

The Concept of Carrying Capacity
as a Tool for Managing Scenic Roadways

by

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Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the
degree of

Master of Landscape Architecture

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December, 1988
Blacksburg, Virginia

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(ABSTRACT)

Increasing interest in driving for pleasure has put a burden of crowding and over-use on many of our nation's scenic highways. The carrying capacity concept says that there is an acceptable level of use or change for a resource beyond which that resource will be significantly degraded. This thesis examines the applicability of this concept to the problems of crowding and over-use of scenic roadways.

This study developed as an attempt to bridge the gap between recently developed carrying capacity models in recreation resource management and planning and the specific problems of scenic roadways. While carrying capacity theory and practice have produced good models, the unusual characteristics of scenic roadways challenge the direct application of these models.

A questionnaire was distributed to scenic roadway designers, planners, and managers; roadway researchers; carrying capacity researchers; and recreation resource managers nationwide. Respondents answered questions about the value of carrying capacity for managing scenic roadways, about perceived problems in implementing a carrying capacity program for scenic

roadways, about the appropriate scope of a carrying capacity management tool for scenic roadways, and about needs for future research to support development of a carrying capacity model for scenic roadways.

Responses to the questionnaire indicate strong support for developing a management tool for scenic roadways based on the carrying capacity concept. Responses support a broad-based approach to addressing the carrying capacity of scenic roadways, looking at both the roadway and lands adjacent to the roadway in attempts to determine carrying capacity.

ACKNOWLEDGEMENTS

I would like to express my appreciation to Dr. Patrick Miller whose commitment to my research and to the landscape program encouraged me through this effort. I also express thanks to Professor Ben Johnson and Dr. John Randolph whose enduring support and words of advice added to my learning. I thank _____ whose help and inspiration started me on this project.

I would like to thank my classmate and companion, _____, for her tireless support and good-natured prodding through three years of course work and through the finishing years of this thesis.

Finally, I wish to thank my parents, _____, whose encouragement, support, and love have allowed me to undertake and finish this task.

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INTRODUCTION

A 1984 survey cosponsored by the National Park Service and the National Parks and Conservation Association listed driving for pleasure as one of the top four outdoor activities among people seeking outdoor recreation (Loomis, 1985). Americans have long glorified the auto and the freedom it gives to explore the vast wealth of our national landscape. This glorified notion of auto and open road has been fostered through the decades by "See-America" campaigns sponsored by the National Park Service and state and federal commerce agencies. New car advertisements have linked driving with pleasure and freedom for decades. However, pleasure drivers have begun to strain the resources of our nation's scenic highways. Increasingly drivers seeking the open road find themselves locked in congested traffic on popular stretches of scenic roads. Roadside amenities and overlooks show the wear of too large crowds. The Blue Ridge Parkway in 1985 had over twenty million visitors making it the most visited National Park in the National Park System (Bonn, 1986).

Increasing personal wealth and leisure time coupled with the wave of international terrorism in the early 1980's curtailed international travel and produced larger and larger crowds for America's national parks and scenic resources. Gary Everhardt, the superintendent for the

Blue Ridge Parkway, voiced the concerns of the National Park Service in his opening address to the Blue Ridge Parkway Fiftieth Anniversary Conference in 1985.

Speaking on growing number of visitors to the Parkway:

" . . . At the present rate of growth, which is about five percent per year, we could reach 25 million visitors annually by 1990.

How much is too much? At what point will the volume of traffic and resultant increased use begin to degrade the Parkway experience for most visitors? We don't know, but we need to begin to try to find out. We also need to explore various alternatives--such as alternative forms of transportation--and possibly adjusting use patterns at recreational sites at various times--providing additional visitor use information and service facilities in order to mitigate the problem.

(Everhardt, 1986)

This study developed in response to the questions and issues Mr. Everhardt posed for the Blue Ridge Parkway.

The concept of carrying capacity is inexorably linked to the question "how much is too much?" The carrying capacity concept, simply stated, says that there is an acceptable level of use (or change, in some definitions) for an environment beyond which the environment or the experience of the environment would be significantly degraded. In the late 1970's, in an uncharacteristic break from its policies of advocating more travel and tourism in the National Parks, Congress mandated carrying capacity studies for all units of the National Park System (Public Law 95-625, Sec. 604-b, Nov.

10, 1978). However, as Mr. Everhardt hinted in his address, carrying capacity of a scenic roadway is not limited to managing the numbers of users.

Scenic roadways, by nature, have at least two components: (1) the roadway itself; and (2) the area that can be viewed from the roadway, sometimes referred to as the scenic corridor or viewshed. This complicates the management of scenic roadways, requiring that management address not only the roadway and its supporting facilities, but also the use of lands adjacent to the roadway.

The political, environmental, and economic factors that influence the quality of experience on a scenic roadway are numerous. Lands adjacent to scenic roadways are often outside the direct control of the agency managing the roadway. To achieve some influence in the management of these lands the managing agency must attempt a thoughtful and strategic political posture.

At issue in managing scenic roadways is the competition between factors of human use and influence on the landscape and sensitive ecological conditions that work to create the scenic beauty. Managing this competition so that neither the roadway users' experience nor the roadway environment is degraded provides a difficult task for a carrying capacity management program.

The carrying capacity concept, though simple in theory, can be difficult in application and measurement

when applied to scenic roadways. As a result there are differing opinions on its value and proper application. This study attempts to identify and address these problems by: (1) identifying the factors that limit acceptance and application of carrying capacity as a management tool; and (2) examining the scope of issues and concerns that should be addressed when determining carrying capacity for a scenic roadway.

To achieve these objectives a questionnaire was developed and mailed to carrying capacity researchers, scenic roadway planners and managers, and recreation resource managers. The questionnaire examined perceived knowledge of carrying capacity and roadway management issues. It also asked questions to establish bounds for a management tool based on carrying capacity. The opinions of the respondents are reported and give some insights into future steps needed to develop a carrying capacity management strategy for scenic roadways.

LITERATURE REVIEW

The literature supporting existing carrying capacity models has its roots in ecology and recreation resource management. This review will trace the development of carrying capacity theory and modeling showing a progression from its ecological base to two recently developed models in recreation resource management: the National Parks and Conservation Association's Visitor Impact Management model and the Forest Service's Limits of Acceptable Change model. This review will also show trends in carrying capacity developing concurrently in the fields of land planning and management. These models and theories provide a launching point for examining the carrying capacity of scenic roadways.

Background

Use of the carrying capacity concept to identify ideal resource/user group ratios has had many applications since its inception. The earliest records of using the concept were in Australia with sheep populations and grazing lands in the early seventeenth century (Odum, 1959). However, the carrying capacity phraseology of today developed much later. The users of carrying capacity are indebted to the fields of ecology and biology for developing a language for the concept.

Ecologists in the early 1950's formulated a definition for carrying capacity, giving it recognition

as a management principle. Those ecologists defined carrying capacity for an ecological system as "the maximum population density for a given species in an environment which could be supported without degradation of the environment" (Schneider, Godschalk, Axler, 1978). This definition implies that population levels exceeding this level or capacity will cause a degradation of the system.

Physical Concepts of Carrying Capacity

Early studies of carrying capacity introduced the notion of environmental resistance or factors within a system that limit population growth as a population approaches its capacity. Since these studies usually concerned themselves with populations of wild or domestic animals, these factors of environmental resistance could have included reduced food supply from trampling, overgrazing, or introduction of new competitive species. Loss of habitat to fire or other competing land uses was another form of environmental resistance examined in early carrying capacity studies (Gugel, 1985). As a resource was diminished, the population it could support was also diminished.

These studies developed technical measures for evaluating the impacts of populations on their habitat. Methods evolved for examining vegetation regeneration or the lack of regeneration produced by trampling or

overuse. Scientists studied the effects of populations on water quality and supply. Formulae were devised for calculating soil loss on over-grazed land. These studies provided not only the skeleton for later carrying capacity models that were to evolve, but also many of the technical measures for ecological impacts that must be addressed as part of the carrying capacity of a scenic roadway.

Social Concepts of Carrying Capacity

Recognizing that the early applications in ecology and biology could be adapted to other situations social scientists, particularly recreationists, applied the concept to social situations. Recreationists and other environmental behaviorists began to study the impact of crowding on the quality of human experience in a space. This development in carrying capacity thought is responsible for much of the literature relevant to this study.

Wagar, a pioneer of recreational/social carrying capacity, redefined carrying capacity for his purposes as "the level of recreational use an area can withstand while providing a sustained quality of recreation" (Wagar, 1964, p. 3). Wagar in his studies began to address the social values of recreation inherent in a quality recreation experience. He studied the effects of increased use and crowding on recognized values of

outdoor recreation such as opportunities for solitude and ability to view natural and scenic beauty (Wagar, 1974).

Despite his role as a leader in recreational carrying capacity research, Wagar was cautious in his advocacy of carrying capacity as a management tool, pointing out problems that have continued to surface throughout the literature. He warned that the early biophysical models of carrying capacity would not translate clearly to applications with social/recreation values: "Outdoor recreation is primarily a psychological experience whose quality may depend as much (or more) on a person's expectations, belief systems, and prior experiences as on the physical condition of the area he visits" (Wagar, 1974, p. 274).

Wagar was an early prescriber of the notion that social carrying capacity is primarily a value judgment and should not be confused with the technical issues that allow measurement of a physical carrying capacity. Whether carrying capacity can be a technical decision making tool or is merely a disguise for value laden management directives has fueled much writing (Burch, 1984; Becker, Jubenville, Burnett, 1984; Shelby and Heberlein, 1984; Wagar, 1974). Burch asserts, ". . . we have a large amount of research driven by a poorly understood concept whose main function is to help

managers control something they do not understand"
(Burch, 1984, p. 489).

