pass if avalanche forecasting and control operations did not occur in the winter.

Visitor use in the park would include both motorized and to non-motorized use. As noted in chapter 3 (figure 16), as commercial guiding requirements were implemented, the number of OSV moving violations and arrests has continued to decline. Alternative 4 would continue OSV management measures put in place since 2004 including requiring commercially guided use of all OSV and in

addition would require wheeled vehicles to be commercially guided (with the exception of the northern park road, which would still permit private vehicles). Commercially guided use also ensures that guides have been trained (as part of their agreement with the NPS) in operation in winter conditions and in avoiding conflict with non-motorized users. The use of commercial guides for wheeled vehicles within the park is also expected to contribute to visitor safety because guides would be trained to handle fast changing weather conditions, have communication equipment to report any problems, and would be required to carry safety equipment on board, resulting in long-term beneficial impacts. Alternative 4, as with all action alternatives, would not advise non-essential work/OSVs travel at below -20°F , which would reduce the amount of time both visitors and staff would spend in harsh winter conditions. Because OSV use would still occur, and staff and visitors would still be exposed to the winter elements, impacts would be long-term minor adverse, because OSV management and park practices would minimize both user conflict and risk from the elements.

Overall air pollution and noise levels would be expected to be below applicable standards and conflicts between users and exposure to harsh winter conditions would be minimized through OSV management measures under alternative 4. NPS employees working in Sylvan Pass would not be exposed to avalanche risk because Sylvan Pass would be closed. Under alternative 4, impacts to human health and safety would be long-term negligible adverse from air and noise emissions as well as long-term beneficial from the closure of Sylvan Pass, and long-term minor adverse from user conflicts and exposure to the elements.

Cumulative Impacts

The long-term negligible adverse and long-term beneficial impacts on the health and safety of NPS staff and visitors from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term negligible to minor adverse and long-term beneficial impacts of alternative 4, would result in long-term negligible adverse cumulative impacts on health and safety. Alternative 4 would contribute a minimal amount to the overall cumulative impacts because many of these actions occur across a larger region of which Yellowstone is a part.

Conclusion

Under alternative 4, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term beneficial from the closure of Sylvan Pass, and long-term minor adverse from user conflicts and exposure to the elements. Cumulative impacts would be long-term negligible adverse.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Under alternative 5, until 2014/2015 when the transition to BAT snowcoaches only would begin, use levels and their impacts to health and safety would be the same as under alternative 2, long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass and long-term minor adverse from user conflicts and exposure to the elements.

After the 2014/2015 season, OSV use would potentially transition to snowcoach only after five years, based on user demand or at the Superintendent's discretion, and could result in use levels at 120 snowcoaches and zero snowmobiles at the end of the transition. Existing regulations on OSV use would continue that include BAT guidelines for snowmobiles, commercial guiding requirements, and hour of operations restrictions. In addition to the current management measures employed, BAT guidelines would be developed and implemented for snowcoaches by the 2014/2015 season. Further,

if the EPA adopts standards for any class of OSV that are more stringent than the requirements resulting from this draft plan/EIS, the EPA standards would become the NPS standards. Non-motorized uses would continue within the park, throughout the interior as currently occurring. Under alternative 5, Sylvan Pass would be open to visitor use and would require staff for daily avalanche control operations.

As described above under alternative 2, exposure assessments were conducted over Presidents' Day weekend 2008 and 2009. These assessments found that at use levels between 635 and 691 snowmobiles and 64 and 71 snowcoaches over a three-day weekend, exposures to air emissions were below all occupational exposure limits (Radtke 2008 and 2009). Because use levels for OSV would be lower (approximately one-sixth of less than the measured use), it is expected that air emissions exposure from OSV for alternative 5 would continue to be below all occupational exposure limits. As shown in the 2009 study, peak levels of carbon monoxide were higher for snowmobiles than snowcoaches, but still within established levels. As the number of snowcoaches permitted increases above the levels studied, additional exposure assessments would occur to ensure emission levels stay below occupational exposure limits. However, since the additional 42 snowcoaches would be offset by a reduction of 318 snowmobiles, it is expected that these limits would not be exceeded. Because use would likely be within OSHA PELs and ACGIH TLVs with no exceedences, based on past monitoring, impacts on health and safety from air emissions would be long-term negligible adverse.

The 2008 and 2009 assessments also looked at noise emissions at the west entrance as well as for employees using OSV on a daily basis. As described in alternative 2, personal noise exposures within the two kiosks at the west entrance were below the OSHA action level/PEL as well as EPA and NIOSH (Radtke 2008, 2009). With lower levels of total OSV use proposed after the transition to snowcoaches only than assessed in 2008 and 2009, it is expected that noise emissions under alternative 5 would continue to be below the OSHA action level and impacts on health and safety from noise emissions would be long-term negligible adverse.

Alternative 5 would provide for the continued operation of Sylvan Pass, with avalanche control operations continuing at their current levels, as described in detail under alternative 2. These operations were rated by the recent ORMA as amber, or caution in terms of the risk to NPS staff (NPS 2010n), therefore impacts to NPS staff from avalanche operations would be long-term moderate adverse.

Visitor use in the park would include both motorized and to non-motorized use. As noted in chapter 3 (figure 16), as commercial guiding requirements were implemented, the number of OSV moving violations and arrests has continued to decline. Alternative 5 would continue OSV management measures put in place since 2004, including requiring commercially guided use of all OSVs and after the transition would potentially include snowcoaches only. Commercially guided use also ensures that guides have been trained (as part of their agreement with the NPS) in operation in winter conditions and in avoiding conflict with non-motorized users. The continuation of commercial guiding requirements would have long-term beneficial impacts to health and safety. Alternative 5, as with all action alternatives, would not advise non-essential work/OSVs travel at below -20°F, which would reduce the amount of time both visitors and staff would spend in harsh winter conditions. Because OSV use would still occur, and staff and visitors would still be exposed to the winter elements, impacts would be long-term minor adverse, because OSV management and park practices would minimize both user conflict and risk from the elements.

Overall, air pollution and noise levels would be expected to be below applicable standards, and conflicts between users and exposure to harsh winter conditions would be minimized through OSV management measures under alternative 5. NPS employees working in Sylvan Pass would still be

exposed to avalanche risk, which has been rated at an amber (caution) level in a recent ORMA process (NPS 2010n). Under alternative 5, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass and long-term minor adverse from user conflicts and exposure to the elements.

Cumulative Impacts

The long-term negligible adverse impacts and long-term beneficial impacts on the health and safety of NPS staff and visitors from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term negligible to moderate adverse impacts of alternative 5, would result in long-term minor adverse cumulative impacts on health and safety. Alternative 5 would contribute a minimal amount to the overall cumulative impacts because many of these actions occur across a larger region of which Yellowstone is a part.

Conclusion

Under alternative 5, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass, and long-term minor adverse from user conflicts and exposure to the elements, both before and after the transition to snowcoach only. Cumulative impacts would be long-term minor adverse.

Impacts of Alternative 6: Implement Variable Management

Under alternative 6, there would be a seasonal limit of 32,000 snowmobiles and 4,600 snowcoaches. The level of daily use would vary throughout the season, based on a pre-determined schedule; however, daily use would not exceed 540 snowmobiles and 78 snowcoaches. Existing regulations on OSV use would continue that include BAT guidelines for snowmobiles, commercial guiding requirements, and hour of operations restrictions would continue. In addition to the current management measures employed, BAT guidelines would be developed and implemented for snowcoaches by the 2014/2015 season. Further, if the EPA adopts standards for any class of OSV that are more stringent than the requirements resulting from this draft plan/EIS, the EPA standards would become the NPS standards. Alternative 6 would also provide for up to 25% of snowmobile use to be unguided or non-commercially guided. This additional requirement would bring a level of uncertainty with regard to health and safety as, without commercial guides, the NPS would not have assurance that all applicable rules put in place to reduce risk, such as speed limits and protocols for passing groups, would be followed, and would result in long-term minor adverse impacts. Non-motorized uses would continue in the park, throughout the interior as currently occurring. Under alternative 6, Sylvan Pass would be open to visitor use and would require staff for daily avalanche control operations.

As described above under alternative 2, exposure assessments were conducted over Presidents' Day weekend 2008 and 2009. These assessments found that at use levels between 635 and 691 snowmobiles and 64 and 71 snowcoaches over a three-day weekend, exposures to air emissions were below all occupational exposure limits (Radtke 2008, 2009). Although OSV numbers would range from zero to 540 under alternative 6, they would still be lower than measured in 2008 and 2009; therefore, it is expected that air emissions exposure from OSVs for alternative 6 would continue to be below all occupational exposure limits. As shown in the 2009 study, peak levels of carbon monoxide were higher for snowmobiles than snowcoaches, but still within established levels, and this would be expected to continue. Because use would likely be within OSHA PELs and ACGIH TLVs with no exceedences, based on past monitoring, impacts on health and safety from air emissions would be long-term negligible adverse.

The 2008 and 2009 assessments also looked at noise emissions at the west entrance as well as for employees using OSVs on a daily basis. As described in alternative 2, personal noise exposures in the two kiosks at the west entrance were below the OSHA action level/PEL as well as EPA and NIOSH standards (Radtke 2008, 2009). With lower levels of total OSV use proposed (even on peak days of up to 540 snowmobiles and 78 snowcoaches) than those assessed in 2008 and 2009, it is expected that noise emissions under alternative 6 would continue to be below the OSHA action level and impacts on health and safety from noise emissions would be long-term negligible adverse.

Alternative 6 would provide for the continued operation of Sylvan Pass, with avalanche control operations continuing at their current levels, as described in detail under alternative 2. These operations were rated by the recent ORMA as amber, or caution in terms of the risk to NPS staff (NPS 2010n); therefore, impacts to NPS staff from avalanche operations would be long-term moderate adverse.

Visitor use in the park would include both motorized and to non-motorized use. As noted in chapter 3 (figure 16), as requirements for commercial guiding were implemented, the number of OSV moving violations and arrests has continued to decline. Alternative 6 would continue OSV management measures put in place since 2004, including requiring commercially guided use of most OSVs. In addition, alternative 6 would allow for up to 25% of unguided or non-commercially guided use. Commercially guided use also ensures that guides have been trained (as part of their agreement with the NPS) in operation in winter conditions and in avoiding conflict with non-motorized users. Although those engaging in unguided or non-commercially guided use would receive training, these users would not receive the same level of education and instruction as a commercial guide, which could result in additional conflicts between users. Alternative 6, as with all action alternatives, would not advise non-essential work/OSVs travel at below -20°F , which would reduce the amount of time both visitors and staff would spend in harsh winter conditions. Because OSV use would still occur and the addition of unguided or non-commercially guided use could increase non-compliance with OSV management measures, and staff and visitors would still be exposed to the winter elements, impacts would be long-term minor to moderate adverse, because OSV management and park practices would minimize both user conflict and risk from the elements.

Overall air pollution and noise levels would be expected to be below applicable standards and conflicts between users and exposure to harsh winter conditions would be minimized through OSV management measures under alternative 6. Alternative 6 would have the potential for increased non-compliance with OSV management measures due to up to 25% of unguided or non-commercially guided use and could increase visitor use conflicts. NPS employees working in Sylvan Pass would still be exposed to avalanche risk, which has been rated at an amber (caution) level in a recent ORMA process (NPS 2010n). Under alternative 6, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass and long-term minor to moderate adverse from user conflicts and exposure to the elements.

Cumulative Impacts

The long-term negligible adverse impacts and long-term beneficial impacts on the health and safety of NPS staff and visitors from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term negligible to moderate adverse impacts of alternative 6, would result in long-term minor adverse cumulative impacts on health and safety. Alternative 6 would contribute a minimal amount to the overall cumulative impacts because many of these actions occur across a larger region of which Yellowstone is a part.

Conclusion

Under alternative 6, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass, and long-term minor to moderate adverse from user conflicts and exposure to the elements. Cumulative impacts would be long-term minor adverse.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Under alternative 7, daily use levels would vary throughout the season, based on a pre-determined schedule. For snowmobiles, an average of 254 snowmobiles would operate in the park per day for a total of 23,122 per season should the maximum capacity be reached each day throughout the winter season. For snowcoaches, an average of 63 snowcoaches would operate in the park per day for a total of 5,730 per season should the maximum capacity be reached each day throughout the winter season. Actual use days may be higher or lower than this average ranging from a low of 132 snowmobiles and 30 snowcoaches to a high of 330 snowmobiles per day and 80 snowcoaches per day. All OSVs would be required to enter the park by 10:30 a.m. under alternative 7.

As with alternative 6, existing regulations on OSV use would continue that include BAT guidelines for snowmobiles and snowcoaches, commercial guiding requirements, and hour of operation restrictions would continue. Additional BAT restriction would include development of BAT for NO_x. Further, if the EPA adopts standards for any class of OSV that are more stringent than the requirements resulting from this draft plan/EIS, the EPA standards would become the NPS standards. Non-motorized uses would continue in the park, throughout the interior as currently occurring. Under alternative 7, Sylvan Pass would be open to visitor use and would require staff for daily avalanche control operations.

As described above under alternative 2, exposure assessments were conducted over Presidents' Day weekend 2008 and 2009. These assessments found that at use levels between 635 and 691 snowmobiles and 64 and 71 snowcoaches over a three-day weekend, exposures to air emissions were below all occupational exposure limits (Radtke 2008, 2009). Although numbers of OSVs would range from zero to 330 under alternative 7, they would still be lower than those measured in 2008 and 2009; therefore, it is expected that air emissions exposure from OSVs under alternative 7 would continue to be below all occupational exposure limits. As shown in the 2009 study, peak levels of carbon monoxide were higher for snowmobiles than snowcoaches, but still within established levels, and this would be expected to continue. Because use would likely be within OSHA PELs and ACGIH TLVs with no exceedences, based on past monitoring, impacts on health and safety from air emissions would be long-term negligible adverse.

The 2008 and 2009 assessments also looked at noise emissions at the west entrance as well as for employees using OSV on a daily basis. As described in alternative 2, personal noise exposures in the two kiosks at the west entrance were below the OSHA action level/PEL as well as EPA and NIOSH standards (Radtke 2008, 2009). With similar or slightly higher numbers of total OSV use proposed (even on peak days of 330 snowmobiles and 80 snowcoaches) than those assessed in 2008 and 2009, it is expected that noise emissions under alternative 7 would continue to be below the OSHA action level and impacts on health and safety from noise emissions would be long-term negligible adverse.

Alternative 7 would provide for the continued operation of Sylvan Pass, with avalanche control operations continuing at their current levels, as described in detail under alternative 2. These operations were rated by the recent ORMA as amber, or caution in terms of the risk to NPS staff (NPS

2010n), therefore impacts on NPS staff from avalanche operations would be long-term moderate adverse.

Visitor use in the park would include both motorized and to non-motorized use. As noted in chapter 3 (figure 16), as commercial guiding requirements were implemented, the number of OSV moving violations and arrests has continued to decline. Alternative 7 would continue OSV management measures put in place since 2004 including requiring guided use of OSVs. Commercial guided use also ensures that guides have been trained (as part of their agreement with the NPS) in operation in winter conditions and in avoiding conflict with non-motorized users. The continuation of commercial guiding requirements would have long-term beneficial impacts on health and safety. Alternative 7, as with all action alternatives, would not advise non-essential work/OSVs travel at below -20°F , which would reduce the amount of time both visitors and staff would spend in harsh winter conditions. Because OSV use would still occur and staff and visitors would still be exposed to the winter elements, impacts would be long-term minor adverse, because OSV management and park practices would minimize both user conflict and risk from the elements.

Overall air pollution and noise levels would be expected to be below applicable standards and conflicts between users and exposure to harsh winter conditions would be minimized through OSV management measures under alternative 7. NPS employees working in Sylvan Pass would still be exposed to avalanche risk, which has been rated at an amber (caution) level in a recent ORMA process (NPS 2010n). Under alternative 7, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass and long-term minor adverse from user conflicts and exposure to the elements.

Cumulative Impacts

The long-term negligible adverse impacts and long-term beneficial impacts on the health and safety of NPS staff and visitors from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The effects of these actions, when combined with the long-term negligible to moderate adverse impacts of alternative 7, would result in long-term minor adverse cumulative impacts on health and safety. Alternative 7 would contribute a minimal amount to the overall cumulative impacts because many of these actions occur across a larger region, of which Yellowstone is a part.

Conclusion

Under alternative 7, impacts to human health and safety would be long-term negligible adverse from air and noise emissions, long-term moderate adverse from the operation of Sylvan Pass and long-term minor adverse from user conflicts and exposure to the elements. Cumulative impacts would be long-term minor adverse.

SOCIOECONOMIC VALUES

GUIDING REGULATIONS AND POLICIES

Economic and social values are fully entwined through the regulatory and policy environment of the NPS. The NPS Director's Order 12 Handbook (NPS 2001) requires analysis of economic and social impacts as part of the NEPA process. The document specifies that economic and social analysis includes "employment, occupation, income changes, tax base, infrastructure" (Appendix 1, NPS 2001). Indirect effects on concessioners and other businesses that may be affected by the alternatives must be considered.

ASSUMPTIONS, METHODOLOGY, AND IMPACT DEFINITIONS

This section analyzes how winter use management alternatives would likely impact recreational use in the greater Yellowstone area and how change in recreational use would impact economic activity (expenditures and employment) within the area.

Impact results are presented at three different levels: the three-state area (Idaho, Montana, and Wyoming), the five-county area (Fremont County in Idaho, Gallatin and Park counties in Montana, and Park and Teton counties in Wyoming), and at the community level (Cody and Jackson, Wyoming, and West Yellowstone, Montana). Past reports including Duffield and Neher (2006 and 2007) and the 2008 environmental assessment prepared by NPS (NPS 2008a) present a host of results on the economic impacts of different alternatives, along with the data on recreational use and visitor expenditure levels used in the analysis. The current analysis draws on these past reports, updating the results with more recent economic data.

The impact analysis uses the upper and lower bounds on visitation estimated for previous reports (Duffield and Neher 2006; NPS 2008a) to analyze the impacts of the current set of action alternatives relative to the no-action alternative, except alternative 7. Alternative 7 does not match previous alternatives and the assumptions used to create the bounds on visitation are described below. The impacts were estimated using the most recent version of IMPLAN (Minnesota IMPLAN Group, 2008). The analysis looks at impacts for the three state area (Idaho, Montana, and Wyoming) the five county area (Fremont County in Idaho, Gallatin and Park counties in Montana, and Park and Teton counties in Wyoming), Cody and Jackson, Wyoming, and West Yellowstone, Montana. The community regions are approximated using zip code boundaries.

Table 63 compares the current alternatives to the alternatives from previous reports that were used to derive assumptions about visitation change. Current alternatives 1, 2, and 3 are identical to alternatives considered in past reports. Alternatives 4, 5, 6, and 7 differ from the alternatives in the previous reports. Alternative 4 would set lower limits on snowmobile use compared to similar alternatives in the 2007 EIS and Duffield and Neher (2006). Alternative 5 would have a period of five years over which snowmobile use would be phased out, which is not included in the similar alternatives in the 2007 EIS and Duffield and Neher (2006). Alternative 6 would set daily limits, whereas the similar alternative from 2007 EIS and Duffield and Neher (2006) would allow for extra snowmobiles to enter on crowded days, but the snowmobiles count against a seasonal total. Alternative 6 has a higher seasonal total for snowmobiles, a lower seasonal total for snowcoaches, and it allows a higher percent of unguided snowmobiles than the similar alternative from the earlier reports. Alternative 7 includes variable use levels, like alternative 6, but with use levels closer to alternative 2.

TABLE 63: SUMMARY OF ALTERNATIVES FOR SOCIOECONOMICS

Alternative	Description of Alternative	Comparable Alternatives from Previous Reports	Differences with Previous Reports
Alternative 1 (no-action alternative)	Once the 2009 interim rule expired (after the 2010/2011 season) there would be no rule in place and OSV use would not be permitted. Administrative OSV use would continue as needed. Visitors could ski or snowshoe into the park.	<ol style="list-style-type: none"> 1. Duffield and Neher 2006: Motorized Ban Baseline 2. 2007 EIS: Alternative 3B (Recreational OSV access would cease in all the park) 3. 2008 EA: Alternative 1 (No recreational snowmobile or snowcoach use would be allowed in the park) 	No difference
Alternative 2	OSV use would continue at levels described under the 2009 interim rule – up to 318 snowmobiles and up to 78 snowcoaches per day.	<ol style="list-style-type: none"> 1. 2008 EA: Alternative 2 would allow up to 318 snowmobiles and 78 snowcoaches in Yellowstone 	No difference
Alternative 3	OSV levels in the park would return to the 2004 plan limits – up to 720 snowmobiles and 78 snowcoaches per day.	<ol style="list-style-type: none"> 1. Duffield and Neher, 2006: Temporary Rules Baseline 2. 2007 EIS: Alternative 1 	No difference
Alternative 4	Access to the park would be by commercial wheeled vehicles (north and west entrances) and snowmobiles and snowcoach (south entrance) only. The east entrance would be closed to through travel for OSVs, but open for non-motorized use. Up to 110 snowmobiles per day, 30 snowcoaches per day	<ol style="list-style-type: none"> 1. 2007 EIS: Alternative 6 (Wheeled commercial vehicle access, OSV access through the south entrance and on the east side of the park, 350 snowmobiles per day (250 south entrance, 100 Old Faithful), 40 snowcoaches per day, 100 commercial wheeled vehicles) 2. Duffield and Neher 2006: Alternative 6 	2007 EIS and Duffield and Neher 2006 allow an additional 240 snowmobiles per day and 10 additional snowcoaches per day compared to the current alternative 4. Visitation would be lower under the current alternative 4.
Alternative 5	OSV access to the park would be via BAT snowcoach only. This would be accomplished by phasing out snowmobiles beginning in the 2014/2015 season, when all snowcoaches would be required to have BAT. Snowcoaches would replace snowmobiles within a five-year period (depending on coach user demand). Up to 318 snowmobiles per day through 2014/2015 winter season. Up to 78 snowcoaches per day initially, allocated by entrance the same as in alternative 2. As of 2014/2015, increase to 120 BAT snowcoaches per day, (with a corresponding decrease in snowmobiles over a five-year period as snowcoach numbers increase).	<ol style="list-style-type: none"> 1. 2007 EIS: Alternative 2 (Emphasizes snowcoach access; prohibits recreational snowmobiling. Road grooming would continue. Sylvan Pass would be closed to through travel. 120 snowcoaches per day) 2. Duffield and Neher 2006: Alternative 2 	2007 EIS and Duffield and Neher 2006 do not have a period during which snowmobiles would phase out. Visitation would be higher under the current alternative 5 because of the phase out period that could last 9 years.

Alternative	Description of Alternative	Comparable Alternatives from Previous Reports	Differences with Previous Reports
Alternative 6	OSV levels would vary by creating times and places for higher and lower levels of use. 32,000 snowmobiles would be permitted each season. Daily numbers could vary between 0 and 540. Mostly guided, with up to 25% of snowmobile use unguided or non-commercially guided. 4,600 snowcoaches would be permitted per season	<ol style="list-style-type: none"> 2007 EIS: Alternative 5 (Features a seasonal limit as well as a flexible daily limit. Sylvan Pass would be open to through travel. Up to 540 snowmobiles per day, 80% commercially guided 20% unguided or non-commercially guided, 83 snowcoaches per day.) The seasonal limit would be 27,540 for snowmobiles. 5,291 snowcoaches would be allowed per season. Duffield and Neher 2006: Alternative 5 	Alternative 6 sets daily limits, whereas alternative 5 from the 2007 EIS allows for additional snowmobiles on crowded days that count against a seasonal total. Alternative 6 has a higher seasonal total for snowmobiles and a lower seasonal total for snowcoaches than alternative 5. Alternative 6 allows for more unguided snowmobiles, as well.
Alternative 7	Three different daily limits for OSV levels would be set to provide days with higher and lower use. During the season the limit on snowmobiles would be 330 for 45 days, 220 for 30 days, and 132 for 16 days. This yields a maximum of 23,562 per season. All snowmobiles would be part of commercially guided tours. Three daily limits are used for snowcoaches, as well. Daily limits are 80 snowcoaches for 45 days during the season, 50 snowcoaches for 30 days and 30 snowcoaches for 16 days. The maximum number of snowcoaches would be 5,730 per season.	No similar alternative.	No similar alternative.

IMPLAN Modeling

As in the previous reports, the socioeconomic analysis relies on IMPLAN modeling. The 2008 EA (NPS 2008a) describes IMPLAN as follows: IMPLAN is an “input/output” economic model designed by the USFS and is commonly used by state and federal agencies for planning and evaluation purposes. For example, Dean Runyan and Associates (2006) used IMPLAN modeling in a report to the State of Wyoming on the economic impact of travel in Wyoming. Among other outputs, IMPLAN generates estimates of output and employment. Output is the total business revenue generated by a given activity such as park visitation, and employment is the resulting number of jobs (all jobs – full and part time) associated with that activity.

There are four important caveats that are relevant to the interpretation of the IMPLAN model estimates generated for this analysis. First, the model is static in nature and measures only those effects resulting from a specific activity change at one point in time. Thus, IMPLAN does not account for any subsequent behavioral adjustments that may occur in the economy. For example, a change in the NPS plan for snowmobile management within the park may encourage local businesses to diversify or modify their operations. These changes could thereby abate potential reductions in output and employment, a change not captured by IMPLAN. Further, IMPLAN does not estimate any

potential re-employment of the labor force that may be displaced by management changes (for example the increased employment opportunity provided by guiding). Therefore, the long-run net output and employment impacts resulting from the modeled changes in winter use management would likely be smaller than those estimated by the model. The second caveat to the interpretation of the IMPLAN model estimates generated for this analysis is that they rely on the economic relationships derived from the latest data available, which are from 2008 (prior analyses relied on earlier IMPLAN data sets. Third, IMPLAN information is based on year-round data; winter seasonal information may not be as accurate. Fourth, for small analysis areas (West Yellowstone, Montana, for example) the IMPLAN data may not be an accurate representation of the actual economy due to lack of information. However, the most powerful use for economic modeling is in the comparisons between alternatives. The impacts of the six action alternatives on economic resources can be modeled and compared and the decision maker can understand the effects of the different alternatives.

IMPLAN Model Application

The modeling of the regional economic impacts associated with changes in visitation (and associated visitor spending) on an economic area requires several types of information.

1. **The change in the number of visitors to the different analysis areas in the greater Yellowstone area.** For the following analysis, the percentage of visitors to the park who did not live in each of the economic analysis areas was taken from the results of the 1997-1998 survey of winter park visitors (Duffield and Neher 2000). Specifically, 82.5% of visitors lived outside of the five-county area, 65.5% lived outside the three-state region, and 99% lived outside each of the three communities (Cody, Jackson, and West Yellowstone). Only non-local visitation was included in the IMPLAN model since only their spending drives local economic growth.
2. **The change in visitation is multiplied by the average spending per visitor.** The analyses from which the impacts are taken use \$175.33 per visitor for all the alternatives except alternative 4, which uses \$106.33 (Duffield and Neher 2006). As noted in these reports, per-visit expenditures were estimated using a time series model of West Yellowstone resort tax collections and west entrance visits (Duffield and Neher 2006). This regression model of winter visitation and tax receipts estimates that for every west entrance winter visit, \$175.33 is spent on taxable goods and services in the community of West Yellowstone. Spending for alternative 4, which involves commercial wheeled vehicle access to the park through the north and west entrances, was estimated to cost approximately \$69 less (Duffield and Neher 2006). This spending does not represent total trip spending for an individual because he or she may visit the park more than once on a trip or may visit other areas in the vicinity such as national forest lands.
3. **The IMPLAN model divides economic activity into industry categories, so the per visitor spending must be divided between categories.** The distribution of spending across economic sectors is also drawn from the 1997-1998 winter visitor survey (see Duffield and Neher 2006). That survey asked winter park visitors to detail their spending patterns within the greater Yellowstone area. Based on these responses, visitor spending was allocated as 27.5% lodging, 24.6% automotive and gas stations, 17.1% miscellaneous retail expenditures, 14.3% eating and drinking establishments, 11.5% scenic and recreational transportation, and 5% other amusement services.

Using the change in visitation, per visitor spending, and the distribution of spending across industry categories, an estimate is calculated for direct changes in non-resident visitor spending due to an action alternative and relative to the no-action alternatives. The direct spending changes by sector are then input into the IMPLAN program.

The IMPLAN program estimates total output and employment impacts, including indirect and induced impacts arising from the initial direct spending impact, and allocates these impacts across the sectors of the analysis area. Direct impacts reflect the initial spending at local businesses by visitors from outside the greater Yellowstone area (the change in direct spending described above). Indirect impacts reflect the ripple effect of this spending, as businesses pay for the inputs they need such as capital and labor. The induced effects reflect the resulting changes in household income for local residents.

At its most aggregated level, IMPLAN modeling applies output and employment multipliers to the initial visitor spending to arrive at estimated total output and employment impacts. In general, the smaller and less diverse the analysis area is, the closer its expenditure multiplier is to 1.0. Conversely, the larger and more diverse an economy, the larger are its multipliers.

Current Use Levels

Recent visitation data and trends are presented in the “Visitor Use and Experience” section of chapter 3. For the economic impact estimates, the 2005/2006 winter (a total of 88,718 visits) was selected as the assumed level of use for the current alternative (alternative 2). This level of use was selected to be consistent with Duffield and Neher (2006). In the 2005/2006 winter season, approximately 28,833 snowmobile passengers entered the park and 19,856 snowcoach passengers. For comparison, use levels for the 2009/2010 winter season there were 22,228 snowmobiles and 20,388 snowcoaches.

Assumptions for Recreational Use Levels by Alternative

Using the 2005/2006 visitation data, there was an average of 240 snowmobiles per day and 19 snowcoaches per day. Alternative 1 would allow no snowmobile or snowcoach access. Historically, motorized oversnow use has comprised more than 70% of the total winter visitation in the park. Nearly all visitors entered via the west, south, and east entrances. An analysis of the distribution of recreational use since the winter use management plan changes began in 2001 suggests little evidence of substitution between park entrances. Additionally, an analysis of snowmobile use on national forest land near the west entrance suggests that snowmobile use in national forests is possibly a complement to snowmobiling in the park rather than a direct substitute. For these reasons, the level of recreational use under the no-action conditions represented by alternative 1 was assumed to be equal to the north entrance wheeled vehicle entries plus parkwide skiing entries during the 2005/2006 winter for a total of 40,029 visits (NPS 2008a). Table 64 summarizes upper and lower bound visitation estimates. Estimates for alternatives 2 through 6 are based on estimates from previous reports (NPS 2007c; Duffield and Neher 2006). Alternative 7 offers different limits on snowmobiles and snowcoaches over the course of the season. For this alternative, the lower bound was set equal to visitation in 2005/2006 and for the upper bound, the assumption was that there would be 85 days in the season, 8 people per snowcoach, 1.3 people per snowmobile, and that 50,000 cars would enter the park. The lower bound was set equal to current visitation.

TABLE 64: LOWER AND UPPER BOUND VISITATION FORECASTS AND VISITOR SPENDING PER DAY ASSUMPTIONS

	Lower Bound Estimate	Upper Bound Estimate	Visitor Spending per day
Alternative 1	40,029	40,029	\$175.33
Alternative 2	88,718	88,718	\$175.33
Alternative 3	88,718	172,316	\$175.33
Alternative 4	77,892	291,342	\$106.33
Alternative 5	59,885	125,736	\$175.33
Alternative 6	100,652	158,206	\$175.33
Alternative 7	88,718	125, 736	\$175.33

Source for alternatives 1-6: Duffield and Neher (2006) and NPS (2008a).

