



Figure 1 (left). Built for horse-drawn carriages in the early 1900s, the well-engineered, gravel carriage roads of Acadia National Park (Maine) are very popular among bicyclists and hikers today, creating the potential for crowding and conflict.

Figures 2 and 3 (right, far right). Visitors participating in the social carrying capacity study were asked to rate the acceptability of scenes depicted in 19 computer-generated photos, including these, that illustrated varying numbers and types of carriage road use. These photographs show a typical viewscape on the carriage roads—approximately 100 meters in length.

Crowding and conflict on the carriage roads of Acadia National Park:

An application of the Visitor Experience Resource Protection framework

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The carriage roads of Acadia National Park are a unique system of more than 50 miles of beautifully designed and highly engineered gravel roads built under the direction of John D. Rockefeller, Jr., in the early 1900s (figure 1). Although the roads were built for horse-drawn carriages, they are now used mainly by bicyclists and walkers, providing a welcome escape from automobile traffic and access to many undeveloped areas of the park. Equestrian use is low. Longtime observers agree that carriage road use increased greatly with the rise in popularity of the mountain bike in the 1980s, although no data on carriage road use were collected during this time period. However, the park fielded an increasing number of complaints from visitors and area residents during this time about “crowding” and “conflict” on the carriage roads.

In response to these threats to the quality of the visitor experience, park managers decided to apply the Visitor Experience Resource Protection (VERP) framework to carriage road use (National Park Service 1997). VERP addresses carrying capacity and visitor use management of national park areas through nine elements in a generally linear but also iterative process. VERP is one of several frameworks that provide a logical and rational basis for decision-making, and it is becoming more

commonly used throughout the national park system.

The VERP framework can also include a natural or cultural resource component for determining carrying capacity. However, we determined that resource impacts at Acadia were minimal. Social trails, erosion, and trampling of vegetation are potential natural resource problems, especially around bridges, ponds, and viewpoints. However, bicyclists, the main users of the carriage roads, are not now causing these problems. Bicyclists are also not using the carriage roads to access hiking trails (biking is not allowed on hiking trails) and thus adding to trail erosion. Nesting peregrine falcons were located well above the carriage road at Jordan Pond and their productivity suggests they were not affected by visitor use. Although the park does not formally monitor natural resources adjacent to the carriage roads, the best professional judgment of park staff was that current impacts were not significant enough to warrant a natural resource component to the carrying capacity process.

As long as the carriage roads are properly maintained (a private endowment now ensures this) visitor use is also unlikely to degrade the road or the bridges (the cultural resource). Only increased equestrian use might pose a threat, and only then if road maintenance is unable to keep up with damage caused by horse use. Thus, this

application of VERP is limited to social science and the visitor experience. Through VERP, park managers sought to understand, define, and maintain high quality experiences on the carriage roads.

Park staff received training in applying VERP through a three-day workshop conducted by Marilyn Hof of the NPS Denver Service Center. Based on this workshop, we recognized that more information about carriage road use and users was needed. A three-phase research program was planned, and Dr. Robert Manning of the University of Vermont served as lead investigator.

This paper describes the application of the VERP framework to carriage road visitor use. It begins with a brief description of the supporting research program, and then outlines the application according to the nine elements of the VERP framework¹.

Research program

Phase I

Phase I research was designed to identify potential indicators of quality for the carriage road experience through a survey (questionnaire) of carriage road visitors and

¹This application started with an earlier draft version of VERP consisting of nine steps that are slightly different than the nine elements in the latest version (National Park Service 1997). The team continued to follow the nine steps of the earlier version of VERP and they are referred to as steps in this paper.



focus group sessions with representatives of major user groups (Manning et al. 1996a; Stillwater Assoc. 1995). Indicators of quality are specific, measurable variables that are important in determining the quality of park resources and visitor experiences. Study findings suggested that most carriage road visitors enjoyed their experience.

However, visitors also suggested that problems with too many people using the carriage roads were emerging, and that selected behaviors experienced on the carriage roads were a problem. These variables—crowding and problem behaviors—were selected as the best indicators of a quality visitor experience. Estimates of visitor use levels using electronic trail counters and a census of carriage road use were also conducted as part of phase I research.

Phase II

Phase II research focused on identifying *standards of quality* for crowding and problem behaviors (Manning et al. 1998a; Manning et al. 1999). Standards of quality define the minimal acceptable condition of indicator variables (Manning, et al. 1996c). Research indicates that visitors often have normative standards concerning acceptable conditions in parks and related areas (e.g., Vaske et al. 1986; Shelby and Heberlein 1986; Hof et al. 1994; Manning et al. 1996b; Manning et al. 1996c). Thus, we administered a second survey to carriage road visitors to determine standards of quality for crowding and problem behaviors.