In concurrent work Stankey and Lime echo Wagar's sentiment that value judgments cannot be divorced from carrying capacity measures. They emphasize that effective use of a carrying capacity tool starts with a well-defined set of management objectives for a recreation resource. They issued five conclusions from their early work that have influenced the direction of Forest Service policy with regard to carrying capacity and have importance to this study.

First, areas have many different carrying capacities. One area can support different activities with varying tolerances in level of use. Managing agencies have to select the activity most suited to an area based on availability of other areas for that activity. Managing agencies must cooperate to provide a range of opportunities. Scenic roadways often serve more than one purpose and more than one group. Bikers and runners can add to the congestion of a scenic roadway. Yet some roadway users may prefer the added activity to the more solitary scenic drive.

Second, carrying capacity requires consideration of subjective human values. Therefore, use of carrying capacity for managing an area requires dialogue with the public groups using the area.

Third, knowing how varying levels of use impact the physical resources of an area is important to carrying capacity. Determining, for example, how the scenic roadway can recover from days of peak use when sightseers spill over onto the grassy shoulders and slopes for picnics is important to understanding the roadway's carrying capacity. However, determining the level of acceptable change to the resource ultimately hinges on management objectives or statements about the direction of management initiatives.

Fourth, resource managers need far better understanding of how recreationists perceive their recreation experience and environment. It is recognized that users of scenic roadways have different tolerances for other people and different needs to be met in their recreation experience. Attempts must be made to understand how the resource can be managed to meet the needs of groups caravanning to a picnic site while allowing the solitary driver his desired experience.

Fifth, there are several management options that will achieve the goals of increasing user satisfaction and preventing the destruction of a site. Learning how to encourage behavior changes to protect a resource without regulating those behavioral changes is important to recreation resource and roadway managers alike (Lime and Stankey, 1971).

Theoretical Basis

To understand the difficulty of developing a carrying capacity management program for a scenic roadway it is necessary to understand some of the conflicts among leading social/recreational carrying capacity researchers regarding the theory supporting the concept. The theory of social/recreational carrying capacity is still in its infancy, but the more recent work attempts to address some perceived shortcomings.

Much of the writing on recreational carrying capacity comes from management agencies notably the U. S. Forest Service. Naturally, a prime concern for these agencies has been the development of management tools. Critics of recreational carrying capacity warn that a lack of theory to support management decisions is a trap in using the concept. William Burch, a frequent critic of carrying capacity studies, asks, "Are we primarily interested in understanding the human behavioral dimensions of wildland systems or are we primarily interested in providing a rationale for a priori management decisions?" (Burch, 1984, p. 488). Burch indicates that many social science theories from psychology, sociology, geography, and economics seem to have applicability to carrying capacity, but that none are being tested. Burch also warns against creating a "pseudo-scientific halo" for carrying capacity which

would encourage resource managers to think carrying capacity has a "sense of precision" that the concept does not merit (Burch, 1984).

Responding to the perceived lack of theory behind recreational/social carrying capacity voiced by Burch and others, Graefe, Vaske and Kuss (1981) synthesized twenty years of carrying capacity research as part of a study funded by the Nation Parks and Conservation Association. Graefe, Vaske, and Kuss suggest that recreational/social carrying capacity theory is closely tied to related theories of recreation participation and motivation (Graefe, Vaske, and Kuss, 1984).

One such theory, expectancy theory, says that people usually approach recreation expecting to have a good time. This attitude permeates the recreation experience and increases the likelihood of satisfaction despite conditions that might be less than optimal. Research related to expectancy theory emphasizes that participants approach recreation activities with different desired psychological and physical outcomes. A related concept suggests that people establish norms for the quality of recreation experience they expect. These norms provide a basis for comparing each recreation experience to a preferred standard (Graefe, Vaske, and Kuss, 1984). These theories which begin to explain how people respond to recreation experiences give insight into how people

might adjust their concept of the proper carrying capacity for a scenic roadway. A roadway user out for a mid-winter's drive might have different expectations of his experience than he would if he were out driving on a peak color weekend in October.

In the search for a theoretical framework for social carrying capacity, much research has addressed the correlation between user densities and visitor satisfaction. Initially studies concentrated on the effects of increasing user numbers on visitor satisfaction. These studies produced little convincing evidence of a strong correlation between user density and visitor satisfaction. In some circumstances, notably social recreation situations like singles beaches, there were positive correlations between user density and satisfaction (Graefe, Vaske and Kuss, 1984; McConnell, 1977).

More recent studies have focused on social and situational factors that cause a negative evaluation of high user densities. Several notions supported by this research have relevance to this study. Studies indicate that a perception of crowding is more likely if recreationists have noticeably different motivations and goals or noticeably different modes of participation. Groups of campers out for a weekend party would be in direct conflict with a solitary hiker. Horsemen might also sense conflict with a trail bike rider that could lead to

a judgment that a resource is over-used or crowded (Graefe, Vaske, Kuss, 1984; Lime, 1972; Stankey, 1973).

Research on social carrying capacity has also considered factors other than perceived crowding and visitor satisfaction as it relates to user density. These studies have looked at visitor perceptions of human impacts on the environment. Graefe, Vaske, and Kuss (1984) report that a number of factors affect the perception of an impact as desirable or undesirable. An impact that is directly attributable to human influence, such as litter, is often judged more severely than a more serious impact, such as trail erosion, produced by a combination of over-use and weather (Stankey, 1973). Other studies suggest recreationists tend to decrease their negative evaluations of impacts produced by their mode of use of a setting. Horsemen might overlook trampling of vegetation by livestock that would seem abhorrent to a hiker using the same trail (Lucas, 1979).

Geographical features and locations play a role in visitor perceptions of crowding. A study by Stankey (1973) found hikers using wilderness settings were more tolerant of contacts near the edge of the wilderness than those further from points of entry to the wilderness. Geographic features such as undulating topography, forest cover, or winding trails or roads can make the impact of higher use levels less significant (Graefe, Vaske, Kuss,

1984). Landscapes acclaimed to be of notable significance or those receiving special designations such as wilderness are viewed differently from those not receiving special designations. Anderson (1981) and Hendee (1978) found that visitors will tolerate far fewer negative human impacts in these landscapes.

Other studies have examined various coping strategies to mitigate the negative impacts of higher use levels. Among the strategies examined in several studies were shifts in behavior patterns or recreation displacement. This is a simple notion that suggests people voluntarily remove themselves from a recreational setting if crowds exceed their normative standards.

D. Anderson (1981) found that among boaters, those with more experience tended to remove themselves from high use rivers. Similarly, it might be assumed that pleasure drivers with a greater degree of familiarity or accessibility to a road might remove themselves during periods of peak use. Another coping strategy is expectation modification. People can eliminate negative perceptions of crowding by adjusting their normative standards upward (Schreyer and Roggenbuck, 1978).

Graefe, Vaske, and Kuss conclude that carrying capacity research and accompanying social/recreational theoretical research to date provide a preliminary understanding of how recreationists interact with other

recreationists and the recreation resource. However, they concur with Wagar that value judgments are still required of managers determining how best to manage the resource.

A more recent paper by Shelby and Heberlein (1984) coming from the perspective of recreation resource management and rural sociology presented a conceptual framework for carrying capacity determination. This paper is part of a trend to combine the ecological carrying capacity model with the social carrying capacity model. Since it attempts to be a model based in theory rather than one for direct application, it avoids the criticism that Burch makes of many existing models of carrying capacity, that they are a framework for rationalizing already made management decisions. The paper suggests that in both social and ecological carrying capacity there are descriptive and evaluative components. The descriptive component tells how an environmental system functions in light of management parameters, those factors that can be manipulated by a management agency, and impact parameters, the resulting experiential or use factors such as perceived crowding or vegetation trampling. The evaluative component tells how the system should be managed to provide desired types of recreation experiences with standards set for measuring success (Heberlein and Shelby, 1984). This model, by

staying in the realm of the theoretical and by avoiding the pull to become a model for wilderness or park management, provides a skeleton for building models to manage resources like scenic roadways.

As mentioned at the outset of this section much of social carrying capacity research has been related to attempts to manage specific resources. Often studies have ignored work that has already been done and have started from the beginning rather than building on existing knowledge. However, work like that by Graefe, Vaske, and Kuss; Stankey and Lime; and Shelby and Heberlein has provided a theoretical framework for building good models for carrying capacity management.

Two Carrying Capacity Models

In concurrent studies Graefe, Vaske, and Kuss, working for the National Parks and Conservation Association (NPCA), and George Stankey, working for the United States Forest Service, developed models for carrying capacity management that reflect existing recreation and carrying capacity theory. The NPCA model, the Visitor Impact Management (VIM) process, was developed primarily for managing lands within the control of self-contained National Park Service Units. The Forest Service model, the Limits of Acceptable Change (LAC) model, was developed for managing wilderness recreation areas within the Forest Service's control.

These models provide a good framework for beginning the discussion of carrying capacity for scenic roadways. Both of these model might be adapted to scenic roadway management with slight modification.

Visitor Impact Management (VIM) Model:

After spending three years synthesizing the literature reviewed above, Graefe, Vaske, and Kuss developed the Visitor Impact Management model for implementing carrying capacity in the National Park System. It is an eight step process that first determines the impacts of visitors and then addresses these impacts with management strategies (see Figure 1).