IMPLAN Results by Alternative

The resulting IMPLAN estimates for output and employment impacts relative to the alternative 1 are presented in tables 65 and 66 for the lower and upper bounds, respectively, for the three-state and five-county areas. Table 67 presents the results of the analyses for the communities of Cody and Jackson, Wyoming, and West Yellowstone, Montana. The size of the impacts in each area depend on the size of the multipliers used by the IMPLAN model, which can change over time based on changes in interrelationships between sectors of the economy and assumptions about the size of the revenue change within the region of interest. Because visitation from outside the region of interest is driving the regional economic impacts, the distribution of changes in visitation between resident and non-resident visitors is a key determinant of estimated impacts. Assumptions about visitation suggest that the non-resident visitor population increases as the size of the region of interest decreases. Since 66% of the total of new visitors comes from outside the three state area, only 66% of the new visitor spending is assumed to be new spending in the region that flows through the entire three-state economy. In the county model, the assumption was made that 82.5% of the visitors live outside the five counties, so 82.5% of the total new visitor spending is circulated within the smaller five-county region. Similarly, 99% of the total new visitor spending is injected into the each of the three individual communities. Although the multipliers are larger at the three-state level than the five-county level, the amount of new money injected into the five-county economy is larger than the amount of new money injected into the three-state economy. In some cases, the result is larger total impacts for the smaller geographic areas even though the multipliers are smaller. The same holds for the analysis at the community level.

TABLE 65: IMPACTS OF ACTION ALTERNATIVES RELATIVE TO NO-ACTION ALTERNATIVE (ALTERNATIVE 1) AND PERCENT CHANGE FROM TOTAL FOR THE 3-STATE AND 5-COUNTY REGIONS, LOWER BOUND VISITATION

Lower Bound	5-county area		3-state area	
	Total Output	Total Employment	Total Output	Total Employment
No-Action (Alternative 1)	\$8,568,430,041	127,791	\$130,462,241,081	1,942,947
Alternative 2	\$8,199,085	108	\$7,932,883	100
% change	0.096%	0.085%	0.006%	0.005%
Alternative 3	\$8,199,085	108	\$7,932,883	100
% change	0.096%	0.085%	0.006%	0.005%
Alternative 4	\$1,073,248	15	\$1,174,576	15
% change	0.013%	0.011%	0.001%	0.001%
Alternative 5	\$3,343,692	44	\$3,235,132	41
% change	0.039%	0.035%	0.002%	0.002%
Alternative 6	\$10,208,736	135	\$9,877,286	125
% change	0.119%	0.105%	0.008%	0.006%
Alternative 7	\$8,199,085	108	\$7,932,883	100
% change	0.096%	0.085%	0.006%	0.005%

TABLE 66: IMPACTS OF ACTION ALTERNATIVES RELATIVE TO NO-ACTION ALTERNATIVE (ALTERNATIVE 1) AND PERCENT CHANGE FROM TOTAL FOR THE 3-STATE AND 5-COUNTY REGIONS, UPPER BOUND VISITATION

Upper Bound	5-county area		3-state area	
	Total Output	Total Employment	Total Output	Total Employment
No-Action (Alternative 1)	\$8,568,430,041	127,791	\$130,462,241,081	1,942,947
Alternative 2	\$8,199,085	108	\$7,932,883	100
% change	0.096%	0.085%	0.006%	0.005%
Alternative 3	\$22,276,745	294	\$21,553,479	272
% change	0.260%	0.230%	0.017%	0.014%
Alternative 4	\$23,012,676	304	\$22,265,518	281
% change	0.269%	0.238%	0.017%	0.014%
Alternative 5	\$14,432,809	190	\$13,964,214	176
% change	0.168%	0.149%	0.011%	0.009%
Alternative 6	\$16,836,219	220	\$19,254,542	243
% change	0.196%	0.172%	0.015%	0.013%
Alternative 7	\$14,432,809	190	\$13,964,214	176
% change	0.168%	0.149%	0.011%	0.009%

TABLE 67: AVERAGE IMPACTS OF ACTION ALTERNATIVES RELATIVE TO NO-ACTION ALTERNATIVE (ALTERNATIVE 1) AND PERCENT CHANGE FROM TOTAL FOR THREE GATEWAY COMMUNITIES

Average	Cody, Wyoming		Jackson, Wyoming		West Yellowstone, Montana	
	Total Output	Total Employment	Total Output	Total Employment	Total Output	Total Employment
No-Action (Alternative 1)	\$786,677,477	11,876	\$1,854,443,978	22,565	\$101,281,028	1,740
Alternative 2	\$9,480,799	153	\$9,118,021	106	\$8,488,011	129
% change	1.21%	1.28%	0.49%	0.47%	8.38%	7.39%
Alternative 3	\$17,619,968	284	\$16,945,746	198	\$15,774,881	239
% change	2.24%	2.39%	0.91%	0.88%	15.58%	13.73%
Alternative 4	\$14,006,940	225	\$13,470,969	157	\$12,540,194	190
% change	1.78%	1.90%	0.73%	0.70%	12.38%	10.92%
Alternative 5	\$10,277,698	165	\$9,884,426	115	\$9,201,462	139
% change	1.31%	1.39%	0.53%	0.51%	9.09%	8.01%
Alternative 6	\$17,408,110	280	\$7,000,257	122	\$15,585,208	236
% change	2.21%	2.36%	0.38%	0.60%	15.39%	13.57%
Alternative 7	\$9,879,249	159	\$9,501,224	110.5	\$8,844,737	134
% change	1.26%	1.34%	0.51%	0.49%	8.74%	7.70%

Cost of Meeting New Standards for Snowcoaches

As of December 15, 2014, all snowcoaches (diesel or gasoline) would have to meet EPA model year 2010 air emission requirements. This requirement could involve replacing engine and/or emission control systems so that the vehicle is in compliance, or purchasing 2010 or newer model year vehicles. Coaches would also need to meet a sound obligation that is similar to the snowmobile sound emission requirement. Once approved, a snowcoach could operate for 10 years without being upgraded or replaced.

Under all the alternatives except alternative 4, between 78 and 80 snowcoaches would be allowed to operate in Yellowstone per day. The actual number of snowcoaches needed depends on demand for snowcoach trips. In 2009/2010, on the peak day 66 snowcoaches entered the park. Alternative 4 would allow for up to 30 snowcoaches per day.

Out of the 78 snowcoach fleet in 2009/2010, approximately 29 are Bombardiers, and the balance (49) are vans to small and mid-size buses converted from wheeled vehicles in the summer to tracks and oversnow operations in the winter.

To calculate the cost of the snowcoach upgrades required by the alternatives, NPS assumed the following:

- The 29 Bombardiers would continue to operate and their engine and emission control systems would be upgraded to meet 2010 model year requirements. The cost would be approximately \$10,000 per vehicle.

- Of the 51 conversion vehicles, as of 2014/2015, 10 percent (or 10 vehicles) would be 2010 or newer vehicles through normal replacement. No additional cost is assumed because they would be already replaced.
- Of the 41 remaining vehicles, owners would upgrade the engine and emission systems on 20 percent (or 8 vehicles) to meet 2010 standards. Cost per upgrade is approximately \$10,000 per vehicle.
- The 33 remaining vehicles would be replaced.
- 25 percent (or 8) would be 12- to 15-passenger vans at a cost of \$50,000 per vehicle.
- 50 percent (or 17) would be small airport-style vehicles at a cost of \$160,000 per vehicle.
- 25 percent (or 8) would be mid-size buses at a cost of \$200,000 each.

Based on these assumptions, the total cost of converting the current fleet to meet the new requirements would be approximately \$5,090,000.

All snowcoach companies are also authorized to provide summer tours in the park. The 51 conversion vehicles would be available for wheeled summer tours; they are not purpose-built winter vehicles like the Bombardiers. Existing, older conversion vehicles could continue to be operated in the summer for wheeled vehicle tours. The investment in new vehicles would be spread over both seasons and a 10-year period.

Thresholds

The following thresholds for evaluating impacts on socioeconomic values were defined.

- Negligible:* The impact is at the lower levels of detection (< 5% change in either total output or employment)
- Minor:* The impact is slight, but detectable (5-10% change in either total output or employment)
- Moderate:* The impact is readily apparent and has the potential to become major (10-20% change in either total output or employment)
- Major:* The impact is severe, or if beneficial, has exceptional beneficial effects (>20% change in either total output or employment).

Study Area

The geographic area for the socioeconomic analysis includes the three state-area of Wyoming, Montana and Idaho; the five-county area of Fremont County in Idaho, Gallatin and Park counties in Montana, and Park and Teton counties in Wyoming; and the communities of Cody and Jackson, Wyoming, and West Yellowstone, Montana.

SUMMARY OF IMPACTS

A brief summary of the impacts to socioeconomic values is presented below, followed by the detailed impact analysis.

- Under alternative 1, the impacts would be long-term negligible adverse for the three-state area, the five-county area, and Cody and Jackson, Wyoming. West Yellowstone is projected to experience long-term minor adverse impacts. The adverse impacts would be most directly felt by communities and businesses near the park, especially in areas that have a higher proportion of business tied directly to park visitation. At the north entrance, Gardiner, Montana, might experience beneficial impacts if visitors who would have visited the other entrances switch to the North.
- Under alternative 2 there would be long-term beneficial impacts for the three-state area, the five county area, and the communities of Cody and Jackson. In West Yellowstone, the long-term beneficial impacts would be larger on average.
- Under alternative 3 there would be long-term beneficial impacts for the states, counties, and communities surrounding Yellowstone. West Yellowstone could experience larger beneficial, long-term impacts compared to the other communities. Alternative 3 has higher daily limits on snowmobile and snowcoach use, and so the alternative could accommodate higher growth in visitation than all the alternatives, except alternative 4. If demand for snowmobile and snowcoach tours grew beyond the current limits, alternative 3 would allow for a larger increase in visitation by out-of-region visitors.
- Under alternative 4, all of the communities would be expected to experience long-term beneficial impacts and West Yellowstone is expected to experience the largest beneficial impacts. The size of the impacts would depend on demand for commercial, wheeled vehicle tours out of the west and north entrances, which would represent a new winter experience for visitors.
- Under alternative 5 there would be long-term beneficial impacts for all the communities. In order to generate larger beneficial impacts under this alternative, demand for snowcoach tours must increase to more than make up for the eventual phase-out of snowmobiles.
- Under alternative 6 there would be long-term beneficial impacts for all the communities. West Yellowstone could experience larger, long-term beneficial impacts, on average. The larger beneficial impacts would be more likely under this alternative compared to others because of the provision for unguided snowmobile trips, which were historically more popular.
- Under alternative 7 there would be long-term beneficial impacts for all the communities. West Yellowstone could have larger, beneficial long-term impacts, on average due to the use levels permitted.

DETAILED IMPACT ANALYSIS

Below the impacts of each alternative are discussed. The impacts of alternative 1 (the no-action alternative) are described relative to current conditions (governed by the same rule as alternative 2). The impacts of alternatives 2 through 7 are described relative to the no-action alternative (alternative 1).

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Under alternative 1, no oversnow motorized recreational access would occur. Wheeled vehicle access would continue to occur through the north entrance of Yellowstone as far east as Cooke City, Montana. Of the four entrances, the west entrance and the community of West Yellowstone would experience the largest impacts over time, because the west entrance is the most popular entrance point into Yellowstone for snowmobiles and snowcoaches. Although some visitors would visit the area to snowmobile in the national forests or cross-country ski in Yellowstone and on trails near West Yellowstone, traffic through the entrance would be almost completely shut down. Similarly, traffic through the east and south entrances is almost completely via snowmobiles and snowcoaches in the winter season. With no motorized oversnow access, the Old Faithful Snow Lodge and the yurt camp at Canyon would be closed for the winter. The north entrance would experience the smallest change in visitation, since visitors could still drive in by car.

If visitation is low enough, the resulting reduction in business in the affected communities would lead to a loss of year-round population. A year-round population provides a more stable tax base and gives the community the ability to provide public services that may not be possible with a very small year-round population.

Alternative 1 represents what would happen if no new rule is passed, and oversnow motorized access for visitors were prohibited. Compared to the levels permitted under the 2009 interim rule, which is alternative 2, alternative 1 would result in lower visitation. Table 64 lists the visitation projections under each alternative. Visitation under alternative 1 is projected to be about half of 2009/2010 levels (alternative 2). This projection assumes that the north entrance would continue to receive approximately the same number of visitors, but the other entrances would service the small number of non-motorized visitors to the park. The number of cross-country skiers and other non-motorized visitors might increase if new visitors who want a non-motorized experience start visiting, but the increase is not expected to be large.

Based on the visitation numbers in table 64 and the impacts of alternative 2 relative to alternative 1 in tables 65, 66 and 67, the impact of alternative 1 over time would be a reduction in output and employment from the levels expected under alternative 2. The impacts are estimated to be negligible, adverse, and long term for Cody and Jackson, Wyoming. West Yellowstone is projected to experience minor, adverse, long-term impacts. At the north entrance, Gardiner, Montana, might experience beneficial impacts if visitors who would have visited the other entrances switch to the North. The five-county and three-state regions would experience negligible, adverse, long term impacts.

The terms negligible and minor represent the thresholds defined above, and not subjective descriptions of how the impacts would feel to the individuals who do experience a loss of business or employment. For these individuals, the effects would not seem negligible or minor. For example, the 2008 EA reported that business owners along the North Fork of the Shoshone River stated that if the east entrance is closed under alternative 1, most of them would close their businesses in the winter. Further exacerbating their situation is the recent downturn in visitation that has already caused some of the businesses to curtail operations or close entirely in the winter (NPS 2008a). The IMPLAN modeling captures the indirect and induced effects as well. As individual businesses are adversely affected, they would reduce purchases of other goods and services from suppliers. Conversely, if individual businesses are beneficially affected they would increase the purchase of goods and services from suppliers. These feedback effects impact sectors of the economy beyond those that are influenced directly by visitors.

Cumulative Impacts

Increasing population, oil and gas leasing, and economic opportunities over time should provide beneficial impacts to the economy of the greater Yellowstone area. As long as the growth and economic activity are managed in a way that does not harm park resources and potentially park visitation, these trends should boost economic growth. Road construction in the area may depress visitation in the short-term, but should be beneficial once the construction is completed. Plans for improvements to nearby attractions such as ski resorts could also bring additional visitors into the area.

For example, the Sleeping Giant Ski Resort near the east entrance to the park reopened in 2009. In addition, there is a development plan for the Rendezvous Ski Trail. Activities in the surrounding national forests also impact greater Yellowstone area. These plans should improve the management of the forests and contribute to the overall wellbeing of the greater Yellowstone area. The Gallatin National Forest Travel Plan, revised in 2006, is being implemented along with the Beartooth District of Custer National Forest Travel Management Plan and the Gallatin National Forest Travel Plan. Over time, consolidating the checkerboard lands on the Gallatin National Forest should also benefit the forest and the surrounding area. Specific projects in the park that have (or would have) a generally beneficial bearing on socioeconomics include the construction of a new west entrance and reconstruction of the east entrance road. These longer-term beneficial projects may depress visitation in their implementation phase. For example, road construction projects are aggravating to most drivers, some of whom may avoid the portion of the park (and nearby communities) where road work is occurring. Similarly, replacing visitor centers often means a temporary facility is provided (construction activities may also result in disturbance). This may also be discouraging to some visitors.

Finally, the current economic recession is having a dampening effect on the national and local economy; however, despite the poor economic conditions visitation to Yellowstone increased somewhat in the winter of 2010 compared to 2009. As discussed in chapter 3, unemployment has increased in the counties and states that border Yellowstone. Timber harvesting on USFS land has also been decreasing.

With the prohibition of motorized oversnow recreational use, and the lack of access to the interior of the park, alternative 1 would likely discourage out-of-state visitors from traveling to the area and contributing to local regional economies. It is likely that this alternative would represent an overall negligible adverse impact on regional economic trends. In the current economic conditions, a decline in winter visitors would contribute to the overall weaker economy. When the economy recovers, a reduction in park visitation would be somewhat offset by the beneficial regional economic trend related to resource extraction, residential growth, other recreation opportunities, and wildlife and other natural environment attractions.

The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible adverse impacts of alternative 1, would result in long-term negligible adverse impacts in the towns of Jackson and Cody. In West Yellowstone, as long as the economic downturn continues, the long-term minor adverse impacts expected from alternative A could result in negligible to minor adverse cumulative impacts, of which alternative 1 would contribute a large part.

Conclusion

The impacts are estimated to be negligible, adverse, and long term for the three-state area, the five-county area and Cody and Jackson, Wyoming. West Yellowstone is projected to experience minor,

adverse, long-term impacts. As described earlier, the adverse direct impacts would be most directly felt by communities and businesses near the park, especially in areas that have a higher proportion of business tied directly to park visitation. At the north entrance, Gardiner, Montana, might experience beneficial impacts if visitors who would have visited the other entrances switch to the North. The IMPLAN modeling captures the indirect and induced effects as well. As individual businesses are adversely affected, they would reduce purchases of other goods and services from suppliers. Conversely if individual businesses are beneficially affected they would increase the purchase of goods and services from suppliers. These feedback effects impact sectors of the economy beyond those that are influenced directly by visitors. Cumulative impacts would be long-term negligible adverse or beneficial cumulative impacts on the socioeconomic environment. In West Yellowstone cumulative negligible to minor adverse impacts could result.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Alternative 2 continues the current management, which allows up to 318 snowmobiles per day and 78 snowcoaches. The visitation estimate is based on 2005-06 visitation, when the up to 720 snowmobiles per day were allowed. The limit of 318 would have been exceeded 29 times in 2007/2008 and 6 times in 2008/2009. For the past two seasons, the limit of 318 has not been reached. Compared to alternative 1, alternative 2 would result in beneficial, long-term impacts for the three-state area, the five-county area, and the three communities. In West Yellowstone, the average beneficial impacts shown in table 67 are larger than the other areas. As discussed in chapter 3, after an initial drop-in visitation after the new rules were implemented, visitation increased for the first three winters. In the last two winters, visitation was higher than in 2004/2005 but lower than 2005/2006 through 2007/2008. Although winter visitation dropped when the new rules went into place, most communities still saw rising tax revenues through 2006. The exception is West Yellowstone, where tax revenues dropped along with visitation. Alternative 2 provides for continued growth in visitation, especially through the use of snowcoaches. The beneficial impacts would be tempered by the cost of upgrading the existing snowmobile fleet to meet new requirements by December 2014.

Cumulative Impacts

The impacts of these past, present, and reasonably foreseeable future actions would be the same as under alternative 1. The impacts of these actions combined with the long-term beneficial impacts of alternative 2, would result in long-term beneficial impacts (of which alternative 2 would contribute a large part) in the towns of Jackson, Cody, and West Yellowstone.

Conclusion

In conclusion, compared to alternative 1, alternative 2 would result in beneficial, long-term impacts for the three-state area, the five county area, and the communities of Cody and Jackson. In West Yellowstone, the beneficial, long-term impacts would be larger on average. Alternative 2 continues current management, under which there has been some increase in visitation, especially for snowcoach use. Cumulative impacts would be long-term beneficial.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Alternative 3 would allow expanded snowmobile use with a daily limit of 720. However, guided snowmobile tours would still be required. The lower bound estimate for visitation shown in table 64 assumes that visitation would remain at current levels, since simply raising the daily limit would not necessarily generate more visitors, at least in the short term. The upper bound estimate assumes growth in both snowmobile and snowcoach trips. If demand for visits increased to the daily limit,

alternative 3 would allow the one of the highest numbers of visitors into the park. As with the other alternatives that allow snowcoach use in the park, businesses would have to bear the cost of upgrading the existing snowmobile fleet to meet new requirements by December 2014. Alternative 3 is expected to result in beneficial, long-term impacts for the three-state area, the five-county area, and the towns of Jackson and Cody, Wyoming. As shown in table 67, West Yellowstone could experience larger beneficial, long-term impacts on average, given that the community attracts a larger share of winter visitation. As mentioned above, for the businesses and individuals who experience the benefits, the benefits may not be negligible. The impacts would be negligible in comparison to the entire economy of the region being analyzed.

Cumulative Impacts

The impacts of these past, present, and reasonably foreseeable future actions would be the same as under alternative 1. The impacts of these actions, combined with the long-term beneficial impacts of alternative 3, would result in long-term beneficial impacts (of which alternative 3 would contribute a large part) in the towns of Jackson, Cody, and West Yellowstone.

Conclusion

Alternative 3 is expected to result in negligible to beneficial, long-term impacts for the states, counties and communities surrounding Yellowstone. West Yellowstone could experience larger beneficial, long-term impacts compared to the other communities. Alternative 3 has higher daily limits on snowmobile and snowcoach use, and so the alternative could accommodate higher growth in visitation than all the alternatives, except alternative 4. If demand for snowmobile and snowcoach tours grew beyond the current limits, alternative 3 would allow for a larger increase in visitation by out-of-region visitors. However, the lower estimate of visitation is equal to alternative 2 because the snowmobiles must still be part of a guided tour and must meet BAT restrictions. Cumulative impacts would be long-term beneficial.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Alternative 4 provides for a variety of winter use experiences that currently offered. For this reason, it is difficult to forecast visitation, which would depend on demand for commercial, wheeled vehicle tours from the west and north entrances. The upper bound estimate for visitation is much higher than the other alternatives, so this alternative allows for the most growth in visitation. Because the daily limit for snowmobiles is 110 and the limit for snowcoaches is only 30, the growth in visitation depends on visitor demand for commercial wheeled vehicle trips and the park's ability to keep the roads plowed. Under the upper bound assumptions, the daily limits for snowmobiles, snowcoaches, and commercial wheeled vehicles are all met. The daily limits for snowmobiles and snowcoaches are lower than alternatives 2, 3, and 6, which would result in lower overall visitation if there is not demand for wheeled vehicle tours. In addition, per visitor spending is expected to be lower because wheeled vehicle tours would be less expensive than snowmobile or snowcoach tours. The cost of upgrading the existing snowmobile fleet to meet new requirements by December 2014 could be lower than other alternatives that allow more snowcoaches into the park. The impacts in tables 65, 66, and 67 overstate the beneficial impacts of alternative 4 because they are based on a similar alternative from the 2007 EIS that allowed 350 snowmobiles per day and 40 snowcoaches.

The town of West Yellowstone could experience on average larger beneficial impacts, whereas the other areas and communities are expected to experience smaller, beneficial, long-term impacts.

Cumulative Impacts

The impacts of these past, present, and reasonably foreseeable future actions would be the same as under alternative 1. The impacts of these actions, combined with the long-term beneficial impacts of alternative 4, would result in long-term beneficial impacts (of which alternative 4 would contribute a large part) in the towns of Jackson, Cody, and West Yellowstone.

Conclusion

Compared to alternative 1, all the communities are expected to experience beneficial, long-term impacts and West Yellowstone is expected to experience the largest beneficial impacts. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term beneficial impacts of alternative 4 would result in long-term beneficial cumulative impacts on the socioeconomic environment. The size of the impacts would depend on demand for commercial, wheeled vehicle tours out of the west and north entrances, which would represent a new winter experience for visitors. Cumulative impacts would be long-term beneficial.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Alternative 5 would transition to BAT snowcoaches starting in the 2014/2015 season. Snowcoach limits would increase with demand, while snowmobile limits were reduced during a five-year phase-out. Until the phase-out begins, alternative 5 would have similar impacts to alternative 2. Because alternative 5 ultimately allows for about 40 additional snowcoaches per day, more visitors could be accommodated under alternative 5 than under alternatives 1 and 2, but less than under the other alternatives. At the same time, greater use of snowcoaches would increase the cost to businesses that would be required to upgrade the existing snowmobile fleet to meet new requirements by December 2014.

Compared to alternative 1, alternative 5 is expected to bring beneficial, long-term impacts for all the communities, as seen in table 67. The larger beneficial impacts would only materialize if visitor demand for snowcoach tours increases, because over time snowmobiles would be phased out. The impact estimates in table 67 likely underestimate the beneficial impacts in the near term, because the impacts are based on an alternative from the 2007 EIS did not allow for a phase-out period, but switched directly to snowcoach-only trips. Tables 65 and 66 show a similar pattern for the three-state area and the five-county area.

Cumulative Impacts

The impacts of these past, present, and reasonably foreseeable future actions would be the same as under alternative 1. The impacts of these actions, combined with the long-term beneficial impacts of alternative 5, would result in long-term beneficial impacts (of which alternative 5 would contribute a large part) in the towns of Jackson, Cody, and West Yellowstone.

Conclusion

Compared to alternative 1, alternative 5 is expected to have on average beneficial, long-term impacts for all the communities, as seen in tables 65, 66 and 67. In order to generate larger beneficial impacts under this alternative, demand for snowcoach tours must increase to more than make up for the eventual phase-out of snowmobiles. Cumulative impacts would be long-term beneficial.

Impacts of Alternative 6: Implement Variable Management

Alternative 6 would allow for variable limits on snowmobiles and snowcoaches. Based on the visitation forecasts in table 64, alternative 6 has the highest lower bound estimate for visitation. Alternative 6 is the only alternative that allows for unguided snowmobile trips. Under this alternative, up to 25% of the snowmobiles could be for unguided commercial use. Given the popularity of unguided (or non-commercially guided) trips historically, it is expected that the daily limit for unguided trips would be reached regularly during the winter. The variable limits might also attract more visitors who want a non-motorized experience than alternatives with constant daily limits for motorized recreation. Similar to the other alternatives that allow snowcoach use in the park, businesses would have to bear the cost of upgrading the existing snowmobile fleet to meet new requirements by December 2014.

Compared to alternative 1, alternative 6 could provide beneficial long-term impacts for all the communities, with the possibility of larger beneficial impacts in West Yellowstone.

Cumulative Impacts

The impacts of these past, present, and reasonably foreseeable future actions would be the same as under alternative 1. The impacts of these actions combined with the long-term beneficial impacts of alternative 6, would result in long-term beneficial impacts (of which alternative 6 would contribute a large part) in the towns of Jackson, Cody, and West Yellowstone.

Conclusion

Compared to alternative 1, alternative 6 could provide beneficial, long-term impacts for all the communities, the three-state area, and the five-county area. West Yellowstone could experience larger, beneficial long-term impacts, on average, as reported in tables 65, 66 and 67. The larger beneficial impacts are more likely under this alternative compared to others because of the provision for unguided snowmobile trips, which were historically more popular. Cumulative impacts would be long-term beneficial.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Alternative 7 includes three sets of daily limits on snowmobiles and snowcoaches that would be in place during different times of the season to provide a variety of experiences. Based on the visitation forecasts shown in table 64, alternative 7 has the fourth highest upper bound visitation level (the same as alternative 5) and the second highest lower bound visitation level (the same as alternatives 2 and 3). The daily limits would be set in advance allowing visitors to plan their trips accordingly. The alternative allows for growth in visitation, while still providing opportunities for visiting the park in uncrowded conditions. Similar to the other alternatives that allow snowcoach use in the park, businesses would have to bear the cost of upgrading the existing snowmobile fleet to meet new requirements by December 2014. Compared to alternative 1, alternative 7 could provide beneficial long-term impacts for all the communities. The community-level impacts presented in table 67 are conservative estimates; based on visitation levels, the output and employment impacts are expected to fall between those of alternative 2 and alternative 5.

Cumulative Impacts

The impacts of these past, present, and reasonably foreseeable future actions would be the same as under alternative 1. The impacts of these actions combined with the long-term beneficial impacts of alternative 7, would result in long-term beneficial impacts (of which alternative 7 would contribute a large part) in the towns of Jackson, Cody, and West Yellowstone.

Conclusion

Compared to alternative 1, alternative 7 could provide beneficial, long-term impacts for the three-state area, the five-county area, and the three communities. West Yellowstone could reach larger, beneficial, long term impacts, on average, as reported in tables 65, 66 and 67. Cumulative impacts would be long-term beneficial.

PARK OPERATIONS AND MANAGEMENT

GUIDING REGULATIONS AND POLICIES

The NPS, park concessioners, contractors, researchers, and other duly permitted parties depend on snowmobiles and snowcoaches for their administrative functions. These uses of the park are not within the purpose and need, but are within the scope of analysis in this EIS because as shown in the analysis for some impact topics, such as soundscapes, winter operations have an effect. Likewise, these uses are not part of the decision to be made relative to this plan. When considering park operations, specifically winter operations, the following regulations and policies were taken into account:

- Executive Order 11644 (Use of Off-Road Vehicles on the Public Lands, section 2(3)(B) and (C))
- NPS *Management Policies 2006*, section 8.2.3
- February 17, 2004, memorandum from Assistant Secretary, Fish and Wildlife and Parks, to Director, NPS
- 36 CFR 1.2 (d)

In essence, because administrative use of OSVs can adversely impact park resources and values, it is to be limited to the level necessary for management of public use or to conduct emergency operations, construction, and resource protection activities that cannot be accomplished by other means.

ASSUMPTIONS, METHODOLOGY, AND INTENSITY DEFINITIONS

The topic of park management and operations, for the purpose of this analysis, refers to the quality and effectiveness of park staff to maintain and administer park resources and provide for an appropriate visitor experience during the winter season. The impact analysis is based on the current description of park operations presented in “Chapter 3: Affected Environment” of this document.

To assess the level of impact to winter operations for each alternative, the following were considered:

- NPS staffing requirements
- Available funding to implement the plan
- Operating environment and conditions.

The following are intensity definitions for evaluating impacts on park management and operations.

- Negligible:* Park operations would not be affected or the effect would be at or below the lower levels of detection and would not have an appreciable effect on park operations.
- Minor:* The effect would be detectable, but would be of a magnitude that would not have an appreciable effect on park operations. If changes are needed to offset adverse effects, they would be relatively simple and likely successful.
- Moderate:* The effects would be readily apparent and would result in a change in park operations in a manner noticeable to staff and the public. Changes would probably be necessary to offset adverse effects and would likely be successful.
- Major:* The effects would be readily apparent and would result in a change in park operations in a manner noticeable to staff and the public and would be markedly different from existing operations. Changes to offset adverse effects would be needed, would be extensive, and their success could not be guaranteed.

Assumptions

The cost of implementing the alternatives in this draft plan/EIS includes the operational costs that would occur if an alternative were implemented. This information can help the reader see the cost differences among the alternatives. For example, the cost of plowing versus grooming roads is illustrated. Similarly, the cost of conducting avalanche control, or not, is illustrated in the alternatives.

The costs in this analysis are not the total costs of operating the park in the winter. For example, utility costs (propane, oil, electricity, water, and sewer) are not included. Other costs related to the overall administration of the park (for example, contracting services, personnel services, safety services, budget and finance, and overall park management) are not included in the costs. Winter monitoring costs are also not included because the program would be similar across most alternatives (with the possible exception of alternative 1). The initial costs of implementing the alternatives are generally not included, except where a specific building would need to be built to implement an alternative.

Although the actual length of the winter season is typically 91 or 92 days, the cost assumptions include preparation time prior to the start of the winter season and are common across all alternatives.

Study Area

The study area for park operations is the boundaries of Yellowstone and areas where winter use occurs.

SUMMARY OF IMPACTS

- Alternative 1 would have long-term negligible adverse impacts to park operations because staffing and resource requirements would be covered by existing funding, as well as long-term benefits from the potential reallocation of staff to other areas of the park during the winter season. In addition, fuel requirements and green house gas emissions would be reduced from current

levels as the number of staff needed in the interior of the park, and therefore use of OSVs, would be reduced.

- Alternative 2 would result in long-term negligible to minor adverse impacts because the staffing and resource requirements would be similar to those currently funded, and this level of funding would be expected to continue. Any additional required resources may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations.
- Alternative 3 would result in long-term minor to moderate adverse impacts because the staffing and resource requirements would require additional funding that may or may not be available in the annual park budget. Any additional required resources may impact park operations and could be slightly noticeable to park staff and visitors as resources are reallocated from one part of the park to another.
- Alternative 4 would result in long-term negligible to minor adverse impacts to park operations and management because the staffing and resource requirements for implementation of the alternative would likely be met with existing funding sources. Additional requirements (one-time costs) of this alternative may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations.
- Alternative 5 would result in long-term negligible to minor adverse impacts to park operations and management because the staffing and resource requirements for implementation of the alternative would likely be met with existing funding sources. Additional requirements (one-time costs) of this alternative as well as the slight increase in funding required over current conditions may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations.
- Alternative 6 would result in long-term negligible to minor adverse impacts because the staffing and resource requirements would be similar to those currently funded (if not slightly lower), and this level of funding would be expected to continue. Any additional required resources may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations.
- Alternative 7 would result in long-term negligible to minor adverse impacts because the staffing and resource requirements would be similar to those currently funded (if not slightly lower), and this level of funding would be expected to continue. Any additional required resources may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations.

