

**VISITOR-EXPERIENCE INDICATORS AND STANDARDS FOR THE
WILDERNESS MANAGEMENT ZONES IN MOUNT RAINIER NATIONAL
PARK: RECOMMENDATIONS FOR FINAL SELECTION**

MARK E. VANDE KAMP

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Table of Contents

Table of Contents	iv
Introduction	1
<i>The Basis for Evaluating Potential Visitor Experience Indicators</i>	1
Significance	2
Is the Experiential Outcome Threatened by Visitation?	3
Does the Indicator Accurately Assess the Relationship Between Visitation and Impact?.....	3
Difficulty of Monitoring	4
<i>Format for discussion of potential indicators</i>	4
<i>Unique Characteristics of Wilderness Zones</i>	5
Pristine and Primitive (Wilderness) Zones	6
<i>Desired Visitor Experience</i>	6
Pristine	6
Primitive	6
<i>Focal Experiential Outcome</i>	6
<i>Recommended Indicator: Encounters with Other Parties</i>	7
The Indicator and the Way in Which Visitation Leads to Impact.....	7
Specifying Standards for Encounters with Other Parties	7
Implementing a Monitoring Program for Encounters with Other Parties	8
Information Needs	9
Possible Management Actions Necessary to Maintain Standard	10
<i>Recommended Indicator: Camping Isolation</i>	10
The Indicator and the Way in Which Visitation Leads to Impact.....	10
Specifying a Standard for Camping Isolation	11
Implementing a Monitoring Program for Camping Isolation	11
Information Needs	11
Possible Management Actions Necessary to Maintain Standard	12
Semi-primitive Trail Zone	13
<i>Desired Visitor Experience</i>	13
<i>Focal Experiential Outcome</i>	13
<i>Recommended Indicator: Encounters with Other Parties</i>	13
The Indicator and the Way in Which Visitation Leads to Impact.....	13
Specifying a Standard for Encounters with Other Parties	14
Implementing a Monitoring Program for Encounters with Other Parties	15
Information Needs	16
Possible Management Actions Necessary to Maintain Standard	16
<i>Recommended Indicator: Audible Sounds of Visitors</i>	17

The Indicator and the Way in Which Visitation Leads to Impact	17
Specifying a Standard for Audible Sounds of Visitors	17
Implementing a Monitoring Program for Audible sounds of visitors	18
Information Needs	18
Possible Management Actions Necessary to Maintain Standard	19
<i>Recommended Indicator: Campsite Availability</i>	19
The Indicator and the Way in Which Visitation Leads to Impact	19
Specifying a Standard for Campsite Availability	19
Implementing a Monitoring Program for Campsite Availability	20
Information Needs	20
Possible Management Actions Necessary to Maintain Standard	20
Transition Trail Zone	21
<i>Desired Visitor Experience</i>	21
<i>Focal Experiential Outcome</i>	21
<i>Recommended Indicator: Encounters with Other Parties</i>	21
The Indicator and the Way in Which Visitation Leads to Impact	21
Specifying a Standard for Encounters with Other Parties	21
Implementing a Monitoring Program for Encounters with Other Parties	22
Information Needs	23
Possible Management Actions Necessary to Maintain Standard	24
<i>Recommended Indicator: Audible Sounds of Visitors</i>	24
The Indicator and the Way in Which Visitation Leads to Impact	24
Specifying a Standard for Audible Sounds of Visitors	25
Implementing a Monitoring Program for Audible sounds of visitors	25
Information Needs	26
Possible Management Actions Necessary to Maintain Standard	26
<i>Unpicked Potential Indicator: Time Periods When Other Parties Are Not Encountered</i>	27
Percent of Time with No Parties in Sight.....	27
Longest Periods without Encounters.....	27
Discussion.....	27
Moderate Use and High Use Climbing Zones	28
<i>Desired Visitor Experience</i>	28
Moderate Use	28
High Use	28
<i>Focal Experiential Outcome</i>	28
<i>Recommended Indicator: Delay Caused by Other Parties</i>	29
The Indicator and the Way in Which Visitation Leads to Impact	29
Specifying a Standard for Delay Caused by Other Parties.....	29
Implementing a Monitoring Program for Delays Caused by Other Parties	30
Information Needs	30
Possible Management Actions Necessary to Maintain Standard	31

<i>Unpicked Potential Indicator (Moderate and High Use Climbing Zones): Measures of Duration and Variability in Climbing Times</i>	31
Monitoring Delay Based on Climbing Times	32
<i>Unpicked Potential Indicator (Moderate and High Use Climbing Zones): Exposure to Hazards</i>	33
Anthropogenic Hazards	33
Delay in Hazardous Areas	33
References	34

Introduction

The primary mission of the National Park Service is to conserve park resources for present and future generations. Providing visitors with opportunities to enjoy those resources is an important goal. However, this goal sometimes conflicts with conserving park natural and cultural resources. How do managers determine when visitors are unacceptably damaging park resources or degrading the quality of available experiences?

Concern over the impact of rising visitation on park resources and visitor experiences has led the National Park Service to focus on the concept of user capacity. In order to address user capacity, the National Park Service uses the Visitor Experience and Resource Protection (VERP) planning framework. This framework establishes measurable standards for desired resource conditions and visitor experiences.

The first step in developing a VERP plan is to articulate a vision for the desired physical, ecological, and social conditions in the park. The 2002 Mount Rainier General Management Plan defines management zones for the park and specifies the desired conditions for visitor experiences and resources for each zone. Subsequent steps in the VERP planning process focus on maintaining those desired conditions by selecting indicators that will measure the impacts of visitors on resources and experiences and setting standards for the levels of impact at which managers must take action.

This document recommends indicators and standards for the Wilderness management zones of Mount Rainier National Park. The zones serve as the primary structure for this document. Although many indicators are recommended for use in multiple zones, each zone is discussed separately below.¹

Consistent with past implementation of the VERP planning framework in which visitor experiences and resource protection are separated conceptually, this document will discuss only visitor experience indicators, and will not recommend physical resource indicators. Both types of indicators measure impacts of visitation, but the type of impacts are sufficiently different that the selection of the two sets of indicators is generally conceptualized as two parallel efforts. A separate, but parallel document will discuss physical resource indicators for each management zone defined by the GMP.

Although many indicators are available for a given zone, only a few can be selected for the ongoing monitoring and assessment that constitute the implementation of user capacity plans. The recommendations for indicators that are provided in this document were formed based on a mixture of conceptual arguments and empirical information. This document seeks to both present recommendations and provide the rationale for those recommendations.

The Basis for Evaluating Potential Visitor Experience Indicators

One of the primary purposes of the VERP framework is to help managers set policies that protect visitor experiences from threats posed by visitation. In this framework, visitor experience indicators are measurable factors that can be used to assess the degree to which visitation is creating negative affects on visitor experiences.

¹ No indicators will be proposed for the research natural area zone because it has few visitors and thus there is no need to address visitor impacts in that zone. The impacts of human use in the form of research are assumed to be addressed through the research permit process.

Because visitor experiences are complex there are very many ways that the presence and behavior of visitors (i.e., all aspects of visitation) may alter the experiences that are available in a park environment. However, each way in which visitation leads to impact can be conceptualized as having two components that must be directly related. First, there is an objective aspect of visitation that can be measured. Examples might include square feet of trail per hiker or number of persons in line at an information desk. Second, there is a desirable visitor experience or experiential outcome that is negatively affected by the incidents. For example, the ability to move about freely, or the opportunity to obtain all desired information.

It is assumed that changes in visitation will cause the objective aspects of visitation to rise and fall, and that such changes will affect the desired visitor experience or experiential outcome. For example, the amount of time waiting for information could increase, thus preventing some visitors from obtaining desired information.

Indicators are selected from the objective aspects of visitation. However, such selection is not straightforward. Useful indicators must meet multiple requirements. Eight primary and seven secondary criteria for evaluating the effectiveness of indicators are listed in the VERP handbook (NPS 1997)

Primary Criteria	Secondary Criteria
Specific	Easy to measure
Objective	Easy to train for monitoring
Reliable and repeatable	Cost-effective
Related to visitor use	Minimal variability
Sensitive	Responds over a wide range of conditions
Resilient	Large sampling window
Low-impact	Availability of baseline data
Significant	

Table 1. Evaluation criteria for effective indicators.

The fifteen specific criteria can be classified into four more general criteria: 1) the indicator must address an experiential outcome that is significant, 2) the selected experiential outcome must be threatened by visitation, 3) the indicator must accurately assess the degree to which visitation is creating negative impacts on visitors’ experiences, and 4) the indicator must be practical to monitor. Each of the four general criteria is discussed in more detail below.

Significance

The significance of any experiential outcome can arise from a variety of sources – experiential outcomes may be strong determinants of current visitors’ experience quality, they may also be dictated by legal documents such as the Wilderness Act of 1964 or national park establishing legislation. The preferred alternative in the MORA GMP includes “Desired Visitor Experiences” for the management zones, and those desired experiences are based on such sources. Each of the descriptions of desired visitor experiences explicitly or implicitly describes experiential outcomes that were considered

significant by the planning team. For example, the desired visitor experience for the semi-primitive trail zone states, “Opportunities for solitude would be relatively common but would be interspersed with opportunities for social interaction.” Most of the visitor experience indicators proposed in this document are intended to protect experiential outcomes described by the desired visitor experiences for the zone(s) in which the indicators are to be used.

For each potential visitor experience indicator described in this document, the experiential outcome that is targeted for protection will be described, and a case for the significance of that experiential outcome will be presented.

Is the Experiential Outcome Threatened by Visitation?

A variety of evidence can demonstrate that visitation poses a threat to visitor experience. Such evidence might include complaints from visitors, empirical results of visitor surveys, or observation of conditions that are inconsistent with the desired experiential outcome. Much of the social science research examining visitor experience indicators serves to demonstrate impacts resulting from visitation (i.e., threats to visitor experience) by examining relationships between specific aspects of visitation and experiential outcomes.