A key to understanding this model is that it focuses on controlling the negative impacts associated with over utilization of a resource. There are three basic issues of impact management this model addresses: "(1) the identification of problem conditions (or unacceptable visitor impacts); (2) the determination of potential causal factors affecting the occurrence and severity of unacceptable impacts; and (3) the selection of potential management strategies for ameliorating the unacceptable conditions" (Graefe, Kuss, and Loomis, 1985). This model, by focussing on impacts, allows resource managers to select impacts that are most serious and implement the process in pieces as funding, time, and base data allow (see Appendix C for detailed description of the process).

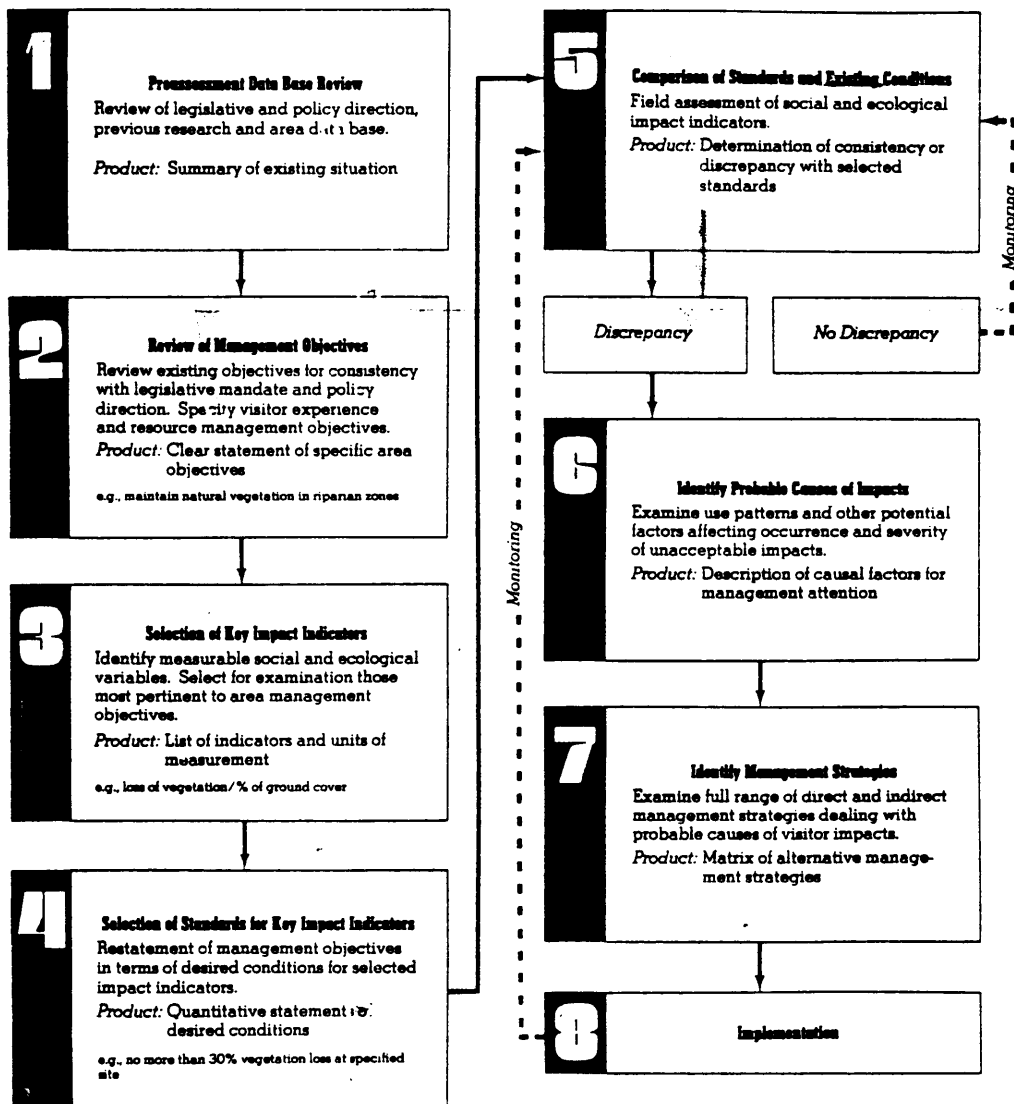


Figure 1. Visitor Impact Management Model: Management Planning Process Steps. (Graefe, Kuss, and Loomis, 1985).

Limits of Acceptable Change (LAC) Model:

Simultaneous studies being conducted under the direction of George Stankey at the United States Forest Service produced the Limits of Acceptable Change (LAC) model for wilderness management based on carrying capacity. In a 1984 article, Stankey outlines the reasoning that created the LAC model. He warned that models focusing on "how much is too much" had been unsuccessful as management models. Focusing on negative impacts and attempts to mitigate those impacts provides too narrow a focus for a management tool. In a reformulated model Stankey and others recognized that change is likely in any setting being used by humans. The LAC model focuses on environmental and social conditions and the amount of change allowable for each identified condition. This approach circumvents problems arising from lack of understanding of the relationships between user density and satisfaction (Stankey and McCool, 1984).

The Limits of Acceptable Change model is a nine step process (Figure 2) developed for management of wilderness settings. The nine steps process identifies wilderness conditions that are acceptable and prescribes actions that are necessary to protect or achieve those conditions (see Appendix D for a more detailed description of the nine step process).

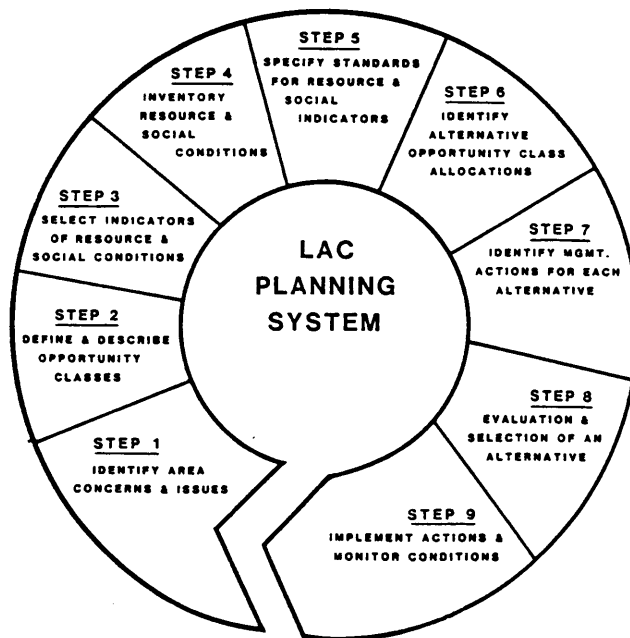


Figure 2. Limits of Acceptable Change Model: Steps in the Planning System. (Stankey and McCool, 1984)

Stankey emphasizes that although the process focuses on technical decisions about resource conditions, determination of the success the model actually occurs in the political arena. He emphasizes the need for active public participation in order to gain valuable resource information and foster support for management policies (Stankey, Cole, Lucas, Petersen, and Frissell, 1985).

While both the NPCA's Visitor Impact Management model and the Forest Service's Limits of Acceptable Change model present a strong theoretical base for their development, they both tend toward practical models for management of specific types of resources. The NPCA's

model shows a bias toward individual units of the National Park System all of which is in control of the managing agency. The LAC model admittedly focuses on wilderness management. While both present good examples, it is necessary to go beyond these types of models to find examples that fit the conditions of scenic roadway management.

Planning Adaptations of Carrying Capacity

Outside of recreation resource management, carrying capacity has been the focus of growth management tools developed by land use planners and managers. Carrying capacity has provided a basis for identifying land capabilities and addressing the politically sensitive issue of growth limits (Gugel, 1985).

Ideas of particular importance that evolved from this genre of studies include the notion of carrying capacity as the aggregate of a number of thresholds. This application of carrying capacity suggests that carrying capacity is best used not as a grand index or absolute population maximum, but as a group of environmental components each with a desired state. This is not unlike the VIM and LAC models which focus on individual impacts of desired conditions. These environmental components are essentially the attributes of carrying

capacity identified as critical indicators of a desired state for the environment.

Schneider, Godschalk, and Axler (1978) categorize planning studies using the carrying capacity concept in two groups: "One, directed toward developing land use controls; the other, more global, directed toward providing regions with an early warning system concerning projected population growth" (Schneider, Godschalk, and Axler, 1978, p. 3). Since scenic roadways can have urban segments or urban types of growth threats management should consider the carrying capacity concerns being addressed in urban and land use planning.

Many of the planning studies take a more land based approach (Randolph, 1985) than do the recreational/social carrying capacity studies. These studies have focused on the ability of land to withstand development looking at factors such as geology, soils, topography, fragile vegetation, threat to water quality, etc. The studies have produced what Schneider calls environmental performance standards. "They acknowledge the importance of natural processes and limit the effects development may have on them. Rather than regulating density or intensity of use, they regulate the effects of development which, if uncontrolled, could lead to serious environmental damage" (Schneider, Godschalk and Axler, 1978, p. 4).

These studies have particular relevance to this study when considering the impacts of development on lands adjacent to scenic roadways. Development of adjacent land affects not only the environmental quality of the roadway, but also the patterns of use of the roadway itself. The level and types of environmental monitoring and measurement found in planning studies is often far more complex than those measures found in recreation studies. Examples of this approach should be used to encourage roadway managers and planners to consider complex problems such as vegetation damage from vehicle exhaust.

Lake Tahoe Carrying Capacity Study

One study that exemplifies the environmental threshold and environmental performance standard approach was a study conducted in Lake Tahoe (Tahoe Regional Planning Agency, 1982-1984). The Lake Tahoe region, like most scenic roadway settings, provides a complex set of political and ecological challenges to the use of carrying capacity. The region composed of the lake and its watershed region lies in two states, five counties and several townships. It encompasses both public and private lands and is under constant pressure for tourist development.