DETAILED IMPACT ANALYSIS

Impacts of Alternative 1: No Snowmobile/Snowcoach Use

Under alternative 1, OSV use would be limited to minimal administrative use. No recreational OSV use would be permitted in the park in the winter. With the minimal level of OSV use, the amount of staff resource and funding needed to implement winter management in the park would decrease from current levels, or levels that were required for the 2009/2010 and 2010/2011 winter seasons. To implement alternative 1, minimal winter keeper/caretaker staff would be needed at each developed area for operation of the housing, garage/office, water treatment plant, and the wastewater treatment plant. Winter upkeep would require staff time and the resources to house staff for the winter. Buildings in the interior of the park may need to be operational to allow concessionaires to carry out winter keeping of structures. In total, about 28 NPS staff would be needed in the park at different

developed areas to provide seven-day-per-week coverage and an adequate margin of safety under alternative 1. Grooming an access route between each developed area would occur as needed, approximately once per week. The south and east entrance roads would not be groomed.

Although many buildings in the interior of the park would be closed for the winter season under alternative 1, complete shutdown of some buildings, even if they are not being used (such as the newer visitor centers) may not be feasible due to the electronics and other systems that were not designed for total shutdown.

Table 68 details the costs associated with implementing alternative 1. In total, implementation of alternative 1 would cost about \$1,744,880 annually. Because no additional facilities would be needed to implement alternative 1, there would be no one-time costs associated with this alternative.

TABLE 68: APPROXIMATE COSTS OF IMPLEMENTING ALTERNATIVE 1

Activity	Cost
Groom Snow Roads	\$95,680
Plow Roads	\$0
Spring Opening	\$789,000
Snowmobile Maintenance	\$75,480
Tracked Vehicle Maintenance	\$50,000
Sylvan Pass Avalanche Management	\$0
NPS Staff	\$734,720
Sand Removal	\$0
Approximate Total	\$1,744,880

Costs under alternative 1 would be less than those currently funded, therefore ample funds and staff resources would be available for implementing this alternative. Because park operations would not be affected or the effect would be at or below the lower levels of detection, impacts to park operations and maintenance from the cost of implementing alternative 1 would be long-term negligible adverse. In terms of green house gas emissions and fuel consumption, as park staff would be reduced from a current level of 82 to 28, fuel requirements and associated emissions would be reduced. Long-term benefits would also occur as staff currently assigned to winter use activities in the park could be reassigned to other areas, taking additional burden off park staff and resources in other areas of the park.

Cumulative Impacts

Actions with the potential to impact park operations include the activities within the park that require additional time and resources from NPS staff during the winter months. These activities include past construction projects (the construction of a new West Entrance and of the East Entrance road) as well as the current and future operation of these projects. In addition to these construction projects, visitor activities occurring outside of the interior of the park would require staff time and resources. One example of this type of activity includes managing the park concessioners that operate lodging accommodations at Mammoth Hot Springs and provide other services such as evening programs, guided ski and snowshoe tours, wildlife tours, ski shop and repair center, massage therapy, hot tub rentals, and ice skating rinks. In addition, a yurt camp is available at Canyon, which is currently

operated by one of the park's snowcoach outfitters. NPS staff also provides ranger-led winter programs that offer insight into the history, culture, and geography of the park. Winter programs begin when the park opens for the winter season December 15 and end on March 15. All of these actions would require various levels of staff time and resources, however, the funds for these activities are part of annual funding cycles and would be accommodated with existing and expected budgets. If additional resources are needed for these activities, such as operating a new facility, they would be accommodated by existing funding or by the reallocation of existing staff. The impacts of these actions would have no to little effect on park operations, and if detectable, would not be of a magnitude that would not have an appreciable effect on park operations, resulting in long-term negligible to minor impacts.

The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible adverse impacts of alternative 1, would result in long-term negligible to minor adverse cumulative impacts on park operations and maintenance. Alternative 1 would contribute a large amount to these actions because the reduction in the need for OSV management during the winter season would impact a large portion of the park's budget during this time.

Conclusion

Alternative 1 would have long-term negligible adverse impacts to park operations because staffing and resource requirements would be covered by existing funding, as well as long-term benefits from the potential reallocation of staff to other areas of the park during the winter season. In addition, fuel requirements and green house gas emissions would be reduced from current levels because the number of staff needed in the interior of the park, and therefore OSV use, would be reduced. Cumulative impacts under alternative 1 would be long-term, negligible to minor adverse, of which alternative 1 would contribute a large part.

Impacts of Alternative 2: Continue Snowmobile/Snowcoach Use at 2008 Plan Limits

Alternative 2 would continue to allow for use levels permitted under the 2009 interim rule, which allows up to 318 snowmobiles per day and 78 snowcoaches. As a result, staffing levels needed under alternative 2 would be similar to those observed over the 2009/2010 and 2010/2011 winter seasons, and would represent the cost of park winter operations in recent years. Sylvan Pass would be open and avalanche control activities would continue. Eighty-two park employees would continue to remain duty stationed in interior locations, including the West Entrance, to execute winter management activities. One-third of their year would be allocated to the winter season (including preparation and post-season work). One-hundred twenty six snowmobiles are in the park's administrative fleet, along with 14 tracked vehicles and these OSVs would be expected to continue operating using fuel expenditures similar to those in the 2009 interim rule. As part of this management, the NPS would continue to transition to an almost an entirely leased fleet of snowmobiles. To further accommodate winter use activities in the park, the park would continue to groom 180 miles of snow roads, currently an average of every third day. Alternative 2 would also include constructing a new warming hut at Old Faithful. In terms of green house gas emissions and fuel consumption, park staff would be kept at levels similar to the 2009/2010 and 2010/2011 winter seasons, and would continue to consume approximately 23,000 gallons of bio-diesel and 14,000 gallons of ethanol over the winter season.

Table 69 details the costs associated with implementing alternative 2. Alternative 2 would cost \$3,967,350 to implement each year, plus the one-time cost (\$200,000) for a new warming hut at Old Faithful.

TABLE 69: APPROXIMATE COSTS OF IMPLEMENTING ALTERNATIVE 2

Activity	Cost
Groom Snow Roads	\$314,640
Plow Roads	\$0
Spring Opening	\$789,000
Snowmobile Maintenance	\$317,030
Tracked Vehicle Maintenance	\$70,000
Sylvan Pass Avalanche Management	\$325,000
NPS Staff	\$2,151,680
Sand Removal	\$0
Approximate Total	\$3,967,350

Because costs under alternative 2 would be similar to those currently funded for the past two winter seasons (2009/2010 and 2010/2011), it would be expected that the needed funds and staff resources would be available for implementing this alternative. Additional one-time costs could occur (such as establishment of a new warming hut at Old Faithful) that could require additional resources, but it is expected that the impacts from additional costs would have little to no effect on park management and operations. If an effect is detectable, it would not be of a magnitude that would have an appreciable effect on park operations. Therefore, under alternative 2 impacts to park operations and management would be long-term, negligible to minor adverse.

Cumulative Impacts

Impacts on park operations and management from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible to minor adverse impacts of alternative 2, would result in long-term negligible to minor adverse cumulative impacts, of which alternative 2 would contribute a large amount because winter use management activities constitute a large portion of the park's operating budget during the winter season.

Conclusion

Alternative 2 would result in long-term negligible to minor adverse impacts because the staffing and resource requirements would be similar to those currently funded, and this level of funding would be expected to continue. Any additional resources required may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations. Cumulative impacts under alternative 2 would be long-term negligible to minor adverse, of which alternative 2 would constitute a large part.

Impacts of Alternative 3: Return Snowmobile/Snowcoach Use to 2004 Plan Limits

Alternative 3 would allow for an increase in the number of OSVs allowed in the park compared to the 2009 interim rule. Winter use management under alternative 3 would allow for up to 720 snowmobiles and 78 snowcoaches per day in the park. The increase in the number of OSVs allowed per day would require a small increase in staff over the number of staff required for the 2009/2010 and 2010/2011

winter seasons. Similar to alternative 2, the operation of Sylvan Pass would continue, but the costs of operations would not increase over alternative 2. The use from additional OSVs would also require additional grooming activities; grooming would be expected to occur every other day. In order to carry out the winter use management activities required to implement alternative 3, approximately 90 NPS employees would be duty stationed in the interior of Yellowstone. In addition 90 snowmobiles and 16 tracked vehicles would be required for these staff. In terms of green house gas emissions and fuel consumption, park staff and the number of OSVs for them would be increased slightly over 2009/2010 and 2010/2011 winter seasons levels, and would therefore require a slight increase in fuel consumption and associated emissions.

Table 70 details the costs associated with implementing alternative 3. Alternative 3 would cost \$4,346,360 annually to implement, plus the \$200,000 cost for a new warming hut at Old Faithful.

TABLE 70: APPROXIMATE COSTS OF IMPLEMENTING ALTERNATIVE 3

Activity	Cost
Groom Snow Roads	\$463,680
Plow Roads	\$0
Spring Opening	\$789,000
Snowmobile Maintenance	\$327,080
Tracked Vehicle Maintenance	\$80,000
Sylvan Pass Avalanche Management	\$325,000
NPS Staff	\$2,361,600
Sand Removal	\$0
Approximate Total	\$4,346,360

With the increased level of use as compared with the past two winter seasons (2009/2010 and 2010/2011), additional funding of approximately \$380,000 would be required to implement alternative 3. Much of this funding is expected to be available from current sources, but the additional staff time and resources may need to be accomplished by reallocating resources from other areas of the park. Also, additional onetime costs could occur (such as establishment of a new warming hut at Old Faithful) that could require additional resources. Any changes to park operations from the additional funding needed under alternative 3 may be noticeable to the staff or the public, and resources may need to be moved from one part of the park to another in order to accommodate additional funding needed. However, even if noticeable, these changes are expected to be small, resulting in long-term minor to moderate adverse impacts to park operations and management under alternative 3.

Cumulative Impacts

Impacts on park operations and management from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term minor to moderate adverse impacts of alternative 3, would result in long-term minor to moderate adverse cumulative impacts, of which alternative 3 would contribute a large amount because winter use management activities constitute a large portion of the park's operating budget during the winter season.

Conclusion

Alternative 3 would result in long-term minor to moderate adverse impacts because the staffing and resource requirements would require additional funding that may or may not be available in the park's annual budget. Any additional resources required may impact park operations and could be slightly noticeable to park staff and visitors when resources are allocated from one part of the park to another. Cumulative impacts under alternative 3 would be long-term minor to moderate adverse, of which alternative 3 would constitute a large part.

Impacts of Alternative 4: Mixed-Use: Snowcoaches, Snowmobiles, and Road Plowing for Wheeled Vehicles

Alternative 4 provides for a different variety of winter use experiences than those currently offered at the park. This alternative would provide for a lower level of OSV use than occurred during the past two winter seasons (2009/2010 and 2010/2011). This alternative would also reduce the amount of road that requires grooming for OSVs but would add additional visitation opportunities including commercial wheeled vehicle access that would increase the overall visitor access to the park in the winter season. In addition to expenses for park staff operations and OSVs (including maintenance, fuel, and grooming), alternative 4 would also require the use of park resources for road plowing, sand removal, and additional structures such as a sand and vehicle storage shed. Alternative 4 would also include the closure of Sylvan Pass, and therefore would not include any costs associated with management in this area during the winter season.

Under alternative 4, 78 employees would be required and 70 park OSVs. There would be a slight reduction in the amount of required grooming (a decrease in 65 miles throughout the park), staff at the east entrance and throughout the park, and park OSVs needed over current levels due to the reduced number of OSVs permitted in the park. However, much of this cost savings would be offset by the requirements for road plowing and sand removal for spring opening. In terms of green house gas emissions and fuel consumption, park staff and the number of OSVs for them, as well as the addition of commercial wheeled vehicles, would be increased slightly over 2009/2010 and 2010/2011 winter seasons levels, and would therefore require a slight increase in fuel consumption and associated emissions.

Table 71 details the costs associated with implementing alternative 4. Alternative 4 would cost about \$3,415,334 to implement, plus \$850,000 for new warming huts at Old Faithful and Norris and a sand and vehicle storage building at the west entrance.

TABLE 71: APPROXIMATE COSTS OF IMPLEMENTING ALTERNATIVE 4

Activity	Cost
Groom Snow Roads	\$171,304
Plow Roads	\$457,240
Spring Opening	\$531,310
Snowmobile Maintenance	\$150,960
Tracked Vehicle Maintenance	\$50,000
Sylvan Pass Avalanche Management	\$0
NPS Staff	\$2,046,720
Sand Removal	\$7,800
Approximate Total	\$3,415,334

Costs for implementing alternative 4 would be slightly less than funding for the past two winter seasons (2009/2010 and 2010/2011). It would be expected that the needed funds and staff resources would be available for implementing this alternative. Additional one-time costs could occur, such as establishment of a new warming hut at Old Faithful as well as a sand and vehicle storage facility. These one-time costs could require additional resources, but it is expected that the impacts from additional costs would have little to no effect on park management and operations. If detectable, these costs would not be of a magnitude that would have an appreciable effect on park operations. Therefore, impacts under alternative 4 to park operations and management would be long-term, negligible to minor adverse.

Cumulative Impacts

Impacts on park operations and management from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible to minor adverse impacts of alternative 4, would result in long-term negligible to minor adverse cumulative impacts, of which alternative 4 would contribute a large amount because winter use management activities constitute a large portion of the park's operating budget during the winter season.

Conclusion

Alternative 4 would result in long-term negligible to minor adverse impacts to park operations and management because the staffing and resource requirements for implementation of the alternative would likely be met with existing funding sources. Additional requirements (one-time costs) of this alternative may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations. Cumulative impacts under alternative 4 would be long-term negligible to minor adverse, of which alternative 4 would constitute a large part.

Impacts of Alternative 5: Transition to Snowcoaches meeting BAT Requirements Only

Alternative 5 would transition OSV use in the park to BAT snowcoaches starting in the 2014/2015 season. Snowcoach limits would increase with demand and snowmobile limits would be reduced during a five-year phase-out. Until the phase-out begins, alternative 5 would have impacts similar to

alternative 2. Because alternative 5 would ultimately allow for about 40 additional snowcoaches per day, more visitors could be accommodated under alternative 5 than under alternatives 1 and 2, but less than under the other alternatives. Although the total number of OSVs in the park would be reduced, the number and location of routes would stay the same as currently permitted, and grooming requirements would likely increase to every other day because snowcoaches cause more rutting and damage to snow roads than snowmobile use.

Under alternative 5, approximately 82 employees would be required for winter use management activities in the interior of the park, the same number as under the 2009 interim rule. Due to the decrease in the overall number of OSVs permitted, the administrative fleet for the park would be slightly reduced from current levels (2009/2010 and 2010/2011 winter season) to approximately 100 snowmobiles, with a slight increase in tracked vehicles to 20. Sylvan Pass would be open and avalanche control activities would continue.

In terms of green house gas emissions and fuel consumption, park staff and the number of OSVs to support them would be similar to funding required for the 2009/2010 and 2010/2011 winter seasons, and would therefore not result in a large increase in fuel consumption and associated emissions.

Table 72 details the costs associated with implementing alternative 5. Alternative 5 would cost \$4,080,960 when fully implemented, plus \$200,000 for a new warming hut at Old Faithful.

TABLE 72: APPROXIMATE COSTS OF IMPLEMENTING ALTERNATIVE 5

Activity	Cost
Groom Snow Roads	\$463,680
Plow Roads	\$0
Spring Opening	\$789,000
Snowmobile Maintenance	\$251,600
Tracked Vehicle Maintenance	\$100,000
Sylvan Pass Avalanche Management	\$325,000
NPS Staff	\$2,151,680
Sand Removal	\$0
Approximate Total	\$4,080,960

Cost for implementing alternative 5 would be slightly more (by approximately \$113,000) than funding for the past two winter seasons (2009/2010 and 2010/2011), but it would be expected that the needed funds and staff resources would be available for implementing this alternative. Additional one-time costs could occur (such as establishment of a new warming hut at Old Faithful) that could require additional resources. It is expected that the impacts from additional costs would have little to no effect on park management and operations. If detectable, it would not be of a magnitude that would have an appreciable effect on park operations. Therefore, impacts under alternative 5 to park operations and management would be long-term, negligible to minor adverse.

Cumulative Impacts

Impacts on park operations and management from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The impacts of these past, present, and

reasonably foreseeable future actions, combined with the long-term negligible to minor adverse impacts of alternative 5, would result in long-term negligible to minor adverse cumulative impacts, of which alternative 5 would contribute a large amount because winter use management activities would constitute a large portion of the park's operating budget during the winter season.

Conclusion

Alternative 5 would result in long-term negligible to minor adverse impacts to park operations and management because the staffing and resource requirements for implementation of the alternative would likely be met with existing funding sources. Additional requirements (one-time costs) of this alternative as well as the slight increase in funding required over current conditions may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations. Cumulative impacts under alternative 5 would be long-term negligible to minor adverse, of which alternative 5 would constitute a large part.

Impacts of Alternative 6: Implement Variable Management

Alternative 6 would allow for variable limits on snowmobiles and snowcoaches, as well as up to 25% of unguided or non-commercially guided use. Although use limits under alternative 6 may reach levels higher than currently permitted on some days, the variation in use would also allow for days of lower use. With this variation, on the whole, staffing and OSV requirements under alternative 6 would be the same as under alternative 2. However, alternative 6 provides for closure of the east side of the park during the last two weeks of the season, slightly reducing grooming requirements on 60 miles of road during this time. In addition, under alternative 6, the operation of Sylvan Pass would continue and a new warming hut would be established at Old Faithful, similar to alternative 2. In terms of greenhouse gas emissions and fuel consumption, park staff levels would be similar to the 2009/2010 and 2010/2011 winter seasons, and would continue to consume approximately 23,000 gallons of bio-diesel and 14,000 gallons of ethanol over the winter season.

Table 73 details the costs associated with implementing alternative 6. Alternative 6 would cost \$3,953,550 to implement plus an additional \$200,000 for a new warming hut at Old Faithful.

TABLE 73: APPROXIMATE COSTS OF IMPLEMENTING ALTERNATIVE 6

Activity	Cost
Groom Snow Roads	\$300,840
Plow Roads	\$0
Spring Opening	\$789,000
Snowmobile Maintenance	\$317,030
Tracked Vehicle Maintenance	\$70,000
Sylvan Pass Avalanche Management	\$325,000
NPS Staff	\$2,151,680
Sand Removal	\$0
Approximate Total	\$3,953,550

Costs under alternative 6 would be similar, if not slightly less due to decreased plowing requirements, to those currently funded for the past two winter seasons (2009/2010 and 2010/2011). Therefore, it would be expected that the needed funds and staff resources would be available for implementing this alternative. Additional one-time costs could occur, such as establishment of a new warming hut at Old Faithful, that could require additional resources. But it is expected that the impacts from additional costs would have little to no effect on park management and operations, and if an effect is detectable, would not be of a magnitude that would have an appreciable effect on park operations. Therefore, impacts under alternative 6 to park operations and management would be long-term, negligible to minor adverse.

Cumulative Impacts

Impacts on park operations and management from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible to minor adverse impacts of alternative 6, would result in long-term negligible to minor adverse cumulative impacts, of which alternative 6 would contribute a large amount because winter use management activities constitute a large portion of the park's operating budget during the winter season.

Conclusion

Alternative 6 would result in long-term negligible to minor adverse impacts because the staffing and resource requirements would be similar to those currently funded (if not slightly lower), and this level of funding expected to continue. Any additional resources required may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations. Cumulative impacts under alternative 6 would be long-term negligible to minor adverse, of which alternative 6 would constitute a large part.

Impacts of Alternative 7: Provide a Variety of Use Levels and Experiences for Visitors (NPS Preferred Alternative)

Similar to alternative 6, alternative 7 would allow for variable limits on snowmobiles and snowcoaches. Use limits and the number of OSVs in the park would be similar to or less than the number of OSVs during the 2009/2010 and 2010/2011 winter seasons, depending on the use level that particular day. With this variation, on the whole, staffing and OSV requirements under alternative 7 would be the same as under alternative 2. However, alternative 7 provides for closure of the east side of the park during the last two weeks of the season, slightly reducing grooming requirements on 60 miles of road during this time. In addition, under alternative 7, the operation of Sylvan Pass would continue and a new warming hut would be established at Old Faithful, similar to alternative 2. In terms of green house gas emissions and fuel consumption, park staff levels would be similar to the 2009/2010 and 2010/2011 winter seasons, and would continue to consume approximately 23,000 gallons of bio-diesel and 14,000 gallons of ethanol over the winter season.

Table 74 details the costs associated with implementing alternative 7. Alternative 7 is expected to cost \$3,953,550 per year to implement, plus \$200,000 for a new warming hut at Old Faithful.

TABLE 74: APPROXIMATE COSTS OF IMPLEMENTING ALTERNATIVE 7

Activity	Cost
Groom Snow Roads	\$300,840
Plow Roads	\$0
Spring Opening	\$789,000
Snowmobile Maintenance	\$317,030
Tracked Vehicle Maintenance	\$70,000
Sylvan Pass Avalanche Management	\$325,000
NPS Staff	\$2,151,680
Sand Removal	\$0
Approximate Total	\$3,953,5500

Costs under alternative 7 would be similar (if not slightly less due to decreased plowing requirements) to funding for the 2009/2010 and 2010/2011 winter seasons. Therefore, it would be expected that the needed funds and staff resources would be available for implementing this alternative. Additional one-time costs could occur, such as establishment of a new warming hut at Old Faithful, that could require additional resources, but it is expected that the impacts from additional costs would have little to no effect on park management and operations. If an effect is detectable, it would not be of a magnitude that would have an appreciable effect on park operations. Therefore, impacts under alternative 7 to park operations and management would be long-term, negligible to minor adverse.

Cumulative Impacts

Impacts on park operations and management from other past, present, and reasonably foreseeable future actions would be the same as described for alternative 1. The impacts of these past, present, and reasonably foreseeable future actions, combined with the long-term negligible to minor adverse impacts of alternative 7, would result in long-term negligible to minor adverse cumulative impacts, of which alternative 7 would contribute a large amount because winter use management activities constitute a large portion of the park's operating budget during the winter season.

Conclusion

Alternative 7 would result in long-term negligible to minor adverse impacts because the staffing and resource requirements would be similar to current funding (if not slightly lower), and this level of funding would be expected to continue. Any additional resources required may impact park operations, but through other funding sources or reallocation of resources, would not have a noticeable impact on park operations. Cumulative impacts under alternative 7 would be long-term negligible to minor adverse, of which alternative 7 would constitute a large part.

Consultation and Coordination



CHAPTER 5: CONSULTATION AND COORDINATION

Yellowstone National Park staff place a high priority on meeting the intent of public involvement in the National Environmental Policy Act (NEPA) process and providing the public an opportunity to comment on proposed actions. As part of the National Park Service (NPS) NEPA process, issues associated with the plan/EIS were identified during scoping meetings with NPS staff (including the Inter-disciplinary Team, coordination with other affected agencies, public meetings, and public comment). For this project, an Inter-disciplinary Team, also called the Project Team, consisted of members from the park, region, and Washington Office. The purpose of the Project Team is to provide a framework for shared decision-making.

This chapter describes the consultation that occurred during development of this Winter Use Plan and Environmental Impact Statement (plan/EIS), including consultation with stakeholders and other agencies. This chapter also includes a description of the public involvement process and a list of the recipients of the draft document.

THE SCOPING PROCESS

The NPS divides the scoping process into two parts: internal scoping and external public scoping. Internal scoping involved discussions among NPS personnel regarding the purpose of and need for management actions, issues, potential management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics.

Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that people are given an opportunity to comment and contribute early in the decision-making process. For this plan/EIS, project information was distributed to individuals, agencies, and organizations early in the scoping process, and people were given a variety of opportunities to express concerns or views and identify important issues or even other alternatives or alternative elements.

Taken together, internal and public scoping are essential elements of the NEPA planning process. The following sections describe the various ways scoping was conducted for this project.

INTERNAL SCOPING

Internal scoping for the plan/EIS was held December 16–18, 2009, to discuss the development of a plan/EIS with staff members from the park, Department of the Interior, NPS Environmental Quality Division, NPS Intermountain Region, and NPS Air Resources Division. This group is collectively referred to as the Project Team. Contractor personnel assisted in facilitating the internal scoping meetings and public scoping meetings. During the three-day internal scoping meeting, the NPS identified the purpose of and need for action, management objectives, issues, and impact topics. The Project Team also discussed possible alternative elements, cumulative impacts, and strategies for public involvement throughout the process.

The Project Team coordinated with technical experts during the planning process and established a Science Advisory Team to provide input to this plan. Comprised of subject matter experts, the Science Advisory Team was chartered to advise and provide technical recommendations to the NPS on matters regarding scientific data and analysis. The team met periodically, providing technical background information and research references for this plan/EIS. Science Advisory Team participants included

individuals with scientific background in the fields of air quality, acoustic resources, wildlife biologists, and social scientists. The Science Advisory Team wrote a report that summarized available scientific information related to the effects of winter use at the park, identified key findings, quantitative methods of assessing the potential effects of winter use, and proposed future research to help address questions that could not be resolved. This report, the Scientific Assessment of Yellowstone National Park Winter Use, is available at the Yellowstone Winter Use website at <http://www.nps.gov/yell/planyourvisit/winteruse.htm> and the PEPC website at <http://parkplanning.nps.gov/yell>.

PUBLIC SCOPING

Public scoping began on January 29, 2010, with the release of the public scoping brochure and Federal Register publication of the Notice of Intent to prepare an environmental impact statement (75 FR 4842-4843). The Notice of Intent summarized the history of winter use management at the park, discussed the purpose and need of the plan/EIS, addressed the focus of the alternatives, listed the project website, and announced the upcoming public scoping meetings. The park posted the public scoping newsletter on the NPS Planning, Environment, and Public Comment (PEPC) website at <http://parkplanning.nps.gov/yell>, sent copies of the newsletter to a list of park stakeholders, and issued a news release inviting the public to comment at the scoping meetings.

The public was invited to submit comments on the scope of the planning process and potential alternative elements from January 29, 2010, through March 30, 2010. During this time, the park received more than 9,000 documents commenting on the scope of the plan/EIS. Generally, these comments focused on how the alternative concepts presented could be improved or suggested new elements to be considered. Many comments focused on the potential impact on local communities associated with limiting or changing winter use at the park. Additionally, many comments were received about the experience the visitor would have depending on changes in winter use. Comments were also received that expressed concern for wildlife and their habitat with the use of OSVs in the park. Public comments recommended incorporating additional tours and programs at the park and implementing a fee or permit system for OSV use. Comments indicated the use of OSVs either contributed to or detracted from visitor experiences at the park. A full summary and analysis of the public comments received can be found at <http://parkplanning.nps.gov/yell>.

During the scoping period, six public scoping open houses were held at the following locations:

- Hilton Garden Inn in Idaho Falls, Idaho on February 16, 2010
- Hilton Garden Inn in Billings, Montana on February 18, 2010
- Little America Hotel in Cheyenne, Wyoming on March 15, 2010
- Old Post Office Pavilion in Washington, D.C. on March 17, 2010
- Cody Club Room of the Cody Auditorium in Cody, Wyoming on March 22, 2010
- West Yellowstone Visitor Information Center meeting room in West Yellowstone, Montana on March 24, 2010.

The meetings offered a variety of methods for the public to provide comments. NPS personnel and contractor staff were present at each display to answer questions from attendees and record attendees' comments. Members of the public were given the opportunity to ask questions following a presentation given by the park. Comment sheets were provided to meeting attendees as an additional method for accepting public comments. Park staff were on hand to answer questions and provide additional information to open house participants. To keep the public involved and informed throughout the

planning process, individuals were given the option to receive notification of the availability of the draft range of alternatives and draft plan/EIS documents.

During the scoping period, the park received comments on the purpose, need, objectives, and suggestions for alternatives that should be considered in this draft plan/EIS and incorporated these suggestions into a range of draft alternatives. All together, more than 9,000 letters and web submissions were received. These draft alternatives were provided to the public through a newsletter that was mailed and emailed to the park's mailing list for winter use. The public was given an opportunity to ask questions related to the draft range of alternative through a series of web and phone based meetings. On August 3 and 5, 2010, the park held two one-hour webinars to explain the draft of range of alternatives and to answer questions about them. Additionally on August 4, 2010, the park hosted a one-hour telephone conference call, which allowed for individuals who did not have computer access to participate in the process.

COOPERATING AGENCIES

In January 2010, the NPS sent invitations to federal and state agencies involved in past winter use planning efforts, inviting them to become cooperating agencies for this winter use planning process. The following entities responded that they would serve as cooperating agencies for this effort: the U.S. Environmental Protection Agency; State of Idaho; State of Montana; State of Wyoming; Fremont County, Idaho; Gallatin County, Montana; Park County, Montana; Park County, Wyoming; and Teton County, Wyoming. The U.S. Forest Service and U.S. Fish and Wildlife Service declined the invitation to be cooperating agencies.

As a cooperating agency, most entities signed a Memorandum of Understanding to define the role of each party in the process, including providing technical data and reviews. In addition to the roles stated in the Memorandum of Understanding, the cooperating agencies met during the planning process to provide the NPS information. These meetings included the following:

- In-person meeting, February 18, 2010, Billings, Montana. During this meeting, cooperating agency members were introduced to the planning process and asked to provide input on the purpose, need, and objectives of the plan. Cooperating agency members were also asked to identify issues they felt should be considered in this planning process.
- Teleconference, August 9, 2010. During this teleconference, cooperating agencies were given the opportunity to provide input on the draft range of alternatives. They were also asked to provide any data that had not yet been shared that they felt should be considered in the plan/EIS.

LIST OF RECIPIENTS

The agencies, organizations, and businesses listed below were notified of the availability of the draft plan/EIS. This document was also mailed to other entities and individuals who requested a copy.