For each potential visitor experience indicator described in this document, existing evidence of threats to the experiential outcome targeted for protection will be discussed. In cases where that evidence is not conclusive, the needs for additional information will be presented.

Concluding that visitation poses a threat to a significant experiential outcome does not necessarily imply that the *number* of visitors is the aspect of visitation most strongly associated with that negative impact. For example, it is widely accepted that the ability to camp out of sight and sound of other parties is an important experiential outcome for wilderness visitors. However, because of factors such as campsite clustering at attractive sites, party noise levels, and obtrusiveness of campsite setup, the proportion of nights that a wilderness visitor camps in isolation often depends more on their own behavior and the behavior of other campers than on the number of camping parties. If managers seek to protect an experiential outcome such as campsite isolation, they should select an indicator closely related to the most threatening aspect of visitation. For example, rather than monitoring the number of campers, managers might monitor the number of nights campers spend within sight or sound of other parties. Managers should not assume that a) visitor use levels are the best indicators or b) altering use levels is the best way to protect an experiential outcome.

Does the Indicator Accurately Assess the Relationship Between Visitation and Impact?

For an indicator to accurately assess the degree to which aspects of visitation are creating negative impacts on visitors’ experiences it must have a variety of positive measurement characteristics. Five of the simplest criteria listed in the VERP handbook are that an indicator must be, specific, objective, reliable and repeatable, and have minimal variability (NPS 1997). These characteristics are so familiar to most scientifically trained people that indicators that do not meet them are likely to be weeded out as soon as they are brought to mind. However, an indicator that meets those criteria

in one zone should not be assumed to meet them in all zones. For example, the indicator *self-reported encounters with other visitor parties* might have good measurement characteristics in zones where fewer than about eight such encounters per day are common (Manning, Lime, Freimund, and Pitt 1996), but could prove less satisfactory in more heavily used zones such as the transition trail zone. In a survey of transition trail zone visitors to Spray Park, the number of encounters with other parties reported by members of the same party were not strongly correlated ($r = 0.5$; See Spray Park report), suggesting that self-reported encounters had high variability and were not objective, reliable, nor repeatable.

For each potential visitor experience indicator described in this document, any questionable aspects of its measurement will be discussed in relation to the larger argument for using the indicator.

Difficulty of Monitoring

This last criterion concerns the practical rather than theoretical usefulness of potential indicators. Indicators will not be used effectively if they are impractical to monitor (because of cost, technical complexity, or any other factor). When evaluating the indicators that might be used in a particular zone, it is important to consider the means of monitoring them. This document will discuss such considerations, including methods of monitoring that may not be initially apparent. The steps necessary to implement various monitoring techniques may require research to support the use of a particular indicator in the planning and management process.

Format for discussion of potential indicators

The next sections of this document will discuss the potential visitor experience indicators for the prescriptive management zones described in the GMP for wilderness areas of MORA. For each zone, a standard format of discussion will generally be followed:

1. The desired visitor experience for the zone will be described.
2. One or more specific experiential outcomes will be proposed as the focus for indicator selection in that zone. A case will be presented for the significance of those experiential outcomes.
3. The indicators recommended for use in the zone will be presented. The discussion of these indicators will make up the bulk of the text in each section (i.e., zone discussion), and will again follow a standard format.
 - a. The recommended indicator will be presented and discussed in terms of the relationship between visitation and negative impacts to experiential outcomes.
 - b. Existing information concerning the status of the threat to experiential outcomes will be described and used in discussing a possible standard for the proposed indicator.
 - c. A possible monitoring program for the indicator will be briefly described.
 - d. Some management actions that might be required if standards are exceeded will be described.

4. Some of the potential indicators that were not selected for detailed discussion will also be presented along with the primary reasons they were not recommended for selection.

Readers should note that this document is not a complete record of decisions regarding VERP indicators and standards and is not intended to provide detailed guidance for implementation of the recommended indicators and standards. Aspects of monitoring are discussed in relation to the recommendations but a full implementation plan is beyond the scope of this report.

Unique Characteristics of Wilderness Zones

The GMP defines two categories of prescriptive management zones, those found in non-wilderness areas, and those found in designated wilderness. When considering the potential visitor experience indicators for use in each zone it is crucial to note the distinction between the wilderness and non-wilderness zones, primarily because there are general requirements that apply to each group of zones. For example, the preferred alternative in the GMP states, “Wilderness Zones – In all zones, activities would be consistent with the wilderness designation.” Thus, although the desired visitor experience for the transition trail zone (a wilderness zone) states that there will be “...few opportunities for solitude” that statement should be interpreted as, “...relatively few opportunities for solitude while remaining consistent with the language of the wilderness act regarding opportunities for solitude.”

Pristine and Primitive (Wilderness) Zones

The Pristine and Primitive zones include most areas of MORA that are more than ¼ mile away from official trails or roads. No official trails or maintained campsites are found in these zones.

Desired Visitor Experience

Pristine

Visitors may experience a high sense of adventure and exploration. Opportunities for solitude would be abundant — the chance of encountering park staff or other visitors would usually be very low. All activities would be dependent on cross-country foot travel. Day and overnight party size would be limited. No designated campsites or marked trails or routes would exist. Dispersed camping would require a permit and would adhere to Leave No Trace standards (e.g., camping would be prohibited within 100 feet of surface water.) No onsite interpretation and education (e.g., signs) would be offered; however, offsite interpretation and education would be encouraged. The opportunity to acquire additional knowledge about park resources would be low due to the lack of area-specific information from park and commercial publications and due to the low potential for contacts with park staff and visitors. The degree of outdoor knowledge and skill and the level of risk would be high since trails and other people would not be present.

Primitive

Visitors may experience a moderate sense of adventure and exploration. Opportunities for solitude would be common. With some opportunities for encounters with other people and some signs of human use (greater than in the pristine zone), visitors may feel apart, but not alone. Most activities would be dependent on cross-country foot travel. Dispersed camping would require a permit and adhere to Leave No Trace standards (e.g., camping would be prohibited within 3 miles of any trail or within 100 feet of surface water). A few designated campsites may be present in sensitive alpine areas. Day and overnight use party sizes would be limited. Some way trails would exist. No onsite interpretation and education (e.g., signs) would be offered; however, offsite interpretation and education would be provided. The level of knowledge and skills required to visit these areas would be high, but not as high as in the pristine zone due to the presence of some user-created routes and the greater chance of meeting other people.

Focal Experiential Outcome

The desired visitor experience emphasizes that few people would be present and that many opportunities for solitude would exist. Such statements justify a focal experiential outcome of solitude. Solitude is important both when visitors are hiking in this zone and at their campsites.

Relatively few visitors to Mount Rainier enter the primitive and pristine zones, and compared to other zones, relatively little is known about the experiences they desire, expect, and achieve. A survey of visitors who obtained backcountry camping permits found that only 35 percent reported that they hiked or camped in the primitive or pristine

zones. The survey did not ask specifically about the importance of solitude, but it did ask backpackers how the number of other visitors compared to the number they preferred to see. The results suggest that for most backpackers, solitude is preferable. Only two percent of backpackers said they preferred to see more visitors in the primitive and pristine zones, an additional seven percent said they had no preference (Swanson, Grinley, Vande Kamp, and Johnson 2003).

Recommended Indicator: Encounters with Other Parties

The Indicator and the Way in Which Visitation Leads to Impact

Although feelings of solitude are a subjective experience, the presence of other visitors is closely related to, if not the determining component of solitude. Thus, measurements (i.e., counts) of the number of encounters between visitors are widely adopted as indicators of solitude (Vande Kamp 1998).

In the pristine and primitive zones, the hiking behavior of visitors (such as their dispersal in the environment) may have a greater affect on the number of encounters than the sheer number of hikers. Nonetheless, the relationship between visitation, encounters, and solitude is so clear as to require little experimental support.

Specifying Standards for Encounters with Other Parties

Although it is clear that solitude is an important aspect of the visitor experience to be provided in the pristine and primitive zones, neither the desired visitor experience nor its underlying documentation specify the number of encounters at which appropriate levels of solitude are being provided. In the absence of such language, past efforts to set standards have relied on surveys of visitors to inform the decision process. Such surveys have asked visitors to evaluate different numbers of encounters in terms of their acceptability, relation to preferred levels, or other evaluative dimensions (e.g., Manning 2007). No studies have asked such questions of visitors to the pristine and primitive zones at MORA. However, there is some rough consistency to the responses recorded across studies in other areas. In a review of studies conducted in wilderness zones, it was found that recreationists generally reported that wilderness experiences were achieved when there were no more than five encounters per day with other parties (Vande Kamp 1998).

Given that the desired experiences in the pristine zone states that, “Opportunities for solitude would be abundant.” The VERP planning team generally felt that virtually all visitors should attain wilderness experiences in that zone. Thus, the standard for encounters should ensure that almost all visitors will see no more than five other parties per day (when both parties are in the pristine zone).

The desired experience for the primitive zone places a less stringent emphasis on solitude, stating: “Opportunities for solitude would be common.” The VERP planning team thus felt a slightly less stringent standard for encounters would be appropriate in the primitive zone. Thus, the standard for the primitive zone should ensure that almost all visitors will see no more than two other parties per hour of hiking (when both parties are in the primitive zone).

Implementing a Monitoring Program for Encounters with Other Parties

The first step in the development of a monitoring program is to define the standard in a precise way so that it can be repeatedly measured. Although the standards recommended in the last section are numeric (e.g., “see no more than five parties per day”, and “see no more than two parties per hour”), they are not specified clearly enough to build a monitoring program.

Perhaps the most obvious method of monitoring encounters is to ask visitors how many other parties they saw. This method is difficult at MORA because hikers are frequently unaware which zone they are hiking in (i.e., they are often unaware of the distinction between official trails and way trails, and/or unaware whether they are within ¼ mile of an official trail). A more feasible method of monitoring is for park staff to record encounters with parties of visitors.