In Lake Tahoe citizens met to identify environmental concerns that were essential parts of the Lake Tahoe

experience. From these meetings a list of environmental components emerged: water quality, soil conservation, air quality, vegetation, wildlife, fisheries, outdoor recreation, noise, scenic quality. For each of these components a set of measurable variables was selected which allowed an existing condition to be gauged for each component. Once the existing condition was established, standards or thresholds were set for each of the variables. These standards reflected the input of historic research, public input, and environmental management experts. Once the components and standards were established, it was possible to identify actions or sources that had impact on a component. Once air quality had been identified as a component, carbon monoxide levels could be monitored as a variable. Natural ambient air standards were chosen as the threshold. Car exhaust could be linked to the carbon monoxide and steps could be taken to prevent automobile emissions from exceeding the threshold. This is just one example of the complex undertaking of the Tahoe Regional Planning Agency (TRPA, 1982-1984). The Lake Tahoe study is one of the most comprehensive uses of the carrying capacity concept and merits monitoring for its successes and failures. The study's success to date reflects a substantial financial investment, an existing and well-managed public

desire for growth management, and a thoughtful approach to developing a comprehensive and workable plan.

This study could provide valuable baseline data for scenic roadway planners as they attempt to predict the effects of various levels of use and development on the environmental resources they are trying to protect. This study is also relevant because it shows the scope of a carrying capacity management model that is known to be costly and far reaching in its attempts at management. This information is valuable to managers attempting to direct programs that can be implemented within their budgets.

The Lake Tahoe study, the Visitor Impact Management model, and the Limits of Acceptable Change model indicate that the first step in establishing a carrying capacity management tool is evaluation of the resource and the management concerns and objectives for the resource (Graefe, Vaske, Kuss, 1987; Stankey and McCool, 1984; TRPA, 1982-1984). Until recently the question of carrying capacity of scenic roadways was not one that had been addressed. Carrying capacity research in the ecological, social/recreational, and planning realms offer insight into the development of a carrying capacity management model for scenic roadways, but many questions are unanswered. Current thought on carrying capacity accepts the fact that a landscape used by man will

change. Understanding monitoring and mitigating the negative effects of change seems to be the new carrying capacity challenge.

METHODOLOGY

This study is an attempt to bridge the gap between existing carrying capacity models and theory and the specific management problems and concerns of scenic roadways. Open-ended telephone interviews were conducted with leading carrying capacity researchers, roadway researchers, and park and roadway managers. This group identified concerns and issues that were relevant to the carrying capacity of scenic roadways.

Together with management issues identified from the management objectives for the Blue Ridge Parkway these concerns formed the basis for a questionnaire which was distributed to a much larger group of scenic roadway planners and designers, roadway researchers, carrying capacity researchers, and recreation resource managers. This questionnaire was structured to gain information on the perceived value of carrying capacity as a management concept for scenic roadways and on the appropriate scope of a carrying capacity management tool for scenic roadways.

The methods used in selecting telephone interview participants and for structuring those interviews follows. The questionnaire that developed from concerns identified in these interviews is described in greater detail as well as the process for selecting respondents

and distributing the questionnaire. The methods for analyzing and summarizing the responses to the questionnaire are also examined.

Telephone Interviews

A series of informal telephone interviews was conducted with carrying capacity researchers and roadway planners, managers, and researchers. The telephone interviews were conducted in an attempt to identify potential problems in translating existing carrying capacity management models to a model for managing the carrying capacity of scenic roadways. They also attempted to identify management concerns and objectives for scenic roadways that were relevant to carrying capacity, a first step discussed in both the VIM and LAC models of carrying capacity.

Potential interview candidates were selected based on their expressed concerns with the problems of carrying capacity or roadway management. They were identified both from their writings on the topics and from discussions with other researchers and roadway managers. In the course of the interviews those people being interviewed often suggested other researchers or managers who could provide insights into the discussion of carrying capacity for scenic roadways.

The telephone interviews themselves had an informal structure. It was explained that a study was being

conducted to gain a better understanding of carrying capacity for scenic roadways. Those being interviewed were asked to briefly discuss their research or planning efforts and to identify any issues or concerns they perceived as relevant to the carrying capacity of scenic roadways. The specific problems of the Blue Ridge Parkway, as identified by Parkway officials and management objectives, were used as a launching point for discussion for those less familiar with scenic roadways.

These interviews produced a list of management issues relevant to carrying capacity of scenic roadways. It was also evident from the telephone interviews that there were differences in the perceived value of carrying capacity as a management concept for scenic roadways. A working definition of carrying capacity for scenic roadways was a common request among those interviewed. It was often clear that the definition desired was one that set limits on the scope of issues to be considered. Understanding which management concerns of scenic roadways could be addressed by a carrying capacity management tool appeared to be a real need in establishing an effective carrying capacity model for scenic roadways. It also seemed necessary to understand where experts perceived shortcomings in carrying capacity application if a carrying capacity model for scenic roadways was to be successfully implemented.

Development of the Questionnaire

A questionnaire was developed based on the issues identified in the telephone interviews along with other management concerns from the management objectives of the Blue Ridge Parkway. The questionnaire contained six parts: (1) a section designed to let respondents evaluate their knowledge of scenic roadway management and the carrying capacity concept; (2) a section to examine the perceptions of carrying capacity; (3) a section to examine management concerns of scenic roadways that relate to carrying capacity; (4) a section on the management concerns of lands adjacent to scenic roadways and their role in determining the carrying capacity of the roadway; (5) a section on the future direction of carrying capacity management and research efforts; and (6) a section of demographic questions to help analyze the results. The questions in each section and the rationale behind those questions are discussed in greater detail below. The complete questionnaire is given in Appendix B.

Knowledge of Scenic Roadway Management and Carrying Capacity Concept:

The first section of the questionnaire (questions one through four) allowed respondents to evaluate their knowledge of scenic roadway management and carrying

capacity. Two questions dealing with knowledge of scenic roadway management and sources of that knowledge were followed by questions on carrying capacity knowledge and sources of knowledge. These questions allow an examination of the relationship between knowledge of the issues and opinions on how carrying capacity management of scenic roadways should be structured. Additionally, the questions identified the most used channels for disseminating information on carrying capacity and scenic roadway management.

Perceived Value of Carrying Capacity for Managing Scenic Roadways:

The second set of questions and statements (five through thirteen) gauged the perceived value of carrying capacity as a management tool for scenic roadways. Question five, as a lead question, asked respondents for a direct response on whether carrying capacity has potential for managing scenic roadways. This question was asked to see if respondents accorded validity to the concept. The remaining questions in this section attempt to expose factors that might predispose respondents to have either a positive or negative view of the concept as a management principle for scenic roadways. Questions six and seven dealt with whether the lack of information on carrying capacity concepts and existing environmental conditions hinder the use and acceptance of a carrying

capacity management program. Question eight was asked to see if knowledge, or lack of knowledge, of a good working model might affect its perceived value. Question nine attempts to gauge whether perceived costs of a carrying capacity management program relative to other management alternatives might hinder its acceptance. Questions ten, eleven, twelve, and thirteen measure knowledge and use of existing models for implementing carrying capacity concepts. This will allow for an examination of the relationship between knowledge of a working carrying capacity model and its perceived value as a management option for scenic roadways.

Carrying Capacity Management Issues for Scenic Roadways:

The third set of questions (fourteen through nineteen) was structured to identify concerns related to managing the roadway and its facilities. This section was one of two major sections aimed at establishing bounds for a carrying capacity management program. This section dealt with both management problems and management practices for the scenic roadway and its support facilities which could affect the implementation of a carrying capacity management program.

Question fourteen dealt with the relative importance of specific issues (see Table 1 for issues examined with this question).

Table 1. SCENIC ROADWAY MANAGEMENT CONCERNS

- A. Number Of Users Of The Roadway
- B. Number Of Users Of Facilities Associated With The Roadway (picnic areas, overlooks, etc.)
- C. Type Of Roadway Use (pleasure driving, bicycling, commuting, etc.)
- D. Amount Of Development On Land Within View Of The Roadway
- E. Type Of Development On Land Within View Of The Roadway
- F. Development On Land Adjacent To The Roadway, But Not Within View Of The Road

Questions fifteen and seventeen dealt with management practices and tools available to scenic roadway managers which could affect the carrying capacity of the roadway. Question fifteen asks respondents if managing carrying capacity is possible if limiting the use of the roadway is not an option. Limiting use is often difficult for scenic roadways because of numerous points of ingress and egress. This question attempts to examine whether respondents perceive this as an insurmountable problem. Question seventeen is a follow-up question for question fifteen. It gauges the importance of controlling access as a management tool. Questions sixteen, eighteen, and nineteen introduced questions of management philosophy that need to be addressed before a

carrying capacity management program can be implemented. Question eighteen introduces a question of management philosophy. It was asked to see how experts in carrying capacity and roadway research and planning respond to a specific problem common to the management of carrying capacity for many scenic roadways. Question nineteen introduces the conflict between environmental protection and human use. This question like question eighteen was asked to see if respondents thought that some rules of carrying capacity might be generalized to most scenic roadway situations. It was recognized that these questions might be considered unanswerable except on a case-by-case basis, but they were included to gather opinions that could serve as a launching point for similar decisions about a specific roadway.

Carrying Capacity Management Issues for Land Adjacent to Scenic Roadways:

The fourth section looked at issues associated with land adjacent to scenic roadways. This is the second major section directed toward establishing the bounds of a carrying capacity management tool for scenic roadways. The issues broached in this section reflect that this questionnaire is just a first step in developing a direction for carrying capacity of scenic roadways. They attempt to get an initial impression of whether lands not controlled by the managing agency should be considered in

a carrying capacity management program. The questions were geared to examine the role of a carrying capacity management model with regard to issues such as public involvement in establishing the management policies, distance as a factor in determining acceptable land uses, and the importance of an urban or rural context in establishing acceptable uses of adjacent lands.