CONGRESSIONAL DELEGATES

- Raúl Labrador, Idaho, U.S. House of Representatives
- Michael K. Simpson, Idaho, U.S. House of Representatives
- Mike Crapo, Idaho, U.S. Senate
- James Risch, Idaho, U.S. Senate
- Denny Rehberg, Montana, U.S. House of Representatives

- Jon Tester, Montana, U.S. Senate
- Max Baucus, Montana, U.S. Senate
- John Barrasso, Wyoming Senator
- Mike Enzi, Wyoming Senator
- Cynthia Lummis, Wyoming U.S. House of Representative

NATIONAL PARK SERVICE

- Big Hole National Battlefield
- Glacier National Park
- Grand Teton National Park
- Grant-Kohrs Ranch NHS
- Little Bighorn Battlefield NM

U.S. FOREST SERVICE

- Beaverhead National Forest
- Bridger-Teton National Forest
- Custer National Forest
- Gallatin National Forest
- Shoshone National Forest
- Targhee National Forest

ENVIRONMENTAL PROTECTION AGENCY

- Region 8 – Denver

U.S. ARMY CORPS OF ENGINEERS

U.S. FISH AND WILDLIFE SERVICE

WESTERN FEDERAL LANDS HIGHWAY DIVISION

STATE OF IDAHO

- C.L. “Butch” Otter, Governor of Idaho
- Idaho Department of Commerce
- Idaho Department of Parks and Recreation
- Idaho Fish and Game Department
- Idaho State Historic Preservation Office
- Freemont County, Idaho, Commissioners

STATE OF MONTANA

- Brian Schweitzer, Governor of Montana
- Montana Department of Commerce
- Montana Department of Fish Wildlife and Parks
- Montana Intergovernment Review Clearinghouse
- Town of West Yellowstone
- Gallatin County, Montana, Commissioners
- Park County, Montana, Commissioners

STATE OF WYOMING

- Matt Mead, Governor of Wyoming
- Wyoming Department of Environmental Quality
- Wyoming Department of Transportation
- Wyoming Game and Fish Department
- Wyoming Office of Federal Land Policy
- Wyoming State Clearinghouse
- Wyoming State Historic Preservation Office
- Wyoming State Lands and Investments
- Wyoming Travel Commission
- Park County, Wyoming, Commissioners
- Teton County, Wyoming, Commissioners
- Teton County Certified Local Government

AMERICAN INDIAN TRIBES

Yellowstone's 26 Associated Indian Tribes:

- Assiniboine & Sioux Tribes
- Blackfeet Tribe
- Cheyenne River Sioux Tribe
- Coeur d'Alene Tribe
- Comanche Tribe of Oklahoma
- Confederated Tribes of the Colville Reservation
- Confederated Tribes of the Umatilla Reservation
- Confederated Salish & Kootenai Tribes
- Crow Tribe

- Crow Creek Sioux Tribe
- Eastern Shoshone Tribe
- Flandreau Santee Sioux Tribe
- Gros Ventre and Assiniboine Tribes
- Kiowa Tribe of Oklahoma
- Lower Brule Sioux Tribe
- Nez Perce Tribe
- Northern Arapaho Tribe
- Northern Cheyenne Tribe
- Oglala Sioux Tribe
- Rosebud Sioux Tribe
- Shoshone-Bannock Tribes
- Sisseton-Wahpeton Sioux Tribe
- Spirit Lake Sioux Tribe
- Standing Rock Sioux Tribe
- Turtle Mountain Band of the Chippewa Indians
- Yankton Sioux Tribe

LIBRARIES

- Billings, Montana Public Library
- Bozeman, Montana Public Library
- Cody, Wyoming Public Library
- Jackson, Wyoming Public Library
- West Yellowstone, Montana, Public Library
- Wyoming State Library
- Yellowstone National Park Research Library

OTHER ORGANIZATIONS AND BUSINESSES

- Alliance for Wild Rockies
- American Fisheries Society
- American Wildlands
- Animal Welfare Institute
- Bear Creek Council
- Beartooth Alliance

- Billings Chamber of Commerce
- Bluewater Network
- Bozeman Area Chamber of Commerce
- Buffalo Bill Historical Center
- Center for Urban Affairs
- Cheyenne High Plains Audubon
- Citizens for Teton Valley
- Coalition of National Park Service Retirees
- Cody Chamber of Commerce
- Cooke City/Silver Gate Chamber of Commerce
- Defenders of the Rockies
- Defenders of Wildlife
- Fremont County Audubon Society
- Fund for Animals
- Gardiner Chamber of Commerce
- Great Bear Foundation
- Greater Yellowstone Coalition
- Delaware North, Inc.
- Humane Society of the United States
- Idaho Falls Chamber of Commerce
- Idaho Wildlife Federation
- Jackson Hole Alliance for Responsible Planning
- Jackson Hole Chamber of Commerce
- Lander Chamber of Commerce
- Livingston Chamber of Commerce
- Montana Audubon Council
- Montana State Preservation Office
- Montana State University
- Montana Wildlife Federation
- National Audubon Society
- National Parks Conservation Association
- National Wildlife Federation
- Natural Resource Conservation Service – Bozeman and Cody

- Nature Conservancy – Idaho Chapter
- Nature Conservancy – Montana Chapter
- Nature Conservancy – Wyoming Chapter
- Northern Plains Resource Council
- Northern Rockies Conservation Cooperative
- Northwestern University
- Park County Environmental Council
- Pinedale Chamber of Commerce
- Red Lodge Chamber of Commerce
- Riverton Chamber of Commerce
- Sacajawea Audubon Society
- Sierra Club Idaho Chapter
- Sierra Club Northern Plains Regional Office
- Sierra Club Teton Group
- Sierra Club Utah Chapter
- Snake River Audubon Society
- Star Valley Development Association
- Stone Fly Society
- Teton County Historic Preservation Board
- University of Colorado
- University of Wyoming
- Upper Missouri Breaks Audubon Society
- Utah Audubon Society
- Utah Wilderness Association
- Utah Wildlife Federation
- West Yellowstone Chamber of Commerce
- Wild Forever
- Wilderness Society
- Wyoming Association of Professional Historians
- Wyoming Heritage Society
- Wyoming Hospitality and Retail Network
- Wyoming Outdoor Council
- Wyoming Wildlife Federation

- Xanterra Parks and Resorts
- Yellowstone Association
- Yellowstone Park Foundation
- Yellowstone Valley Audubon Society

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GLOSSARY

adaptive management—A system of management practices based on clearly identified outcomes, monitoring to determine if management actions are meeting outcomes, and, if not, facilitating management changes that will best ensure that outcomes are met or to re-evaluate the outcomes. Adaptive management recognizes that knowledge about natural resource systems is sometimes uncertain and is the preferred method of management in these cases (source: Departmental Manual 516 DM 4.16).

alternatives—Sets of management elements that represent a range of options for how, or whether to proceed with a proposed action. An environmental assessment or environmental impact statement analyzes the potential environmental impacts of the range of alternatives, as required under National Environmental Policy Act (NEPA).

Best Available Technology (BAT)—BAT is a term applied with regulations on limiting pollutant discharges with regard to abatement strategy.

buffer—A protective area or distance surrounding a sensitive resource that limits visitor access.

cumulative effect or impact—The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.6).

ecology—The pattern of relations between organisms and their environment.

environmental consequences—Environmental effects of project alternatives, including the proposed action, any adverse environmental effects which cannot be avoided, the relationship between short term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented (40 CFR 1502.16).

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

Federal Register—Published by the Office of the Federal Register, National Archives and Records Administration (NARA), the Federal Register is the official daily publication for rules, proposed rules, and notices of federal agencies and organizations, as well as executive orders and other presidential documents (<http://www.gpoaccess.gov/fr/>).

federally listed endangered species—An endangered species is one that is in danger of extinction throughout all or a significant portion of its range. Before a species can receive protection under the ESA, it must first be placed on the federal list of endangered species. All actions leading up to and including listing of a species as endangered are published in the Federal Register (USFWS Endangered Species Program).

habitat—The environment in which a plant or animal lives (includes vegetation, soil, water, and other factors).

habituation—the psychological process in humans and other organisms in which there is a decrease in psychological and behavioral response to a stimulus after repeated exposure to that stimulus over a

duration of time. In some instances, apparent habituation could also mean an animal is under physiological stress and would, under healthy circumstances, respond to the threat.

IMPLAN—An economic impact assessment modeling system that allows the user to build economic models to estimate the impacts of economic changes.

mitigation—“Mitigation” as defined in the National Environmental Policy Act (40 CFR 1508.20), includes: avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action and its Implementation; rectifying the impact of repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; compensating for the impact by replacing or providing substitute resources or environments.

monitoring—A process of collecting information to evaluate if an objective and/or anticipated or assumed results of a management plan are being realized (effectiveness monitoring) or if implementation is proceeding as planned (implementation monitoring).

planning—An interdisciplinary process for developing short- and long-term goals and alternatives for visitor experience, resource conditions, projects, facility type and placement, and other proposed actions.

population (or species population)—A group of individual plants or animals that have common characteristics and interbreed among themselves and not with other similar groups.

preferred alternative—The alternative in an EA or EIS that the agency believes would best fulfill the purpose and need for action.

scoping—An early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

soundscape (natural)—The aggregate of all the natural, nonhuman-caused sounds that occur in parks, together with the physical capacity for transmitting natural sounds.

threatened or endangered species—Plants or animals that receive special protection under federal or state laws, including the Endangered Species Act. Species may be listed threatened or endangered in the state, but not by the federal government (USFWS), or vice versa. Some USFWS regional offices also maintain a list of those species of special concern, either nationally or locally, which may be being or may have been previously considered for listing as threatened or endangered.

threatened species—Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

ungulate—A hoofed, typically herbivorous, animal; includes deer, elk, and bison.

visitor experience—The perceptions, feelings, reactions, and activities of a park visitor in relationship to the surrounding environment.

visitor use—The types of recreation activities engaged in by visitors, including the type of activity, visitor behavior, timing, and distribution of use.

visitor—In this plan, anyone who physically visits a park for recreational, educational or scientific purposes, or who otherwise uses a park’s interpretive and educational services.

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Appendices



APPENDIX A: ADAPTIVE MANAGEMENT AND POTENTIAL FUTURE STUDIES

ADAPTIVE MANAGEMENT AND POTENTIAL FUTURE STUDIES

This appendix describes the winter use plan's adaptive management framework and some potential future studies that illustrate the types of information that may be useful for developing changes in future winter use management.

ADAPTIVE MANAGEMENT

Adaptive management recognizes that there are uncertainties surrounding the management of natural systems and helps natural resource managers respond to resource or system conditions through time and the collection and evaluation of additional information. Knowing uncertainties exist provides managers the ability to consider them in their planning and the latitude to change direction when deemed necessary. Adaptive management improves manager's understanding of ecological systems to better achieve management objectives and suggest changes in action to improve progress towards desired outcomes.

The emphasis in an adaptive approach is first and foremost on resource management. The value of understanding, and the monitoring and analysis that produce understanding, is inherited from their contributions to the objectives of resource management. Although the focus is on learning, the ultimate goal of the effort is smart management. It is important to recognize that adaptive management is a complex endeavor that includes much more than simply following a sequence of steps. Properly executed, the process involves ongoing, real-time learning, both in a technical sense and in terms of process itself. Stakeholders need to be engaged at the stage of initial problem formulation and remain engaged throughout implementation (Williams et al. 2007).

ACTIVE VERSUS PASSIVE ADAPTIVE MANAGEMENT

There are two different forms of adaptive management which results in different approaches to addressing uncertainty in natural resource management. Active adaptive management focuses on the learning aspect through a "management by experiment" approach where specific experiments are carried out to better understand the resource response and reduce uncertainty. Passive adaptive management also recognizes that there is uncertainty in natural resource management; however, the focus is on achieving prescribed management objectives. Learning and the reduction of uncertainty is also a component of passive adaptive management, but it is more of a by-product of the process. (Williams et al. 2007). The adaptive management framework described for the winter use plan is a passive adaptive management approach.

ADAPTIVE MANAGEMENT PROCESS

Adaptive management is a continuing iterative process where the problem is first assessed, potential management actions are designed and implemented, those actions and resource responses are monitored over time, that data is evaluated, and actions are adjusted if necessary to better achieve desired management outcomes (See figure A-1).

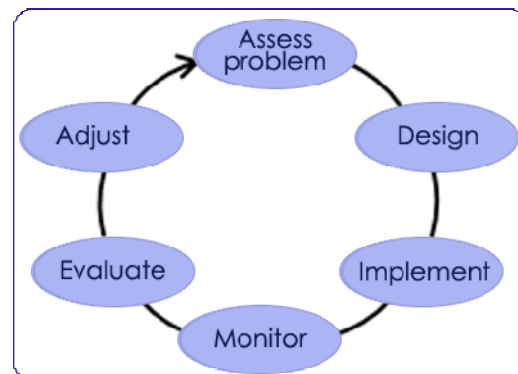


Diagram from Williams et al. 2007.

FIGURE A-1. GENERAL ADAPTIVE MANAGEMENT PROCESS

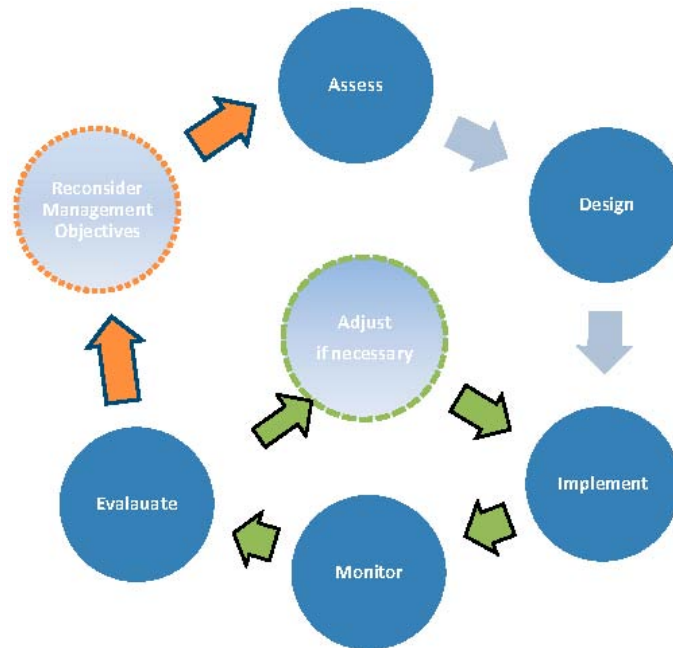
Williams identifies nine steps in adaptive management. These steps can be categorized into two phases: the set-up phase and the iterative phase.

Set-Up Phase	Iterative Phase
1. Stakeholder Involvement	6. Decision Making
2. Objectives	7. Follow-up Monitoring
3. Management Actions / Alternatives	8. Assessment
4. Models	9. Iteration
5. Monitoring Plans	

The set-up phase includes the “Assess the Problem” and “Design” portion of figure X above while the iterative phase includes “Implement,” “Monitor,” “Evaluate,” and “Adjust.”

Through this and previous winter planning processes, steps 1-5 of the Set-up phase have been completed, though could be revisited in the future. The Record of Decision is step 6 in her Iterative phase.

Adaptive management plan is different from monitoring in that it allows park managers to act when information exists about a specific resource but there is still some level of uncertainty. A key step in adaptive management is to develop and implement a management scenario (preferred alternative) based on the best available information. As part of this adaptive management planning process, management objectives were developed. In addition, metrics were established for each affected resource in terms of impact intensity definitions. These objectives and metrics were established to help a manager understand the results of a monitoring program and as guides for taking future actions if a problem is perceived. Failure maintain or achieve an objective does not mean that the actions being taken are resulting in unacceptable results. In fact, it could provide managers an insight when conditions may be moving away from those that are desirable or that the original objectives need to be revised (double-loop learning). For this reason, adaptive management objectives could be adjusted in the future, based on monitoring information, research, stakeholder input, and best professional judgment (See figure A-2).



The green arrows indicate the single loop learning where actions are *Implemented*, conditions are *Monitored*, data is *Evaluated*, and actions are *Adjusted* (if necessary) or continue to be *implemented*. Double loop learning is based on the concept that upon data being *Evaluated* there is a determination to *Reconsider Management Objectives*, this results in initiating the *Assess* and *Design* stages of the adaptive management cycle.

FIGURE A-2. AN ILLUSTRATION OF SINGLE LOOP AND DOUBLE LOOP LEARNING INHERENT IN AN ADAPTIVE MANAGEMENT APPROACH

After taking a management action, the next step is to implement a monitoring program. Monitoring is a critical step in the process, as it focuses on collecting data that can be used to evaluate the response of the system or resource to the implemented management action. This evaluation plays a vital role within the framework of adaptive management because of the level of uncertainty in initial predictions. Managers then review results of the evaluation program and determine whether to maintain the implemented management action, adjust management actions to better meet objectives, or revisit original objectives.

This winter use plan recognizes that there is a certain amount of uncertainty in how specific resources will respond or be affected by the implementation of an alternative. An adaptive management approach will help decrease the level of uncertainty and adjust actions as necessary based on responses or effects and the Park's overall objectives. The affected resources that will be monitored over time include wildlife and wildlife habitat, air quality, soundscapes, health and safety, and visitor use and experience.

Park personnel will monitor those resources described above during the winter use season in terms of how they are affected by the implementation of the preferred alternative and provide that information to Park management to evaluate on a monthly basis. This information would be compared with how the resources were expected to be affected by the preferred alternative. In addition to information related to resource response to OSV use levels, the Park will also consider the totality of information that would have bearing on the resources including such environmental and other factors such as overall winter severity, weather impacts, motorized and non-motorized use patterns, among others.

If based on the evaluation of the monitoring data, Park management determines that an OSV use change is necessary, it would implement some type of response action. These potential management response options are those future actions that the Park may consider taking in order to better achieve or maintain

objectives. These management options or subsequent actions are described generally in order to illustrate the types of actions that may be taken and understand the types of potential impacts associated with those actions. These management options or actions could include requiring new low-emission technologies, adjusting the number of daily vehicle entries permitted, establishing timed-entry requirements, requiring new low-sound technologies, closing certain areas to OSV use, adjusting the duration of the winter use season, and increasing recreational and educational opportunities for other visitors, among others options.

It is expected that full implementation of the preferred alternative would not be realized for up to four winter seasons. In addition, once the preferred alternative is fully implemented it would likely require several (3-4) winter seasons in order to adequately determine if the objectives are being met or if there is a positive trend to suggest they will be met fully in the future. Some potential response action would occur in the interim in order to avoid unpredicted effect given OSV use and environmental and other conditions. The identification of negative trends may suggest the need to implement a management response option. No change in condition would suggest either that the amount of time has not been sufficient to measure a change in conditions or the action is one that will not result in a change. In this situation, the Park may consider adjusting the action through the implementation of a response options or continuing to monitor the resources for additional winter seasons.

Once it is determined that a subsequent action is necessary and desirable to better achieve plan objectives, an analysis will be conducted to determine what if any additional environmental processes may be required under NEPA. Some actions may be implemented quickly, as they are within the scope of the preferred alternative and their impacts have been adequately assessed. Some non-emergency actions, such as designating a new route for oversnow vehicle travel, may require additional site-specific NEPA analysis, which includes public involvement. This NEPA analysis could take several different forms including a tiered Environmental Assessment and corresponding Finding of No New Significant Impacts if those impacts have been adequately evaluated in the overarching EIS (43 CFR 46.140). Other actions might be administrative in nature or could be implemented through application of a categorical exclusion under NEPA.

The adaptive management framework will ensure the park's obligation to preserve resources and values in an acceptable condition, while allowing for winter use of the park.

POTENTIAL FUTURE STUDIES

As part of the process of developing this EIS, a group of scientists and managers were convened to determine the types of information that may prove useful in informing the long term management of resources at Yellowstone National Park, including those prevalent during the OSV winter use period. The implementation of any of the studies described below would be subject to available funding and prioritized based on the Park's need. The list of studies listed below is not exhaustive but rather illustrative of the types of studies that may be suggested.

As additional baseline information is gathered and analyzed, these studies may be used in the future to modify the adaptive management framework described above including the development of adaptive management objectives, monitoring methods, and potential management responses. These studies are listed and described below in terms of soundscapes, wildlife, and visitor use and experience; however, the scientific study of other resources would also likely be informative.

SOUNDSCAPES (ACOUSTIC RESOURCES)

- Assess methods for understanding the duration of peak noise levels.
- Evaluate the two noise models being used to better understand their application when predicting the spatial and temporal extent of audible OSV noise.

WILDLIFE

- Investigate cumulative effects of winter use on wildlife habitat selection, rates of movements, time budgets, and levels of activity.
- Investigate the winter availability of forage for ungulates and implications of variable use for plant communities considering OSV use.
- Investigate distribution, abundance, probabilities of occupancy, and detection rates of park wildlife where current knowledge is lacking.
- Continue to understand bison use of winter roads through implementation of studies, such as “Evaluating Key Uncertainties Regarding Road Grooming and Bison Movements” (Garrot and White 2007).

SOCIAL SCIENCE

- Investigate visitor and/or local displacement during the winter use periods.
- Assess the potential for social and economic impacts from Yellowstone winter use management in areas surrounding the park.

AIR QUALITY

- Assess effects of changes to snowmobile and snowcoach technology on OSV air emissions.

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APPENDIX B: DRAFT AIR QUALITY MODELING REPORT SNOWMOBILE AND SNOWCOACH EMISSIONS

DRAFT
AIR QUALITY MODELING REPORT
SNOWMOBILE AND SNOWCOACH EMISSIONS

WINTER USE PLAN
Environmental Impact Statement

YELLOWSTONE NATIONAL PARK

Prepared for

NATIONAL PARK SERVICE
12795 West Alameda Parkway
Lakewood, Colorado 80225-0287

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Air Quality Modeling Report
Winter Use Plan Environmental Impact Statement
Yellowstone National Park

1.0 Introduction and Background

In support of the Winter Use Plan Draft Environmental Impact Statement (DEIS) for Yellowstone National Park (Yellowstone), Air Resource Specialists, Inc. (ARS) completed an analysis of potential air quality impacts from snowmobile and snowcoach operations. This report analyzes potential air quality impacts for several alternatives utilizing air dispersion modeling and other accepted methods and models. Motorized over-snow vehicle (OSV) vehicle entry limits and other details for each of the alternatives were provided by NPS to ARS and are discussed in Section 3.0 and Attachment A.

This air quality study is part of the National Park Service's (NPS) efforts to complete a long-term analysis of the environmental impacts of winter use in the parks. At present, the NPS is operating under the current interim rule governing OSV use for a limited period. This rule is in effect through the winter of 2010-11.

Within Yellowstone, all snowmobiles must also meet Best Available Technology (BAT) requirements. The assessment of alternatives analyzed in this study is based on implementation of the associated entry limits and BAT requirements under consideration in the PDEIS, and beginning during the winter season of 2011-2012, which determines emissions factors.

For this air quality study of OSV emissions in Yellowstone, maximum predicted ambient concentrations of carbon monoxide (CO), nitrogen dioxide (NO₂), and particulate matter (PM₁₀ and PM_{2.5}) were calculated using U.S. Environmental Protection Agency (EPA) approved air quality models. Impacts for each alternative were assessed with respect to the National Ambient Air Quality Standards (NAAQS). Modeling results were also compared to Prevention of Significant Deterioration (PSD) increments for particulate matter, and potential visibility impacts for each alternative were assessed. Winter-season emission estimates for criteria pollutants (CO, PM, and nitrogen oxides (NO_x)), hydrocarbons (HC), and hazardous air pollutants (HAPs) (benzene, 1,3 butadiene, formaldehyde, and acetaldehyde) were calculated. The methodology employed for this study is discussed in the following sections.

2.0 Regulatory Overview

Yellowstone is classified as a Class I area under the Federal Clean Air Act. This air quality classification is to provide protection against air quality degradation in national parks and wilderness areas. The Clean Air Act defines mandatory Class I areas as national parks over 6,000 acres, wilderness areas over 5,000 acres, and national memorial parks over 5,000 acres designated as of the date of the Act.

For this study, dispersion modeling was utilized to predict concentrations of CO, nitrogen dioxide (NO₂), and particulates (PM₁₀ and PM_{2.5}) for a short-term localized basis at specific locations in the parks. These predicted concentrations were assessed with respect to the NAAQS, which are discussed below, to determine the potential for air quality impacts. In addition, an emission inventory was completed for the four (4) pollutants discussed below to assess regional OSV emissions during the winter season. Also, as a Class I area, an analysis of potential visibility impacts resulting from OSV emissions was conducted for four (4) areas. The methodology and results of this visibility analysis are presented in Section 8.0.

In 2002, EPA adopted new standards for new non-road engines, including snowmobiles, which were previously unregulated. As a significant source of air pollution, newly manufactured non-road engines will need to meet exhaust emission standards. For snowmobiles, the new HC and CO standards began to take effect for the 2006 model year, with a 50 percent phase-in requirement. Further details on these standards are provided below in Section 4.0.

2.1 Pollutants

Carbon monoxide (CO), a colorless, odorless, and poisonous gas, is produced in locations with motor vehicles, primarily by the incomplete combustion of gasoline and other fossil fuels. Health effects include impairment of the central nervous system, particularly on people with heart disease. CO also interferes with the transport of oxygen in the blood. In the vicinity of roadways, the majority, if not all, CO emissions are from motor vehicles. CO concentrations can vary greatly over relatively short distances. Elevated concentrations are usually limited to locations near crowded intersections, typically along heavily traveled and congested roadways.

Consequently, CO concentrations must be predicted on a localized or microscale basis. Elevated traffic volumes of snowmobiles and snowcoaches on certain park roadways could result in localized increases in CO levels. Therefore, the mobile source analysis evaluated CO concentrations from snowmobiles and snowcoaches at several modeling locations within the park.

Particulate matter (PM₁₀ and PM_{2.5}) is emitted into the atmosphere from a variety of sources: industrial facilities, power plants, construction activity, etc. Gasoline powered vehicles typically do not produce any significant quantities of particulate emissions. Although less relevant to this study, diesel-powered vehicles, especially heavy trucks and buses, also emit particulates, and particulate concentrations may be locally elevated near roadways with high volumes of heavy diesel-powered vehicles. The mobile source analysis evaluated particulate (PM₁₀ and PM_{2.5}) concentrations from snowmobiles, snowcoaches, and diesel buses (for one alternative) at several modeling locations within the park.

Hydrocarbon (HC) emissions from motor vehicles can result from partially-burned fuel emitted through the tailpipe and from fuel evaporations from the crankcase, carburetor and gas tank. Hydrocarbons are also released from gasoline fuel vapor when vehicles are re-fueled at gas stations and when bulk storage tanks are refilled. When

exposed to sunlight, hydrocarbons or volatile organic compounds (VOCs) contribute to formation of harmful ground level ozone, also known as smog. For the purposes of this study, hydrocarbons may also be expressed as VOCs, which include air toxins or hazardous air pollutants (HAPs). Within the park, these pollutants are of primary concern due to their potential serious health effects on NPS workers and visitors.

Air toxins or HAPs associated with motor vehicles also result from fuel evaporation and the fuel-burning process. These pollutants include a variety of chemicals known to cause cancer, poisoning and other ailments. The emission inventory completed for this study included hydrocarbon emissions as well as the following HAPs: benzene; 1,3 butadiene; formaldehyde; and acetaldehyde.

Nitrogen oxides (NO_x), are typically of principal concern because of their role as precursors in the formation of photochemical oxidants, such as ozone. Ozone is formed through a series of reactions that take place in the atmosphere in the presence of sunlight. However, ozone is not an issue in the parks in the winter, although NO_x also contributes to atmospheric particles, and can cause respiratory problems and visibility impairment. NO_x emissions from mobile sources and the pollutants formed from NO_x can be transported over long distances, so they are generally examined on a regional basis and are assessed in the emission inventory component of this study. However, on a localized basis, the mobile source analysis evaluated NO_2 concentrations from snowmobiles and snowcoaches at several modeling locations within the park, for comparison to the 1-hour NAAQS.

2.2 Air Quality Standards

As required by the Clean Air Act and its amendments, the Environmental Protection Agency has established primary and secondary National Ambient Air Quality Standards (NAAQS) for six major air pollutants: CO, NO_2 , ozone, particulate matter (PM_{10} and $\text{PM}_{2.5}$), SO_2 , and lead. The NAAQS of primary concern for this analysis (CO, NO_2 , PM_{10} and $\text{PM}_{2.5}$) are shown in Table 2-1.

The primary standards protect public health, and represent levels at which there are no known significant effects on human health. The secondary standards are intended to protect the nation's welfare, and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the environment. For CO, NO_2 , PM_{10} and $\text{PM}_{2.5}$, the primary and secondary standards are the same.

Impacts for each alternative were assessed with respect to the NAAQS and relative to current and historical conditions. For Wyoming, Montana, and Idaho, the applicable state standards for CO, NO_2 , and particulates are the same as the federal standards, with the exception of the 1-hour CO standard in Montana, which is 23 ppm.

Since Yellowstone is classified as Federal Class I area, PM_{10} increment comparison under PSD was also assessed. PSD increments are the maximum permitted increases in pollutant concentrations over baseline levels. For Class I areas, the PM_{10} PSD increments are 4 and 8 micrograms per cubic meter, for the annual and 24-hour

Table 2-1
National Ambient Air Quality Standards

Pollutant	Primary		Secondary	
	PPM	Micrograms Per Cubic Meter	PPM	Micrograms Per Cubic Meter
Carbon Monoxide (CO)				
Maximum 8-Hour Concentration ¹	9		None	
Maximum 1-Hour Concentration ¹	35			
Nitrogen Dioxide (NO₂)				
Annual Arithmetic Mean	0.053		Same as Primary	
Maximum 1-Hour Concentration ²	0.100			
Respirable Particulates (PM₁₀)				
Maximum 24-Hour Concentration ³		150	Same as Primary	
Respirable Particulates (PM_{2.5})				
Annual Arithmetic Mean ⁴		15	Same as Primary	
Maximum 24-Hour Concentration ⁵		35		
Notes: ¹ Not to be exceeded more than once per year. ² To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010). ³ Not to be exceeded more than once per year on average over 3 years. ⁴ To attain this standard, the 3-year average of the weighted annual mean PM _{2.5} concentrations from single or multiple community-oriented monitors must not exceed 15.0 ug/m ³ . ⁵ To attain this standard, the 3-year average of the 98 th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 ug/m ³ . PPM = parts per million				
Source: 40 CFR Part 50—National Primary and Secondary Ambient Air Quality Standards				

averaging periods, respectively. Winter OSV emissions were considered increment consuming or contributing sources for this analysis. This study only assessed PSD increments for the 24-hour averaging period, since the sources of concern are only present during the winter season and an applicable annual average cannot be prepared. This assessment is a screening level approach and may indicate that a detailed analysis is required if concentrations are near the PM₁₀ PSD increments. Furthermore, as the methodology employed in this study is a screening-level analysis, it is not intended for regulatory purposes and does not constitute a regulatory PSD increment consumption analysis.

2.3 Air Quality Monitoring

In recent years, ARS has been contracted by NPS to conduct winter air quality monitoring in Yellowstone near the Old Faithful geyser. Meteorological, gaseous, and particulate variables were monitored continuously.

The most recent monitored CO and PM_{2.5} concentrations at these locations can be found in the *Data Transmittal Report for the Yellowstone National Park Winter Use Air*

Quality Study December 15, 2009 - March 15, 2010, Air Resource Specialists, July 2010. The highest CO 1- and 8-hour averages were 2.5 and 0.8 ppm, respectively, at the Old Faithful monitor for 2009-2010. These were well below the respective 1- and 8-hour CO NAAQS (35 and 9 ppm), Montana and Wyoming air quality standards. Similarly, the highest PM_{2.5} 24-hour average in 2009-2010 was 5.1 micrograms per cubic meter at the Old Faithful monitor, which was well below the PM_{2.5} NAAQS of 35 micrograms per cubic meter for the 24-hour averaging period.

Since monitoring began in 1998 for CO and in 2002 for PM_{2.5} at Yellowstone, measured pollutant concentrations have steadily decreased, consistent with the decrease in number of snowmobile visits and the recent snowmobile technology emission requirements under the temporary plan. As documented in the *Winter Air Quality Study 2004-2005*, John D. Ray, Ph.D., NPS Air Resources Division, December 2005, at the West Entrance, the highest measured 8-hour average CO concentrations have gone from a near NAAQS exceedance of 8.9 ppm in the 1998-1999 winter season to 1.0 ppm in 2004-2005. At Old Faithful, the highest measured 8-hour average CO concentrations have declined from 1.2 ppm in the 2002-2003 winter season to 0.8 ppm in 2009-2010.

Similarly, the highest measured 24-hour average PM_{2.5} concentrations at Old Faithful have declined from 32.1 micrograms per cubic meter in the 2002-2003 winter season to 5.1 micrograms per cubic meter in 2009-2010. These monitored maximum values demonstrate a distinct trend of improvement in winter pollutant concentrations in Yellowstone.

3.0 Alternatives

OSV entry limits and other details of the alternatives required as inputs for the air quality modeling and emission inventory were provided by the National Park Service (NPS). Descriptions of the six (6) alternatives are provided in Table 8, Summary of Alternative Elements, of Chapter 2 of the DEIS. In addition, distribution factors spreadsheets are included as Attachment A of this report. Although the methods used to develop the alternatives and general assumptions are discussed in detail in Chapter 2 of the DEIS, a summary of the development of modeling scenarios analyzed in this study follows.

The development of a model to distribute use within the park, based on the entrance limits specified under each alternative, is necessary in order to understand the impacts of the alternatives on park resources and values. These models, called travel factors, were developed in the past for the Temporary Winter Use EA and the 2007 Plan/EIS. The scenarios attempt to predict the total amount of daily winter recreational (motorized) traffic on each road segment within Yellowstone, by vehicle type.