Park staff will likely hike differently than visitors. Thus, staff encounters with visitor parties may not be perfectly representative of the number of encounters between visitor parties in the pristine and primitive zones. It is not clear how staff encounters might differ. If park staff distribute their movements more broadly than visitors, they are likely to have fewer encounters with visitor parties. However, staff may also hike faster than most visitors and often seek out contact with visitors that they see, making them likely to have more encounters. For the initial implementation of the VERP planning effort, managers should assume that the numbers of encounters recorded by park staff in the pristine and primitive zones are equal to, or greater than the number of encounters between visitors. Given this assumption, slightly more precise statements of the recommended standard might be:

For at least 95 percent of daily patrols through a pristine zone, park staff will see no more than 5 visitor parties (counting only parties that are also in the pristine zone).

For at least 95 percent of hours spent hiking in the primitive zone, park staff will see no more than 2 visitor parties (counting only parties that are also in the primitive zone).

Several problems are likely to arise in monitoring these standards. First, there is no specific definition of a “daily patrol”, and even if there was, it would be difficult to relate a patrol to a day of visitor hiking. Second, there is no specific definition of what it means to “see” a party of visitors. Third, there is no specific definition of the time in which observations should occur. Each of these problems can be addressed before stating a more refined version of the recommended standards.

The recommended method for park staff to monitor encounters with visitor parties in the pristine and primitive zones is that they record the time when they enter and leave primitive and pristine zones, and the number of visitor parties they encounter during their stay in a zone. This information can be used to compute the encounters per hour in the primitive and pristine zone for each day of patrol. Encounters per hour is the unit of measure for the primitive zone standard, but the unit for the pristine zone is encounters per day. A conversion to encounters per day can be made based on the results of a survey of overnight backpackers at MORA that found backpackers spent an average of just over

7 hours hiking from one campsite to the next (Vande Kamp 2008). Using this information, a standard of 5 encounters per day can be closely approximated by a standard of 0.7 encounters per hour.²

To say that a park staffer or visitor “encounters” or “sees” another party, is an imprecise description. A more specific operational definition is needed to monitor the indicator. It is recommended that only parties coming within 100 meters of the observer be counted as encounters.

Finally, the specific times in which park staff monitor encounters determines the stringency of the standard. If monitoring focused only on sunny weekends in July and August, the standard would be more likely to be exceeded than if monitoring was spread across all of July and August. At the same time, conducting sufficient patrols to accurately describe conditions on sunny weekends would probably be difficult. The VERP team has generally focused on standards that would protect visitor experiences during peak use times, as guided by the GMP. For this standard, it is recommended that the “peak use period” be the months of July and August. The distribution of observed times can be focused more closely, or the standard can be altered (e.g., to 98 percent of hikes or hours) if monitoring suggest that conditions consistently exceed the standard on peak weekends.

Based on the above recommendations to address the weaknesses of the preliminary standards, the final statements of the recommended standards are:

For at least 95 percent of daily patrols that enter the pristine zone during July and August, park staff will encounter no more than 0.7 visitor parties per hour. An encounter is defined as coming within 100 meters of a visitor party that is also in the pristine zone.

For at least 95 percent of hours spent hiking in the primitive zone during July and August, park staff will encounter no more than 2 visitor parties. An encounter is defined as coming within 100 meters of another party that is also in the primitive zone.

Information Needs

At least two types of information would better support and refine the implementation of the encounter standards for encounters in the pristine and primitive zone. First, studies relating the number of encounters recorded by park staff to the number of encounters between visitor parties would serve to validate the monitoring method.

Second, information about the usefulness of defining an encounter as “coming within 100 meters of another party” would be useful. Such information could examine both the consistency or inconsistency of that definition with visitors’ conception of encounters, and the ability of park staff to consistently differentiate between encounters and non-encounters in the field.

² Although this conversion factor is based only on the average “hiking day” for backpackers, it should protect the desired conditions for other hikers as well, because day-hikers generally spend considerably less than 7 hours hiking (Vande Kamp Describing Visitor Use Report 2009b) and only a fraction of their hiking time is spent in the primitive or pristine zone.

Possible Management Actions Necessary to Maintain Standard

A variety of management actions might serve to limit encounters between visitors. The least obtrusive would be to provide information to day-hikers and backpackers that would seek to persuade them to avoid areas that are out of standard. Such programs are likely to be more feasible for use in zones more heavily visited than the pristine and primitive zone. It is conceivable that if information drawing attention to specific areas of the pristine and primitive zones was widely disseminated, it could actually increase encounters in those areas. The use levels could be dramatically altered if only a small percentage of visitors decided to find out why the highlighted areas are so popular.

A second strategy would be to determine if use levels are high due to the presence of way trails. If encounters are out of standard because of such use, managers could evaluate whether to: a) close and rehabilitate the trail (note that it is likely that the trail would be quickly re-established if it provides the only access to a desirable hiking destination), or b) take action to deter visitors from using the trail, possibly by placing brush or other obstacles across the tread, or by the placement of temporary signs.

Finally, managers could directly regulate use of a specific area or of the whole zone. Currently, the only means to implement such regulation would be to stop taking cross-country camping reservations for the area that is out of standard. However, such actions are likely to have little effect because the total number of campers displaced is likely to make up only a small proportion of the area users.³ It is unlikely that encounters would exceed the standard without the presence of day-hikers. Thus, it is likely that altering use levels sufficiently to effectively regulate encounters between visitors in the pristine and primitive zones would require a program to manage day-hiking use.

Recommended Indicator: Camping Isolation

The Indicator and the Way in Which Visitation Leads to Impact

Just as when hiking, the presence of other visitors is closely related to, if not the determining component of solitude after a backpacker has set up camp. Thus, measurements (i.e., counts) of the number of nights that visitor parties camp out of sight and sound of other parties have been widely adopted as an indicator of solitude. The recommendation of campsite isolation as an indicator for use at Mount Rainier is supported by the wide range of studies that have found that: a) backpackers prefer to camp in isolation, b) that they feel campsite isolation is important to the quality of their experience, and c) that a survey of scientists involved in user capacity found that they consider campsite isolation to be a useful indicator (Vande Kamp 1998).

In the pristine and primitive zones, the choices that visitors make in selecting their campsites (e.g., their concentration at desirable locations) will have a greater affect on campsite isolation than the sheer number of backpackers. Nonetheless, the relationship between visitation, campsite isolation, and solitude is so clear as to require little experimental support.

³ Currently, there is little data available to estimate the relative proportion of day and overnight users in different areas. Future monitoring efforts should differential counts of such users.

Specifying a Standard for Camping Isolation

It is clear that solitude is an important aspect of the visitor experience to be provided in the pristine and primitive zones. The statements of desired visitor experiences say, “Opportunities for solitude would be abundant” and, “Opportunities for solitude would be common.” However, there is no specific mention of campsite isolation or the proportion of nights that campsite isolation should be available. In the absence of such language, past efforts to set standards have relied on surveys of visitors to inform the decision process. Such surveys have asked visitors to state their preferences regarding campsite isolation and the importance of campsite isolation in determining the quality of their wilderness experiences. Although no studies have asked such questions of visitors to the pristine and primitive zones at MORA, research in other wilderness areas has shown that most wilderness visitors prefer to camp in isolation from other parties, that campsite isolation is an important determinant of experience quality, and that the negative impact of other campsites within sight or sound increases rapidly with the first few neighboring camps. (Vande Kamp 1998).

Given the desired experiences for the pristine and primitive zones that were included in the GMP, the VERP planning team generally felt that camping experience should be the same in both the pristine and primitive zones. Thus, the recommended standard for campsite isolation in both zones is that visitors will camp out of sight and sound of other parties on at least 90 percent of nights. It is recognized that some parties will choose to camp in close proximity – when such agreements are mutual, campsites will still be considered isolated.

Implementing a Monitoring Program for Camping Isolation

The recommended means of monitoring campsite isolation is to ask backpackers who make camping reservations in cross-country zones to record whether they camped out of site and sound of other parties (except by mutual choice). Such information could be collected by a simple survey question collected from a sample of those backpackers and used to determine whether 90 percent of nights are spent in isolation.

One complicating factor for campsite isolation in some areas of the pristine and primitive zones would be situations in which campsites that are very far apart are visible to each other. It is unlikely that such situations threaten visitors’ sense of solitude in the same manner as a camp located within easy sight and hearing range. Some attempt in the initial monitoring to measure the distance between camps might be useful in determining if and when sub-standard levels of campsite isolation truly threaten the desired experience.

Information Needs

The primary information need is to determine whether Mount Rainier is currently meeting the proposed standard for campsite isolation. Some limited data were available from a recent survey of backpackers (Vande Kamp 2008). In that survey, backpackers recorded the location of their campsites on a map and were also asked to indicate the number of other camps within sight and sound. A GIS analysis of the 656 campsites recorded in the survey found that only 25 of them were located in primitive or pristine zones. Of those, 21 (84%) were reported to be out of sight and sound of all other camps. Taken at face value, these data suggest that campsite isolation is not currently within the

recommended standard. However, the question did not exclude camps where parties chose to camp in close proximity, and even if it had, the small sample of campsites is not sufficient to reliably establish whether current camping conditions meet the proposed standard.⁴

Possible Management Actions Necessary to Maintain Standard

The first, and least obtrusive, means of promoting campsite isolation would be to target backpackers camping in cross-country zones with information seeking to persuade them to avoid camping within sight or sound of other parties. Such programs are likely to be least effective in areas where specific attractions such as lakes attract campers. However, information may be more effective in maintaining this standard than most others. Backcountry campers tend to be highly committed park users who are often willing to limit their behavior to protect resources and visitor conditions.

A second strategy would be to more tightly regulate camping in the primitive and pristine zones. Backcountry camping in many of the management zones at Denali National Park is limited to a single party. Campsite isolation in the pristine and primitive zones at Mount Rainier could be similarly protected if only one party was given a reservation to camp in a specified management zone. The obtrusiveness of such an action would be determined in part by whether managers would reduce the number of cross-country camping permits, or would maintain current camping levels by sub-dividing the management zones.