Questions twenty and twenty-one ask respondents directly if they feel carrying capacity management for scenic roadways should extend beyond the rights of way of the roadway. These questions attempt to gauge the response to these potentially expensive and politically difficult tasks. Questions twenty-three and twenty-four, by looking at the importance of distance as a factor in development of adjacent land, were structured to gain information that might launch a discussion of how far a carrying capacity management program for scenic roadways should extend. Question twenty-four attempts to gauge whether respondents think a management practice that has proven effective in some situation (e.g. Tahoe Regional Planning Agency) might be effective with scenic roadways.

Future Direction of Carrying Capacity Research:

A fifth section (questions twenty-five through twenty-eight) asks for direction of future management attempts and research efforts linking carrying capacity

to scenic roadway management. Question twenty-five examines the perceived potential of carrying capacity in meeting a number of general objectives (see Table 2 for scenic roadway management objectives included in this question) for scenic roadway management. This section (question twenty-six) addresses the political question of who establishes carrying capacity for a resource. Question twenty-seven asks respondents if more predictable links are needed between use levels and environmental conditions or user satisfaction.

Table 2. Scenic Roadway Management Goals

- A. Preserving Spectacular Views
- B. Preserving Cultural Landscapes
- C. Maintaining A Leisure Atmosphere
- D. Monitoring Visitor Enjoyment
- E. Education Of The Public About The Environment

Demographic Information:

The final section asked for demographic information about the respondents to the questionnaire. These questions sought information related to work experience which might have influenced responses. Respondents were asked to identify themselves with respect to type of work, length of work with carrying capacity or roadway management issues, and the type of agency or organization

for which they worked. These questions were asked to see if those respondents who worked with carrying capacity concepts might have a more favorable opinion of the concept. Likewise, these questions sought to determine if experienced roadway or recreation resource managers might perceive difficulties in implementing a carrying capacity management program that researchers would not perceive.

Additionally, respondents were asked to characterize whether their roadway experiences were most influenced by roadways in urban, rural, or natural areas. Recognizing that a respondent would most likely answer questions based on his experience with scenic roadways, this question attempts to examine possible differences based on the urban-rural experience factor. A final question asked respondents to identify the geographic region where they most commonly work to isolate biases that could be affected by regional differences such as topography, vegetation, or air clarity.

The six sections of this questionnaire examine a broad range of issues and concerns relevant to the successful management of a scenic roadway and the implementation of a carrying capacity management program. The questions follow major division suggested from earlier telephone interviews. Questions were structured to give roadway managers and planners specific inform-

ation for beginning to establish a carrying capacity management program. At the same time questions of theory attempted to bridge the gap between existing theoretical and practical models of carrying capacity and the specific management concerns of scenic roadways.

Questionnaire Respondents

The population of carrying capacity researchers and scenic roadway planners and managers nationwide is relatively small. The sample of respondents used in this study was selected to include as much of this population as possible. The respondents were identified from three major sources: the National Parks and Conservation/ Visitor Impact Management review team, the National Transportation Research Board, scenic roadway planners within the National Park Service. One hundred seventy-two carrying capacity researchers, roadway planners and managers, roadway researchers, and recreation resource planners were identified as respondents for the questionnaire.

Identifying Questionnaire Respondents:

The National Parks and Conservation Association had been working for three years on their recreational carrying capacity project, the Visitor Impact Management Process. In the course of their work they had identified one hundred and three researchers and resource managers

as potential reviewers for their Visitor Impact Management model. These one hundred and three people represented a wide range of management and research positions. This group brought a knowledge of both carrying capacity and recreation resource management to the sample.

A second resource used to identify respondents was the National Transportation Research Council. This group of transportation researchers included academics, state and federal highway planners and managers, and private highway design consultants. This group was selected to bring knowledge of highway and scenic roadway management policies to the sample.

A third group was identified with the help of Gary Johnson of the National Park Service's Denver Service Center. Mr. Johnson, who was working on scenic roadway projects for the National Park Service, identified a group of researchers, planners, and designers within the National Park Service who had interest and experience working with scenic roadways in the National Park Service. This group was included in the sample to expand the group of resource planners and to insure that scenic roadway planners and designers were represented in the sample.

Distribution of the Questionnaire:

One hundred seventy-two questionnaires were mailed to those respondents identified above along with a cover letter explaining the purpose of the study. Two weeks after the initial mailing, a follow-up letter was mailed to encourage non-respondents to complete the questionnaire. After eight weeks, one hundred and eight questionnaires had been returned completed, eight had been returned uncompleted with explanations of the non-completion, fourteen were returned because of improper mailing addresses, and forty-two were not returned. A short-coming of the study was that no follow-up questionnaire was sent to non-respondents. Of the one hundred eight returned, two were removed from the statistical analysis due to unorthodox means of completing the questionnaire. However, the comments on the two non-recorded questionnaires were included in discussion of the findings.

Profile of Respondents:

Respondents to the questionnaire were a self-selecting group which represents a large portion of the population of scenic roadway planner and managers, roadway researchers, carrying capacity researchers, and recreation resource managers targeted for this study.

Respondents were asked to classify themselves according to their work experience and their years of experience working with carrying capacity and roadway management issues. Respondent were also asked to identify the setting for their work in terms of their agency, geographic, and urban/rural context. See Tables 3-8 (pages 44-46) for a profile of the respondents.

Respondents to the questionnaire were distributed among the demographic variables so that most groups were represented in each of the demographic questions. In the career orientation question most respondents identified themselves as either roadway planners and designers or as carrying capacity researchers. Recreation resource managers were also well represented. The only group not well represented was scenic roadway researchers. This should not bias the results too heavily since many of the roadway planners, designers, and managers have probably done research at some point in their careers. In both questions on length of experience with scenic roadways and carrying capacity respondents spread themselves evenly across the possible responses.

With regard to experience on the urban/rural continuum more respondents reported experience with roadways in rural and natural settings, but a substantial group (28%) also reported some experience with roadways

in urban settings. That group should accord urban roadways a fair representation in the results.

Respondents were also spread across all of the nation's geographic regions. Only the Rocky Mountains and the Middle Atlantic regions showed higher numbers of respondents than other regions. The overall responses based on geographic distribution of respondents should be a good indicator of thought nation-wide.

The only way in which the population is skewed is toward a heavy concentration of respondents working in federal park or resource management agencies. Sixty-two (58.5%) respondents work in federal agencies. Since it is these agencies which are calling for and supporting much of the carrying capacity research, this factor might make the responses toward carrying capacity more favorable than in a group less populated with federal employees.

Despite a heavy concentration of federal workers, respondents represent a wide variety of knowledge and experience factors. This range among the respondents makes the study applicable to scenic roadways nationwide.

Table 3. PROFESSIONAL ORIENTATION

<u>Professional Orientation:</u>	<u>Percentage</u>
(1) Roadway Planner or Designer	31.1%
(2) Roadway Manager	9.4%
(3) Researcher with Interest in Carrying Capacity	32.1%
(4) Researcher with Interest in Scenic Roadways	2.8%
(5) Recreation Resource Manager or Planner	18.9%

Table 4. SCENIC ROADWAY EXPERIENCE

<u>Length of Experience With Scenic Roadways:</u>	<u>Percentage</u>
(1) Under 2 years	1.9%
(2) 2-5 years	11.3%
(3) 6-10 years	12.3%
(4) 11-15 years	13.2%
(5) Over 15 years	34.0%
(6) Not Applicable	27.4%

Table 5. CARRYING CAPACITY EXPERIENCE

<u>Length of Experience With Carrying Capacity:</u>	<u>Percentage</u>
(1) Under 2 years	1.9%
(2) 2-5 years	12.6%
(3) 6-10 years	21.4%
(4) 11-15 years	16.5%
(5) Over 15 years	35.9%
(6) Not Applicable	11.7%

Table 6. URBAN/RURAL EXPERIENCE

<u>Urban/Rural Continuum:</u>	<u>Percentage</u>
(1) Roadway in Urban Settings	7.5%
(2) Roadways in Rural Settings	21.7%
(3) Roadways in Natural Settings	20.8%
(4) Not Applicable	19.8%
(5) Urban and Rural	6.6%
(6) Urban, Rural, and Natural	15.1%
(8) Rural and Natural	8.5%

Table 7. AGENCY TYPE

<u>Agency or Organization:</u>	<u>Percentage</u>
(1) Federal Park or Resource Management Agency	58.5%
(2) State or Federal Transportation Agency	17.0%
(3) Educational Institution	17.0%
(4) Private Consulting or Design Firm	5.7%
(5) Other	1.9%

Table 8. GEOGRAPHIC REGION

<u>Geographic Region:</u>	<u>Frequency</u>
(1) Pacific Northwest	8
(2) Pacific Southwest	6
(3) Rocky Mountains	15
(4) Southwest	3
(5) Plains	3
(6) Great Lakes	6
(7) South	5
(8) Appalachia	4
(9) Middle Atlantic	13
(10) New England	6
(11) Alaska	3
(12) Nationwide	23
(13) Eastern U.S.	7
(14) Western U.S.	4

Statistical Analysis

The overall number of responses to the questionnaire (106) was small for statistical analysis, but represents a large portion of the total population identified. As a result there is little need to infer the results of this study to a larger group.