The scenarios provide both a sense of how much snowmobile or snowcoach traffic one can expect in a day on each road segment within the parks and a comparison of the relative differences among the alternatives. This approach facilitates an understanding of the magnitude of differences of the environmental consequences of each alternative. The alternatives also provide fundamental air quality inputs to the modeling analyses.

4.0 Mobile Source Modeling

Estimates of maximum concentrations for pollutant averaging periods were prepared to compare with the national ambient air quality standards (which are based on 1- and 8-hour averages for CO concentrations, 1-hour averages for NO₂ concentrations, and 24-hour averages for particulate concentrations). The prediction of CO, NO₂, PM₁₀ and PM_{2.5} concentrations generated by over-snow vehicles takes into account emissions data, meteorological phenomena, vehicle traffic/travel conditions, and physical configurations (of roadways and staging areas). The mathematical formulations that comprise the dispersion and emission models attempt to simulate the extremely complex physical phenomenon as closely as possible. Although most dispersion models are typically conservative, especially under adverse meteorological conditions, the results of the modeling below compared with monitored concentrations show predicted concentrations within the reasonable in range of possibility, considering that all models must employ approximations of actual conditions.

The analysis employs a modeling approach widely used for evaluating air quality impacts throughout the country. This approach was coupled with a series of conservative assumptions for meteorology, traffic conditions, background concentration levels, etc. This combination results in conservative, yet realistic, estimates of expected pollutant concentrations and resulting potential impacts to air quality from the winter use vehicle emissions.

4.1 Dispersion Modeling

Air dispersion modeling analyses were conducted for emissions of CO, NO₂, PM₁₀, and PM_{2.5} employing EPA's CAL3QHCR and AERMOD models. The models and modeling inputs, parameters, and assumptions, along with emission factors are discussed in detail below.

4.1.1 CAL3QHCR

At the entrance stations and roadways selected for study, analysis was performed using EPA's CAL3QHCR model (*Addendum to the User's Guide to CAL3QHC, A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections*, Office of Air Quality, Planning Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina). The CAL3QHCR model is an enhanced, but separate, version of CAL3QHC, which is based on the CALINE-3 line source dispersion model, with an additional algorithm for estimating vehicle queue lengths at signalized intersections. It is a Gaussian model utilized for predicting CO and PM concentrations along roadway segments and assumes the dispersion of pollutants downwind of a pollution source along a Gaussian (or normal) distribution. The pollution source is the emissions from motorized vehicles operating under free flow conditions. CAL3QHCR processes up to a year of meteorological data, vehicle emissions and traffic data using algorithms from CAL3QHC.

For this analysis, CAL3QHCR was run using the Tier II approach, with detailed data reflecting traffic conditions for each hour of the day and week. In addition to maximum hourly averages, CAL3QHCR is able to calculate running 8-hour averaged CO or 24-hour averaged PM concentrations. Similar to CAL3QHC, CAL3QHCR also provides the refinement of including the contribution of emissions from idling vehicles in the overall concentration. The model's queuing algorithm requires additional input for local traffic parameters, such as signal timing, and performs delay calculations to estimate the number of idling vehicles. In this study, locations with snowmobiles and snowcoaches stopping and idling were simulated with the characteristics of a signalized intersection for CAL3QHCR modeling.

4.1.2 AERMOD

Air pollutant concentrations from emissions at the snowmobile staging areas were evaluated with the AERMOD, developed by EPA. All modeling was performed using BEE-Line Software's BEEST suite, which integrates AERMOD (Version 09292), ISC, and related programs (AERMET, AERMAP, BPIP, etc.) into a graphical user interface. Since vehicles in the staging area are clustered (in the parking lots), the AERMOD model was selected, utilizing its area source dispersion modeling capabilities. All AERMOD technical options selected followed the *regulatory default option*.

Model inputs also specified rural conditions for dispersion coefficients and other variables. Terrain data for the park was obtained from United States Geological Survey (USGS) using The National Map Seamless Server website. Coordinates for the modeled area were input into a coordinate search in the National Map, in order to zoom into the site and 1-Arc Second National Elevation Dataset (NED) terrain files were downloaded as a Tagged Image File Format (TIFF) file for an area big enough to encompass the area to be modeled area.

4.2 Modeling Locations

Four (4) locations in the park were selected for air quality modeling because they were expected to generate the most elevated ambient air quality impacts associated with snowmobile and snowcoach operations, due to expected vehicle traffic levels. These locations (shown on Figure 4-1) are: Site 1, The West Entrance; Site 2, West Entrance to Madison Junction; Site 3, Canyon to Fishing Bridge; and Site 4, Old Faithful Staging Area. At the roadway modeling locations, multiple ground-level receptors (computer simulations of roadside locations) were modeled for CAL3QHCR along the approach and departure links at spaced intervals, outside of the mixing zone, the area of uniform emissions and turbulence. The receptor with the highest predicted concentration was used to represent each modeling site for each alternative.

Figure 4-1



Site 1: West Entrance

The West Entrance is a unique location for modeling as snowmobiles and snowcoaches approach the entrance station and then stop for a short time while entrance permits are checked. Vehicles experience delay and queuing traffic conditions. In addition, this location is in close proximity to West Yellowstone, MT. Modeling was performed based on an average “low speed” approach and departure and an average engine idle time of 30 seconds at each kiosk. The approach and departure paths of the vehicles were simulated by line sources or “links”, up to 1,000 feet in each direction from the West Entrance. CAL3QHCR modeling was performed for this intersection-type location.

At the West Entrance modeling location, receptors were spaced oppositely in each direction out from a central receptor placed at the origin of the queuing links, with receptors placed in pairs on each side of the links. Receptors were placed 3 feet both east and west (lengthwise) of the central receptor; the next pair of receptors were placed 25 feet from the central receptor. The remaining receptors were placed at intervals of 25 feet out to a distance of 500 feet along the link.

Site 2: West Entrance to Madison

For many of the alternatives, this modeling location is expected to have the highest traffic volumes compared to other roadway segments in Yellowstone. This is expected to result in elevated emissions and associated impacts from snowmobile and snowcoach traffic. CAL3QHCR modeling was performed for the free-flow roadway segments of this location, employing emissions data for OSVs traveling at “cruise” speeds (see discussion of modes below). In winter, the speed limit for this road segment is 35 mph, whereas the limit is 45 mph for most of the park. As discussed above, vehicle traffic levels were based on the proposed entry limits in the winter use plan for each alternative.

For the West Entrance to Madison location, receptors were spaced along 2000 feet of the straight portions of the links. For the middle section of this modeling location, a gradual curve in the roadway geometry could result in potential overlapping emission contributions from roadway link segments at some modeling wind directions. Therefore, along these links, receptors were placed in pairs at intervals of 5, 25, 25, 50, 200, 200, 1500, and 1500 feet in both directions from the central receptors at the apex of the curve. As at the West Entrance, receptors were placed in pairs on each side of the links.

Site 3: Canyon to Fishing Bridge

This modeling location is expected to have moderate traffic volumes compared to other roadway segments in Yellowstone and is expected to result in lower emissions and associated impacts. CAL3QHCR modeling was performed for the free-flow roadway segments of this location, employing emissions data for snowmobiles and snowcoaches traveling at “cruise” speeds. As discussed above, vehicle traffic levels were based on the proposed entry limits for each alternative. For this location, receptors were placed in pairs on each side of the modeling roadway at intervals of 100 feet in both directions.

Site 4: Old Faithful Staging Area

The Old Faithful staging area was selected for modeling because of the concentration of emissions from snowmobiles and snowcoaches bringing visitors to the Old Faithful Geyser Basin and parking area. The primary contributor of emissions is the idling of engines after visitors enter and also prior to leaving these staging areas.

At the staging areas, emissions are clustered in distinct areas (the parking lots). Therefore, the AERMOD model was selected for area source modeling. Emissions at the staging area were calculated only for engine idling, which is assumed to be a total of five minutes on average for each vehicle, including during arrival and before departure. Engine emission calculations for the staging area did not explicitly include ingress and egress emissions from the vehicles, as these were included in the roadway segment emissions. It was conservatively assumed that all vehicles traveling from Madison and West Thumb to Old Faithful would enter the Old Faithful staging area, to maximize the number of vehicles included in the modeling for this site.

The Old Faithful staging area, including the three (3) main parking areas, was modeled as a 630 meter by 1037 meter rectangular area source for AERMOD modeling, aligned north-south. These dimensions were confirmed by Yellowstone staff.

At the staging areas, a grid network of receptors was modeled for AERMOD along the perimeters of the area sources representing idling vehicles. Receptors were arranged in rectangular grids surrounding the Old Faithful staging area. At Old Faithful, receptors were placed at 100 meter intervals around the perimeter of the staging area out to approximately 1.5 kilometers in both the east and west directions, and out to approximately 2.0 kilometers in both the north and south directions.

4.3 Vehicle Emissions Data

To predict ambient concentrations of pollutants generated by vehicular traffic, emissions from vehicle exhaust systems must be estimated accurately. This analysis focuses primarily on emissions associated with visitor use of OSVs within the park, however, administrative vehicles are also included in the modeling. In addition, alternative 4 would also provide guided visitor access by on-road vehicles, by plowing Yellowstone's west-side roadways.

Emissions data and vehicle usage data (discussed below) were used for atmospheric dispersion modeling analyses to calculate the ambient levels of CO, NO₂, PM₁₀ and PM_{2.5} at four (4) locations within the park, for the alternatives. Emissions data will also be utilized to predict the total winter-season emissions of CO, PM, NO_x, HC, and HAPs from the operation of OSVs in the park. The data to be employed for this analysis were obtained from past air quality and emissions testing, research studies, as well as from vehicle manufacturers. Snowmobile laboratory test data utilized may not reflect actual operating conditions in Yellowstone, as high altitude and low winter temperatures in the parks are likely to decrease overall snowmobile engine performance and increase relative emissions. However, this data may be the best available.

For most alternatives, the analysis assumed that all snowmobiles are 4-stroke engines meeting NPS Best Available Technology (BAT) requirements. Current BAT for snowmobiles operating in Yellowstone has been established for CO and HC emissions, at less than 120 and 15 grams per kilowatt hour, respectively. BAT requirements are shown in Table 4-1.

Table 4-1
Snowmobile BAT Requirements and EPA Standards

	Emission Requirement or Standard		Phase-in*
	Hydrocarbons (HC) (g/KW-hr)	Carbon Monoxide (CO) (g/KW-hr)	
NPS BAT	15	120	-
EPA Emission Standards			
Model Year			
2006	100	275	50%
2007-2009	100	275	100%
2010	75	275	100%
2012	75	200	100%
Note: * Percent of newly manufactured sleds for the model year that must meet the applicable requirement.			

In addition, EPA adopted new standards for new non-road engines in 2002. For snowmobiles, the new standards will begin to take effect for the 2006 model year, with a 50 percent phase-in requirement. These standards and the corresponding implementation years are also provided in Table 4-1.

Composite emission factors for each alternative were calculated by weighting the snowmobile and snowcoach emission factors appropriate for each particular alternative according to usage levels of each vehicle type. These composite emission factors (weighted averages) were inputted to the CAL3QHC modeling.

4.3.1 4-Stroke Snowmobile Emission Factors

4-stroke snowmobile emission factors for CO, NO_x and HC used this analysis were calculated based on testing performed in the University of Denver's *Portable Emission Measurements of Snowmobiles and Snowcoaches in Yellowstone National Park*, Gary A. Bishop, Ryan Stadtmuller, and Donald H. Stedman, January 2007. This study collected in-use measurements of emissions from two snowmobiles (2006 Arctic Cat T660 Touring and a 2004 Ski Doo Legend GT) operating in Yellowstone during January and February of 2006, using a remote sensing device.

Particulate emission factors for 4-stroke snowmobiles were not measured in the above study, and were determined from manufacturers' EPA certification modal emission testing and engine performance results, following standard EPA test procedures, for the

BAT-approved snowmobile engines of two different manufacturers (Arctic Cat T660 Touring and Polaris Frontier), in SwRI's *Laboratory Testing of Snowmobile Emissions*, Lela and White, July 2002. The average 4-stroke snowmobile emission factors based on these data are shown in Table 4-2.

Table 4-2
Snowmobile Emission Factors

	PM			CO			HC			NO _x		
	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)
BAT 4- Stroke snowmobiles	0.49	0.065	0.031	201.6	37.0	14.0	7.7	1.7	1.0	1.2	4.0	4.5

4.3.2 Snowcoach Emission Factors

Snowcoach emission factors for this analysis were also obtained from the University of Denver's *Portable Emission Measurements of Snowmobiles and Snowcoaches in Yellowstone National Park*, reference in the section above. This study measured emissions from ten (10) snowcoaches operating in Yellowstone during January and February of 2006. This data provides the most comprehensive collection of emissions data from in-use snowcoaches to date. These studies, along with others, show that the vehicle operating conditions (altitude, temperature, terrain, vehicle operator, etc.) can greatly affect snowcoach emission factors.

A summary of the idle and traveling (low speeds of less than 15 mph and cruise speeds of 15 to 35 mph) emissions is shown in Table 4-3, representing gas and diesel BAT emissions, along the "current conditions" non-BAT gas emission for modeling purposes.

All alternatives assume implementation of a snowcoach BAT requirement based on EPA Tier 2 light-duty vehicle emission standards. Separate requirements would also need to be developed for heavy-duty/diesel snowcoaches, possibly based on EPA's Heavy-duty Diesel regulation. Future snowcoach BAT requirements are likely to only require the vehicles employ the related technologies associated with these EPA emission standards, rather than meet the actual standards themselves, as snowcoaches operate in conditions very different from their on-road counterparts.

For modeling purposes, gas snowcoach BAT emission factors were determined by the average of emission factors of the port fuel-injected gas snowcoaches tested in the University of Denver study. "Current conditions" non-BAT gas snowcoach emission factors were determined by a 50/50 average of the one carbureted gas snowcoach tested and the average of the newer port fuel-injected gas snowcoaches. Since only one diesel snowcoach was tested, its emission factors represented both diesel BAT and "current conditions" for diesel snowcoach BAT. All alternatives assume a 50/50 split of gas to diesel BAT snowcoaches for modeling purposes, except for alternative 5a, which

assumes an 83/17 split of “current conditions” gas snowcoaches to diesel snowcoaches. Snowcoach emission calculations are provided in Attachment C.

Table 4-3
Snowcoach Emission Factors for Modeling

	PM			CO			HC			NO _x		
	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)
BAT Gas Snowcoaches	0.07	0.03	0.03	42.4	27.2	107.4	11.2	1.3	1.4	2.1	3.8	5.8
BAT Diesel Snowcoaches*	0.11	0.40	0.30	14.0	24.0	5.7	4.9	1.4	0.8	43.2	50.5	30.0
Current Condition Gas Snowcoaches**	0.07	0.03	0.03	741.2	133.6	208.7	29.0	3.7	2.3	1.2	19.4	20.9
Note: Gas snowcoach PM and diesel snowcoach HC emissions from MOBILE6. * Diesel emissions measured only from NPS Bus. **Gas non-carbureted (port fuel-injected) snowcoaches averaged 50/50 with carbureted snowcoach tested. Source: <i>Portable Emission Measurements of Snowmobiles and Snowcoaches in Yellowstone National Park</i> , Bishop, Stadtmuller, and Stedman, University of Denver.												

4.3.3 On-road Vehicle Emission Factors

For the analysis of Alternative 4, which includes plowing of Yellowstone’s west-side roads, on-road (wheeled) vehicular emissions (CO, PM, NO_x and HC) were necessary. Emission factor estimates were computed using the EPA-developed Mobile Source Emissions Model (MOBILE6) for up to five (5) classes of motor vehicles: light-duty, gasoline-powered trucks (LDGT3 and LDGT4); heavy-duty, gasoline-powered trucks (HDGV); heavy-duty, diesel vehicles (HDDV); gasoline buses (HDGB); and diesel buses (HDDBT). The types of on-road vehicles in the fleet for this alternative would be limited since all vehicle entry would be commercially guided. The vehicle mix for this analysis was estimated to be one third of each of the following vehicle types: suburban/large passenger truck or similar; 12-15 person vans/small buses or similar light-duty trucks; and large, heavy-duty buses (30-40 feet in length).

MOBILE6 emission factors were prepared to account for high altitude, no Inspection and Maintenance (I&M) programs, conventional gasoline, and current winter inputs such as temperature (0° to 30° Fahrenheit), fuel parameters, etc. (e.g., fuel volatility). NPS provided vehicle classification data, and national default vehicle age distributions were used. Emission factors for on-road vehicles were determined for idle conditions and the same low and cruise speeds as modeled for OSVs, representing slower winter conditions traveling speeds.

Emission estimates typically account for three possible vehicle operating conditions: cold vehicle operation, hot start operation, and hot stabilized operation. It is

important to distinguish between these three operating categories, because vehicles emit pollutants at different rates depending on whether they are cold or warmed up. Since local data are not available, MOBILE6 defaults were employed for operating conditions. Composite emission factors for modeling on-road vehicles were determined based on the vehicle mix estimated above and are shown in Table 4-4. MOBILE6 input and output files are included as Attachment D. In addition, particulate emission factors for Alternative 4 on-road vehicle travel on paved roads (plowed) were determined using EPA's *AP-42 Section 13.2.1, Paved Roads*, January 2011. These calculations are included in Attachment H.

Table 4-4
MOBILE6 Emission Factors for On-road Vehicles
(Alternative 4 only)

	PM ₁₀			CO			HC			NO _x		
	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)	Idle (g/hr)	Low Speed mph (g/mi)	Cruise Speed mph (g/mi)
On-Road Vehicles (Composite Mix)	0.54	0.065	0.065	116.3	25.8	14.7	8.3	1.49	0.88	13.5	4.13	2.96
Note: Vehicle mix / VMT fractions: 34% LDT4, 11% CLASS 2b HDV, 11% CLASS 3 HDV, 11% CLASS 4 HDV, 33% BUS PM ₁₀ emissions include tire and brake wear. Source: MOBILE6.2												

4.4 Traffic Activity Data

Traffic data for the air quality analysis were derived from snowmobile and snowcoach entry limits and other information for each alternative provided to ARS by NPS (Appendices A and J). Refined microscale, or localized, dispersion modeling analysis was conducted for the each hour of the day, at each of the four modeling locations, to most accurately assess the potential for significant air quality impacts.

To determine hourly vehicle inputs for the modeling locations, hourly distribution data of OSVs collected by the park was used together with the travel factor spreadsheets previously discussed in Section 3.0 to determine hourly traffic activity and emission factors for each alternative. The modeling assumed two lanes open in the morning, with about two thirds of daily entries going to the southernmost booth and third going to the middle (north) booth; the northernmost booth is currently unused in winter.

4.5 Meteorological Conditions

Following EPA methodology and guidance from NPS, on-site meteorological data from Yellowstone's Water Tank site IMPROVE monitoring site, along with concurrent upper air data from Riverton, Wyoming Airport, were processed with AERMET for use in the AERMOD modeling. In addition, the same data were processed with the Meteorological Processor for Regulatory Models (MPRM) for use in CAL3QHCR

modeling. The meteorological data sets employed for the modeling include five (5) individual full years of data for 2003 to 2007. However, both AERMOD and CAL3QHCR modeling were completed selecting only the January 1st thru March 31st and December 15th thru December 31st periods of each modeling year, as meteorological conditions for these periods would most closely represent the park's winter use season.

4.6 Background Concentrations

Background concentrations are those pollutant concentrations not directly accounted for by the modeling analysis. Background concentrations must be added to modeling results to obtain total pollutant concentrations at prediction sites. Background concentrations can typically be attributed to local sources, long-range transport and natural sources. For this analysis, background levels include smoke (from wood-burning stoves and fireplaces) and other emissions from West Yellowstone. Background concentrations for this analysis were estimated considering the guidelines provided in *Guideline on Air Quality Models, Appendix W to 40 CFR part 51*, Federal Register, November 9, 2005.

Recent data collected at West Yellowstone and Old Faithful monitors provided background concentration estimates of a 1-hour average CO background of 0.17 ppm, and an 8-hour average CO background of 0.15 ppm, based on overnight monitoring data (John D. Ray, Atmospheric Chemist, NPS Air Resources Division, Denver, Colorado, July 2006 personal communication), so that emissions from the daytime OSVs modeled in this analysis would not be "double-counted".

The 24-hour average PM₁₀ background concentration was determined from the IMPROVE network aerosol data (gravimetric mass average of 2002-04 annual mean values) and is 4.2 micrograms per cubic meter. The 24-hour average PM_{2.5} background concentration was determined from *PM_{2.5} Winter Air Quality in Yellowstone National Park*, John D. Ray, Ph.D., National Park Service, and is 1.4 micrograms per cubic meter. Consistent with EPA guidance, IMPROVE data provide representative background particulate levels that are not directly affected by winter OSVs emissions, as the monitoring station is located near Lake Village. All background concentrations used in this analysis are shown in Table 4-5.

5.0 **Dispersion Modeling Results**

As noted previously, receptors were placed at multiple locations at each of four modeling locations. The receptor with the highest predicted concentration was used to represent each modeling site for each of the alternatives. CO, NO₂, and PM concentrations were calculated for each location, for each alternative.

For all modeling results, the values shown are the highest predicted concentrations for each receptor location and include background levels. CO concentrations under each alternative were determined using the methodology previously described.

**Table 4-5
Background Concentrations**

CO (ppm)	
1-hour	8-hour
0.17	0.15
24-hour Particulates (ug/m ³)	
PM ₁₀	PM _{2.5}
4.2	1.4
Note: CO backgrounds estimated from average overnight values from John D. Ray (Atmospheric Chemist, NPS Air Resources Division, Denver Colorado), July 2006, personal communication. Particulate backgrounds based on IMPROVE network aerosol data.	

Tables 5-1 and 5-2 show the maximum predicted 1- and 8-hour average CO concentrations for each of the alternatives at the analysis sites. The modeling results indicate that winter use vehicle emissions would not result in any exceedances of the CO NAAQS, or the Montana or Wyoming ambient air quality standards, under any of the alternatives.

Table 5-3 shows the maximum predicted 1-hour average NO₂ concentrations for each of the alternatives at the analysis sites. Based on guidance in the *Guideline on Air Quality Models, Appendix W to 40 CFR part 51*, and discussion with NPS, a ratio of 0.78 was used to determine the NO₂ fraction of NO_x. The modeling results indicate that winter use vehicle emissions would not result in any exceedances of the NO₂ NAAQS, or the Montana or Wyoming ambient air quality standards, under any of the alternatives.

Table 5-4 shows the maximum predicted 24-hour PM_{2.5} concentrations for each of the alternatives at the analysis sites. The modeling results indicate that no winter use vehicle emissions from any of the alternatives would result in exceedances of the 24-hour PM_{2.5} NAAQS, or the Montana or Wyoming ambient air quality standards. In addition, it should be noted that all predicted PM_{2.5} concentrations for this analysis are conservative, as most available emission factors utilized for vehicles assumed total particulates, or PM₁₀ as all PM_{2.5}. However, the modeling results indicate there would not be any exceedances of the 24-hour PM₁₀ NAAQS, or the Montana or Wyoming ambient air quality standards, under any of the alternatives.

Since Yellowstone is a Class I area, PM₁₀ increment consumption under PSD was also assessed. For Class I areas, the PM₁₀ PSD increment is 8 micrograms per cubic meter, for the 24-hour averaging period, which EPA has determined is the small “allowable” incremental increase for PM₁₀ in these areas. This increment is evaluated in reference to the previously established (by Montana and Wyoming) baseline date of 1979 for Yellowstone (*Air Quality Concerns Related to Snowmobile Usage in National Parks*, National Park Service Air Resources Division, February 2000), which was used to determine baseline concentrations. This study employed only a screening level approach in comparing predicted PM₁₀ increments (no background contribution) with estimated 1979 baseline concentrations to determine the increment for the alternatives.

Table 5-1
Maximum Predicted 1-hour CO Concentrations
(parts per million)

Scenario	Description	Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
		1-hour (ppm)	1-hour (ppm)	1-hour (ppm)	1-hour (ppm)
Alternative 2	2008 Plan Limits	1.0	0.4	0.3	0.3
Alternative 3	2004 Plan Limits	1.8	0.7	0.3	0.4
Alternative 4	Mixed Use	0.3	0.3	0.2	0.2
Alternative 5a START	Transition to BAT Snowcoaches Only	1.2	0.5	0.3	0.4
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	0.2	0.3	0.3	0.2
Alternative 6	Implement Variable Management	1.5	0.4	0.3	0.4
Alternative 7a	Provide Variety of Use Levels - Max	1.5	0.4	0.3	0.3
Alternative 7b	Provide Variety of Use Levels - Mid	0.7	0.3	0.3	0.3
Alternative 7c	Provide Variety of Use Levels - Low	0.4	0.3	0.2	0.2
Note: NAAQS for CO are 35 and 9 parts per million (ppm), for the 1-hour and 8-hour averaging periods, respectively.					

Table 5-2
Maximum Predicted 8-hour CO Concentrations
(parts per million)

Scenario	Description	Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
		8-hour (ppm)	8-hour (ppm)	8-hour (ppm)	8-hour (ppm)
Alternative 2	2008 Plan Limits	0.4	0.2	0.3	0.2
Alternative 3	2004 Plan Limits	0.6	0.3	0.2	0.2
Alternative 4	Mixed Use	0.2	0.2	0.2	0.2
Alternative 5a START	Transition to BAT Snowcoaches Only	0.5	0.3	0.2	0.2
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	0.2	0.2	0.2	0.2
Alternative 6	Implement Variable Management	0.5	0.3	0.2	0.2
Alternative 7a	Provide Variety of Use Levels - Max	0.4	0.2	0.2	0.2
Alternative 7b	Provide Variety of Use Levels - Mid	0.3	0.2	0.2	0.2
Alternative 7c	Provide Variety of Use Levels - Low	0.2	0.2	0.2	0.2
Note: NAAQS for CO are 35 and 9 parts per million (ppm), for the 1-hour and 8-hour averaging periods, respectively.					

Table 5-3
Maximum Predicted 1-hour NO₂ Concentrations
(parts per billion)

Scenario	Description	Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
		1-hour (ppb)	1-hour (ppb)	1-hour (ppb)	1-hour (ppb)
Alternative 2	2008 Plan Limits	27	17	16	1
Alternative 3	2004 Plan Limits	27	30	17	1
Alternative 4	Mixed Use	10	5	7	2
Alternative 5a START	Transition to BAT Snowcoaches Only	20	18	11	1
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	19	10	10	1
Alternative 6	Implement Variable Management	32	24	14	1
Alternative 7a	Provide Variety of Use Levels - Max	32	18	11	1
Alternative 7b	Provide Variety of Use Levels - Mid	29	12	8	1
Alternative 7c	Provide Variety of Use Levels - Low	8	7	5	1
Note: NAAQS for NO ₂ is 100 parts per billion (ppb), for the 1-hour averaging period.					

Table 5-4
Maximum Predicted 24-hour PM_{2.5} Concentrations
(micrograms per cubic meter)

Scenario	Description	Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
		24-hour (ug/m ³)	24-hour (ug/m ³)	24-hour (ug/m ³)	24-hour (ug/m ³)
Alternative 2	2008 Plan Limits	1.9	1.5	1.4	1.5
Alternative 3	2004 Plan Limits	2.5	1.5	1.5	1.5
Alternative 4	Mixed Use	2.1	2.4	1.4	1.5
Alternative 5a START	Transition to BAT Snowcoaches Only	1.9	1.4	1.4	1.5
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	1.4	1.5	1.4	1.4
Alternative 6	Implement Variable Management	2.2	1.5	1.4	1.5
Alternative 7a	Provide Variety of Use Levels - Max	1.9	1.5	1.4	1.5
Alternative 7b	Provide Variety of Use Levels - Mid	1.6	1.4	1.4	1.4
Alternative 7c	Provide Variety of Use Levels - Low	1.5	1.4	1.4	1.4
Note: NAAQS for PM ₁₀ is 150 µg/m ³ and for PM _{2.5} is 35 µg/m ³ , for the 24-hour averaging period.					

Although snowmobile (and snowcoach) traffic in the parks has increased since 1979, it was expected that the 4-stroke BAT snowmobiles required by the alternatives would generally result in a net decrease in 24-hour PM₁₀ levels compared to the established baseline date. The 1979 baseline levels were estimated from adjusting 1999 Historical Conditions Scenario modeled PM₁₀ levels (from the 2007 Plan/EIS) based on the maximum daily snowmobile levels (from Yellowstone entry records) of the two years. As the methodology employed in this study is a screening-level analysis, it is not intended for regulatory purposes and does not constitute a regulatory PSD increment consumption analysis. Typically, detailed analysis would be required if concentrations are near or “consume” allowable Class I PM₁₀ PSD increment. Calculations for estimating baseline levels are included as Attachment G.

The predicted 24-hour PM₁₀ increment consumption values based on the previously described particulate modeling are shown in Table 5-5 for each of the alternatives. There is no 24-hour PM₁₀ increment consumption for any of the modeling locations compared to the baseline date.

Table 5-5
24-hour PM₁₀ PSD Increment Consumption

Scenario	Description	Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
		24-hour (ug/m ³)	24-hour (ug/m ³)	24-hour (ug/m ³)	24-hour (ug/m ³)
Alternative 2	2008 Plan Limits	0.5	0.1	0.0	0.1
Alternative 3	2004 Plan Limits	1.1	0.1	0.1	0.1
Alternative 4	Mixed Use	0.7	1.0	0.0	0.1
Alternative 5a START	Transition to BAT Snowcoaches Only	0.5	0.0	0.0	0.1
Alternative 5B FINAL	Transition to BAT Snowcoaches Only	0.0	0.1	0.0	0.0
Alternative 6	Implement Variable Management	0.8	0.1	0.0	0.1
Alternative 7a	Provide Variety of Use Levels - Max	0.5	0.1	0.0	0.1
Alternative 7b	Provide Variety of Use Levels - Mid	0.2	0.0	0.0	0.0
Alternative 7c	Provide Variety of Use Levels - Low	0.1	0.0	0.0	0.0
1999 Historical	Historical Unregulated Scenario	191.5	40.2	5.9	3.8
PSD Baseline Year	1979 Historical Conditions	42.5	8.9	1.1	0.7
Note: Baseline Year concentrations are based on the ratio of 1979 to 1999 snowmobile levels at the modeling locations. Class I PSD Increment for 24-hour average PM ₁₀ is 8 µg/m ³ As the methodology employed in this study is a screening-level analysis, it is not intended for regulatory purposes and does not constitute a regulatory PSD increment consumption analysis.					

6.0 Emissions Inventory

In addition to the dispersion modeling analysis for determining potential short-term CO and particulate concentrations, an emissions inventory of snowmobiles and snowcoaches operating in Yellowstone in tons per winter season was completed for each alternative, based on vehicle entry limits and other information provided (Attachment A).

Emissions were calculated using travel estimates of OSV and on-road vehicles used on Yellowstone roadways, the roadway lengths, and modes of operation of the vehicles. Emission factor data previously discussed in Section 4.3 were combined with daily vehicle traffic levels for each roadway segment, for each alternative, to determine total park-wide emissions for each pollutant. The winter season was defined as a 90-day period that typically runs from about mid-December to early March.

Estimates were prepared for criteria pollutants (CO, PM, and NO_x) and HC. The total maximum potential winter season emissions due to operations of snowmobiles and snowcoaches in the parks in tons per winter season are shown for each alternative in Table 6-1. Detailed emission inventory calculations are included as Attachment H. An emissions inventory for HAPs was also completed for each alternative and is discussed in the next section. Table 6-2 shows the contribution by vehicle type by percentage of the total season emissions for the alternatives.