Finally, managers could protect campsite isolation by simply reducing the number of camping permits for the primitive and pristine zones. However, such an action would likely be relatively ineffective because campsite isolation is determined much more by backpackers' decision process in selecting a campsite than by the sheer number of backpackers in the zone.

⁴ The small number of cross-country zone campers also complicates monitoring of campsite isolation. Monitoring must target only backpackers who camped outside the backcountry camps and only those specific nights when they did so.

Semi-primitive Trail Zone

Desired Visitor Experience

Visitors can experience a sense of adventure and exploration. Signs of human use and structures would be readily apparent in localized areas. Travel would be on foot along user-developed (way) trails and maintained trails. Along the trails, visitors would be generally widely dispersed. Opportunities for solitude would be relatively common but would be interspersed with opportunities for social interaction. Day and overnight party size would be limited. Camping would be allowed by permit in designated camps (with marked campsites); a moderate number of visitors may be encountered in these areas. (There would be few opportunities to camp apart from other parties during peak periods.) No onsite interpretation and education would be offered; however, mileage, directional, resource protection and warning signs would be provided along the trails and in camps. Offsite interpretation and education also would be provided. Visitors would understand and appreciate the cultural landscape. The level of knowledge and skills required to use these areas would be lower than in the pristine and primitive zones due to the presence of more trails and people.

Focal Experiential Outcome

The desired visitor experience emphasizes that visitors would be generally widely dispersed and that opportunities for solitude would be relatively common. Such statements, in conjunction with the location of this zone in designated wilderness, justify a focal experiential outcome of solitude.

The semi-primitive trail zone is used by day-hikers, backpackers, and climbers. Such diverse users are likely to perceive solitude differently. However, surveys suggest that at least some visitors felt there was less solitude in the zone than they preferred. Almost half (46.1%) of backpackers surveyed in 1995 (Swanson, Grinley, Vande Kamp, and Johnson 2003) reported that they saw more visitors than they preferred in trail zones during their backpacking trip. This result is not conclusive, however, because the trails described in the survey were located in both the semi-primitive and transition trail zones. Nonetheless, it is unlikely that respondents' impressions were based entirely on experiences in the transition trail zone.

Recommended Indicator: Encounters with Other Parties

The Indicator and the Way in Which Visitation Leads to Impact

Although feelings of solitude are a subjective experience, the presence of other visitors is closely related to, if not the determining component of, solitude. Thus, measurements (i.e., counts) of the number of encounters between visitors are widely adopted as indicators of solitude (Vande Kamp 1998).

Because the semi-primitive trail zone is focused closely on trails that form a linear system of visitor movement, the relationship between visitation, encounters, and solitude is very strong. Aspects of visitor movement such as the direction of travel, variability in hiking speeds, and relative prevalence of loops or out-and-back hiking routes all

influence the relationship between the number of visitors and the number of times they encounter each other, but there is no question that the relationship is strong.

Specifying a Standard for Encounters with Other Parties

Although a degree of solitude is an important aspect of the visitor experience to be provided in the semi-primitive trail zone, neither the desired visitor experience nor its underlying documentation specify the number of encounters at which appropriate levels of solitude are being provided. In the absence of such language, the VERP planning team turned to estimates of the number of encounters that currently occur in the semi-primitive trail zones as the primary source of numeric information to be used in selecting encounter standards. The sources of those estimates were simulation models of visitor use at three heavily-visited trails in MORA (see Vande Kamp 2009a). The models simulated visitor use on the trails to Comet Falls, Spray Park, and Summerland, all of which were located in the transition trail zone. However, the models also provided estimates of encounters per hour among visitors hiking on adjacent semi-primitive trails. Given that the three transition trails were selected for simulation modeling because they are among the most heavily-used wilderness trails at MORA, it is reasonable to assume that the adjacent semi-primitive trails are also among the most heavily used trail segments in the semi-primitive trail zone. Numeric description of visitor use on these trail segments, combined with direct experience of current use levels and professional judgment concerning the appropriateness of those conditions provide a reasonable basis for managers to select encounter standards for the semi-primitive trail zone. The estimated encounters for each trail are described briefly below.

At Comet Falls, the boundary between the transition trail and semi-primitive trail zone occurs immediately above the vicinity of the falls. This boundary corresponds quite closely with current use patterns. The simulation model estimates that on 95th percentile days (i.e., days busier than 95 percent of all days during July and August), visitors hiking the trail segment below Comet Falls will experience more than 6.3 encounters per hour, but that encounters on the semi-primitive segment above the falls drop to 3.1 encounters per hour.

The Spray Park Trail enters the semi-primitive trail zone in upper Spray Park near the point where the trail begins descending toward Mist Park. In the transition trail zone, hikers averaged at least 7.3 encounters per hour on simulated 95th percentile days. Encounters between hikers on the semi-primitive trail segment immediately past the boundary were nearly as common, averaging 5.8 encounters per hour.

Finally, at Summerland, the boundary between the transition trail and semi-primitive trail zone occurs immediately after the Summerland shelter, where the trail first enters the Summerland meadows. This boundary is markedly inconsistent with current use patterns. More encounters between simulated hiking parties occurred on the semi-primitive trail segments just past the shelter (13.7 encounters per hour on 95th percentile days) than on any of the trail segments currently in the transition trail zone (a maximum of 9.9 encounters per hour). **The zoning would more closely correspond to current use patterns if the transition trail zone was extended to Panhandle Gap.** The trail segment immediately prior to Panhandle Gap averaged 3.7 encounters per hour on simulated 95th percentile days.

Based on the GMP description of desired conditions, professional judgment, direct experience with current use levels, and the numeric estimates of current encounter levels described above, the VERP planning team recommended that the standard for encounters between parties in the semi-primitive trail zone should ensure that even on the busiest trail segments during the busiest (i.e., 95th percentile) days, almost all visitors (at least 80 percent) will pass fewer than four other parties per hour while hiking.

Implementing a Monitoring Program for Encounters with Other Parties

One of the benefits of estimating encounters based on simulation modeling is the clear definition of what constitutes an encounter between hiking parties. In the simulation models, an encounter occurs when hiking parties pass each other (either in opposite directions or overtaking) while hiking on the trail. This definition excludes some types of encounters between parties that may influence experiences. For example, parties that are stopped at attraction sites when another party hikes past are not counted in the encounter total. However, the indicator can be explained clearly, measured consistently, and related to more comprehensive impressions of existing conditions.

A variety of methods could be used to monitor encounters between hiking parties. Perhaps the most obvious method of monitoring encounters is to ask visitors how many other parties they passed. This method is problematic at MORA because hikers have no reason to differentiate between encounters that occur in semi-primitive or transition trail zones. They are even unlikely to make distinctions between official trails and way trails. Further, research has found that hikers' estimates of encounters are inaccurate once the number of encounters rises above approximately 7 per day (Manning, Lime, Freimund, and Pitt 1996).

Currently, the simplest method of monitoring encounters would be to install trail counters at the same sites used to collect the visitor counts used in developing and validating the simulation models. The monitored counts could then be fed into the simulation models to determine whether the estimated number of encounters per hour on semi-primitive trail segments exceeds the standard. The effectiveness of such monitoring depends on the validity of the simulation models. Thus, it should be combined with periodic validation of those models. Such validation could be accomplished by recording use levels on observed days using trail counters or direct observation, and by having trained observers walk the semi-primitive trail segments included in the simulation models and record the number of times they pass other parties of visitors. Comparing the observed encounters to the estimated encounters provided by the simulations would serve to validate (or invalidate) the models. Conducting such validation studies would immediately buttress the validity of the simulation models, and should also be repeated regularly (e.g., every five years, or when other factors suggest that visitation patterns have changed) to insure that changes in visitor use do not alter conditions in ways that allow the standard for encounters to be exceeded.

Monitoring encounters on semi-primitive trails that have not been simulated is more difficult. The most accurate method would be to have trained observers record hiking encounters as in the validation studies. However, without a valid simulation model, observations would have to occur on very busy (i.e., 95th percentile) days that are limited in number and difficult to predict. A more feasible method would be to install trail

counters at busy points and compare the raw number of passages per hour to the number of passages when conditions first exceed the standard on the trails that were simulated (passages on the simulated trails could be estimated based on the model). There is no guarantee that the relationship between passages and encounters would be identical for the simulated and non-simulated trails (encounters are affected by hikers' route selection, distribution in time, and variability in hiking speed), but it is unlikely that standards will be exceeded if the number of passages per hour is 75 percent or less than the number of passages when standards are exceeded on the simulated trails.⁵

Information Needs

Two types of information would be useful to support and refine the implementation of the standard for encounters in the semi-primitive trail zone. First, studies that would directly observe the number of hiking encounters per hour on the simulated trails and compare those observations to the number of encounters estimated by the simulation models would serve to validate the models (or provide a basis for their refinement) and thus buttress the use of the models in monitoring the encounter standard.

The second type of useful information would be counts (recorded by electronic trail counters or direct observation) of the number of hiker passages on those trail segments in the semi-primitive trail zone that are not simulated by the existing models but are thought to be most heavily visited. Such counts could inform managers about the potential for encounters to exceed the standard throughout the semi-primitive trail zone.

Possible Management Actions Necessary to Maintain Standard

A variety of management actions might serve to limit encounters between visitors. The least obtrusive would be to provide information to day-hikers and backpackers that would seek to persuade them to avoid areas that are out of standard. Care would be necessary to design effective messages. It is conceivable that if information drawing attention to specific trails was widely disseminated, it could actually increase encounters in those areas.

It may be desirable to target persuasive messages at day-hikers. It is very unlikely that use by backpackers or climbers would be so heavily concentrated as to exceed the encounter standard. Given the absolute number of hikers using the busiest semi-primitive trails and the known number of overnight hikers, the bulk of hiking parties on trails that approach the standard are almost certainly day-hikers.