We identified crowding norms using numerical and visual methods. In the visual approach, a representative sample of carriage road visitors rated the acceptability of 19 computer-generated photos of carriage road use. These photos illustrated varying numbers (0-30) and types (hikers and bikers) of carriage road visitors. Sample photos are shown in figures 2 and 3. The viewscape in the photos represented a typical 100-meter carriage road segment. In the numerical approach, visitors reported the maximum number of people they would

find acceptable to see at one time (per viewscape) on the carriage roads. The number of persons-per-viewscape (PPV) then became the measure for crowding and eventual standards of quality. Study findings suggested the maximum acceptable PPV ranged from 11 to 18 based on the various numerical or visual methods used. Visitors reported they now typically see about 5 PPV, suggesting that the carriage roads have not yet reached carrying capacity. Visitors also reported that they would accept seeing the maximum PPV level for about 40% of their visit. This temporal element of crowding norms was a new element of research, and it was addressed more fully in Phase III.

We also developed numerical norms for the four most important problem behaviors—bicycles passing from behind without warning, excessive bicycle speed, obstructing the road, and dogs off leash—from visitor surveys. Visitors reported that existing conditions were close to exceeding their maximum level of acceptability for only one behavior (obstructing the road).

We continued to estimate visitor use with trail counters and censuses in phase II and also developed a computer-based simulation model (see sidebar at end of article on page 26) of carriage road use. Daily car-

riage road use in the summer of 1995 ranged between 1,000 and 2,000 visitors. These daily estimates can be used as the primary input for the simulation model. For any total use level, the model estimates the number of minutes visitors see various PPVs, informing managers when standards of quality are violated.

Phase III

In phase III research, a representative sample of residents of surrounding communities was asked about their standards of quality using the same questions as phase II research (Manning et al 1998b). Residents also rated the quality of five hypothetical one-hour carriage road visits representing different total carriage road use levels (table 1). These scenarios were developed using the simulation model, and were designed to measure the temporal component of crowding norms in a more detailed way than was done in Phase II research. For comparison purposes, another representative sample of carriage road *visitors* also rated the same five scenarios. Residents were also asked how they had changed their carriage road use over the past several years because of increased use and problem behaviors. Concern about displacement of longtime users was a major reason for administering a survey to local residents.

Findings showed residents have adjusted their personal carriage road use substantially in recent years because of the changes in overall carriage road use. These adjustments include using the carriage roads less often, and shifting use to less-used times and places. Acceptability ratings of both residents and visitors for the five scenarios

Table 1.
Average number of minutes per hour visitors see selected numbers of persons per viewscape (PPV) for five carriage road total use scenarios

PPV	Scenario 1 Total Use=750	Scenario 2 Total Use=1,500	Scenario 3 Total Use=3,000	Scenario 4 Total Use=6,000	Scenario 5 Total Use=12,000
0	55	48	40	28	17
1-5	5	11	18	26	28
6-10	0	1	2	5	10
11-15	0	0	0	1	3
16-20	0	0	0	0	1
21-30	0	0	0	0	1

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are shown in figure 4. These data suggest that at current use levels, most visitors are having a high quality experience.

However, visitor and resident standards of acceptability for the four problem behaviors differed significantly. Residents were considerably less tolerant of problem behaviors than were visitors. This may be because most residents are walkers and most visitors are bikers. Residents reported that existing conditions of these behaviors are very close to violating their standards of quality.

Application of VERP

Step 1 of the VERP framework calls for appointment of an interdisciplinary planning and management team. The VERP team for the carriage roads included the superintendent, deputy superintendent, several division chiefs, a recreation specialist (team leader), and supervisor of carriage road rovers (interpretive ranger). Marilyn Hof and Robert Manning served as consultants to the team.

Steps 2-3 of the VERP framework prompted a statement of purpose and significance for the carriage roads and the production of maps of resource and social conditions on the roads. This was important because the carriage road system is set amidst a great diversity of natural resources, and use levels and patterns on the roads are also diverse.

In *step 4*, a range of appropriate resource and social conditions was considered for the carriage roads. As already discussed, no natural or cultural resource issues were considered to be significant, although the potential for them exists. Thus, we focused on social conditions only for this application of VERP. In *step 4*, we also established the major carriage road management goals: shared recreation use of the carriage roads by all types of visitors, a diversity of experiences based on visitor use levels and behaviors, and a high quality visitor experience.

The VERP team zoned the carriage road system in *step 5* and established peak and nonpeak zones based on existing levels and patterns of use. Zones were defined by location, time of day, and time of year.² We decided to use the same *indicators of quality* for each zone, but we set different *standards of quality*.