7.0 Hazardous Air Pollutant (HAP) Emissions

Emissions of HAPs (benzene, 1,3 butadiene, formaldehyde, and acetaldehyde) occur in OSVs emissions and are associated with incomplete fuel combustion. An emission inventory for these HAPs was completed based on HC speciation estimates and the total winter season HC emissions previously determined. For snowmobiles, HAPs emissions were estimated as a fraction of measured HC emissions from 4-stroke snowmobiles based on data reported in SwRI's *Laboratory Testing of Snowmobile Emissions*, Lela and White, July 2002. HAPs classified as air toxics are presented in Table 7-1 as a percentage of the total HC mass, for snowmobiles.

HAPs emissions from on-road vehicles were determined using MOBILE6. HAPs emissions from snowcoaches were calculated using the percentages of the total HC mass derived from MOBILE6, based on the on-road vehicle types that are converted to snowcoaches and the snowcoach HC emissions data from the University of Denver testing. The snowcoach vehicle mix was approximated by the following MOBILE6 vehicle mix fractions: 50 percent light-duty trucks (LDT4), 17 percent CLASS 2b heavy-duty vehicles (HDV), 17 percent CLASS 3 HDV, and 16 percent CLASS 4 HDV. A diesel fraction of five (5) percent for all vehicle classes was assumed. HAP emissions as a percentage of total HC mass, for snowcoaches and on-road vehicles are presented in Table 7-2. Using the methodology described, total winter season mobile source emissions of HAPs were estimated and are summarized in Table 7-3.

Table 6-1
Park-wide Total Winter Season Mobile Source Emissions (Pounds per Day / Tons per Year)

Scenario	Description	CO		HC		NOx		PM	
		lb/day	tpy	lb/day	tpy	lb/day	tpy	lb/day	tpy
Alternative 2	2008 Plan Limits	1,952	88	93	4.16	619	28	5	0.2
Alternative 3	2004 Plan Limits	2,992	135	166	7.48	947	43	7	0.3
Alternative 4	Mixed Use	1,177	53	64	2.90	345	16	201	9.0
Alternative 5a START	Transition to BAT Snowcoaches Only	3,809	171	108	4.85	690	31	4	0.2
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	1,540	69	41	1.86	489	22	4	0.2
Alternative 6	Implement Variable Management	1,663	75	88	3.94	527	24	4	0.2
Alternative 7*	Provide Variety of Use Levels	1,998	73	95	3.53	633	23	5	0.2
Note: All Alternatives assume snowmobile and snowcoach BAT, except Alternative 5a Start, which assumes only snowmobile BAT. * Daily estimates (lb/day) for Alternative 7 are based on the maximum use levels for a given day.									

Table 6-2
Percent Contribution by Vehicle Type to Total Scenario Emissions

Scenario	Description	CO			HC			NOx			PM		
		Snowmobile	Snowcoach	On-road Vehicle	Snowmobile	Snowcoach	On-road Vehicle	Snowmobile	Snowcoach	On-road Vehicle	Snowmobile	Snowcoach	On-road Vehicle
Alternative 2	2008 Plan Limits	54%	46%	na	81%	19%	na	54%	46%	na	48%	52%	na
Alternative 3	2004 Plan Limits	70%	30%	na	90%	10%	na	70%	30%	na	64%	36%	na
Alternative 4	Mixed Use	43%	36%	21%	56%	13%	31%	47%	39%	14%	0.6%	0.6%	98.8%
Alternative 5a START	Transition to BAT Snowcoaches Only	28%	72%	na	70%	30%	na	49%	51%	na	67%	33%	na
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	15%	85%	na	39%	61%	na	15%	85%	na	11%	89%	na
Alternative 6	Implement Variable Management	65%	35%	na	87%	13%	na	65%	35%	na	58%	42%	na
Alternative 7	Provide Variety of Use Levels	56%	44%	na	82%	18%	na	56%	44%	na	56%	44%	na

**Table 7-1
Snowmobile HC Speciation Data**

	4-stroke Snowmobiles (percent of HC)
Benzene	2.60 %
1-3 Butadiene	0.00 %
Formaldehyde	2.81 %
Acetaldehyde	1.08 %

**Table 7-2
Snowcoach and On-road Vehicle HC Speciation**

	Snowcoach (percent of HC)	On-road Vehicles (percent of HC)
Benzene	3.19 %	3.26 %
1-3 Butadiene	0.60 %	0.64 %
Formaldehyde	2.63 %	3.54 %
Acetaldehyde	0.85 %	1.32 %

**Table 7-3
Park-wide Total Winter Season Mobile Sources HAPs Emissions
(Tons per Year)**

Scenario	Description	Benzene (tpy)	1-3 Butadiene (tpy)	Formaldehyde (tpy)	Acetaldehyde (tpy)
Alternative 2	2008 Plan Limits	0.11	0.00	0.12	0.04
Alternative 3	2004 Plan Limits	0.20	0.00	0.21	0.08
Alternative 4	Mixed Use	0.08	0.01	0.09	0.03
Alternative 5a START	Transition to BAT Snowcoaches Only	0.14	0.01	0.12	0.04
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	0.06	0.01	0.05	0.02
Alternative 6	Implement Variable Management	0.11	0.00	0.11	0.04
Alternative 7	Provide Variety of Use Levels	0.10	0.00	0.10	0.04

Note:

4-stroke snowmobile HAPs estimated as a fraction of measured HC emissions based on data reported in SwRI's *Laboratory Testing of Snowmobile Emissions*, Lela and White, July 2002.

Snowcoach and on-road vehicle HAPs estimated as a fraction of HC emissions based on MOBILE6 modeling of HC and air toxics emission factors for light- and heavy-duty vehicles.

8.0 Visibility

Yellowstone and Grand Teton are classified as Class I areas under the Federal Clean Air Act. As required by the visibility protection provision of the Clean Air Act, additional procedural requirements apply when a proposed source has the potential to impair visibility in a Class I area (40 CFR 52.27 (d)). Therefore, an analysis of

anticipated visibility impacts resulting from on-snow vehicle emissions was conducted following procedures in the *Workbook for Plume Visual Impact Screening and Analysis*, EPA-450/4-88-015, 1992. The EPA model VISCREEN incorporates the methodology and was used to conduct a Level 1 screening analysis of potential visibility impacts. Virtual point source methods were applied to adapt procedures originally designed for assessing plume impacts resulting from industrial stacks to the line and area sources modeled at the four locations in this study.

For the visibility analysis, a winter Yellowstone value of 240 kilometers was assumed for the background visual range. This was converted from the reference level light-extinction coefficient for Yellowstone (winter) provided in Appendix 2.B of the *Federal Land Managers' Air Quality Related Values Workgroup (FLAG), Phase I Report*, U.S Forest Service, NPS, and U.S. Fish and Wildlife Service (December 2000) using conversion equation 1 in Appendix 2.A of the report.

The results of the VISCREEN modeling are shown in Table 8-1. There were no potential localized, perceptible, visibility impairments predicted for any of the alternatives at the screening locations. Visibility modeling parameters and modeling input and output files are included as Attachment I.

Table 8-1
Visibility Impairment

Scenario	Description	Screening Criteria Exceedance			
		Site 1: West Entrance	Site 2: West Entrance to Madison	Site 3: Canyon to Fishing Bridge	Site 4: Old Faithful Staging Area
Alternative 2	2008 Plan Limits	No	No	No	No
Alternative 3	2004 Plan Limits	No	No	No	No
Alternative 4	Mixed Use	No	No	No	No
Alternative 5a START	Transition to BAT Snowcoaches Only	No	No	No	No
Alternative 5b FINAL	Transition to BAT Snowcoaches Only	No	No	No	No
Alternative 6	Implement Variable Management	No	No	No	No
Alternative 7a	Provide Variety of Use Levels - Max	No	No	No	No
Alternative 7b	Provide Variety of Use Levels - Mid	No	No	No	No
Alternative 7c	Provide Variety of Use Levels - Low	No	No	No	No

9.0 Summary and Conclusions

In support of the Winter Use Plan DEIS for Yellowstone, this report analyzed potential air quality impacts from snowmobile and snowcoach operations for several alternatives, utilizing air dispersion modeling and other accepted methods and models. For all alternatives, snowmobiles entering Yellowstone must be BAT machines. In addition, all alternatives assume implementation of a snowcoach BAT.

For each alternative, maximum predicted ambient concentrations of CO, NO₂ and PM_{2.5} were calculated using dispersion modeling and impacts were assessed with respect to the NAAQS. Modeling results were also compared to PSD increments for particulate matter. Winter-season emission estimates in tons per year were calculated for CO, PM, NO_x, HC, and HAPs, and potential visibility impacts for each alternative were also assessed.

The results of the air quality modeling revealed that none of the alternatives would be likely to exceed the CO, NO₂, and PM_{2.5} NAAQS, or the Montana or Wyoming ambient air quality standards. With respect to both predicted pollutant concentrations and total winter-season emissions, compared to current levels, all of the alternatives would generally improve pollutant concentrations as a result of BAT requirements and daily entry limits, with the exception of alternative 4, which results in slightly higher predicted localized particulate emissions from the modeled wheeled vehicle travel contribution of resuspended particulate emissions under winter conditions. However, particulate levels for this alternative still would be significantly below all relevant standards, and in addition, the prediction of resuspended particulate emissions is based on conservative assumptions standardized methodologies that may not fully represent actual conditions in the park.

In addition, the results of the Class I PSD assessment shows that 24-hour PM₁₀ increment consumption for each of the alternatives at all modeling locations would be lower than the PSD increment of 8 micrograms per cubic meter. However, as the methodology employed in this study is a screening-level analysis, it is not intended for regulatory purposes and does not constitute a regulatory PSD increment consumption analysis

DRAFT
AIR QUALITY MODELING REPORT
SNOWMOBILE AND SNOWCOACH EMISSIONS

ATTACHMENTS

YELLOWSTONE NATIONAL PARK

Prepared for

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***Note: Attachment B – J are available at the park’s winter use website at <http://www.nps.gov/yell/planyourvisit/winteruse.htm>.**

ATTACHMENT A
MOTORIZED OVERSNOW VEHICLE ALTERNATIVES

2011 DEIS Alternative 2 - 318 / 78

Snowmobiles	West Entrance 160		South Entrance 114		East Entrance 20		North Entrance 12		Old Faithful 12		Total 318
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	8	0.03	3.42	0.1	2	1.8	21.6	0.3	3.6	38.62
West Entrance to Madison	1.8	288	0.05	5.7	0.1	2	0.15	1.8	0.15	1.8	299.3
Madison to Norris	0.59	94.4	0.08	9.12	0.1	2	1.2	14.4	1	12	131.92
Norris to Canyon Village	0.44	70.4	0.05	5.7	0.2	4	0.56	6.72	0.7	8.4	95.22
Canyon Village to Fishing Bridge	0.34	54.4	0.45	51.3	1.4	28	0.36	4.32	0.7	8.4	146.42
Fishing Bridge to East Entrance	0.02	3.2	0.05	5.7	1.6	32	0.02	0.24	0.02	0.24	41.38
Fishing Bridge to West Thumb	0.08	12.8	0.46	52.44	0.3	6	0.02	0.24	0.7	8.4	79.88
Madison to Old Faithful	1.41	225.6	0.47	53.58	0.1	2	1.15	13.8	1.05	12.6	307.58
Old Faithful to West Thumb	0.27	43.2	1.35	153.9	0.2	4	0.05	0.6	0.75	9	210.7
West Thumb to Flagg Ranch	0.05	8	1.75	199.5	0.1	2	0.05	0.6	0.05	0.6	210.7

Snowcoaches	West Entrance 34		South Entrance 13		East Entrance 2		North Entrance 13		Old Faithful 16		Total 78
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.7	0.03	0.39	0.1	0.2	1.8	23.4	0	0	25.69
West Entrance to Madison	1.8	61.2	0.05	0.65	0.1	0.2	0.15	1.95	0.48	7.68	71.68
Madison to Norris	0.59	20.06	0.08	1.04	0.1	0.2	1.2	15.6	0.06	0.96	37.86
Norris to Canyon Village	0.44	14.96	0.05	0.65	0.2	0.4	0.56	7.28	0.06	0.96	24.25
Canyon Village to Fishing Bridge	0.34	11.56	0.45	5.85	1.4	2.8	0.36	4.68	0.06	0.96	25.85
Fishing Bridge to East Entrance	0.02	0.68	0.05	0.65	1.6	3.2	0.02	0.26	0	0	4.79
Fishing Bridge to West Thumb	0.08	2.72	0.46	5.98	0.3	0.6	0.02	0.26	0.06	0.96	10.52
Madison to Old Faithful	1.41	47.94	0.47	6.11	0.1	0.2	1.15	14.95	0.6	9.6	78.8
Old Faithful to West Thumb	0.27	9.18	1.35	17.55	0.2	0.4	0.05	0.65	1.3	20.8	48.58
West Thumb to Flagg Ranch	0.05	1.7	1.75	22.75	0.1	0.2	0.05	0.65	1.18	18.88	44.18

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Note:

YELL group sizes are modeled at an average of 8 snowmobiles/group.

2011 DEIS Alternative 3 720 / 78

Snowmobiles	West Entrance 400		South Entrance 220		East Entrance 40		North Entrance 30		Old Faithful 30		Total 720
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	20	0.03	6.6	0.1	4	1.8	54	0.3	9	93.6
West Entrance to Madison	1.8	720	0.05	11	0.1	4	0.15	4.5	0.15	4.5	744
Madison to Norris	0.59	236	0.08	17.6	0.1	4	1.2	36	1	30	323.6
Norris to Canyon Village	0.44	176	0.05	11	0.2	8	0.56	16.8	0.7	21	232.8
Canyon Village to Fishing Bridge	0.34	136	0.45	99	1.4	56	0.36	10.8	0.7	21	322.8
Fishing Bridge to East Entrance	0.02	8	0.05	11	1.6	64	0.02	0.6	0.02	0.6	84.2
Fishing Bridge to West Thumb	0.08	32	0.46	101.2	0.3	12	0.02	0.6	0.7	21	166.8
Madison to Old Faithful	1.41	564	0.47	103.4	0.1	4	1.15	34.5	1.05	31.5	737.4
Old Faithful to West Thumb	0.27	108	1.35	297	0.2	8	0.05	1.5	0.75	22.5	437
West Thumb to Flagg Ranch	0.05	20	1.75	385	0.1	4	0.05	1.5	0.05	1.5	412

Snowcoaches	West Entrance 34		South Entrance 13		East Entrance 2		North Entrance 13		Old Faithful 16		Total 78
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.7	0.03	0.39	0.1	0.2	1.8	23.4	0	0	25.69
West Entrance to Madison	1.8	61.2	0.05	0.65	0.1	0.2	0.15	1.95	0.48	7.68	71.68
Madison to Norris	0.59	20.06	0.08	1.04	0.1	0.2	1.2	15.6	0.06	0.96	37.86
Norris to Canyon Village	0.44	14.96	0.05	0.65	0.2	0.4	0.56	7.28	0.06	0.96	24.25
Canyon Village to Fishing Bridge	0.34	11.56	0.45	5.85	1.4	2.8	0.36	4.68	0.06	0.96	25.85
Fishing Bridge to East Entrance	0.02	0.68	0.05	0.65	1.6	3.2	0.02	0.26	0	0	4.79
Fishing Bridge to West Thumb	0.08	2.72	0.46	5.98	0.3	0.6	0.02	0.26	0.06	0.96	10.52
Madison to Old Faithful	1.41	47.94	0.47	6.11	0.1	0.2	1.15	14.95	0.6	9.6	78.8
Old Faithful to West Thumb	0.27	9.18	1.35	17.55	0.2	0.4	0.05	0.65	1.3	20.8	48.58
West Thumb to Flagg Ranch	0.05	1.7	1.75	22.75	0.1	0.2	0.05	0.65	1.18	18.88	44.18

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

2011 DEIS Alternative 4 - Old Faithful, South, Norris

Snowmobiles	West Entrance 0		South Entrance 66		East Entrance 0		Norris 22		Old Faithful 22		Total 110
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	0	0	0	0.1	0	0	0	0	0	0
West Entrance to Madison	1.8	0	0	0	0.1	0	0	0	0	0	0
Madison to Norris	0.59	0	0	0	0.1	0	0	0	0	0	0
Norris to Canyon Village	0.44	0	0.1	6.6	0.2	0	1.8	39.6	0.5	11	57.2
Canyon Village to Fishing Bridge	0.34	0	0.4	26.4	1.4	0	0.9	19.8	1.4	30.8	77
Fishing Bridge to East Entrance	0.02	0	0	0	1.6	0	0	0	0	0	0
Fishing Bridge to West Thumb	0.08	0	0.4	26.4	0.3	0	0.8	17.6	1.5	33	77
Madison to Old Faithful	1.41	0	0	0	0.1	0	0	0	0	0	0
Old Faithful to West Thumb	0.27	0	1.4	92.4	0.2	0	0.7	15.4	1.8	39.6	147.4
West Thumb to Flagg Ranch	0.05	0	1.8	118.8	0.1	0	0.1	2.2	0.2	4.4	125.4

Snowcoaches	West Entrance 0		South Entrance 20		East Entrance 0		Norris 2		Old Faithful 8		Total 30
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	0	0	0	0.1	0	0	0	0	0	0
West Entrance to Madison	1.8	0	0	0	0.1	0	0	0	0	0	0
Madison to Norris	0.59	0	0	0	0.1	0	0	0	0	0	0
Norris to Canyon Village	0.44	0	0.1	2	0.2	0	1.8	3.6	0.5	4	9.6
Canyon Village to Fishing Bridge	0.34	0	0.4	8	1.4	0	0.9	1.8	1.5	12	21.8
Fishing Bridge to East Entrance	0.02	0	0	0	1.6	0	0	0	0	0	0
Fishing Bridge to West Thumb	0.08	0	0.4	8	0.3	0	0.8	1.6	1.6	12.8	22.4
Madison to Old Faithful	1.41	0	0	0	0.1	0	0	0	0	0	0
Old Faithful to West Thumb	0.27	0	1.4	28	0.2	0	0.7	1.4	1.8	14.4	43.8
West Thumb to Flagg Ranch	0.05	0	1.8	36	0.1	0	0.1	0.2	0.2	1.6	37.8

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

[illegible]

2011 DEIS Alternative 5 - Start 318 / 78

Snowmobiles	West Entrance 160		South Entrance 114		East Entrance 20		North Entrance 12		Old Faithful 12		Total 318
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	8	0.03	3.42	0.1	2	1.8	21.6	0.3	3.6	38.62
West Entrance to Madison	1.8	288	0.05	5.7	0.1	2	0.15	1.8	0.15	1.8	299.3
Madison to Norris	0.59	94.4	0.08	9.12	0.1	2	1.2	14.4	1	12	131.92
Norris to Canyon Village	0.44	70.4	0.05	5.7	0.2	4	0.56	6.72	0.7	8.4	95.22
Canyon Village to Fishing Bridge	0.34	54.4	0.45	51.3	1.4	28	0.36	4.32	0.7	8.4	146.42
Fishing Bridge to East Entrance	0.02	3.2	0.05	5.7	1.6	32	0.02	0.24	0.02	0.24	41.38
Fishing Bridge to West Thumb	0.08	12.8	0.46	52.44	0.3	6	0.02	0.24	0.7	8.4	79.88
Madison to Old Faithful	1.41	225.6	0.47	53.58	0.1	2	1.15	13.8	1.05	12.6	307.58
Old Faithful to West Thumb	0.27	43.2	1.35	153.9	0.2	4	0.05	0.6	0.75	9	210.7
West Thumb to Flagg Ranch	0.05	8	1.75	199.5	0.1	2	0.05	0.6	0.05	0.6	210.7

Snowcoaches	West Entrance 34		South Entrance 13		East Entrance 2		North Entrance 13		Old Faithful 16		Total 78
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.7	0.03	0.39	0.1	0.2	1.8	23.4	0	0	25.69
West Entrance to Madison	1.8	61.2	0.05	0.65	0.1	0.2	0.15	1.95	0.48	7.68	71.68
Madison to Norris	0.59	20.06	0.08	1.04	0.1	0.2	1.2	15.6	0.06	0.96	37.86
Norris to Canyon Village	0.44	14.96	0.05	0.65	0.2	0.4	0.56	7.28	0.06	0.96	24.25
Canyon Village to Fishing Bridge	0.34	11.56	0.45	5.85	1.4	2.8	0.36	4.68	0.06	0.96	25.85
Fishing Bridge to East Entrance	0.02	0.68	0.05	0.65	1.6	3.2	0.02	0.26	0	0	4.79
Fishing Bridge to West Thumb	0.08	2.72	0.46	5.98	0.3	0.6	0.02	0.26	0.06	0.96	10.52
Madison to Old Faithful	1.41	47.94	0.47	6.11	0.1	0.2	1.15	14.95	0.6	9.6	78.8
Old Faithful to West Thumb	0.27	9.18	1.35	17.55	0.2	0.4	0.05	0.65	1.3	20.8	48.58
West Thumb to Flagg Ranch	0.05	1.7	1.75	22.75	0.1	0.2	0.05	0.65	1.18	18.88	44.18

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

2011 DEIS Alternative 2 - 318 / 78

Snowmobiles	West Entrance 160		South Entrance 114		East Entrance 20		North Entrance 12		Old Faithful 12		Total 318
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	8	0.03	3.42	0.1	2	1.8	21.6	0.3	3.6	38.62
West Entrance to Madison	1.8	288	0.05	5.7	0.1	2	0.15	1.8	0.15	1.8	299.3
Madison to Norris	0.59	94.4	0.08	9.12	0.1	2	1.2	14.4	1	12	131.92
Norris to Canyon Village	0.44	70.4	0.05	5.7	0.2	4	0.56	6.72	0.7	8.4	95.22
Canyon Village to Fishing Bridge	0.34	54.4	0.45	51.3	1.4	28	0.36	4.32	0.7	8.4	146.42
Fishing Bridge to East Entrance	0.02	3.2	0.05	5.7	1.6	32	0.02	0.24	0.02	0.24	41.38
Fishing Bridge to West Thumb	0.08	12.8	0.46	52.44	0.3	6	0.02	0.24	0.7	8.4	79.88
Madison to Old Faithful	1.41	225.6	0.47	53.58	0.1	2	1.15	13.8	1.05	12.6	307.58
Old Faithful to West Thumb	0.27	43.2	1.35	153.9	0.2	4	0.05	0.6	0.75	9	210.7
West Thumb to Flagg Ranch	0.05	8	1.75	199.5	0.1	2	0.05	0.6	0.05	0.6	210.7

Snowcoaches	West Entrance 34		South Entrance 13		East Entrance 2		North Entrance 13		Old Faithful 16		Total 78
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.7	0.03	0.39	0.1	0.2	1.8	23.4	0	0	25.69
West Entrance to Madison	1.8	61.2	0.05	0.65	0.1	0.2	0.15	1.95	0.48	7.68	71.68
Madison to Norris	0.59	20.06	0.08	1.04	0.1	0.2	1.2	15.6	0.06	0.96	37.86
Norris to Canyon Village	0.44	14.96	0.05	0.65	0.2	0.4	0.56	7.28	0.06	0.96	24.25
Canyon Village to Fishing Bridge	0.34	11.56	0.45	5.85	1.4	2.8	0.36	4.68	0.06	0.96	25.85
Fishing Bridge to East Entrance	0.02	0.68	0.05	0.65	1.6	3.2	0.02	0.26	0	0	4.79
Fishing Bridge to West Thumb	0.08	2.72	0.46	5.98	0.3	0.6	0.02	0.26	0.06	0.96	10.52
Madison to Old Faithful	1.41	47.94	0.47	6.11	0.1	0.2	1.15	14.95	0.6	9.6	78.8
Old Faithful to West Thumb	0.27	9.18	1.35	17.55	0.2	0.4	0.05	0.65	1.3	20.8	48.58
West Thumb to Flagg Ranch	0.05	1.7	1.75	22.75	0.1	0.2	0.05	0.65	1.18	18.88	44.18

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Note:

YELL group sizes are modeled at an average of 8 snowmobiles/group.

2011 DEIS Alternative 3 720 / 78

Snowmobiles	West Entrance 400		South Entrance 220		East Entrance 40		North Entrance 30		Old Faithful 30		Total 720
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	20	0.03	6.6	0.1	4	1.8	54	0.3	9	93.6
West Entrance to Madison	1.8	720	0.05	11	0.1	4	0.15	4.5	0.15	4.5	744
Madison to Norris	0.59	236	0.08	17.6	0.1	4	1.2	36	1	30	323.6
Norris to Canyon Village	0.44	176	0.05	11	0.2	8	0.56	16.8	0.7	21	232.8
Canyon Village to Fishing Bridge	0.34	136	0.45	99	1.4	56	0.36	10.8	0.7	21	322.8
Fishing Bridge to East Entrance	0.02	8	0.05	11	1.6	64	0.02	0.6	0.02	0.6	84.2
Fishing Bridge to West Thumb	0.08	32	0.46	101.2	0.3	12	0.02	0.6	0.7	21	166.8
Madison to Old Faithful	1.41	564	0.47	103.4	0.1	4	1.15	34.5	1.05	31.5	737.4
Old Faithful to West Thumb	0.27	108	1.35	297	0.2	8	0.05	1.5	0.75	22.5	437
West Thumb to Flagg Ranch	0.05	20	1.75	385	0.1	4	0.05	1.5	0.05	1.5	412

Snowcoaches	West Entrance 34		South Entrance 13		East Entrance 2		North Entrance 13		Old Faithful 16		Total 78
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.7	0.03	0.39	0.1	0.2	1.8	23.4	0	0	25.69
West Entrance to Madison	1.8	61.2	0.05	0.65	0.1	0.2	0.15	1.95	0.48	7.68	71.68
Madison to Norris	0.59	20.06	0.08	1.04	0.1	0.2	1.2	15.6	0.06	0.96	37.86
Norris to Canyon Village	0.44	14.96	0.05	0.65	0.2	0.4	0.56	7.28	0.06	0.96	24.25
Canyon Village to Fishing Bridge	0.34	11.56	0.45	5.85	1.4	2.8	0.36	4.68	0.06	0.96	25.85
Fishing Bridge to East Entrance	0.02	0.68	0.05	0.65	1.6	3.2	0.02	0.26	0	0	4.79
Fishing Bridge to West Thumb	0.08	2.72	0.46	5.98	0.3	0.6	0.02	0.26	0.06	0.96	10.52
Madison to Old Faithful	1.41	47.94	0.47	6.11	0.1	0.2	1.15	14.95	0.6	9.6	78.8
Old Faithful to West Thumb	0.27	9.18	1.35	17.55	0.2	0.4	0.05	0.65	1.3	20.8	48.58
West Thumb to Flagg Ranch	0.05	1.7	1.75	22.75	0.1	0.2	0.05	0.65	1.18	18.88	44.18

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

2011 DEIS Alternative 4 - Old Faithful, South, Norris

Snowmobiles	West Entrance 0		South Entrance 66		East Entrance 0		Norris 22		Old Faithful 22		Total 110
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	0	0	0	0.1	0	0	0	0	0	0
West Entrance to Madison	1.8	0	0	0	0.1	0	0	0	0	0	0
Madison to Norris	0.59	0	0	0	0.1	0	0	0	0	0	0
Norris to Canyon Village	0.44	0	0.1	6.6	0.2	0	1.8	39.6	0.5	11	57.2
Canyon Village to Fishing Bridge	0.34	0	0.4	26.4	1.4	0	0.9	19.8	1.4	30.8	77
Fishing Bridge to East Entrance	0.02	0	0	0	1.6	0	0	0	0	0	0
Fishing Bridge to West Thumb	0.08	0	0.4	26.4	0.3	0	0.8	17.6	1.5	33	77
Madison to Old Faithful	1.41	0	0	0	0.1	0	0	0	0	0	0
Old Faithful to West Thumb	0.27	0	1.4	92.4	0.2	0	0.7	15.4	1.8	39.6	147.4
West Thumb to Flagg Ranch	0.05	0	1.8	118.8	0.1	0	0.1	2.2	0.2	4.4	125.4

Snowcoaches	West Entrance 0		South Entrance 20		East Entrance 0		Norris 2		Old Faithful 8		Total 30
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	0	0	0	0.1	0	0	0	0	0	0
West Entrance to Madison	1.8	0	0	0	0.1	0	0	0	0	0	0
Madison to Norris	0.59	0	0	0	0.1	0	0	0	0	0	0
Norris to Canyon Village	0.44	0	0.1	2	0.2	0	1.8	3.6	0.5	4	9.6
Canyon Village to Fishing Bridge	0.34	0	0.4	8	1.4	0	0.9	1.8	1.5	12	21.8
Fishing Bridge to East Entrance	0.02	0	0	0	1.6	0	0	0	0	0	0
Fishing Bridge to West Thumb	0.08	0	0.4	8	0.3	0	0.8	1.6	1.6	12.8	22.4
Madison to Old Faithful	1.41	0	0	0	0.1	0	0	0	0	0	0
Old Faithful to West Thumb	0.27	0	1.4	28	0.2	0	0.7	1.4	1.8	14.4	43.8
West Thumb to Flagg Ranch	0.05	0	1.8	36	0.1	0	0.1	0.2	0.2	1.6	37.8

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

[illegible]

2011 DEIS Alternative 5 - Start 318 / 78

Snowmobiles	West Entrance 160		South Entrance 114		East Entrance 20		North Entrance 12		Old Faithful 12		Total 318
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	8	0.03	3.42	0.1	2	1.8	21.6	0.3	3.6	38.62
West Entrance to Madison	1.8	288	0.05	5.7	0.1	2	0.15	1.8	0.15	1.8	299.3
Madison to Norris	0.59	94.4	0.08	9.12	0.1	2	1.2	14.4	1	12	131.92
Norris to Canyon Village	0.44	70.4	0.05	5.7	0.2	4	0.56	6.72	0.7	8.4	95.22
Canyon Village to Fishing Bridge	0.34	54.4	0.45	51.3	1.4	28	0.36	4.32	0.7	8.4	146.42
Fishing Bridge to East Entrance	0.02	3.2	0.05	5.7	1.6	32	0.02	0.24	0.02	0.24	41.38
Fishing Bridge to West Thumb	0.08	12.8	0.46	52.44	0.3	6	0.02	0.24	0.7	8.4	79.88
Madison to Old Faithful	1.41	225.6	0.47	53.58	0.1	2	1.15	13.8	1.05	12.6	307.58
Old Faithful to West Thumb	0.27	43.2	1.35	153.9	0.2	4	0.05	0.6	0.75	9	210.7
West Thumb to Flagg Ranch	0.05	8	1.75	199.5	0.1	2	0.05	0.6	0.05	0.6	210.7

Snowcoaches	West Entrance 34		South Entrance 13		East Entrance 2		North Entrance 13		Old Faithful 16		Total 78
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.7	0.03	0.39	0.1	0.2	1.8	23.4	0	0	25.69
West Entrance to Madison	1.8	61.2	0.05	0.65	0.1	0.2	0.15	1.95	0.48	7.68	71.68
Madison to Norris	0.59	20.06	0.08	1.04	0.1	0.2	1.2	15.6	0.06	0.96	37.86
Norris to Canyon Village	0.44	14.96	0.05	0.65	0.2	0.4	0.56	7.28	0.06	0.96	24.25
Canyon Village to Fishing Bridge	0.34	11.56	0.45	5.85	1.4	2.8	0.36	4.68	0.06	0.96	25.85
Fishing Bridge to East Entrance	0.02	0.68	0.05	0.65	1.6	3.2	0.02	0.26	0	0	4.79
Fishing Bridge to West Thumb	0.08	2.72	0.46	5.98	0.3	0.6	0.02	0.26	0.06	0.96	10.52
Madison to Old Faithful	1.41	47.94	0.47	6.11	0.1	0.2	1.15	14.95	0.6	9.6	78.8
Old Faithful to West Thumb	0.27	9.18	1.35	17.55	0.2	0.4	0.05	0.65	1.3	20.8	48.58
West Thumb to Flagg Ranch	0.05	1.7	1.75	22.75	0.1	0.2	0.05	0.65	1.18	18.88	44.18