Managers could also directly regulate use of specific trails or trail networks in the semi-primitive trail zone. Currently, the only means to implement such regulation would be to stop taking reservations for the area that is out of standard. However, such actions are likely to have little effect because the total number of campers is likely to make up only a small proportion of the area users. Thus, it is likely that altering use levels sufficiently to effectively regulate encounters between visitors in the semi-primitive trail zone would require a program to manage day-hiking use.

⁵ As noted by a reviewer, future research could define this relationship more precisely.

Recommended Indicator: Audible Sounds of Visitors

The Indicator and the Way in Which Visitation Leads to Impact

We argued above that although feelings of solitude are a subjective experience, the presence of other visitors is closely related to, if not the determining component of, solitude. Passing other parties on the trail is one way in which their presence is made evident. However, sounds made by other visitors can reveal their presence, even if they don't pass by on the trail.

Some sounds detract particularly strongly from visitor experiences. For example, when asking about incidents in which other visitors detracted from experience, surveys of hikers on a number of trails in the transition trail zone found that inappropriate noise from rowdy visitors was the most commonly reported behavior (Vande Kamp, Johnson, and Swanson 1998; Vande Kamp, Swanson, and Johnson 1999).

Whether sounds simply indicate visitors' presence or are considered inappropriate, an indicator measuring the audible sounds of visitors could be useful to monitor and protect solitude and other aspects of experience quality. In addition, natural soundscapes have recently gained prominence as a resource worthy of protection in their own right (NPS 2000), and sounds are one way in which visitors may have negative impacts on wildlife (Bowles 1995). All these factors support the adoption of an indicator measuring audible sounds of visitors.

Obviously, the number of times that the sounds of visitors are audible is determined as much by visitor behavior as by the number of visitors. Thus, the indicator may appear conceptually inconsistent with the idea of establishing a user capacity. However, the VERP handbook (NPS, 1997) defines user capacity as, "...the types and levels of visitor and other public use that can be accommodated while sustaining the desired resource and social conditions that complement the purpose of the park." Note that this definition, a) emphasizes the goal of sustaining desired conditions, and b) addresses both the level and type of public use. Natural soundscapes are an important aspect of desired conditions, and types of visitors might be defined based on their sound levels. Accordingly, a VERP indicator measuring the audible sounds of visitors is appropriate.

Specifying a Standard for Audible Sounds of Visitors

Current information concerning the impacts of sounds on visitor experience is not sufficient to recommend a numeric standard for audible sounds of visitors.⁶ Such a standard might eventually be stated in a form such as, "During at least 95 percent of peak use hours, observers will hear no more than X sounds per hour from other visitor parties." Several sources will be useful in selecting such a standard, including: a) research describing the impacts of visitor sounds on other visitors' experiences, b) monitoring of existing sound levels in the semi-primitive trail zone at MORA, and c) the professional judgment of managers concerning appropriate sound levels in relation to the desired conditions for the semi-primitive trail zone. Research at MORA has established that the

⁶ Although a standard for the audible sounds of visitors can be based on their impacts on natural soundscapes or wildlife, this section focuses only on protecting visitor experiences from the impact of sound.

sounds of other visitors are commonly reported to negatively affect hikers' experiences (Vande Kamp, Johnson and Swanson 1998, Vande Kamp, Swanson, and Johnson 1999), but the relationship between the number and intensity of audible sounds and the level of impact on experiences has not been investigated.

Implementing a Monitoring Program for Audible sounds of visitors

Monitoring sound can be a complex undertaking. The simplest and most appropriate method of monitoring the audible sounds of visitors in the semi-primitive trail zone is probably attended listening. In attended listening, a trained observer sits quietly with a data sheet or other means of recording information. When they hear a sound, they record the time at which they first heard it, the amount of time it was audible, and a description of the sound. In quiet environments, attended listening can be used to record all audible sounds, but for the purposes of monitoring this indicator, it might be necessary to focus on recording only the sounds of visitors. Monitoring can also be conducted using microphones and recording equipment. However, such efforts introduce technical issues related to the equipment, and generally require that observers listen to the recorded sounds in order to identify them, thus providing only a limited advantage over attended listening in the hours of labor necessary to produce useable information.

A monitoring program must include descriptions of both how to record sounds and when to record them. One problem would be to schedule listening sessions during peak use. If standards are stated in terms of 95th percentile conditions, then only a very small number of hours every season provide an opportunity to directly measure whether conditions are within standard. One means of addressing this problem is discussed in the next section.

Information Needs

The primary form of information useful to managers would be a study designed to: a) provide a baseline inventory of the sounds of visitors at different sites in the semi-primitive trail zone, and b) describe the relationship between sounds and use levels (i.e., direct or electronic counts of the number of visitors) at those sites. Such a study would help managers specify a standard for visitor sounds by providing numeric descriptions of conditions they have experienced. For example, the study might establish that on summer weekends, observers hear 9 sounds per hour on the Wonderland Trail south of Panhandle Gap, but that observers in upper Spray Park hear 15 sounds per hour. By comparing such numbers with professional judgment about the appropriateness of the conditions at those sites, a numeric standard might be selected.

Such a study might also greatly simplify the task of future monitoring. If sound events are consistently and highly related to use levels, then attended listening during busy, but not peak use, time periods could be used to estimate sound conditions during the busiest times. It would be much easier to design monitoring programs to simultaneously measure sound events and use levels than to arrange monitoring of sound events on enough 95th percentile days to provide reliable direct evidence of whether conditions meet standards.

Possible Management Actions Necessary to Maintain Standard

A variety of management actions might serve to limit the sounds made by visitors. The least obtrusive would be to provide information to day-hikers that would seek to persuade them to hike quietly, particularly in high, open, rocky areas where sounds travel most readily. Slightly more intrusive would be messages encouraging hikers to alter their trips in some way (either in scheduling or the routes they hike) so as to minimize the density of hikers, particularly in sensitive areas. Care would be necessary to design effective messages. The content might vary from persuasive appeals (“please hike quietly to help everyone enjoy this special place”) to more coercive messages (“visitors who yell or otherwise make excessive noise may be subject to fines”). Selecting the appropriate content would depend on the degree that conditions exceed the standard, or evidence showing that the less coercive messages were not sufficient to meet the standard.

If sound events are related to use levels, managers could also directly regulate use of specific trails or trail networks in the semi-primitive trail zone. Currently, the only means to implement such regulation would be to stop taking reservations for the area that is out of standard. However, such actions are likely to have almost no effect on sound events because the total number of campers is likely to make up only a tiny proportion of users in the areas of the semi-primitive trail zone where standards are exceeded. Thus, it is likely that altering use levels sufficiently to effectively regulate the sounds of visitors in the semi-primitive trail zone would require a program to manage day-hiking use.

Recommended Indicator: Campsite Availability

The Indicator and the Way in Which Visitation Leads to Impact

One event that visitors sometimes encounter is to reach a campground and find that all the campsites are full. Studies have shown that such situations detract from the quality of visitor experiences (Manning 2007). In the semi-primitive trail zone at MORA, campsite reservations are intended to eliminate such situations. Nonetheless, visitors occasionally stay in trailside camps where they do not have reservations and other parties with valid reservations may then find themselves faced with a choice of asking to share a campsite or camping elsewhere in technical violation of their permit. The number of times that backpackers encounter this situation is an indicator of experience quality in the semi-primitive trail zone.

Obviously, the number of times that campsites are unavailable is determined almost entirely by visitor behavior (i.e., noncompliance) rather than the number of visitors. Thus, the indicator may appear conceptually inconsistent with the idea of establishing a user capacity. Nonetheless, the MORA VERP planning team wanted to explore an indicator for campsite availability because they wanted to establish that inappropriate impacts to visitor experiences arise when parties find that their reserved camps are full.

Specifying a Standard for Campsite Availability

The recommended standard for campsite availability is that no parties will find that their reserved camps are full. Such a “zero tolerance” standard can be problematic under some interpretations of the VERP process. In VERP, conditions that exceed a standard trigger management action. Thus, every report of a full camp would require a

management response. If one assumes that management responses are limited to major, zone-wide actions, then “zero tolerance” standards are undesirable. However, management actions might also occur on a much smaller scale. For example, affected parties might be reassured that camping in technical violation of their permit is acceptable under special conditions, and area rangers might be advised to make special efforts to check reservations at certain camps. The MORA VERP team felt that the standard should imply no tolerance for camping in violation of regulations and that small scale management actions were appropriate in response to isolated reports of unavailable campsites.

Implementing a Monitoring Program for Campsite Availability

The simplest and most appropriate method of monitoring campsite availability would be to ask a sample of backpackers whether they found that campsites were not available at any of the trailside camps at which they held reservations. A simple survey could be conducted periodically by contacting backpackers using the information recorded during the backcountry permit process.

Information Needs

The primary form of information useful to managers would be an initial survey that could be used to estimate the number of times that MORA backpackers currently find that campsites are unavailable. This information would help managers determine whether current actions to ensure campsite availability are adequate, whether small scale actions are sufficient to address current incidents, or whether larger scale actions are necessary to protect backpackers from the negative effects on trip enjoyment resulting when campsites are unavailable to parties with valid reservations.

Possible Management Actions Necessary to Maintain Standard

As mentioned above, small scale management actions might include reassurance to affected parties that camping in technical violation of their permit is acceptable under special conditions, or advising backcountry rangers to make special efforts to check reservations at certain camps. Larger scale actions might include adding messages to the permit procedure that strongly discourage visitors from camping at sites where they do not have reservations. Such messages might even threaten fines for violations.

At an extreme level, MORA managers could deliberately under-book reservations at trailside camps so that camps would almost never be full. Such an action might have the unintended consequence of encouraging noncompliance with the reservation system. However, if combined with rigorous enforcement, it would certainly reduce the number of times that campsites are not available.