The reporting of the data is limited to descriptive statistics, using mean, median, and frequency data to explain responses. Mean and median data were calculated for the entire sample on questions in each of the first five sections of the questionnaire: (1) extent of knowledge of scenic roadway management and carrying capacity; (2) perceived value of carrying capacity for managing scenic roadways; (3) issues of scenic roadway and support facility management; (4) issues of adjacent land management; and (5) direction of future research and application attempts.

Additionally, the demographic questions discussed in the previous section were used to analyze responses for apparent differences in the perceived value of carrying capacity or its proper application with scenic roadways. Frequency matrices compared responses of each of the groups on questions from the perceived value and bounds setting sections of the questionnaire. A chi-square analysis was attempted for the frequency matrices, but

there were too few respondents to give adequate numbers for this statistical test.

The questions from the first section of the questionnaire, measuring self-adjudged knowledge of carrying capacity and scenic roadway management, were used in much the same way as the demographic questions. Responses to these questions were also compared in frequency matrices with responses from the perceived value and bounds setting sections of the questionnaire to see if knowledge of the issues corresponds to differences in responses to question about the proper direction of carrying capacity management for scenic roadways.

The data was recorded and reported primarily by group means and percentages, however median and frequency data were noted as corrections if responses for the group were spread over the entire range of possible responses and caused a neutral mean response not indicative of that diversity.

In summary, this study developed as an attempt (1) to collect expert opinions from those knowledgeable in scenic roadway management and from those knowledgeable on carrying capacity issues and (2) to bring them to bear on the specific problem of carrying capacity of scenic roadways. The instruments chosen to collect information, telephone interviews and questionnaires, allowed the collection of a wide range of information. Simple

descriptive statistics were used to analyze and report the data since the objective of the study was primarily to report the opinions of those experts questionsd. The data was also examined to highlight potential problems that roadway managers and planners might face in implementing a carrying capacity management program for a scenic roadway.

RESULTS

The results of this study gauge the opinions of a group of experts on issues of the perceived value of a carrying capacity management model, the concerns a carrying capacity management model should address for a scenic roadway, adjoining facilities, and adjacent lands, and the future direction for carrying capacity research and management efforts. The results are presented in four parts: (1) a reporting of the issues that surfaced in the telephone interviews; (2) a description of the responses of the entire group of respondents to the six part questionnaire discussed previously; (3) an analysis of differences in responses by each of the knowledge and demographic factors used to identify respondents; and (4) a discussion of the additional comments from respondents prompted by the questionnaire. In addition to reporting the data this section will attach possible meanings to responses and highlight significant responses that might impact the development and implementation of a carrying capacity management model for scenic roadways.

Issues Identified in Telephone Interviews

The carrying capacity researchers and scenic roadway planners and managers interviewed by telephone introduced a number of issues and concerns about carrying capacity in general and more specifically about the carrying

capacity of scenic roadways. The issues discussed in the telephone interviews centered around three topics discussed previously: (1) the perceived value of carrying capacity for managing scenic roadways; (2) important management concerns for scenic roadways and their support facilities; and (3) management concerns for land adjacent to scenic roadways. A discussion of specific concerns within each of these issues and their implications for this study follow.

Perceived Value of Carrying Capacity:

The series of informal telephone interviews with carrying capacity researchers and roadway planners and managers introduced a range of opinions on the value of a carrying capacity management tool. This range in opinion seemed to be attributable to a number of factors. There seemed to be a positive correlation between the amount of information an interviewee had about carrying capacity concepts, theories, and applications and the perceived value of the carrying capacity concept as a management tool. Among those interviewed who had a good working knowledge of carrying capacity theory, some disliked use of the term "carrying capacity" because of its association with a grand index or top limit to the number of users or amount of use allowable for the resource being managed. These people felt that existing models, like VIM and LAC had gone beyond the concept of carrying

capacity to more usable and understandable concepts, namely managing visitor impacts and establishing limits of acceptable change. This group also seemed more reluctant to accept the concept at face value because members of the group recognized that there were both good and bad examples of carrying capacity applications.

Another factor affecting value judgments of carrying capacity as a management tool was the perceived cost of implementing and monitoring a management program based on the concept. The cost factor was linked to concerns about gathering sufficient environmental and user data needed as a base for implementing the program. Interviewees were concerned about costs related to enforcing or monitoring behavioral changes that might be required to protect scenic roadways.

Recognizing that negative perceptions could hinder successful implementation of a carrying capacity program, it seemed necessary to gain an understanding of both the perception of carrying capacity among researchers and managers and the factors that influence that perception.

Management Concerns for Scenic Roadways and Their Support Facilities:

The most obvious roadway management concern linked to carrying capacity was the number of users of the roadways and associated facilities. Gaining a better understanding of how increasing user numbers affects the

visitor experience and impact on the physical resources of the roadway was a topic reflected in conversations with both managers and carrying capacity researchers. Techniques for controlling or limiting user numbers followed closely the discussion of impacts.

Controlling access to scenic roadways surfaced as an issue in conversations with both roadway managers and roadway researchers. The factor of access is directly related to demand. Scenic roadways frequently have numerous points of ingress and egress. This offers managers little control over use patterns. As a result, sections of roadways with exceptional beauty or those nearest points of easy access from major population centers are heavily used while other sections are less traveled.

The issue of limiting use to scenic roadways is closely tied to the issue of access. Since scenic roadways frequently have numerous points of access, limiting use by a permit system or fee would be costly at best, infeasible at worst. Limiting use also produces a new set of political problems related to control of a previously free commodity. Shifting policies toward greater control requires a great deal of education and support gathering.

Scenic roadways often experience periods of intense seasonal use. An issue in designing and managing scenic

roadways and their facilities is whether the facilities should be designed and managed for these periods of peak use. An alternative available to increase the carrying capacity of a resource is to design and build so that the resource can tolerate greater use (Randolph, 1985), for example, adding more parking at scenic overlooks.

The need to provide adequate support facilities is an issue of roadway development that affects the carrying capacity of scenic roadways. Selecting activities appropriate to the character of the scenic roadway was an issue. Whether it is to provide bike lanes and more active recreational facilities in urban areas or picnicking and hiking trails in natural areas, these facility decisions affect carrying capacity.

Responding to these issues it seemed necessary to confirm that these issues are an important part of carrying capacity and to attempt to see if certain issues related to managing the roadway and its support facilities are accorded less importance in determining carrying capacity for that scenic roadway.

Management Concerns for Land Adjacent to Scenic Roadways:

Lands adjacent to a scenic roadway which impact the roadway experience but fall outside the direct control (i.e., fee simple ownership or scenic easements) of the managing agency are a complicated management problem for scenic roadway managers. The ability to master public

involvement and cooperation for a carrying capacity management program raises political and economic questions. Whether that support can be garnered by including the public in the decision-making process or whether it would require a more demonstrable economic gain is an unexplored topic for scenic roadways.

Discussions with roadway managers and carrying capacity researchers showed support for the idea that the amount and type of development on adjacent lands is an important factor in the carrying capacity of a scenic roadway. Lands adjacent to scenic roadways are an integral part of the roadway experience. Exerting some control over how these lands are developed has potential links to the environmental conditions on roadway lands and also to visitor satisfaction.

The factor of distance as a determinant in the amount and type of development acceptable on lands adjacent to scenic roadways surfaced in the early telephone conversations. It was agreed that while the effects of distance on perceptions is usually within the realm of visual resource analysis it is necessary to address the question of how distance affects allowable land uses as part of an attempt to establish the scope of a carrying capacity management tool for scenic roadways. Those conversations indicated that interviewees weighed

distance differently in the carrying capacity equation for urban and natural settings.

It seemed clear from those conversations that influencing the management of lands adjacent to scenic roadways was an important but difficult task. Understanding whether the political liabilities and difficulties associated with this task might cause researchers and managers to exclude it from a carrying capacity management model appeared as an important objective of this study. Assuming from the conversations that questionnaire respondents would favor including adjacent lands, it also seemed necessary to examine the issue of distance from the roadway as a factor in carrying capacity management.

The issues that surfaced in these telephone interviews represent a broad range of concerns for managing scenic roadways and their adjacent lands. With most of the issues voiced came a call for more research to promote better understanding of how environmental changes and social/behavioral factors impact the carrying capacity of scenic roadways. It was also clear that knowledge of the concepts and of particular models for implementing carrying capacity influenced responses in the interviews. Those interviewees with greater knowledge of carrying capacity and roadway management concerns were more responsive in the interviews.

Understanding the level of knowledge and the sources of knowledge among those most likely to create and implement carrying capacity management programs emerged as an important precursor to implementing a carrying capacity program.

Results of Questionnaire

The responses of one hundred and six scenic roadway planners, managers, and designers, carrying capacity researchers, roadway researchers, and recreation resource managers to the six part questionnaire on the role of carrying capacity in scenic roadway management are detailed below. This initial report gives the responses of the entire respondent sample to the questions in each of the first five sections of the questionnaire (The sixth section, on demographic characteristics of the sample, has been reported previously as part of the methodology of the study). The data reporting follows the structure of the questionnaire and attempts to highlight general opinions and trends among respondents.

Knowledge of the Issues:

Respondents were asked, in the first section of the questionnaire, to evaluate their knowledge of scenic roadways and the carrying capacity concept. Respondents considered themselves generally knowledgeable (3.35 mean

responses)¹ on issues of scenic roadway management (question 1). Eighty percent of the respondents considered themselves to be in the average or better range (3-5 on a five point scale).