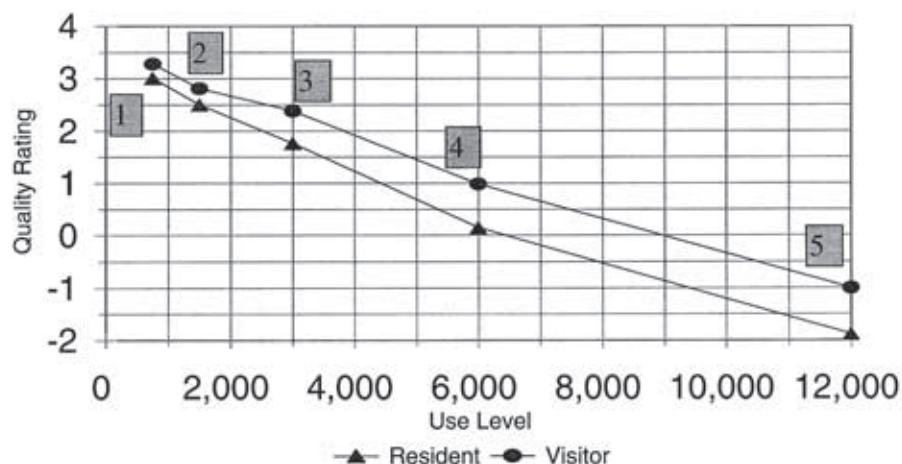


Figure 4. Resident and visitor acceptability (quality) ratings for the five visitor use scenarios were very similar, indicating there was little difference in tolerance for crowding.

Table 2.
Percent of visitors experiencing selected quality ratings (or higher) for selected total carriage road use levels

Carriage Road Use Level (people/day)	Quality Rating 1	Quality Rating 2	Quality Rating 3
1,500	91	85.7	74.2
2,000	91.2	83.4	68.6
2,500	91.5	81.2	62.9
3,000	91.7	79 (quality standard)	57.2
3,500	87.2	73.5	51.7
4,000	82.8	68.1	46
4,500	78.4	62.7	40.3
5,000	74	57.3	34.6
5,500	69.6	51.9	28.9
6,000	65.2	46.5	23.2

Table 3.
Average number of minutes per hour visitors see selected numbers of persons per viewscape (PPV) in peak and nonpeak zones for four total carriage road use levels

Carriage Road Total Use Level (people per day)								
PPV	Use=2,500		Use=3,000		Use=3,500		Use=4,000	
	Nonpeak	Peak	Nonpeak	Peak	Nonpeak	Peak	Nonpeak	Peak
0	50	36	48	31	45	29	45	26
1-5	9	22	11	27	14	28	14	29
6-10	1	2	1	2	1	3	1	4
11-15	0	0	0	0	0	0	0	1
16-20	0	0	0	0	0	0	0	0
21-30	0	0	0	0	0	0	0	0

²The following three conditions occurring together defined the peak zone: a location between intersections 1 and 10 and between 14 and 17, a time between 10:00 a.m. and 5:00 p.m., and a day between June 20 and Labor Day or any of the three

days of the Memorial Day and Columbus Day holidays. All other times and places were in the nonpeak zone. Thus, even on July 4, if someone were biking between intersections 1 and 10 after 5:00 p.m., they would be in the nonpeak zone.

Step 6 required formulating standards of quality for each zone. Study findings from the research described earlier were used to help set standards of quality for crowding and problem behaviors. These findings and the standards are outlined here.

Crowding standards

Formulation of crowding standards relied heavily on visitor and resident norms and findings from the computer simulation model. Table 2, developed from the frequency distributions of visitor acceptability ratings of the five carriage road use scenarios, shows the percent of visitors experiencing selected quality ratings (or higher) for selected carriage road total use levels. These data show the relationship between quality and total use, and empirically represent the trade-offs inherent in managing the carriage roads.

While the data in table 2 were helpful, they raised two challenging questions. What quality rating should the park manage for (i.e., what point on the y-axis in figure 4 should be selected)? What percentage of visitors should have an experience of that quality rating or higher? Insight into answering these questions was provided through development of table 3. This table shows computer simulation estimates of PPVs for the peak and nonpeak zones for a range of four likely use levels. For all four use levels, a wide difference exists between the peak and nonpeak zones for the number of minutes visitors see 0 and 1-5 PPV. Establishing and maintaining this diversity of use conditions was a goal set in step 4.