Transition Trail Zone

Desired Visitor Experience

Same as the semiprimitive zone, except for the number of people that may be encountered. Opportunities for solitude would be uncommon — there would be many opportunities for social interaction. A high number of visitors may be encountered in designated camps. Visitors may be widely dispersed or concentrated along the well-maintained trails.

Focal Experiential Outcome

As a Wilderness zone, the transition trail zone requires some emphasis on solitude. Thus the focal experiential outcome of opportunities for solitude is shared with several other wilderness zones. However, the level of use in this zone is sufficiently high that one might argue that encounters with other visitors (as usually defined) may not be the best indicator of opportunities for solitude in this zone.

The assumption that some level of solitude is important to users of the transition trail zone is supported by research results. A 1995 survey found that at least 44 percent of weekend hikers at Comet Falls, Glacier Basin, Mount Fremont, and Summerland saw more other hikers than they preferred (Vande Kamp, Swanson, and Johnson 1999), and a 1993 survey at Spray Park found that on weekends, 44 percent of respondents said that they felt crowded by the number of other people at some point during their hike (Vande Kamp, Johnson, and Swanson 1998).

Recommended Indicator: Encounters with Other Parties

The Indicator and the Way in Which Visitation Leads to Impact

Although feelings of solitude are a subjective experience, the presence of other visitors is closely related to, if not the determining component of, solitude. Thus, measurements (i.e., counts) of the number of encounters between visitors are widely adopted as indicators of solitude (Vande Kamp 1998).

Because the transition trail zone is focused closely on trails that form a linear system of visitor movement, the relationship between visitation, encounters, and solitude is very strong. Aspects of visitor movement such as the direction of travel, variability in hiking speeds, and relative prevalence of loops or out-and-back hiking routes all influence the relationship between the number of visitors and the number of times they encounter each other, but there is no question that the relationship is strong.

Specifying a Standard for Encounters with Other Parties

Although some degree of solitude is an important aspect of the visitor experience to be provided in the transition trail zone, neither the desired visitor experience nor its underlying documentation specify the number of encounters at which appropriate levels of solitude are being provided. In the absence of such language, the VERP planning team turned to estimates of the number of encounters that currently occur in the transition trail zones as the primary source of numeric information to be used in selecting encounter standards. The sources of those estimates were simulation models of visitor use at three heavily-visited trails in MORA (see Vande Kamp 2009a). The models simulated visitor

use on the trails to Comet Falls, Spray Park, and Summerland. These trails were selected for simulation modeling because they are among the most heavily-used wilderness trails at MORA. Thus, it is likely that if conditions at the trails do not exceed the proposed standard, then the standard will also be met everywhere else in the transition trail zone. Numeric description of visitor use on these trail segments, combined with direct experience of current use levels and professional judgment concerning the appropriateness of those conditions provide a reasonable basis for managers to set encounter standards for the transition trail zone. The estimated encounters for each trail are described very briefly below (see Vande Kamp 2009a for more detail).

At Comet Falls, the simulation model estimates that on 95th percentile days (i.e., days busier than 95 percent of all days during July and August), visitors averaged 6.3 encounters per hour. In addition, the distribution of encounter rates showed that approximately 80 percent of visitors averaged fewer than 8 encounters per hour during simulated hikes.

The Spray Park Trail showed higher encounter rates. Hikers averaged 7.3 encounters per hour on simulated 95th percentile days. In addition, the distribution of encounter rates showed that only 70 percent of visitors averaged fewer than 8 encounters per hour during simulated hikes.

Finally, at Summerland, encounter rates were quite similar to Comet Falls. Hikers averaged 6.5 encounters per hour on simulated 95th percentile days. In addition, the distribution of encounter rates showed that approximately 83 percent of visitors averaged fewer than 8 encounters per hour during simulated hikes.

Based on the GMP description of desired conditions, professional judgment, direct experience with current use levels, and the numeric estimates of current encounter levels described above, the VERP planning team recommended that the standard for encounters between parties in the transition trail zone should ensure that even on the busiest (i.e., 95th percentile) days, almost all visitors (at least 80 percent) will pass fewer than eight other parties per hour during their hikes.

Note that the indicator is average encounters per hour over the course of the hike, not average encounters per hour on given trail segments (as in the semi-primitive trail zone). In practice, this standard would allow some trail segments to have encounter rates higher than eight per hour, as long as the average encounter rate across the entire hike was lower than eight per hour.

Implementing a Monitoring Program for Encounters with Other Parties

As in the semi-primitive zone, one of the benefits of estimating encounters based on simulation modeling is the clear definition of what constitutes an encounter between hiking parties. In the simulation models, an encounter occurs when hiking parties pass each other (either in opposite directions or overtaking) while hiking on the trail. This definition excludes some types of encounters between parties that may influence experiences. For example, parties that are stopped at attraction sites when another party hikes past are not counted in the encounter total. However, the indicator can be explained clearly, measured consistently, and related to general impressions of existing conditions.

A variety of methods could be used to monitor encounters between hiking parties. Perhaps the most obvious method of monitoring encounters is to ask visitors how many

other parties they passed. This method is problematic at MORA because hikers have no reason to differentiate between encounters that occur in semi-primitive or transition trail zones. They are even unlikely to make distinctions between official trails and way trails. Further, research has found that hikers' estimates of encounters are inaccurate once the number of encounters rises above approximately 7 per day (Manning, Lime, Freimund, and Pitt 1996).

Currently, the simplest method of monitoring encounters would be to install trail counters at the same sites used to collect the visitor counts used in developing and validating the simulation models. The monitored counts could then be fed into the simulation models to determine whether the estimated number of encounters per hour exceeds the standard. The effectiveness of such monitoring depends on the validity of the simulation models. Thus, it should be combined with periodic validation of those models. Such validation could be accomplished by recording use levels on observed days using trail counters or direct observation, and by having trained observers hike to Comet Falls, Spray Park, and Summerland, recording the number of times they pass other parties of visitors. Comparing the observed encounters to the estimated encounters provided by the simulations would serve to validate (or invalidate) the models. Conducting such validation studies would immediately buttress the validity of the simulation models, and should be repeated regularly (e.g., every five years, or when other factors suggest that visitation patterns have changed) to insure that changes in visitor use do not alter conditions in ways that allow the standard for encounters to be exceeded.

Monitoring encounters on transition trails that have not been simulated is more difficult. The most accurate method would be to have trained observers record hiking encounters as in the validation studies. However, without a valid simulation model, the most relevant observations would have to occur on very busy (i.e., 95th percentile) days. A more feasible method would be to measure or estimate parameters that could be used in a general equation to estimate encounters. Such an equation was proposed based on the simulation models of Comet Falls, Spray Park, and Summerland (see Vande Kamp 2009), but requires additional testing and evaluation before it can be assumed to produce valid estimates of hiking encounters. In the analysis aimed at producing the general equation, extremely strong linear relationships were observed between the number of hiking parties entering the simulation models and the number of encounters. These relationships suggest that direct observation of hiking encounters need not focus only on very busy (i.e., 95th percentile) days, but could be collected across a range of visitation levels and then used to estimate encounters on the busiest days.

Information Needs

Three types of information would be useful to support and refine the implementation of the standard for encounters in the semi-primitive trail zone. First, studies that would directly observe the number of hiking encounters per hour on the simulated trails and compare those observations to the number of encounters estimated by the simulation models would serve to validate the models (or provide a basis for their refinement) and thus buttress the use of the models in monitoring the encounter standard.

The second type of useful information would be additional simulation models of day-hiking trails. These models would be useful even if they did not represent trails at MORA. If they are similar in character to MORA trails, then their outputs could be used

to establish the validity of the general equation proposed as a means of estimating encounters at trails that are not simulated.

The third type of useful information would be information useful for directly or indirectly estimating the parameters used in the general equation to estimate encounters. Such information would include counts recorded by electronic trail counters of the number of hiker passages on trails that are not simulated by the existing models but are thought to be most heavily visited. Such counts could inform managers about the potential for encounters to exceed the standard on other trails in the transition trail zone.

Possible Management Actions Necessary to Maintain Standard

A variety of management actions might serve to limit encounters between visitors. The least obtrusive would be to provide information to day-hikers that would seek to persuade them to avoid areas that are out of standard, or to alter their trips in some way (either in scheduling or the routes they hike) so as to minimize encounters. Care would be necessary to design effective messages.

Managers could also directly regulate use of specific trails or trail networks in the transition trail zone. Currently, the only means to implement such regulation would be to stop taking cross-country camping reservations for the area that is out of standard. However, such actions are likely to have little effect because the total number of campers is likely to make up only a tiny proportion of users in the transition trail zone. Thus, it is likely that altering use levels sufficiently to effectively regulate encounters between visitors in the transition trail zone would require a program to manage day-hiking use.

Recommended Indicator: Audible Sounds of Visitors⁷

The Indicator and the Way in Which Visitation Leads to Impact

We argued above that although feelings of solitude are a subjective experience, the presence of other visitors is closely related to, if not the determining component of, solitude. Passing other parties on the trail is one way in which their presence is made evident. However, sounds made by other visitors can reveal their presence, even if they don't pass by on the trail.

Some sounds detract particularly strongly from visitor experiences. For example, when asking about incidents in which other visitors detracted from experience, surveys of hikers on a number of trails in the transition trail zone found that inappropriate noise from rowdy visitors was the most commonly reported behavior (Vande Kamp, Johnson, and Swanson 1998; Vande Kamp, Swanson, and Johnson 1999).

Whether sounds simply indicate visitors' presence or are considered inappropriate, an indicator measuring the audible sounds of visitors could be useful to monitor and protect solitude and other aspects of experience quality. In addition, natural soundscapes have recently gained prominence as a resource worthy of protection in their own right (NPS 2000), and sounds are one way in which visitors may have negative impacts on wildlife

⁷ The discussion of this indicator is virtually identical for the semi-primitive and transition trail zones. Although the redundancy presents an obstacle to readers of this entire report, the sections are repeated to ensure that readers focused on a particular zone are presented with all relevant information.