Identifying the sources of their knowledge (question 2) respondents identified use of scenic roadways, reading scholarly and agency literature and work as a roadway planner as the important experiences that had influenced their knowledge of scenic roadway management. Few respondents indicated that work as a roadway manager or research on scenic roadway problems had influenced their knowledge. This is not surprising since fewer roadway managers and researchers answered the questionnaire than other groups. This data would seem to indicate that scholarly journals and magazines as well as exhibits on scenic roadways themselves might be useful tools for conveying information about the carrying capacity of scenic roadways.

Respondents considered themselves more knowledgeable of the carrying capacity concept (4.02) than of scenic roadways (3.35). This higher knowledge of carrying capacity is also understandable since two of the largest groups responding, carrying capacity researchers and

¹Questions on the questionnaire were answered on a five point scale with the highest magnitude corresponding to a five

recreation resource planners, would have been exposed to the concepts.

Respondents again identified reading in scholarly journals as an important source of their information (question 4). However, research and application were also listed as important sources of information, unlike knowledge of roadway management. Few respondents listed university courses as a source of their knowledge. This might suggest two things, either that the concept is too new to have been discussed during respondents tenures at universities or that universities are not teaching about carrying capacity as a management principle.

The high level of knowledge of both roadway issues and the carrying capacity concept confirmed that this group of respondents was qualified to talk about the issues examined in the following sections of the questionnaire.

Perceived Value of Carrying Capacity:

This section of the questionnaire asked respondents to evaluate the potential of carrying capacity for managing scenic roadways (question 5) and then examined issues that might hinder its acceptance and application (questions 6-9).

In response to the statement that the carrying capacity concept has strong potential for managing scenic roadways (question 5) the response was one of general

agreement (3.55). When asked to evaluate their perception of available information on carrying capacity (question 6), the respondents felt that lack of information provided a real limit (3.57). Sixty-one percent of those responding saw lack of information about the concept as a very limiting factor in its usefulness. This group, which considered itself knowledgeable of carrying capacity, agreed that a lack of information about carrying capacity hinders its usefulness. Whether there is a real absence of information about the concept or whether potential users of the concept just perceive a lack of information can not be judged from these responses.

Lack of good baseline data on environmental and social conditions for scenic roadways (question 7) was seen as a very real problem in implementing a carrying capacity management program (mean 3.98 on a 1-5 scale). In order to effectively address social and resource conditions carrying capacity programs must start with an established baseline condition. The level of information available varies from resource to resource, but respondents believe it is a problem that must be addressed if carrying capacity management is possible.

Eighty-three percent of the respondents (question 8) did not know of a good example of a carrying capacity model for scenic roadways. Since some of the respondents

had been identified through their work with the Visitor Impact Management (VIM) and Limits of Acceptable Change (LAC) models of carrying capacity, it was expected that those would appear on the list. Others that appeared included scenic river studies, road monitoring programs in the Washington State Highway Department, and implementation of LAC in the Bob Marshall Wilderness Complex. These models give users of this study more concrete examples of starting directions for implementing carrying capacity management programs. See Appendix E for a complete listing of those examples suggested by respondents.

Respondents indicated that the cost of implementing a carrying capacity management program for scenic roadways (question 9) was not perceived as being unbearable. The mean response was 2.62 on a five point scale with one being "no more than usual" costs and five being "unbearable" costs.

In an attempt to see if knowledge of two currently developing models of carrying capacity management affected perception of carrying capacity's value for managing scenic roadways respondents were asked to rate their knowledge of the Visitor Impact Management (VIM) model and the Limits of Acceptable Change (LAC) model of carrying capacity management (question 10).

Of those responding, sixty-eight percent reported some knowledge of the Visitor Impact Management. A smaller percentage, thirty-two percent, considered themselves knowledgeable of the model (4 and 5 on a 5 point scale). About the same number of respondents knew of the Limits of Acceptable Change model, sixty-eight percent, but a larger percentage, forty-four percent, considered themselves knowledgeable of the model. As the respondents' knowledge of the Visitor Impact Management Model increased so did their perception of the value of carrying capacity as a management tool for scenic roadways. With increasing knowledge of the VIM model lack of information about carrying capacity, lack of good environmental and social baseline data, and perceived costs associated with a carrying capacity management program were viewed as less limiting factors. Respondents who considered themselves knowledgeable of VIM (see above) considered the carrying concepts to have greater potential for managing scenic roadways (3.79) than those who were less knowledgeable (3.43).

There is a weaker tie between knowledge of the Limits of Acceptable Change model and perceived value of carrying capacity. Perhaps since the Limits of Acceptable Change model is further removed from the traditional approaches and language of carrying capacity

increased knowledge of LAC does not increase perceived value of the concept.

The last set of questions (questions 11-13) in this section asked respondents if they used carrying capacity concepts to manage scenic roadways. Only fifteen percent of the respondents used carrying capacity to manage scenic roadways which is understandable since only a small percentage of respondents managed scenic roadways. The interesting finding (question 12) was that only one respondent reported using an actual carrying capacity management model to apply the concept to scenic roadways. These figures highlight the fact that much work is still ahead in developing working models of carrying capacity for scenic roadways.

Carrying Capacity Management Concerns for Scenic Roadways:

Respondents were asked to rate a number of roadway management concerns relating to the carrying capacity of scenic roadways. This group of the questions (questions 14-19) was aimed primarily toward management of the roadway and its support facilities, and toward management of roadway users.

Respondents rated issues relating to type of use (question 14 c) of higher importance (4.41) than issues relating to numbers of users (14 a and b) (4.32 and 4.20 respectively) or amount of development (14d) (3.75).

Respondents also placed a greater degree of importance on managing the roadway and its support facilities (14a, b, and c) than on management of adjacent land though both were rated as important concerns. (See Table 3 for a list of issues rated and their mean responses.) All of the management issues were rated as important. Only development on adjacent lands not in view of the road failed to receive a resounding importance rating. By comparison this one issue seemed less important to respondents.

Table 9. MANAGEMENT CONCERNS IMPORTANT FOR THE CARRYING CAPACITY OF SCENIC ROADWAYS

<u>Issue</u>	<u>Importance Rating*</u>
Number of Users of the Roadway	4.32
Number of Users of Facilities Associated with the Roadway (picnic areas, overlooks, etc.)	4.20
Type of Roadway Use (pleasure driving, bicycling, commuting, etc.)	4.41
Amount of Development on Land Within View of the Roadway	3.75
Type of Development on Land Within View of the Roadway	3.93
Development on Land Adjacent to but not within View of the Road	2.77

*Ratings are mean ratings on a five point scale with five being very important.

An open ended component of this question asked for concerns other than those listed. Responses covered a wide range of topics, but three issues were repeated several times. The issue most frequently mentioned was roadway design and intended use. Related issues of design speed and geometric standards also appeared in the responses. A second concern that was noted frequently was the availability or creation of alternate routes to serve roadway users with differing needs and desires for using the scenic roadway. Several respondents used this question to state that roadway management concerns should reflect the specific management objectives for the roadway. Other responses were mostly concerned with specific management objectives such as safety or protection of flora and fauna. For a complete list of those concerns mentioned see Appendix F.

On the issue of "limiting use" (question 15) respondents supported (3.34) the statement that it is possible to use the carrying capacity concept for managing scenic roadways even if limiting use is not an option. The responses to this statement spanned the range from not possible to use carrying capacity under this condition to very possible.

The responses to this question indicate that many respondents hold to the idea that limiting use is an

essential part of managing carrying capacity. Carrying capacity models like VIM and LAC which move away from user numbers and look more closely at resource conditions might help to overcome these biases about limiting use.

Related to "limiting use" is the issue of controlled access (question 17). Respondents felt that controlled access was a very important management tool relative to other management tools. Respondents reported a mean score of 4.10 on the importance of controlled access with eighty-five percent of the respondents rating it as a four or five on a five point scale.

The question was asked (question 16), if ". . . users tend to modify their expectations of the roadway experience to tolerate more people and their impacts" does this ". . . limit the usefulness of carrying capacity as a management tool?" There was a range of responses to this question. Respondents registered a neutral mean response (3.06). However, two groups of respondents fell at opposite ends of the spectrum. One group felt this theory, Behavior Modification Theory, did not at all limit the usefulness of carrying capacity while another group felt it was very limiting. These responses remind us that, as Wagar (1974) and Shelby and Heberlein (1985) said, the carrying capacity process is not only scientific, but also political and judgmental.

Respondents gave a neutral response (2.97) to the statement that a "primary concern of a carrying capacity model . . . should be to mitigate negative impacts caused by periods of peak use" (question 18). Responses were split almost evenly among those who agreed with the statement and those who disagreed, with forty-three percent agreeing and forty-two percent disagreeing.

Respondents registered slight disagreement (2.62) with the statement that a carrying capacity model should shift its focus from environmental protection to user satisfaction as a roadway shifts from a natural to an urban setting (question 19).

This section of the questionnaire showed that respondents are in agreement on important factors to be considered as part of a carrying capacity management program for scenic roadways (question 14). However, they report much less agreement on approaches and tactics to implementing carrying capacity management (questions 15-19). This data highlights the fact that several approaches to carrying capacity management could achieve the same end result.

Carrying Capacity Management Concerns for Adjacent Lands:

As reported in the section on roadway issues managing development on land adjacent to scenic roadways (question 14 d, e, f) is viewed as an important concern (3.75, 3.93, 2.77, respectively) in the carrying capacity

of a scenic roadway. Essentially the same questions asked in the previous section on managing adjacent land were asked as lead questions in this section.

Respondents were in strong agreement (4.29) that the amount and type of development on lands adjacent to scenic roadways should be addressed as part of the carrying capacity of a scenic roadway (question 20).