Based on research findings as reported in the tables and figures, the VERP team established three crowding-related standards of quality:

1. Eighty percent of visitors should have a high quality experience (defined as quality rating 2 or higher from table 2). This standard of quality is consistent with the management goal of providing a high quality visitor experience as defined in step 4 of the VERP framework.
2. Total use for the carriage roads should not exceed 3,000 visitors per day. This figure is taken from table 2, which indicates that roughly 80% of visitors have an experience of quality rating 2 or higher at this use level.
3. PPV-related standards of quality for peak and nonpeak zones are as follows:

Total use for the carriage roads should not exceed 3,000 visitors per day

- In the *peak zone*, visitors should see 0 PPV *at least* 31 minutes out of each hour; 1-5 PPV *no more than* 27 minutes of each hour, 6-10 PPV *no more than* 2 minutes out of each hour, and never more than 10 PPV.
- In the *nonpeak zone*, visitors should see 0 PPV *at least* 48 minutes out of each hour; 1-5 PPV *no more than* 11 minutes of each hour, 6-10 PPV *no more than* 1 minute out of each hour, and never more than 10 PPV.

These figures are taken from table 3, which shows PPV estimates for a total carriage road use level of 3,000 visitors per day.

Formulation of standards of quality for crowding and other indicators of quality will always involve an element of value judgment by park managers. However, these research findings, along with the decisions made within the context of the VERP framework, provide an informed, empirical, and defensible basis for such decisions.

Behavior standards

Standards of quality for problem behaviors were established by using the norms described earlier and by trying to balance the divergence in such norms between residents and visitors. Based on this analysis, the VERP team established the following behavior-related standards of quality.

For a two-hour visit in the peak zone, visitors should experience no more than:

- Two instances of bicyclists traveling at excessive speed
- Two instances of bicyclists passing from behind without warning
- One instance of visitors obstructing the road
- Zero instances of dogs off leash

For a two-hour visit in the nonpeak zone, visitors should experience no more than:

- One instance of bicyclists traveling at excessive speed
- One instance of bicyclists passing from behind without warning
- One instance of visitors obstructing the road
- Zero instances of dogs off leash

Step 7 of the VERP framework requires monitoring of indicators of quality. Monitoring of crowding-related indicators of quality will rely on the computer-based simulation model and estimations of systemwide use derived from the electronic trail counter. If estimations of systemwide use exceed 3,000 visitors per day, PPV standards are assumed to be violated. Some direct counts of PPVs will be made as a field-check on the simulation model. Monitoring of behavior-related indicators of quality will be accomplished by administering brief surveys, identical to those used in phase II research, conducted once every three years. Based on monitoring results, crowding standards were not violated in 1997 or 1998. The highest daily use, however, was nearly 2,800 visitors. Behavior standards were not violated in 1997; they will be monitored again in 2000.

Assumptions and conditions on which the simulation model was built must also be monitored for changes. Major changes in use patterns, such as an increase in the number of one-way trips taken, might require adjustment of the model.

If monitoring determines that standards of quality are violated, then *step 8* requires analysis of the root cause of such discrepancies. Research and monitoring suggest that current use of the carriage roads meets all standards of quality. However, the VERP team has considered potential causes of such discrepancies. A new transportation system for the park and surrounding communities began in 1999. Visitor use of this transportation system may change visitor use patterns on the carriage roads enough to cause standards of quality to be violated. The park must preserve the quality of the carriage road experience by managing the transportation system schedule (access) to the carriage roads. Parking enforcement, changing visitor demographics, increased use, a new visitor use, or a failure or lapse in visitor education are also potential causes of discrepancies.

Step 9 requires management action to address any discrepancies between existing conditions and standards of quality. Again, no such discrepancies currently ex-

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ist on the carriage roads. However, in phase II and phase III research, visitors and residents were asked the degree to which they supported or opposed a range of possible management actions. Based on these findings, the VERP team has identified four potential management actions in decreasing order of priority: further visitor education, parking control and mass transit, visitor permits, and enforcement patrols.

Conclusions and recommendations

VERP provided a systematic, rational, and, where possible, empirically based approach to developing a management plan for the carriage roads. Carriage road experiences were defined through indicators and standards of quality. Indicators of quality will be monitored to ensure that standards of quality are not violated. Finally, a series of management actions is available if and when needed.

Successful application of VERP was due to: (1) obtaining research funding thanks to the relatively high profile of the issue; (2) a peer-reviewed research program that allowed for informed decision-making; (3) thinking ahead about how monitoring would be accomplished; and (4) the dedication of the VERP team.

Several recommendations for applying VERP emerged from our experience. Moving fast was sometimes helpful, especially through steps 1-3. It also helped to push the application as far as possible and recycle through it often; VERP should be considered an iterative process with many feedback loops. The VERP team struggled with steps 4 and 5, and preferred not to dwell on them when they could be revisited. Furthermore, reliable, quantitative information based on peer-reviewed research was critical to the process. Finally, for the purposes of monitoring, the application should be kept as simple as possible. Fewer indicators, standards, and zones make monitoring more feasible.

Park managers now have a sound understanding of carriage road visitor use issues and a plan for managing the visitor experience. A carrying capacity has been established and monitoring is in place. Management challenges lie ahead as the park tries to maintain a high quality carriage road experience.

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