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

2011 DEIS Alternative 5 - Final 0 / 120

Snowmobiles	West Entrance 0		South Entrance 0		East Entrance 0		North Entrance 0		Old Faithful 0		Total 0
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	0	0.03	0	0.1	0	1.8	0	0.3	0	0
West Entrance to Madison	1.8	0	0.05	0	0.1	0	0.15	0	0.15	0	0
Madison to Norris	0.59	0	0.08	0	0.1	0	1.2	0	1	0	0
Norris to Canyon Village	0.44	0	0.05	0	0.2	0	0.56	0	0.7	0	0
Canyon Village to Fishing Bridge	0.34	0	0.45	0	1.4	0	0.36	0	0.7	0	0
Fishing Bridge to East Entrance	0.02	0	0.05	0	1.6	0	0.02	0	0.02	0	0
Fishing Bridge to West Thumb	0.08	0	0.46	0	0.3	0	0.02	0	0.7	0	0
Madison to Old Faithful	1.41	0	0.47	0	0.1	0	1.15	0	1.05	0	0
Old Faithful to West Thumb	0.27	0	1.35	0	0.2	0	0.05	0	0.75	0	0
West Thumb to Flagg Ranch	0.05	0	1.75	0	0.1	0	0.05	0	0.05	0	0

Snowcoaches	West Entrance 56		South Entrance 24		East Entrance 6		North Entrance 14		Old Faithful 20		Total 120
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	2.8	0.03	0.72	0.1	0.6	1.8	25.2	0	0	29.32
West Entrance to Madison	1.8	100.8	0.05	1.2	0.1	0.6	0.15	2.1	0.48	9.6	114.3
Madison to Norris	0.59	33.04	0.08	1.92	0.1	0.6	1.2	16.8	0.06	1.2	53.56
Norris to Canyon Village	0.44	24.64	0.05	1.2	0.2	1.2	0.56	7.84	0.06	1.2	36.08
Canyon Village to Fishing Bridge	0.34	19.04	0.45	10.8	1.4	8.4	0.36	5.04	0.06	1.2	44.48
Fishing Bridge to East Entrance	0.02	1.12	0.05	1.2	1.6	9.6	0.02	0.28	0	0	12.2
Fishing Bridge to West Thumb	0.08	4.48	0.46	11.04	0.3	1.8	0.02	0.28	0.06	1.2	18.8
Madison to Old Faithful	1.41	78.96	0.47	11.28	0.1	0.6	1.15	16.1	0.6	12	118.94
Old Faithful to West Thumb	0.27	15.12	1.35	32.4	0.2	1.2	0.05	0.7	1.3	26	75.42
West Thumb to Flagg Ranch	0.05	2.8	1.75	42	0.1	0.6	0.05	0.7	1.18	23.6	69.7

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

2011 DEIS Alternative 5 - Final 0 / 120

Snowmobiles	West Entrance 0		South Entrance 0		East Entrance 0		North Entrance 0		Old Faithful 0		Total 0
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	0	0.03	0	0.1	0	1.8	0	0.3	0	0
West Entrance to Madison	1.8	0	0.05	0	0.1	0	0.15	0	0.15	0	0
Madison to Norris	0.59	0	0.08	0	0.1	0	1.2	0	1	0	0
Norris to Canyon Village	0.44	0	0.05	0	0.2	0	0.56	0	0.7	0	0
Canyon Village to Fishing Bridge	0.34	0	0.45	0	1.4	0	0.36	0	0.7	0	0
Fishing Bridge to East Entrance	0.02	0	0.05	0	1.6	0	0.02	0	0.02	0	0
Fishing Bridge to West Thumb	0.08	0	0.46	0	0.3	0	0.02	0	0.7	0	0
Madison to Old Faithful	1.41	0	0.47	0	0.1	0	1.15	0	1.05	0	0
Old Faithful to West Thumb	0.27	0	1.35	0	0.2	0	0.05	0	0.75	0	0
West Thumb to Flagg Ranch	0.05	0	1.75	0	0.1	0	0.05	0	0.05	0	0

Snowcoaches	West Entrance 56		South Entrance 24		East Entrance 6		North Entrance 14		Old Faithful 20		Total 120
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	2.8	0.03	0.72	0.1	0.6	1.8	25.2	0	0	29.32
West Entrance to Madison	1.8	100.8	0.05	1.2	0.1	0.6	0.15	2.1	0.48	9.6	114.3
Madison to Norris	0.59	33.04	0.08	1.92	0.1	0.6	1.2	16.8	0.06	1.2	53.56
Norris to Canyon Village	0.44	24.64	0.05	1.2	0.2	1.2	0.56	7.84	0.06	1.2	36.08
Canyon Village to Fishing Bridge	0.34	19.04	0.45	10.8	1.4	8.4	0.36	5.04	0.06	1.2	44.48
Fishing Bridge to East Entrance	0.02	1.12	0.05	1.2	1.6	9.6	0.02	0.28	0	0	12.2
Fishing Bridge to West Thumb	0.08	4.48	0.46	11.04	0.3	1.8	0.02	0.28	0.06	1.2	18.8
Madison to Old Faithful	1.41	78.96	0.47	11.28	0.1	0.6	1.15	16.1	0.6	12	118.94
Old Faithful to West Thumb	0.27	15.12	1.35	32.4	0.2	1.2	0.05	0.7	1.3	26	75.42
West Thumb to Flagg Ranch	0.05	2.8	1.75	42	0.1	0.6	0.05	0.7	1.18	23.6	69.7

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Note:

YELL group sizes are modeled at 8 snowmobiles/group.

2011 DEIS Alternative 6 - Average Use Day (if seasonal limits are reached)

Snowmobiles	West Entrance 198		South Entrance 99		East Entrance 26.4		North Entrance 19.8		Old Faithful 13.2		Total 356.4
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	9.9	0.03	2.97	0.1	2.64	1.8	35.64	0.3	3.96	55.11
West Entrance to Madison	1.8	356.4	0.05	4.95	0.1	2.64	0.15	2.97	0.15	1.98	368.94
Madison to Norris	0.59	116.82	0.08	7.92	0.1	2.64	1.2	23.76	1	13.2	164.34
Norris to Canyon Village	0.44	87.12	0.05	4.95	0.2	5.28	0.56	11.088	0.7	9.24	117.678
Canyon Village to Fishing Bridge	0.34	67.32	0.45	44.55	1.4	36.96	0.36	7.128	0.7	9.24	165.198
Fishing Bridge to East Entrance	0.02	3.96	0.05	4.95	1.6	42.24	0.02	0.396	0.02	0.264	51.81
Fishing Bridge to West Thumb	0.08	15.84	0.46	45.54	0.3	7.92	0.02	0.396	0.7	9.24	78.936
Madison to Old Faithful	1.41	279.18	0.47	46.53	0.1	2.64	1.15	22.77	1.05	13.86	364.98
Old Faithful to West Thumb	0.27	53.46	1.35	133.65	0.2	5.28	0.05	0.99	0.75	9.9	203.28
West Thumb to Flagg Ranch	0.05	9.9	1.75	173.25	0.1	2.64	0.05	0.99	0.05	0.66	187.44

Snowcoaches	West Entrance 22.44		South Entrance 8.58		East Entrance 1.32		North Entrance 8.58		Old Faithful 10.56		Total 51.48
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.122	0.03	0.2574	0.1	0.132	1.8	15.444	0	0	16.9554
West Entrance to Madison	1.8	40.392	0.05	0.429	0.1	0.132	0.15	1.287	0.48	5.0688	47.3088
Madison to Norris	0.59	13.2396	0.08	0.6864	0.1	0.132	1.2	10.296	0.06	0.6336	24.9876
Norris to Canyon Village	0.44	9.8736	0.05	0.429	0.2	0.264	0.56	4.8048	0.06	0.6336	16.005
Canyon Village to Fishing Bridge	0.34	7.6296	0.45	3.861	1.4	1.848	0.36	3.0888	0.06	0.6336	17.061
Fishing Bridge to East Entrance	0.02	0.4488	0.05	0.429	1.6	2.112	0.02	0.1716	0	0	3.1614
Fishing Bridge to West Thumb	0.08	1.7952	0.46	3.9468	0.3	0.396	0.02	0.1716	0.06	0.6336	6.9432
Madison to Old Faithful	1.41	31.6404	0.47	4.0326	0.1	0.132	1.15	9.867	0.6	6.336	52.008
Old Faithful to West Thumb	0.27	6.0588	1.35	11.583	0.2	0.264	0.05	0.429	1.3	13.728	32.0628
West Thumb to Flagg Ranch	0.05	1.122	1.75	15.015	0.1	0.132	0.05	0.429	1.18	12.4608	29.1588

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Note:

Alternative 6 (average) has a seasonal limit of 32,000 snowmobiles and 4,600 for snowcoaches (2/3 of 540*90 and 2/3 of 78*90).
The daily numbers for each entrance were calculated by multiplying Alternative 6 maximum daily entrance numbers by 2/3 (.66).
YELL group sizes are modeled at 22 snowmobiles/group.

2011 DEIS Alternative 6 - Maximum Use Day

Snowmobiles	West Entrance 300		South Entrance 150		East Entrance 40		North Entrance 30		Old Faithful 20		Total 540
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	15	0.03	4.5	0.1	4	1.8	54	0.3	6	83.5
West Entrance to Madison	1.8	540	0.05	7.5	0.1	4	0.15	4.5	0.15	3	559
Madison to Norris	0.59	177	0.08	12	0.1	4	1.2	36	1	20	249
Norris to Canyon Village	0.44	132	0.05	7.5	0.2	8	0.56	16.8	0.7	14	178.3
Canyon Village to Fishing Bridge	0.34	102	0.45	67.5	1.4	56	0.36	10.8	0.7	14	250.3
Fishing Bridge to East Entrance	0.02	6	0.05	7.5	1.6	64	0.02	0.6	0.02	0.4	78.5
Fishing Bridge to West Thumb	0.08	24	0.46	69	0.3	12	0.02	0.6	0.7	14	119.6
Madison to Old Faithful	1.41	423	0.47	70.5	0.1	4	1.15	34.5	1.05	21	553
Old Faithful to West Thumb	0.27	81	1.35	202.5	0.2	8	0.05	1.5	0.75	15	308
West Thumb to Flagg Ranch	0.05	15	1.75	262.5	0.1	4	0.05	1.5	0.05	1	284

Snowcoaches	West Entrance 34		South Entrance 13		East Entrance 2		North Entrance 13		Old Faithful 16		Total 78
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.7	0.03	0.39	0.1	0.2	1.8	23.4	0	0	25.69
West Entrance to Madison	1.8	61.2	0.05	0.65	0.1	0.2	0.15	1.95	0.48	7.68	71.68
Madison to Norris	0.59	20.06	0.08	1.04	0.1	0.2	1.2	15.6	0.06	0.96	37.86
Norris to Canyon Village	0.44	14.96	0.05	0.65	0.2	0.4	0.56	7.28	0.06	0.96	24.25
Canyon Village to Fishing Bridge	0.34	11.56	0.45	5.85	1.4	2.8	0.36	4.68	0.06	0.96	25.85
Fishing Bridge to East Entrance	0.02	0.68	0.05	0.65	1.6	3.2	0.02	0.26	0	0	4.79
Fishing Bridge to West Thumb	0.08	2.72	0.46	5.98	0.3	0.6	0.02	0.26	0.06	0.96	10.52
Madison to Old Faithful	1.41	47.94	0.47	6.11	0.1	0.2	1.15	14.95	0.6	9.6	78.8
Old Faithful to West Thumb	0.27	9.18	1.35	17.55	0.2	0.4	0.05	0.65	1.3	20.8	48.58
West Thumb to Flagg Ranch	0.05	1.7	1.75	22.75	0.1	0.2	0.05	0.65	1.18	18.88	44.18

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Note:

YELL group sizes are modeled at 22 snowmobiles/group.

2011 DEIS Alternative 7 - 132 / 30 days

Snowmobiles	West Entrance 66		South Entrance 44		East Entrance 0		North Entrance 11		Old Faithful 11		Total 132
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	3.3	0.03	1.32	0.1	0	1.8	19.8	0.3	3.3	27.72
West Entrance to Madison	1.8	118.8	0.05	2.2	0.1	0	0.15	1.65	0.15	1.65	124.3
Madison to Norris	0.59	38.94	0.08	3.52	0.1	0	1.2	13.2	1	11	66.66
Norris to Canyon Village	0.44	29.04	0.05	2.2	0.2	0	0.56	6.16	0.7	7.7	45.1
Canyon Village to Fishing Bridge	0.34	22.44	0.45	19.8	1.4	0	0.36	3.96	0.7	7.7	53.9
Fishing Bridge to East Entrance	0.02	1.32	0.05	2.2	1.6	0	0.02	0.22	0.02	0.22	3.96
Fishing Bridge to West Thumb	0.08	5.28	0.46	20.24	0.3	0	0.02	0.22	0.7	7.7	33.44
Madison to Old Faithful	1.41	93.06	0.47	20.68	0.1	0	1.15	12.65	1.05	11.55	137.94
Old Faithful to West Thumb	0.27	17.82	1.35	59.4	0.2	0	0.05	0.55	0.75	8.25	86.02
West Thumb to Flagg Ranch	0.05	3.3	1.75	77	0.1	0	0.05	0.55	0.05	0.55	81.4

Snowcoaches	West Entrance 12		South Entrance 6		East Entrance 0		North Entrance 6		Old Faithful 6		Total 30
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	0.6	0.03	0.18	0.1	0	1.8	10.8	0	0	11.58
West Entrance to Madison	1.8	21.6	0.05	0.3	0.1	0	0.15	0.9	0.48	2.88	25.68
Madison to Norris	0.59	7.08	0.08	0.48	0.1	0	1.2	7.2	0.06	0.36	15.12
Norris to Canyon Village	0.44	5.28	0.05	0.3	0.2	0	0.56	3.36	0.06	0.36	9.3
Canyon Village to Fishing Bridge	0.34	4.08	0.45	2.7	1.4	0	0.36	2.16	0.06	0.36	9.3
Fishing Bridge to East Entrance	0.02	0.24	0.05	0.3	1.6	0	0.02	0.12	0	0	0.66
Fishing Bridge to West Thumb	0.08	0.96	0.46	2.76	0.3	0	0.02	0.12	0.06	0.36	4.2
Madison to Old Faithful	1.41	16.92	0.47	2.82	0.1	0	1.15	6.9	0.6	3.6	30.24
Old Faithful to West Thumb	0.27	3.24	1.35	8.1	0.2	0	0.05	0.3	1.3	7.8	19.44
West Thumb to Flagg Ranch	0.05	0.6	1.75	10.5	0.1	0	0.05	0.3	1.18	7.08	18.48

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Note:

YELL group sizes are modeled at an average of 8 snowmobiles/group.

2011 DEIS Alternative 7 - 220 / 50 days

Snowmobiles	West Entrance 110		South Entrance 66		East Entrance 22		North Entrance 11		Old Faithful 11		Total 220
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	5.5	0.03	1.98	0.1	2.2	1.8	19.8	0.3	3.3	32.78
West Entrance to Madison	1.8	198	0.05	3.3	0.1	2.2	0.15	1.65	0.15	1.65	206.8
Madison to Norris	0.59	64.9	0.08	5.28	0.1	2.2	1.2	13.2	1	11	96.58
Norris to Canyon Village	0.44	48.4	0.05	3.3	0.2	4.4	0.56	6.16	0.7	7.7	69.96
Canyon Village to Fishing Bridge	0.34	37.4	0.45	29.7	1.4	30.8	0.36	3.96	0.7	7.7	109.56
Fishing Bridge to East Entrance	0.02	2.2	0.05	3.3	1.6	35.2	0.02	0.22	0.02	0.22	41.14
Fishing Bridge to West Thumb	0.08	8.8	0.46	30.36	0.3	6.6	0.02	0.22	0.7	7.7	53.68
Madison to Old Faithful	1.41	155.1	0.47	31.02	0.1	2.2	1.15	12.65	1.05	11.55	212.52
Old Faithful to West Thumb	0.27	29.7	1.35	89.1	0.2	4.4	0.05	0.55	0.75	8.25	132
West Thumb to Flagg Ranch	0.05	5.5	1.75	115.5	0.1	2.2	0.05	0.55	0.05	0.55	124.3

Snowcoaches	West Entrance 22		South Entrance 8		East Entrance 2		North Entrance 8		Old Faithful 10		Total 50
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.1	0.03	0.24	0.1	0.2	1.8	14.4	0	0	15.94
West Entrance to Madison	1.8	39.6	0.05	0.4	0.1	0.2	0.15	1.2	0.48	4.8	46.2
Madison to Norris	0.59	12.98	0.08	0.64	0.1	0.2	1.2	9.6	0.06	0.6	24.02
Norris to Canyon Village	0.44	9.68	0.05	0.4	0.2	0.4	0.56	4.48	0.06	0.6	15.56
Canyon Village to Fishing Bridge	0.34	7.48	0.45	3.6	1.4	2.8	0.36	2.88	0.06	0.6	17.36
Fishing Bridge to East Entrance	0.02	0.44	0.05	0.4	1.6	3.2	0.02	0.16	0	0	4.2
Fishing Bridge to West Thumb	0.08	1.76	0.46	3.68	0.3	0.6	0.02	0.16	0.06	0.6	6.8
Madison to Old Faithful	1.41	31.02	0.47	3.76	0.1	0.2	1.15	9.2	0.6	6	50.18
Old Faithful to West Thumb	0.27	5.94	1.35	10.8	0.2	0.4	0.05	0.4	1.3	13	30.54
West Thumb to Flagg Ranch	0.05	1.1	1.75	14	0.1	0.2	0.05	0.4	1.18	11.8	27.5

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Note:

YELL group sizes are modeled at an average of 8 snowmobiles/group.

2011 DEIS Alternative 7 - 330 / 80 days

Snowmobiles	West Entrance 176		South Entrance 110		East Entrance 22		North Entrance 11		Old Faithful 11		Total 330
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	8.8	0.03	3.3	0.1	2.2	1.8	19.8	0.3	3.3	37.4
West Entrance to Madison	1.8	316.8	0.05	5.5	0.1	2.2	0.15	1.65	0.15	1.65	327.8
Madison to Norris	0.59	103.84	0.08	8.8	0.1	2.2	1.2	13.2	1	11	139.04
Norris to Canyon Village	0.44	77.44	0.05	5.5	0.2	4.4	0.56	6.16	0.7	7.7	101.2
Canyon Village to Fishing Bridge	0.34	59.84	0.45	49.5	1.4	30.8	0.36	3.96	0.7	7.7	151.8
Fishing Bridge to East Entrance	0.02	3.52	0.05	5.5	1.6	35.2	0.02	0.22	0.02	0.22	44.66
Fishing Bridge to West Thumb	0.08	14.08	0.46	50.6	0.3	6.6	0.02	0.22	0.7	7.7	79.2
Madison to Old Faithful	1.41	248.16	0.47	51.7	0.1	2.2	1.15	12.65	1.05	11.55	326.26
Old Faithful to West Thumb	0.27	47.52	1.35	148.5	0.2	4.4	0.05	0.55	0.75	8.25	209.22
West Thumb to Flagg Ranch	0.05	8.8	1.75	192.5	0.1	2.2	0.05	0.55	0.05	0.55	204.6

Snowcoaches	West Entrance 36		South Entrance 14		East Entrance 2		North Entrance 12		Old Faithful 16		Total 80
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.05	1.8	0.03	0.42	0.1	0.2	1.8	21.6	0	0	24.02
West Entrance to Madison	1.8	64.8	0.05	0.7	0.1	0.2	0.15	1.8	0.48	7.68	75.18
Madison to Norris	0.59	21.24	0.08	1.12	0.1	0.2	1.2	14.4	0.06	0.96	37.92
Norris to Canyon Village	0.44	15.84	0.05	0.7	0.2	0.4	0.56	6.72	0.06	0.96	24.62
Canyon Village to Fishing Bridge	0.34	12.24	0.45	6.3	1.4	2.8	0.36	4.32	0.06	0.96	26.62
Fishing Bridge to East Entrance	0.02	0.72	0.05	0.7	1.6	3.2	0.02	0.24	0	0	4.86
Fishing Bridge to West Thumb	0.08	2.88	0.46	6.44	0.3	0.6	0.02	0.24	0.06	0.96	11.12
Madison to Old Faithful	1.41	50.76	0.47	6.58	0.1	0.2	1.15	13.8	0.6	9.6	80.94
Old Faithful to West Thumb	0.27	9.72	1.35	18.9	0.2	0.4	0.05	0.6	1.3	20.8	50.42
West Thumb to Flagg Ranch	0.05	1.8	1.75	24.5	0.1	0.2	0.05	0.6	1.18	18.88	45.98

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Note:

YELL group sizes are modeled at an average of 8 snowmobiles/group.

2011 DEIS Administrative Travel - Estimated Average Use Each Day

Snowmobiles	West Entrance 20		South Entrance 20		East Entrance 20		North Entrance 20		Old Faithful 30		Total 110
	(Madison-5)		(Grant-5)		(Canyon5 Lake10)						
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.1	2	0.1	2	0.1	2	2	40	0.2	6	52
West Entrance to Madison	1.5	30	0.1	2	0.1	2	0.4	8	0.3	9	51
Madison to Norris	0.2	4	0.1	2	0.1	2	1.4	28	0.2	6	42
Norris to Canyon Village	0.1	2	0.1	2	0.2	4	0.6	12	0.1	3	23
Canyon Village to Fishing Bridge	0.1	2	0.1	2	1.4	28	0.2	4	0.1	3	39
Fishing Bridge to East Entrance	0.1	2	0.1	2	0.3	6	0.1	2	0.1	3	15
Fishing Bridge to West Thumb	0.1	2	0.5	10	1.6	32	0.1	2	0.1	3	49
Madison to Old Faithful	0.3	6	0.1	2	0.1	2	1	20	1	30	60
Old Faithful to West Thumb	0.1	2	0.5	10	0.2	4	0.1	2	1	30	48
West Thumb to Flagg Ranch	0.1	2	1	20	0.1	2	0.1	2	0.1	3	29

Snowcoaches	West Entrance 2		South Entrance 2		East Entrance 3		North Entrance 2		Old Faithful 4		Total 13
	(Madison-1)		(Grant-1)		(Canyon-1 Lake-1)						
YELL Road Segment	Factor	Results	Factor	Results	Factor	Results	Factor	Results	Factor	Results	
Mammoth to Norris	0.1	0.2	0.1	0.2	0.1	0.3	2	4	0.2	0.8	5.5
West Entrance to Madison	1.5	3	0.1	0.2	0.1	0.3	0.4	0.8	0.3	1.2	5.5
Madison to Norris	0.2	0.4	0.1	0.2	0.1	0.3	1.4	2.8	0.2	0.8	4.5
Norris to Canyon Village	0.1	0.2	0.1	0.2	0.2	0.6	0.6	1.2	0.1	0.4	2.6
Canyon Village to Fishing Bridge	0.1	0.2	0.1	0.2	1.4	4.2	0.2	0.4	0.1	0.4	5.4
Fishing Bridge to East Entrance	0.1	0.2	0.1	0.2	0.3	0.9	0.1	0.2	0.1	0.4	1.9
Fishing Bridge to West Thumb	0.1	0.2	0.5	1	1.6	4.8	0.1	0.2	0.1	0.4	6.6
Madison to Old Faithful	0.3	0.6	0.1	0.2	0.1	0.3	1	2	1	4	7.1
Old Faithful to West Thumb	0.1	0.2	0.5	1	0.2	0.6	0.1	0.2	1	4	6
West Thumb to Flagg Ranch	0.1	0.2	1	2	0.1	0.3	0.1	0.2	0.1	0.4	3.1

Administrative Local Routes				
See note below regarding Old Faithful				

Note:

In the Old Faithful developed area, all 30 snowmobiles and 4 snowcoaches originating would operate in the developed area.

In addition, 24 snowmobiles and 3 snowcoaches originating elsewhere would operate in the Old Faithful developed area (half of those originating elsewhere).

APPENDIX C: YELLOWSTONE WINTER USE NOISE MODELING FOR THE 2011 EIS

APPENDIX C: YELLOWSTONE WINTER USE NOISE MODELING FOR THE 2011 EIS

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One of the most spatially extensive environmental effects of any transportation system is noise. Noise models are routinely used in airport and road projects to compare the effects of different alternatives. Accordingly, acoustical modeling has played an important role in previous winter use planning for Yellowstone and Grand Teton National Parks. Perhaps the most significant challenge for noise modeling at Yellowstone is the requirement that the audibility of over snow vehicle (OSV) noise be predicted, in terms of spatial extent and duration of effects. The challenge arises from two causes: the extremely low background sound levels that occur during winter in the park, and uncertainties regarding the attenuation of noise energy at very long ranges. This report describes the methods that were used to model OSV noise to support the next winter use plan.

There are two noise propagation models available to the NPS that can model audibility: the Integrated Noise Model (INM) developed by the John A. Volpe National Transportation Systems Center (Volpe: Cambridge, MA), and the Noise Simulation Model (NMSim) developed by Wyle Laboratories (Arlington, VA). NMSim was derived from the Noisemap model used by the U. S. Air Force. Both models were developed to address aircraft noise, but they are readily adaptable to ground noise sources. INM and NMSim take slightly different approaches to noise modeling. INM integrates noise exposure from route segments for each vehicle using the time required to transit that segment and the vehicle noise output. NMSim simulates the noise radiated by each vehicle at closely spaced points along each route. NMSim can explicitly simulate the scheduling of multiple vehicle movements, and can produce noise map animations to illustrate its results.

In 1998 an interagency, multidisciplinary noise model validation study was initiated to empirically test the ability of four noise models to predict the audibility of aircraft noise at Grand Canyon. Forty-seven scientists and engineers from ten federal agencies and engineering companies participated in the study design, execution, and review of the results. The final report (Miller et al. 2003) concluded: “Overall, NMSim proved to be the best model for computing aircraft audibility, because it is shown to have the most consistent combination of low error, low bias, and low scatter for virtually all comparisons.” A subsequent review by the Federal Interagency Committee on Aircraft Noise (Fleming et al. 2005) included the following statements comparing INM and NMSim:

The components of both INM Version 6.2 and NMSim are based on well-established physics, and have been field validated.

Substantial gains have been made with regard to understanding model-to-model differences; and many of those differences have been reduced or eliminated. However, when comparing INM Version 6.2 and NMSim, there still remain some differences, particularly with point-to-point comparisons.

Both INM Version 6.2 and NMSim are performing equally well, on average, when compared with the “gold standard” audibility data measured in the GCNP MVS.

GCNP MVS refers to Miller et al. 2003.

INM was used in the OSV noise study conducted by Volpe in support of the 2007 Yellowstone EIS (Hastings et al. 2006). The report found that the percent of the park area in which any OSV noise would be audible varied from 10-15% for the modeled alternatives. However, the 2007 EIS noted that INM underestimated the measured sound level of OSVs at eight of twelve monitoring sites in the park and underestimated the percent time audible at seven of twelve sites (and overestimated audibility at one site).

INM and NMSim take slightly different approaches to noise modeling, but they should generate comparable results (Fleming et al. 2005). Continued use of INM offers the strongest basis of comparison between any forthcoming alternatives modeling and the previous results, because differences in model outputs will be entirely due to differences in model inputs. Use of NMSim offers an opportunity to broadly cross-validate the results of the different noise models, and to identify modeling results that are contingent on the model used. Stated differently, INM offers more precise comparisons between future noise model results and the 2006 studies, while NMSim modeling would explore how strongly the noise mapping results depend upon the model used.

Given the systematic underestimation of noise exposure in the previous INM model results, we were inclined to use NMSim to see if a different model would produce better agreement with the monitoring data. Two additional considerations further tipped the balance of this choice towards NMSim. NMSim's capability to produce animated maps showing the temporal and spatial dynamics of noise exposure will be valuable for public outreach and interpretation. In addition, NSNS is working with one of the developers of NMSim to integrate sound propagation code that can account for some effects of wind and temperature inversions into NMSim. Previous winter use NEPA documents have acknowledged the substantial effects of these atmospheric conditions on noise propagation in the park. For example, temperature inversions will cause OSV noise to be audible at greater distances than would be predicted under neutral atmospheric conditions (when sound travels along straight ray paths). NMSim will provide the capacity to evaluate these effects quantitatively in the near future.

NMSIM PARAMETERS

We used NMSim (Noise Model Simulation; Wyle Laboratories) to simulate over snow vehicles and potential wheeled vehicle traffic in Yellowstone National Park (YELL). These models were based on data from several sources. A topographic raster file of the study area was ingested from the USGS Seamless Data Warehouse (www.seamless.usgs.gov). To realize compatibility with NMSim, this file was converted into an ASCII file using ArcCatalog version 9.3. The acoustic ground impedance was set to 40 Rayls, corresponding to snow-covered terrain. The air temperature and relative humidity were set to -8.4°C and 73.9% respectively, the seasonal averages for Yellowstone (Hastings et al. 2006). NMSim, like INM, can calculate several summary metrics of noise exposure at sites of interest. Thirteen sites were specified (*ibid.*, Figure 28), with a receiver height of four feet above ground level (AGL). All of these choices conformed to the values used for the previous INM modeling (*ibid.*). One difference between the NMSim modeling and the previous INM models was the ambient sound level specification. The INM models designated two zones of ambient; these NMSim runs simplified the analysis by applying the 1/3 octave spectra data from the "Forested Area Acoustic Zone" (*ibid.* Table 1) throughout the park.

The NMSim simulations utilized a grid size of 200×200 points to evaluate noise exposure throughout Yellowstone. This corresponded to a spatial resolution of approximately 500 m. The full grid and receiver location data for every run were both saved to text files. The full grid data provided the raw material for subsequent evaluations of the aggregate noise exposure due to the full complement of OSV traffic on each route for each of the proposed management alternatives. The receiver location data provided convenient summaries of noise exposure at specific locations. The full grid output is a text file containing all of the 1/3 octave band data at each time step for every grid point. The receiver output is a text file that contains

all of the 1/3 octave band data at each time step for every point of interest and some additional summary metrics.

Each NMS simulation required a trajectory file for the modeled vehicle. This trajectory file incorporated vehicle type, speed, direction of travel, and noise source height as parameters. The snow roads in the park were split into modeled road segments and saved as shape files using ArcGIS 9.3. Each segment shape file was imported into NMSim as a base layer. This base layer was used as a frame of reference to digitize each trajectory. OSV noise source heights were 0.47 m above ground level (AGL) for snowmobiles and 0.91 m AGL for snowcoaches. Wheeled vehicles source heights were 0.47 m AGL for the car and 0.61 m AGL for the bus and medium truck sources.

The road segments that make up the West Entrance to Old Faithful route were modeled at 40 kph (25 mph) and 56 kph (35 mph) for the snowmobile and 40 kph (25 mph) for the snowcoaches. Every other route in the park was modeled using 56 kph (35 mph) and 72 kph (45 mph) for the snowmobile and 40 kph (25 mph) for the snowcoaches. All wheeled vehicles were modeled at 56 kph (35 mph). These speeds were based on local speed limits and park expert observations regarding typical operating speeds. A 5-second time step was used for these simulations, resulting in an approximate spatial resolution of 100 m.

The noise source spectra for the simulations were obtained from the U. S. DOT Volpe Transportation Center. These source data were obtained at a standard measurement distance of 15 m (50 ft). They were transformed for use in NMSim by changing the levels to correspond to a reference distance of 305 m (1000 ft). This transformation utilized instructions provided by the developers of NMSim.

INTERACTIVE MAPPING FRAMEWORK

Noise modeling is a computationally intensive process. Modeling a full alternative can require more than one week of continuous processing on several computers. This delay inhibits an iterative, interactive process of alternative development and evaluation. In order to remove this obstacle, NSNS developed a software framework to separate the computationally intensive effort from the assessment of composite noise impacts. The isolated noise impacts of each component of all planned alternatives were computed in advance. Subsequently, an interactive program was used to add the individual noise contributions together to calculate the composite noise exposure from all operations.