(Bowles 1995). All these factors support the adoption of an indicator measuring audible sounds of visitors.

Obviously, the number of times that the sounds of visitors are audible is determined as much by visitor behavior as by the number of visitors. Thus, the indicator may appear conceptually inconsistent with the idea of establishing a user capacity. However, the VERP handbook (NPS, 1997) defines user capacity as, "...the types and levels of visitor and other public use that can be accommodated while sustaining the desired resource and social conditions that complement the purpose of the park." Note that this definition, a) emphasizes the goal of sustaining desired conditions, and b) addresses both the level and type of public use. Natural soundscapes are an important aspect of desired conditions, and types of visitors might be defined based on their sound levels. Accordingly, a VERP indicator measuring the audible sounds of visitors is appropriate.

Specifying a Standard for Audible Sounds of Visitors

Current information concerning the impacts of sounds on visitor experience is not sufficient to recommend a numeric standard for audible sounds of visitors.⁸ Such a standard might eventually be stated in a form such as, "During at least 95 percent of peak use hours, observers will hear no more than X sounds per hour from visitor parties." Several sources will be useful in selecting such a standard, including: a) research describing the impacts of visitor sounds on other visitors' experiences, b) monitoring of existing sound levels in the transition trail zone at MORA, and c) the professional judgment of managers concerning appropriate sound levels in relation to the desired conditions for the transition trail zone. Research at MORA has established that the sounds of other visitors are commonly reported to negatively affect hikers' experiences (Vande Kamp, Johnson and Swanson 1998, Vande Kamp, Swanson, and Johnson 1999), but the relationship between the number and intensity of audible sounds and the level of impact on experiences has not been investigated.

Implementing a Monitoring Program for Audible sounds of visitors

Monitoring sound can be a complex undertaking. The simplest and most appropriate method of monitoring the audible sounds of visitors in the transition trail zone is probably attended listening. In attended listening, a trained observer sits quietly with a data sheet or other means of recording information. When they hear a sound, they record the time at which they first heard it, the amount of time it was audible, and a description of the sound. In quiet environments, attended listening can be used to record all audible sounds, but for the purposes of monitoring this indicator, it might be necessary to focus on recording only the sounds of visitors. Monitoring can also be conducted using microphones and recording equipment. However, such efforts introduce technical issues related to the equipment, and generally require that observers listen to recorded sounds in order to identify them, thus providing only a limited advantage over attended listening in the hours of labor necessary to produce useable information.

⁸ Although a standard for the audible sounds of visitors can be based on their impacts on natural soundscapes or wildlife, this section focuses only on protecting visitor experiences from the impact of sound.

A monitoring program must include descriptions of both how to record sounds and when to record them. One problem would be to schedule listening sessions during peak use. If standards are stated in terms of 95th percentile conditions, then only a very small number of hours every season provide an opportunity to directly measure whether conditions are within standard. One means of addressing this problem is discussed in the next section.

Information Needs

The primary form of information useful to managers would be a study designed to: a) provide a baseline inventory of the sounds of visitors at different sites in the transition trail zone, and b) describe the relationship between sounds and use levels (i.e., direct or electronic counts of the number of visitors) at those sites. Such a study would help managers specify a standard for visitor sounds by providing numeric descriptions of conditions they have experienced. For example, the study might establish that on summer weekends, observers hear 15 sounds per hour on the Wonderland Trail just past the Summerland Shelter, but that observers on the Mount Fremont Trail hear 25 sounds per hour. By comparing such numbers with professional judgment about the appropriateness of the conditions at those sites, a numeric standard might be selected.

Such a study might also greatly simplify the task of future monitoring. If sound events are related to use levels, then attended listening during busy, but not peak use, time periods could be used to estimate sound conditions during the busiest times. It would be much easier to design monitoring programs to simultaneously measure sound events and use levels than to arrange monitoring of sound events on enough 95th percentile days to provide reliable direct evidence of whether conditions meet standards.

Possible Management Actions Necessary to Maintain Standard

A variety of management actions might serve to limit the sounds made by visitors. The least obtrusive would be to provide information to day-hikers that would seek to persuade them to hike quietly, particularly in high, open, rocky areas where sounds travel most readily. Slightly more intrusive would be messages encouraging hikers to alter their trips in some way (either in scheduling or the routes they hike) so as to minimize the density of hikers, particularly in sensitive areas. Care would be necessary to design effective messages. The content might vary from persuasive appeals (“please hike quietly to help everyone enjoy this special place”) to more coercive messages (“visitors who yell or otherwise make excessive noise may be subject to fines”). Selecting the appropriate content would depend on the degree that conditions exceed the standard, or evidence showing that the less coercive messages were not sufficient to meet the standard.

If sound events are related to use levels, managers could also directly regulate use of specific trails or trail networks in the transition trail zone. Currently, the only means to implement such regulation would be to stop taking cross-country camping reservations for the area that is out of standard. However, such actions are likely to have almost no effect on sound events because the total number of campers is likely to make up only a tiny proportion of users in the areas of the transition trail zone where standards are exceeded. Thus, it is likely that altering use levels sufficiently to effectively regulate the sounds of visitors in the transition trail zone would require a program to manage day-hiking use.

Unpicked Potential Indicator: Time Periods When Other Parties Are Not Encountered

Percent of Time with No Parties in Sight

The recommended indicator, “encounters with other visitors” measures opportunities for solitude by counting instances in which parties are not alone. It might be argued that such a measure is unwieldy in high-density areas because the number of encounters is so high that it becomes difficult for both visitors and managers to relate to the social conditions in a meaningful way. For example, it may be difficult to evaluate the difference between a hike on which one encounters 25 other parties and a hike on which one encounters 50 other parties. In contrast, it may be easier to evaluate a hike when other parties are visible 50 percent of the time versus a hike when others are visible 75 percent of the time. In effect, an indicator measuring durations of solitude may be more intuitive than a measure of deviations from solitude.

Longest Periods without Encounters

It may be even more intuitive to consider the distribution of times that parties are alone. Being alone 50 percent of the time may be more acceptable when long periods of solitude are interspersed with shorter periods of frequent encounters than when shorter periods of solitude are distributed relatively evenly. Based on this argument, an indicator measuring the longest period of solitude experienced by hikers might prove useful.

Discussion

Although both of the indicators measuring periods of solitude may be more intuitive to some people, it is not clear that the potential advantage offsets problems that are likely to arise in measuring the indicators. For example, it would be difficult to design a protocol and train observers to measure the time that other parties are visible during typical hikes. The simulation models could be used to estimate the measure, but validation of those models would still require direct observation and measurement. It could also prove difficult to compare different periods of solitude when setting standards. For example, it is not clear whether or not an hour of hiking split into 50-minute and 10-minute periods of solitude would be preferable to two 30-minute periods of solitude. The planning team recognized the experiential importance of periods of solitude but the recommended indicator, average encounters per hour, was selected because it will protect some degree of solitude no matter how it is measured.

Moderate Use and High Use Climbing Zones

Desired Visitor Experience

Moderate Use

The primary activity in this zone would be mountaineering, [although there also may be day hikers.] Commercial guide services also may be permitted. Visitors may experience a high degree of adventure and exploration in this zone, while encountering a moderate number of other visitors. Many opportunities for solitude would be available, although there also would be the potential for a high degree of social interaction. Visitors would need to have a high degree of self-reliance and have a high level of knowledge and skill to visit this zone due to inherent dangers in the terrain and climate. Although most travel would be cross-country, some way trails or routes may be present. Some routes would have no commercial use. Day and overnight use (commercial and public) and party size would be limited. Permits would be required for wilderness camping and climbing. Camping would be primarily dispersed, although there may be designated trailside camps and a few designated campsites to protect the sensitive alpine environment. Camping would adhere to Leave No Trace standards except in areas where there are designated campsites. No onsite interpretation and education (e.g., signs) would be provided, however, offsite interpretation and education would be provided.

High Use

Same as the moderate use climbing zone, except higher numbers of people would be encountered. There would be few opportunities for solitude; instead, there would be the potential for a high degree of social interaction.

Focal Experiential Outcome

The dominant characteristics of the visitor experience in the climbing zones concern challenge and adventure associated with mountaineering. Within that context, solitude plays a smaller role than in other wilderness zones. Interviews with experienced climbers conducted during the design phase of a 2004 survey of Mount Rainier climbers (Husbands 2006) suggested that concerns about the number of climbers in the zone are rarely focused on aesthetic issues such as solitude, and more often relate to safety hazards that arise when climbers are concentrated in certain areas, and delays (that may or may not be associated with safety) that are more likely to occur when use levels are high.

Subsequent to the initial interviews, a survey of climbers in private parties⁹ was conducted. The questionnaire asked climbers to rate the incidence and impact of delays due to other parties. The survey also asked about several other measures that might conceivably serve as indicators, including climbers' concerns about hazards related to other parties, and a number of other factors present at high camps. However, only delays due to other parties were found to be both related to the number of climbers in the

⁹ Sampling of climbers who were clients of RMI proved to be very difficult due to the logistical constraints of that operation. Because only a few, probably non-representative, RMI clients completed the survey, results of the survey were not generalized to guided climbers.

environment and relatively important to the quality of climbers' experiences. Thus, the focal experience in the moderate and high use climbing zones was the freedom from delays caused by other climbers and the opportunity to climb at the desired pace.

Recommended Indicator: Delay Caused by Other Parties

The Indicator and the Way in Which Visitation Leads to Impact

Most climbers in the climbing zones make use of an established boot-track on their way to the summit. The single-lane nature of a boot-track, as well as the presence of rock or crevasse features that require some technical skill to negotiate, create situations in which many parties will overtake others and experience some delay before they can safely or conveniently pass slower parties. It is logical that the incidence of such delays will increase as the number of climbers grows. Indeed, use levels were a statistically significant predictor of the likelihood of waiting for other climbers at some point on both the Disappointment Cleaver and Emmons climbing routes at Mount Rainier (Husbands 2006).

The degree to which incidence of delay is directly related to the number of climbers on the route may depend to some extent on the behavior of the parties being overtaken. It is possible that if slower parties immediately offer to let faster parties pass, reported delays could be very low, even in situations when many climbers are present. The survey of climbers asking about delays did not define a specific period of time necessary to constitute a delay, but the imperfect relationships between reported delays and use levels that were observed in the climber survey (Husbands 2006) suggest that delays are determined by both the number of climbers and their behavior.

The level of subjectivity inherent in climbers' judgments of when others are presenting a delay is a weakness of the indicator as it was measured in the climber survey. It may be possible to limit this weakness during monitoring by asking the question in a relatively specific way. Alternately, measures of actual delays might be collected and evaluated for future use as an indicator (see the *Information Needs* section below).

Specifying a Standard for Delay Caused by Other Parties

Although climbers report that delays have some importance to their experience, and most climbers on the Disappointment Cleaver route experience at least one delay, it is not obvious that climber experiences with delay constitute inappropriate or unacceptable conditions. Husbands (2006) recommends that standards in the high and moderate use climbing use zones be set to reflect the conditions observed in the climber survey. In accordance with that recommendation, the VERP planning team agreed that the standard for the Emmons route in the moderate use climbing zone should be that on 80 percent of days, at least half of climbers will experience no delays. The VERP planning team felt that it was important to set a different standard for the Kautz Glacier climbing route in the moderate use climbing zone. However, the sample of Kautz Glacier climbers in the climber survey was not sufficient to estimate current levels of delay with any degree of confidence. In the absence of such data, a tentative recommendation for a Kautz Glacier standard is that on 80 percent of days, at least 90 percent of climbers will experience no delays.

The desired experience for the high use climbing zone emphasizes the potential for a high degree of social interaction. The VERP planning team thus felt a less stringent standard consistent with the levels of use observed during the climber survey was appropriate. Thus, the recommended standard for the high use zone is that on 80 percent of days, at least half of climbers will experience fewer than two delays.

Implementing a Monitoring Program for Delays Caused by Other Parties

The most feasible method to monitor delays caused by other climbing parties is to simply ask climbers how many times during their climb from high camp that they were delayed by other parties. In order to limit variability in the way climbers define delay (thus decreasing the likelihood that variations in delay will be due to factors other than changes in visitation) the question should be asked and answered in as specific a manner as possible. For example, at climber check-out, a member from each climbing team might be asked, “How many times after you left high camp were you delayed by parties other than your own? For the purposes of this question, a delay occurred when your climbing pace was slowed for more than two minutes, or when your progress was halted while you waited for other parties to clear a section of the route.”

There are strong conceptual and methodological reasons to monitor delays with a more specific question than that used in the climber survey, but such a change also opens the possibility that the recommended standards will not be appropriate. If monitoring determines that reported delays differ considerably from the recommended standard (recall that the standard was intended to protect conditions similar to those reported in 2004), then it may be possible that the change was due to the more specific question and that social conditions on the route are unchanged.

Managers are faced with two possible courses of action regarding the monitoring of delays and the selection of standards for delays caused by other parties. In the first option, a study could be conducted to determine the relationship between the number of delays reported using the method used in the 2004 Climber Survey and the new method proposed for use in monitoring. Based on the results of that study, the standards recommended above could be adjusted to levels such that the levels recorded by monitoring with the new question would be equal to the levels recorded in the 2004 survey.

The second option for managers would be to evaluate whether they wish to make the case, based on professional judgment and the desired condition statements that the recommended standards are appropriate to protect desired climbing conditions *when delay is measured by the more specific question used in monitoring*. In the absence of empirical information, managers will not be able to argue that the two measures of delay are equivalent, but they could argue that even if the measures do differ, the proposed standard will still adequately protect climbing experiences.

Information Needs

The first potential information need is made clear in the section above discussing monitoring. A study to determine the relationship between the number of delays reported using the method used in the 2004 Climber Survey and the new method proposed for use

in monitoring would be very useful in assessing whether the standards will ensure climbing conditions with no more delays than those recorded in 2004.

Possible Management Actions Necessary to Maintain Standard

Delays are determined by both the behavior and number of climbers. Husbands (2006) described some limited evidence that efforts by rangers and mountain guides to organize a sequence of departure times from high camp limited the number of delays on busy climbing days. Such efforts should be considered moderately obtrusive because they may reduce the “unconfined” nature of climbing as wilderness recreation. Nonetheless, they are apparently an effective management action that might be implemented (or implemented more consistently) to maintain standards for delays caused by other parties.

A second, less obtrusive management action would be to inform climbers about the possibilities for delay and to encourage slower parties to let faster parties pass as soon as possible. This action would likely prove most effective in the moderate use climbing zone, or on lower-use days in the high use climbing zone. Husbands (2006) suggested that on the busiest days in the high use climbing zone “saturation” may occur. Saturation refers to the point at which climbers are so evenly distributed along the route that faster groups give up attempts to pass others and become resigned to the pace established by overall traffic. The climber survey did not investigate the occurrence of saturation or its impact on experience quality (if it occurs). The possibility that saturation occurs could be assessed by measuring climbing times to assess actual (rather than perceived) delays (see the next section, below).

Reducing the number of climbers by limiting camping or climbing permits would likely be a relatively inefficient way of reducing reported delays. If used at all, such an action should be made in conjunction with other efforts to reduce delays by altering climbers’ behavior. It is not at all clear that climbers would support such an action. The climber survey found that a significant number of climbers sampled on the Disappointment Cleaver and Emmons routes disagreed with the statement that the number of climbers should be limited to protect climber experiences (Husbands 2006).

Unpicked Potential Indicator (Moderate and High Use Climbing Zones): Measures of Duration and Variability in Climbing Times

There is an important distinction between the delays reported by climbers and objective evidence of delay that might be measured by recording climbing times. As described above, reported delays can be monitored and used as a VERP indicator protecting experience quality. However, a case can be made that a measure of delay based on actual climbing times might also serve as a useful indicator. Climbing times are simpler to collect than reported delays, and they do not rely as heavily on the judgment of the climber (even with a specifically worded question, the process of judging whether a delay has occurred introduces considerable individual variability into the measurement and can also change over time if the climber population changes).

The significance of actual delays is more difficult to establish than the desirability of its measurement characteristics. One might argue that longer climbing times show that climbers are altering each others’ freedom of movement, or that longer climbing times create more exposure to objective hazards. However, managers should decide whether

such issues are important aspects of desired climbing experiences before selecting, or working to develop an indicator based on delay as measured by climbing times.

Monitoring Delay Based on Climbing Times

Recording climbing times is relatively simple because climbers are required to check in with MORA staff after completing their climbs. Asking climbers six simple questions at that time would be sufficient to gather the critical information needed to assess the relationship between climbing delays and use levels.¹⁰

- Where was your high camp?
- When did you leave high camp? (Date and time)
- Did you reach the summit?
- When did you summit?
- When did you reach high camp on your return?
- How many climbers were in your rope team?

These data would allow relatively sophisticated analysis of the effect of various numbers of climbers on the climbing speeds of all climbers. The first analysis could compare climbing times on busy days to those from less-busy days. It is likely that busy days would have slower times, but the possible impact of other factors such as weather or climbing conditions would also need to be taken into account.

A very closely related analysis would be to compare the variability in climbing times on busy days to that on less-busy days. If the route sometimes becomes so crowded that faster parties eventually become resigned to the general pace of the lined-up groups (i.e., the route reaches “saturation”), then variability should decrease on the busiest days.

The size of roped teams is a potentially important variable because larger teams would be likely to travel more slowly than small teams. If the proportion of large teams is not consistent across use levels, then it will be necessary to include team size in the analysis to separate its effect from the effect of use level in general.

The primary factor that could threaten the use of climbing times as a measure of delay due to other parties is the possibility that faster climbers might choose to climb at less busy times. In that case, climbing times would lengthen on busy days, but the effect would not be due to delays. This possibility suggests that an indicator based on climbing time should not supplant reported delays for use in the climbing zones, but might be used in conjunction with the more subjective indicator.

¹⁰ Note that this information can be collected on either an individual or rope team level of analysis, but it is critical that the unit of analysis be clear and consistent for all data collection. The questions could be included in the climber check-out procedure. The addition of the questions would require OMB review, but this is a very innocuous set of information to collect, so there should be no problem getting approval.

Unpicked Potential Indicator (Moderate and High Use Climbing Zones): Exposure to Hazards

Anthropogenic Hazards

When the climber survey (Husbands, 2006) was designed, it was thought that the level of hazard posed by other climbing parties (i.e., anthropogenic hazards) might serve as a useful indicator. Results of the survey generally failed to support the selection of such an indicator. Anthropogenic hazards were of concern to climbers in only a few locations on the Disappointment Cleaver route (Husbands, 2006). Even more problematic, they were not consistently related to use levels. Finally, it is not clear how managers might alter visitation in order to reduce exposure to anthropogenic hazards.

Delay in Hazardous Areas

Hazards did increase climbers' ratings of the impact of delays. Climbers reported greater detraction from their experiences due to delays in areas where they also reported concerns about hazards (Husbands, 2006). This finding might be used as the basis for an argument that the visitor experience indicator should focus only on the number of reported delays in hazardous areas. However, the survey data were not sufficient to establish a relationship between use levels and the number of delays in hazardous areas. In addition, long-term monitoring would be complicated by a need to distinguish between delays that did or did not occur in hazardous areas. Thus, although the survey found that delays in hazardous areas had a greater negative impact on climbers' experiences, this finding is interpreted as generally supporting the use of all reported delays as a visitor experience indicator (because that measure includes hazardous delays) and not as a strong argument for the more specific indicator of delays in hazardous areas.

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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 and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environment and cultural values of our national parks and historical places, and providing for 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 interest 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 US administration.