The first step was to identify all of the unique combinations of vehicle type, operating parameters, and route segment that might be evaluated in the alternatives development process. For Yellowstone, this involved identifying the segments of the snow road network that could have different traffic levels. The following table lists the junctions that defined the endpoints of the road segments that were modeled:

Location	Vehicles modeled
Upper Terrace, Mammoth Hot Springs	Snowcoaches, Snowmobiles, wheeled vehicles
Norris Junction	Snowcoaches, Snowmobiles, wheeled vehicles
Canyon Village	Snowcoaches, Snowmobiles
West Entrance	Snowcoaches, Snowmobiles, wheeled vehicles
Madison Junction	Snowcoaches, Snowmobiles, wheeled vehicles
Fishing Bridge	Snowcoaches, Snowmobiles
East Entrance	Snowcoaches, Snowmobiles
Old Faithful	Snowcoaches, Snowmobiles, wheeled vehicles
West Thumb	Snowcoaches, Snowmobiles
South Entrance	Snowcoaches, Snowmobiles

Note that typical routes involved a combination of two or more segments. A trip from Mammoth Hot Springs to Old Faithful would involve a combination of the Mammoth-Norris, Norris-Madison, and Madison-Old Faithful segments. For the winter use analysis, ten road segments were modeled.

Each segment was modeled in both directions of travel. NMSim accounts for the change in engine loading with the slope of the road, as well as the speed of the vehicle. Seven vehicle types were modeled to support evaluation of the Yellowstone winter use alternatives: three types of snowcoaches, three types of wheeled vehicles, and a 4-stroke snowmobile. The wheeled vehicles were modeled for two routes: West Entrance to Old Faithful and Mammoth/Upper Terrace to Old Faithful (totaling four road segments). Over snow vehicles were modeled for all ten road segments.

More than 200 NMSim simulations were computed; 84 of these were used to evaluate the EIS alternatives (the EIS analysis was simplified by selecting a single snowcoach type). The simulations took more than a week, with several machines running continuously. They generated nearly one terabyte of output data. These data were processed by software developed by NSNS to compress and index the data for faster loading by a subsequent program. This compression required about one day of continuous processing time.

The interactive software developed by NSNS ingests two files: a comma separated value (CSV) file containing the traffic levels for each vehicle, operating condition, and route segment, and the large data file with the NMSim noise data for each operation. This program generates several maps that graphically summarize the spatial extent of noise exposure, as well as tables providing numerical summaries of noise.

The NSNS iterative mapping framework has several benefits. New kinds of noise maps and tabular summaries can be rapidly implemented, thanks to the flexible structure of this software. All of the NSNS code was implemented in R, an open source software environment that is available for free (R Development Core Team 2010). More importantly, the consequences of revised alternatives can be evaluated in a few minutes, or about 1000 times quicker than would be possible if the revised alternative had to be modeled by computing a full set of noise models.

The computations in this iterative framework utilize the exact same computations that the models would employ if they were used to process the composite alternatives. For peak noise exposure levels, the iterative framework simply identifies the component of the local traffic that generated the loudest event. Aggregate noise energy is very simple to compute, as noise energy from multiple sources can be summed. This simple approach to summing noise energy assumes that the noise signals of different sources are uncorrelated, an assumption that will rarely be violated. For temporal metrics, like the duration of audibility, this framework uses a statistical formula that accounts for the probable overlap of adjacent noise events. This formula is adapted from Tanner (1951). Tests of this formula by the U. S. DOT Volpe Transportation Center using data from the interagency model validation study at Grand Canyon (Miller et al. 2003) have proven this formula to provide the most accurate fit to the field data of the methods tested thus far.

NOISE METRICS

The choice of noise metrics was motivated by three considerations: sustaining connections to previous noise impact analyses for Yellowstone and other NPS park units, incorporating knowledge gained from recent research and engineering developments, and improving the robustness of the results by diminishing the potential effects of modeling idiosyncrasies.

The percent time that vehicle noise is audible was retained; it has been the foundation of all NPS noise impact assessments. Peak noise levels were modeled by Hastings et al. (2006), and a very similar metric

was retained in this modeling effort. Instead of using the peak noise level, this analysis used the energy average (L_{eq}) of the four loudest noise levels (“peak 4”). This slight modification offered two benefits. First, it reduced the variation in estimated peak level that results from the precise locations that the model happened to select when projecting vehicle noise along a road. Second, it provides an indication of the duration of this high noise level: 15 seconds. The third metric modeled was audibility L_{eq} .

L_{eq} metrics have been extensively studied for more than four decades in relation to transportation noise. The World Health Organization (WHO 1999) recommends that: “Where there are no clear reasons for using other measures, it is recommended that $LA_{eq,T}$ be used to evaluate more-or-less continuous environmental noises.” In the quoted text, the “A” refers to A-weighted integration of acoustic power spectra, and the “T” refers to the interval over which energy is averaged. FICON (1992) noted that criticism of L_{dn} (and other L_{eq} metrics) often stems from “lack of understanding of the basis for the measurement, calculation, and application of that metric.” Many people have difficulty relating an aggregate of perceived noise events to an average noise level, especially when the time interval for averaging extends over long periods. Hourly, daily, and even annual LA_{eq} metrics have been used by some U. S. Federal Agencies.

The noise models predict when the noise will be audible, so the $LA_{eq,T}$ metric used to support the winter use planning was $LA_{eq,audible}$. Instead of dividing the integrated noise energy by the entire modeling interval (0800-1600), this formula divides the energy by the total time audible. This summary noise level is more readily interpreted: it is the average noise level when the sound can be heard. $LA_{eq,audible}$ does not discount the average level because there are intervals of silence in the modeled day. Therefore, $LA_{eq,audible}$ is logically and statistically independent of percent time audible. One metric addresses noise intensity when present; the other addresses how often noise is present. This approach addresses the recommendations of Miller (1999) for NPS noise analyses.

Note that $LA_{eq,8h}$ can be calculated from percent time audible and $LA_{eq,audible}$:

$$LA_{eq,T} = LA_{eq,audible} + 10 \cdot \log_{10}(\text{time audible}/T)$$

SCIENTIFIC RATIONALE FOR THE SELECTION OF ACOUSTICAL METRICS FOR WINTER USE ANALYSES

Section 4.9 of the NPS *Management Policies 2006* (NPS 2006) states that the NPS will preserve, to the greatest extent possible, the natural soundscapes of the park, both biological and physical. 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 the visitor experience as well as the natural wildlife interactions.

Sound is an intrinsically variable phenomenon that is often described by some basic properties: loudness, timing, pitch. However, the number of potential descriptors is quite large. For example, more than 40,000 measurements per second are required to fully capture the range of sounds audible to humans. The model used to predict noise exposure from winter use in this EIS (NMSim) generates a more compact summary of OSV sounds – 36 measurements per second – but these summaries are still far too complex for NEPA impact analysis. For management purposes, the time history of each OSV noise event is not pertinent. Instead, metrics are needed to concisely represent the aggregate noise exposure generated by each alternative.

In previous NEPA documents, OSV noise has been evaluated in terms of three metrics: the percent time that OSVs are audible, the maximum OSV noise level, and the percent of the park area in which OSV

noise was audible. The present analysis retains part of this framework, and extends it to provide additional information. Percent time audible is used, as it has been in the past, to evaluate how often noise intrudes in the natural soundscape. This can be measured by an attentive listener with normal hearing, and it was modeled for this EIS using the NMSim software package. This measure of duration was complimented by a measure of the average loudness of OSV noise when it was audible: “Audible L_{eq} .”

L_{eq} metrics have been the primary means of evaluating community noise since the 1970s (EPA 550/9-94-004: “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety”). Virtually all of these metrics, including the metric used here, utilizes an A-weighted filter to sum up all the sound energy across the audible spectrum. The purpose of A-weighting is to add together sound energy across the entire audible spectrum to produce an aggregate measure of perceived loudness. L_{eq} stands for the A-weighted, average squared sound pressure deviations (the sound energy). Many forms of L_{eq} have been used, with one distinguishing feature being the time span over which sound energy is averaged. For the FAA, the primary noise impact metric is DNL (or L_{DN}), which is a 24 hour L_{eq} with a 10 dB_A penalty for noises at night. For Federal Highways, the primary metric is the hourly L_{eq} .

Studies of noise impacts in parks included L_{eq} as one of the metrics used to predict impacts (Anderson et al. 1993; Miller 1999; Rapoza et al. 2005). In the “dose-response” studies conducted at Grand Canyon, Bryce Canyon, Haleakala, and Hawai’i Volcanoes National Parks, L_{eq} referred to the sound energy averaged over the duration of a visit; observers recorded when each visitor entered and exited the study sites. A comprehensive reanalysis of these data (Anderson 2010) revealed that L_{eq} was the most consistent and accurate predictor of annoyance or perceived interference with natural quiet in these surveys. Percent time audible and several other metrics were evaluated in the reanalysis, but they did not perform quite as well across all conditions. A notable feature of the new statistical model is that the magnitudes of park-specific coefficients were dramatically reduced. In contrast to the earlier models (Anderson et al. 1993; Miller 1999; Rapoza et al. 2005), this suggests that the new analysis has revealed a generic predictor of visitor responses, which are much less contingent on the local context.

One difficulty with L_{eq} , especially when it refers to long intervals of time, is that it averages noise energy across the entire interval, which may include substantial periods when no noise is present. In order to address this issue, and produce a summary metric that is more readily interpreted, this EIS uses “Audible L_{eq} .” Audible L_{eq} measures the average noise level when the noise can be perceived by an attentive listener. Intervals of time when no noise is audible are omitted from the calculation. Collectively, Percent Time Audible and Audible L_{eq} provide a direct link to previous L_{eq} metrics: $L_{eq} = \text{Audible } L_{eq} + 10 \cdot \log_{10}(\text{Percent Time Audible})$. This equation provides an opportunity to relate winter use noise impact criteria to the research and standards that addressed community noise impacts.

Combining Percent Time Audible and L_{eq} to analyze noise impacts was recommended more than ten years ago by a noise control expert with extensive experience working in national park settings (Miller 1999). Miller’s paper utilized L_{eq} (aircraft)- L_{eq} (background) in combination with Percent Time Audible, where the averaging time for L_{eq} spanned the duration of a visit. In recent discussions with the Natural Sounds and Night Skies Division, Miller has acknowledged that Audible L_{eq} may be better. Audible L_{eq} is more readily interpreted, because it represents the average level of the noise when it is perceptible. Second, Audible L_{eq} is statistically independent of Percent Time Audible because it is unaffected by periods of silence.

In addition to Percent Time Audible and Audible L_{eq} , one more metric was computed and analyzed for this EIS. Previous analyses used the peak noise level – L_{max} – to assess the most acute noise conditions. The current analysis utilized a very similar metric – Peak 4 – which summarized the L_{eq} of the four loudest noise levels. Peak 4 has two advantages over L_{max} . First, this measurement is highly repeatable in

modeling, because it is not sensitive to the timing of a vehicle's movement along a route or the location of the modeled receiver points. Second, this metric also indicates the minimum duration of the loud event. Successive time steps in the Winter Use models were about five seconds apart, so a Peak 4 event had to be at least 15 seconds long.

SCIENTIFIC BASES FOR TRANSLATING METRIC VALUES INTO PLAUSIBLE LEVELS OF IMPACT

Each metric focuses on a particular aspect of noise exposure, deemphasizing or neglecting others. Peak 4 measures the loudest noise events, but does not indicate how often they occur. Peak 4 will not vary among alternatives unless the loudest vehicles in one alternative are completely eliminated from other alternatives; it is insensitive to changes in daily traffic levels. Audible L_{eq} measures how loud noise is on average (when it can be heard), but does not indicate how often it occurs. Audible L_{eq} will not vary among alternatives if the traffic mix does not vary, even if overall traffic levels change. Percent Time Audible measures how often noise is detectable, and it provides a measure of one effect of changing traffic levels. However, it provides no information about how loud the noise is.

L_{eq} , the metric that has been used for most community noise studies, measures total noise energy, regardless of when it occurs and from what source. The numeric value of L_{eq} is difficult to interpret in a park setting, where there are long intervals of silence, but comparisons among L_{eq}

values for different alternatives can be readily translated into changes in effective traffic level. Accordingly, NPS has decided to utilize L_{eq} as an aggregate measure of the effects of OSV traffic as measured by noise level.

For this EIS, an L_{eq} of 35 dB has been selected as the criterion corresponding to a major impact to travel corridor acoustical environments. A variety of authoritative and scientific sources point to 35 dB_A as a pertinent sound level criterion for quiet environments. ANSI Standard 12.2 – Criteria for Evaluating Room Noise – specifies 35 dB_A as the desired background condition for many indoor spaces where quiet and outstanding listening conditions are important (bedrooms, auditoria, theatres, conference rooms). ANSI 12.60 – Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools – specifies 35 dB_A as the background criterion for empty classrooms, recognizing that children are demonstrably less capable of distinguishing speech in noise and that noise affects attention. Note that an L_{eq} of 35 dB can be realized by several combinations of Percent Time Audible and Audible L_{eq} : 50% and 38 dB, 25% and 41 dB, 10% and 45 dB, 1% and 55 dB. Higher intensity exposures can be evaluated as having equivalent impacts to the acoustical environment if the duration of the exposure is shortened sufficiently.

The lesser impact criteria of moderate and minor have been chosen by successive decrements of 10 dB from the major impact criterion: moderate impacts when L_{eq} is greater than 25 dB, minor impacts when L_{eq} is greater than 15 dB. For backcountry settings, the impact criteria are equal to the travel corridor values minus 10 dB: major impacts when L_{eq} is greater than 25 dB, moderate impacts when L_{eq} is greater than 15 dB, and minor impacts when L_{eq} is greater than 5 dB. Note that a 10 dB decrease in noise exposure is equivalent to a tenfold decrease in traffic or a tenfold increase in distance from a straight segment of road. In accordance with recommendations in the NPS VERP Handbook (NPS 1997) and other management guidance, the overall impact determinations for the park incorporate provisions for exceptions. A major impact determination for the travel corridor zone as a whole requires that more than 90% of the zone exceeds an L_{eq} of 35 dB. The backcountry analysis also requires that more than 90% of this zone exceed an L_{eq} of 25 dB to receive an overall assessment of major impact.

Although these impact criteria do not specify pristine acoustical conditions, they are highly protective. The major impact criterion for the travel corridor corresponds to recommendations for quiet indoor environments where good listening conditions are important. For backcountry sites, the major impact criterion would correspond to requirements for recording studios and other indoor settings demanding the lowest possible sound levels (at significant expense). These criteria should also be protective for wildlife. Landon et al. (2003) found that Sonoran pronghorn antelope avoid areas with $L_{eq} > 55$ dB and preferred areas with $L_{eq} < 45$ dB.

Audible L_{eq} provides an additional basis for relating these impact criteria to a peer-reviewed study. Aasvang and Engdahl (1999) conducted two days of surveys in a park setting near a large airport. On day 1, 10 of 20 subjects found sounds exceeding 60 dB_A to be unacceptable in the park setting. On the second day, 9 of 16 subjects found sounds above 50 dB_A to be unacceptable. In the travel corridor, events exceeding 60 dB_A would have been limited to less than 0.3% of the day, or about one and half minutes in total. Events exceeding 50 dB_A would have been limited to less than 3% of the day, or about fifteen minutes in total. In backcountry sites the allowable durations would be one tenth of these values.

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**APPENDIX D: DRAFT NON-IMPAIRMENT DETERMINATION
FOR THE NATIONAL PARK SERVICE PREFERRED
ALTERNATIVE**

DRAFT NON-IMPAIRMENT DETERMINATION FOR THE NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

The National Park Service (NPS) *Management Policies 2006* (section 1.4) require analysis of potential effects to determine whether or not an NPS action would impair a park's resources and values. The preferred alternative identified for managing winter use in the interior of Yellowstone National Park (Yellowstone or the park) is alternative 7.

The fundamental purpose of the national park system, established by the *Organic Act* and reaffirmed by the *General Authorities Act*, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the NPS the management discretion to allow impacts on park resources and values when necessary and appropriate to fulfill the purposes of the park. That discretion is limited by the statutory requirement that the NPS must leave resources and values unimpaired unless a particular law directly and specifically provides otherwise.

NPS *Management Policies 2006* (section 1.4.7.1) also prohibit unacceptable impacts, which are defined as, "impacts that fall short of impairment, but are still not acceptable within a particular park's environment." During the impairment analysis, the preferred alternative was also evaluated for unacceptable impacts. NPS has concluded that for the same reasons no impairment to park resources or values would occur (discussed below), no unacceptable impacts would occur as a result of implementation of the preferred alternative.

Pursuant to NPS *Management Policies 2006*, impairment is an impact that, in the professional judgment of the responsible NPS manager, "would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values." Whether an impact constitutes impairment depends on the particular resources that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts.

An impact on any park resource or value may, but does not necessarily, constitute impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; or
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- identified in the park's general management plan or other relevant NPS planning documents as being of significance.

An impact would be less likely to constitute impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and it cannot be further mitigated.

Impairment may result from visitor activities, NPS administrative activities, or activities undertaken by concessioners, contractors, and others operating in the park. Impairment may also result from sources or activities outside the park.

For the preferred alternative, a determination of impairment is made for each of the impact topics carried forward for detailed analysis in the environmental impact statement. Pursuant to the *Interim Guidance for Impairment Determinations in NPS NEPA Documents* (NPS 2010), impairment findings are not necessary for visitor experience, health and safety, environmental justice, or park operations because these impact topics are not generally considered to be park resources or values, and are therefore not subject to the written impairment determination requirement found in *NPS Management Policies 2006*. A description of the current state of each of the resource topics evaluated for impairment can be found in “Chapter 3: Affected Environment” of the draft Winter Use Plan / Environmental Impact Statement (plan/EIS).

The park’s purpose and significance were considered during the impairment determination process for the preferred alternative. Congress established the park to “dedicate and set apart as a public park or pleasuring-ground for the benefit and enjoyment of the people ... for the preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition” (U.S. Congress 1872). The purpose and significance of the park are rooted in its legislation and its natural and cultural resources.

Statements of a park’s significance describe why the park is important within a global, national, regional, and ecosystem-wide context and are directly linked to the purpose of the park. Yellowstone National Park is significant for the following reasons:

- It is the world’s first national park.
- It preserves geologic wonders, including the world’s most extraordinary collection of geysers, hot springs, and the underlying volcanic activity that sustains them. Yellowstone is positioned on a “hot spot” where the earth’s crust is unusually thin and molten magma rises relatively close to the surface.
- It preserves abundant and diverse wildlife in one of the largest remaining intact and wild ecosystems on earth, supporting surrounding ecosystems and serving as a benchmark for understanding nature.
- It preserves an 11,000-year continuum of human history, including sites, structures, and events that reflect our shared heritage. This history includes the birthplace of the national park idea—a milestone in conservation history.
- It provides for the benefit, enjoyment, education, and inspiration of this and future generations. Visitors have a range of opportunities to experience the essence of Yellowstone’s wonders and wildness in a way that honors the park’s value to the human spirit and deepens the public’s understanding and connection to it.

The mission statement of Yellowstone National Park follows:

Preserved within Yellowstone National Park are Old Faithful and the majority of the world’s geysers and hot springs. An outstanding mountain wildland with clean water and air, Yellowstone is home of the grizzly bear and wolf and free-ranging herds of bison and elk. Centuries old sites and historic buildings that reflect the unique heritage of America’s first national park are also protected. Yellowstone National Park serves as a model and inspiration for national parks throughout the world. The National Park Service preserves, unimpaired, these and other natural and cultural resources and values for the enjoyment, education, and inspiration of this and future generations.

WILDLIFE AND WILDLIFE HABITAT

Wildlife and wildlife habitat are necessary to fulfill the purposes for which Yellowstone was established. Wildlife and its habitats are vital components of the Yellowstone ecosystems identified in the park's purpose and significance statements, as well as the mission statement. Yellowstone provides winter habitat for many terrestrial wildlife species. Winter use of the park by ungulates such as elk and bison is widespread, and herds of these large ungulates are focal points for visitors. Elk and bison, identified during scoping as species that could be affected by winter use, have been the subject of numerous studies related to motorized oversnow vehicle (OSV) and non-motorized uses. In addition to elk and bison, three species listed or treated (they are species of special concern in the park) as threatened under the Endangered Species Act that could be impacted by OSV use are Canada lynx (*Lynx canadensis*), grizzly bears, and gray wolves. However, due mainly to their hibernation patterns and late season closure of the park's backcountry, grizzly bears are unlikely to experience adverse effects from winter use and were therefore not carried forward for detailed analysis in the draft plan/EIS (see "Issues and Impact Topics Considered but Dismissed from Further Analysis" (page 11 in chapter 1 of the draft plan/EIS).

Winter use, as proposed under the preferred alternative, will have some effects on wildlife, just like every other form of visitor access to the park. However, only minor to moderate impacts to wildlife are expected to result from implementation of the preferred alternative. Extensive studies of the behavioral responses of the species evaluated (elk, bison, wolves, lynx, wolverines, trumpeter swans, and eagles) to over snow traffic showed that these animals rarely showed high-intensity responses (movement, defense postures, or flight) to approaching vehicles. Non-motorized use has also shown some minor effects. The responses that do occur do not rise to the level of the "taking" or disturbance that is prohibited by NPS regulations. More than 35 years of census data do not reveal any relationship between changing winter use patterns and elk or bison population dynamics. No wildlife populations are currently declining due to winter use (swan populations are declining, but this decline is being experienced regionally and due to factors unrelated to winter use in the park or region). In fact, during the last decade or more, motorized oversnow vehicle use levels have been equal to and higher than those called for under the preferred alternative, and populations of species such as grizzly bears and wolves have increased dramatically (USFWS 2010; Smith et al. 1998, 2005, 2006, 2007).

Under the preferred alternative, motorized oversnow vehicle use would be well below levels previously studied by NPS wildlife biologists and well within the limits discussed by those studies and the Scientific Assessment of Yellowstone National Park Winter Use prepared during this EIS process. Based upon this information, there is no reason to suspect that winter use at the proposed levels under the preferred alternative would pose a risk of impairment to any wildlife. All visitors using motorized oversnow vehicles would travel with commercial guides, thus reducing or even eliminating altogether any chances of wildlife harassment. Impact analysis in the draft plan/EIS clearly demonstrates that the preferred alternative will not interfere with wildlife ecology for any species. If the preferred alternative is implemented, the park would meet its mission of preserving these natural resources and associated values unimpaired, and retain its significance in the overall conservation of abundant and diverse wildlife in one of the largest remaining intact and wild ecosystems on earth, supporting surrounding ecosystems and serving as a benchmark for understanding nature.

For all species carried forward for detailed analysis, impacts from the implementation of the preferred alternative include potential displacement of individual animals, potential behavioral and physiological responses of individual animals, and potential small-scale, local population-level impacts. However, in each instance, impacts from motorized oversnow vehicles and non-motorized users would be relatively low, as disclosed in the draft plan/EIS (see chapter 4, pages 187–243). The vast majority of wildlife numbers and habitat would remain intact to allow both individuals and populations to flourish. Therefore,

no wildlife or wildlife habitat would be impaired as a result of the implementation of the preferred alternative.

BISON AND ELK

Scientists have not observed any large-scale shifts in habitat use due to the presence of OSVs, skiers, or snowshoers in the park. A small percent of both bison and elk have demonstrated limited flight responses from OSVs or skiers and avoidance of OSV use areas, resulting in small-scale and temporary shifts in habitat use by bison or elk (White et al. 2008). However, even with the projected level of impact, the impacts to individual elk and bison would be short-term and localized, and impacts to elk and bison populations would be barely noticeable over the long term, if at all. Impacts would occur to relatively few individuals, and the vast majority of wildlife numbers and habitat would remain intact to allow both individuals and populations to flourish. Elements of the preferred alternative such as the commercial guiding requirement, variable use levels that allow for lower use during the season than seen in recent years, and the requirement for Best Alternative Technology (BAT) OSVs would further ensure that impacts to the park's bison and elk remain minor.

LYNX AND WOLVERINES

Adverse impacts of the preferred alternative on lynx and wolverine would be localized and short-term, and would be mitigated through OSV management measures that include a two-week closure of Sylvan Pass at the end of the winter season, which is the critical breeding periods for these species. Use across Sylvan Pass would be quite low – about five OSV groups per day and only an occasional skier. Impacts would occur to relatively few individuals, and the vast majority of wildlife numbers and habitat would remain intact to allow both individuals and populations to flourish.

The preferred alternative would continue the operation of Sylvan Pass, the closest OSV route to prime lynx and wolverine habitat in the eastern sector of the park. The end of season closure of the east entrance and east side road would reduce the impacts of OSVs on wolverines in the area, but OSV use would still overlap with the breeding season by about two weeks. Effects resulting from OSVs on the Sylvan Pass road and maintenance activities could have a minor impact on reproductive success of denning wolverine females, but no injury or mortality to wolverines would occur as a result of implementation of the preferred alternative.

Impacts to lynx could occur because their mating season also overlaps OSV use in the park by about 2 weeks, and roaming lynx travel may be limited by groomed roads necessary for OSV use. Again, the low level of winter use and the early closure of the East Entrance to OSV use (March 2 to 15), would minimize OSV impacts to lynx in this area, but lynx traveling between territories may still be affected by OSV use in the park. No injury or mortality to lynx would occur as a result of implementation of the preferred alternative.

TRUMPETER SWANS AND EAGLES

Impacts to trumpeter swans and eagles would occur to relatively few individuals, and the vast majority of wildlife numbers and habitat would remain intact to allow both individuals and populations to flourish. While trumpeter swan populations are declining in the park, there are successful swan breeding territories near motorized routes in the greater Yellowstone area outside Yellowstone (McEneaney 2006), and winter use has not been shown to be the primary factor in the decline of the resident swan population (Proffitt et al. 2009).

Behavioral observations under recent use levels at or above the levels proposed under the preferred alternative show limited displacement and few energetically costly behavioral responses, which would likely limit physiological responses in swans and eagles (Hardy 2001; White et al. 2008). Therefore a majority of both swans and eagles are expected to demonstrate limited responses to OSVs and non-motorized users under the use limits proposed for the preferred alternative. Impacts on swans and eagles under would be localized and short-term, resulting in impacts to relatively few individuals. No injury or mortality to trumpeter swans or eagles would occur as a result of implementation of the preferred alternative. Impacts would range from not observable or measureable to impacting relatively few individuals. No injury or mortality to trumpeter swans or eagles would occur as a result of implementation of the preferred alternative.

GRAY WOLVES

Impacts to wolves under the preferred alternative would be rare, localized, and short-term. In recent years, motorized OSV use has been at or above levels proposed in the preferred alternative. During this time, winter road monitoring crews have rarely observed behavioral responses by wolves to OSVs in Yellowstone, due to infrequent encounters, with a total of only 14 sightings of wolf-OSV interaction over 7 winter monitoring seasons. Wolves appear to avoid interaction with OSV users, and there is no evidence from wolf territories in the park of large-scale displacement or habitat avoidance (Smith et al. 2005). Wolf tracks were frequently observed on roads at night, suggesting that wolves travel on roads during that time to conserve energy but avoid OSV activity (Smith et al. 2005; Smith et al. 2006). Extensive wolf-watching occurs in the northern portions of the park with no apparent effect on wolves. Wolf populations in the park have grown during periods of much higher OSV use than those proposed under the preferred alternative (Smith et al. 1998, 2005, 2006, 2007). Overall, impacts to gray wolves would be barely noticeable, if at all, and the vast majority of wolf numbers and habitat would remain intact to allow both individuals and populations to flourish.

AIR QUALITY

The park is classified as a Class I area. Class I areas are those where Congress enacted a special “visibility protection” measure for the statutory Class I areas where visibility is an “important value” (NPS 2005b). Maintaining the park’s air quality is necessary to fulfill the purposes for which Yellowstone was established. The importance of air quality in Yellowstone can be seen in its significance and mission (both stated above). The ability of Yellowstone to provide for “the benefit, enjoyment, education, and inspiration of this and future generations” and for visitors to experience the essence of the park’s wonders and wildness is achieved, in part, by the air quality maintained within the park. The importance of air quality is further noted in the park’s mission, which describes the park as “an outstanding mountain wildland with clean water and air.” Both monitoring of recent use levels at or above the levels proposed under the preferred alternative and modeling of the preferred alternative reveal that under the preferred alternative, air quality, in the park, including visibility, would remain very good.

Adverse impacts of the preferred alternative to air quality in the park would be minor and long-term, and would be mitigated through OSV management measures that include the requirement for BAT for snowcoaches as well as continuing and strengthening the BAT requirements for snowmobiles. Modeling has shown that impacts to air quality would be the same, regardless of the variation in use proposed under the preferred alternative. Under alternative 7a (high use), the minor adverse impacts are due to the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 1.5 ppm, 0.4 ppm, and 0.032 ppm, respectively. Under alternative 7b (medium use), the minor adverse impacts are due to the predicted maximum 1-hour CO, 8-hour CO, and 1-hour NO₂ concentrations of 0.7 ppm, 0.3 ppm, and 0.029 ppm, respectively. Under alternative 7c (low use), the minor adverse impacts are due to the predicted maximum 1-hour CO and NO₂ concentrations of 0.4 ppm, and 0.008 ppm, respectively.

Under the preferred alternative, no perceptible visibility impacts are expected. Motorized OSV use would result in emissions that are well below all regulatory standards, never rising to more than 50% of the National Ambient Air Quality Standards for each pollutant, and would constitute a level of air quality that would allow the park to maintain its significance and meet its mission of providing enjoyment of the clean mountain air. Therefore, there is no reason to suspect that winter use at the proposed levels under the preferred alternative would pose a risk of impairment to the park's air quality.

SOUNDSCAPES

The soundscape at Yellowstone includes both natural and human components. The “natural quiet” that occurs in the absence of human sound sources is also defined as the “natural ambient” sound level of a park. These natural ambient sound conditions exist in the absence of any human produced noises. Common natural ambient sounds at Yellowstone include bird and animal calls, running water, wind, and thermal activity (e.g., geysers and hot springs). Non-natural sounds include those produced by snowmobiles, snowcoaches, snow groomers, aircraft, human voices, wheeled vehicles and building operations (Burson 2009). These sounds may be heard as a composite of sound, not individually. Like air quality, the soundscapes in the park are a component of the essence of Yellowstone's wonders and wildness that contribute to the park's significance. In addition, the retention of the natural curiosities and wonders within Yellowstone, the reason why the park was established, includes retaining natural sounds.

Under the preferred alternative, impacts to soundscapes would result from both administrative and visitor OSV use. Impacts to soundscapes from this use would be long-term but localized to the travel corridors themselves, with some sound from motorized OSV use detectable in the backcountry area immediately adjacent to the travel corridors. Winter silence would predominate away from developed areas and road corridors, and would exist for large portions of the day along many of the travel corridors.

The preferred alternative calls for sound levels that provide for times of quiet and large periods of the day that are below 35 decibels, which is a desired background level for empty classrooms and auditoria, where quiet and outstanding listening conditions are important. Under the preferred alternative, visitors would have the opportunity to experience natural sounds including the ability to hear clearly the delicate and quieter intermittent sounds of nature, the ability to experience interludes of extreme quiet for their own sake, and the opportunity to do so for extended periods of time. The park would be able to provide for visitor enjoyment of its soundscape wonders and wildness, and therefore there is no reason to suspect that winter use at the proposed levels under the preferred alternative would pose a risk of impairment to the park's soundscapes.

CONCLUSION

In the best professional judgment of the NPS decision-maker, based upon the impact analysis in the draft plan/EIS, relevant scientific and scholarly studies, advice or insights offered by subject matter experts and others who have relevant knowledge or experience, and the results of civic engagement and public involvement activities, that no impairment of park resources or values would result from implementation of the preferred alternative.

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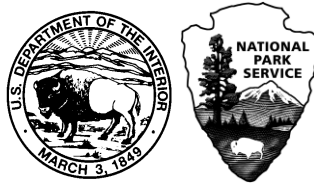
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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish 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.

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