Respondents made a distinction between adjacent lands that were owned or controlled by the managing agency and those not controlled by the agency. Respondents registered a low level of disagreement (2.36) with the statement that a carrying capacity management tool should limit itself to lands controlled by the managing agency (question 21). Respondents clearly believe (4.29) that a management model should extend to lands beyond the roadway (question 20), but that the model should extend beyond lands controlled by the roadway (question 21) is less clear (2.36). Although the level of disagreement with limiting carrying capacity to lands controlled by the managing agency was low sixty-seven percent of respondents report disagreement.

One purpose of the questionnaire was to begin discussion about physical limits of a carrying capacity management tool. If a decision were made to address lands outside the direct control of the managing agency it would be important to consider how far beyond the

property limits the management policies should extend. To begin this discussion, two statements sought responses about distance as factor in determining the impact of development on lands adjacent to scenic roadways.

The first statement (question 22) said, "Generally, the impact of development decreases as distance from the scenic roadway increases." There was general agreement (3.80) with this statement. Eighty-six percent of those responding gave a response of neutrality to agreement.

Respondents were very much in agreement (4.30) with the statement that distance will factor into decisions about acceptable land uses differently in urban and largely undisturbed natural areas (question 23).

Both questions on distance prompted comments from respondents. The comments fell into two groups. One group of those making comments noted that factors of vegetation and topography greatly influenced how distance relates to the impact of development. Others commented on the type of development: a Washington Monument or well designed forest harvest would have different impacts from a mining operation.

Respondents registered both strong responses and comments on the questions of distance as a factor in a carrying capacity model for scenic roadways. They agreed that the impact of development decreases with distance and that the urban-rural setting influences the effects

of distance. While the questions establish agreement among the experts they leave the question of how to incorporate distance factors into a management model unsolved.

The Visitor Impact Management model (Graefe, Vaske and Kuss, 1984), the Limits of Acceptable Change model (Stankey, Cole, Lucas, Petersen, and Frissell, 1985) and the Lake Tahoe study (TRPA, 1982-1984) all recognize the importance of public input in establishing support for carrying capacity management. Question 24 was asked to see if researchers, planners and managers supported this notion. Respondents agreed (3.79) with the statement "there is a positive relationship between the amount of public involvement in managing a scenic roadway and the level of support for roadway management objectives by landowners within view of the road."

Respondents are clearly in agreement with existing models of carrying capacity that public involvement is an important part of a carrying capacity management program. This would suggest that roadway managers trying to implement a carrying capacity program would increase their likelihood of success by involving the public in management decisions.

This section establishes agreement on three very important points about the role of adjacent lands in a carrying capacity management model for scenic roadways.

First, that adjacent lands are indeed important to the carrying capacity of a scenic roadway and should be address in a management model. Second, that distance from the roadway is an important factor in deciding how development of a adjacent lands affect the carrying capacity of a scenic roadway. Third, public involvement has a positive influence on the successful management of lands adjacent to a scenic roadway. While these are all very basic findings, they establish a base for looking at the more intricate problems of managing those lands vital to the scenic quality of a roadway.

Future Direction of Research and Management:

Those surveyed were asked for responses to a set of questions (questions 25 a-f) that attempted to determine links to other roadway research concerns. These questions asked respondents to rate the importance of a carrying capacity management tool with regard to roadway management objectives less clearly tied to carrying capacity.

**Table 10. IMPORTANCE OF CARRYING CAPACITY IN
ACHIEVING ROADWAY MANAGEMENT GOALS**

<u>Issue</u>	<u>Importance Rating*</u>
Preserving Spectacular Views	3.87
Preserving Cultural Landscapes	3.83
Maintaining a Leisure Atmosphere	3.77
Monitoring Visitor Enjoyment	3.73
Educating Public About Environment	3.38

*Ratings are mean ratings on a five point scale with five being very important.

Respondents clearly felt that a carrying capacity management tool could have an important role in achieving all of the goals listed above. Respondents rated educating the public about the environment as a less important role for carrying capacity than other management concerns listed. Whether respondents felt that education of the public was less important or whether achieving it under the auspices of a carrying capacity management model seemed inappropriate is unclear and perhaps deserves further study.

An issue that seemed to divide respondents was the relationship between carrying capacity and public opinions and expectations. Respondents were polarized in their response to the statement that "the carrying capacity of a scenic roadway is not absolute, but should

shift as public opinion and expectations change" (question 26). A mean response of 3.22 reflects that division. Thirty-four percent of those responding felt that carrying capacity should not shift with public opinions. Forty-eight percent felt carrying capacity should shift.

Respondents agreed on the importance of establishing more predictable links between both the level of use and impacts on environmental conditions (4.29) and the link between level of use and user satisfaction (4.12) (question 27). Both issues were accorded some importance (3 or higher on a 5 point scale) by ninety-five percent of those responding. Establishing these links has been the direction of much recreation research, but making these links for the special conditions of a scenic roadway was seen as an important direction for future carrying capacity research efforts.

Respondents were also given a chance to identify other topics that need further research to better understand the carrying capacity of scenic roadways. For a complete list of those topics, see Appendix G.

Respondents affirmed that managing the carrying capacity of a scenic roadway is a multi-faceted task. Respondents indicated that carrying capacity does not have an insurmountable image problem, the perceived value of the concept was high (3.55). Respondents supported

examining a broad range of roadway and adjacent land management issues as part of a carrying capacity management program, but they were divided on some of the proper tactics for dealing with these issues. As a first step in translating existing theory and models for carrying capacity to a specific carrying capacity management process for scenic roadways, these responses provide a launching pad for more research and for a scenic roadway carrying capacity model.

Group Differences By Demographic Variables

Several variables were used to examine differences in the responses to the questionnaire. Variables that were isolated as having a possible ability to influence responses follow: (1) knowledge of scenic roadway management and knowledge of carrying capacity; (2) professional orientation; (3) length of experience with carrying capacity and scenic roadway management concepts. Responses were also analyzed according to setting for work experiences in terms of geographic region and placement on an urban-rural continuum. However, this analysis is not reported because it produced no notable trends. The sample was not large enough to provide much information about geographic differences. When divided among fourteen geographic regions the number of respondents in most regions was far too small to show trends. This section reports differences in responses

among the groups in order to highlight those differences which could impact the development of a carrying capacity management model for scenic roadways.

Extent of Knowledge:

Self-adjudged knowledge of both scenic roadway management principles and the carrying capacity concept was used to separate respondents into groups. Those who rated their knowledge four or five (on a five point scale) were grouped as knowledgeable respondents, those who rated their knowledge three were considered neutral, and those who rated their knowledge one or two were grouped as unknowledgeable. There were few noticeable differences in the responses when the respondents were divided according to levels of knowledge, but some trends bear mention.

The most important trend resulting from this examination was that there was a positive relationship between level of knowledge of both scenic roadway management and carrying capacity and the perceived potential of carrying capacity for managing scenic roadways (question 5). Sixty percent of those who considered themselves knowledgeable of scenic roadway management (see above) rated the concept as having good potential for managing scenic roadways (4 and 5 on a 5 point scale). Only thirty-eight percent of those who rated themselves unknowledgeable rated it as having good potential. Those

who considered themselves neither knowledgeable or un-
knowledgeable also tended to give the concept a high
potential rating, with fifty-nine percent agreeing that
it had strong potential.

The trend is less clear when knowledge of carrying
capacity is used to divide respondents. In both groups,
those knowledgeable and those unknowledgeable of carrying
capacity, sixty-two percent of the respondents agreed
that the concept had strong potential for scenic roadway
management. It should be noted that fewer than eight
percent of respondents considered themselves unknowledge-
able and more than sixty-eight percent considered
themselves knowledgeable of carrying capacity. The fact
that there is not a clear trend here reflects a high
level of agreement among respondents that carrying
capacity has strong potential for managing scenic road-
ways.

When asked if lack of information about carrying
capacity limits its usefulness to scenic roadway planners
and managers (question 6) those with a high level of
knowledge of carrying capacity saw it as a less limiting
factor. Of those who reported a high level of knowledge
of carrying capacity, fifty-two percent saw lack of
information about carrying capacity as a limiting factor.
A higher percentage of those who rated themselves
unknowledgeable considered it a limiting factor. This is

not a surprising relationship since those with a high level of knowledge of carrying capacity would not be faced with a problem of trying to implement a carrying capacity program without an understanding of the concept.

Those with more knowledge of scenic roadway management saw lack of information about carrying capacity as a more limiting factor. This is the exact opposite of the relationship found when using knowledge of carrying capacity to divide respondents. Sixty-five percent of those who were knowledgeable of scenic roadway management saw it as a limiting factor while only forty-seven percent of those who were unknowledgeable of scenic roadways saw it as limiting. It is possible that those respondents who were not knowledgeable of scenic roadway management could have had a higher degree of knowledge of carrying capacity, accounting for this difference in the groups response.

The question of whether costs associated with a carrying capacity management program for scenic roadways would be unbearable also showed an interesting relationship to knowledge of the issues. Of those who considered themselves knowledgeable of scenic roadway management sixty percent thought unbearable costs (4 and 5 on a 5 point scale) would be associated with a carrying capacity management program. Of those unknowledgeable only forty-one percent rated the associated costs as unbearable.

When the same question was examined according to knowledge of carrying capacity a lower percentage, fifty-two percent, of those knowledgeable of carrying capacity thought an unbearable cost would be associated with a carrying capacity management model. Seventy-one percent of those less knowledgeable of carrying capacity associate unbearable costs with the concept. Both categories had a high percentage of respondents associating unbearable costs with a carrying capacity management tool for scenic roadways. However, the trend toward a lower association with unbearable cost as knowledge of carrying capacity increased suggests that those respondents who are knowledgeable of carrying capacity might know of lower cost alternatives for implementing carrying capacity management.

In the section of the questionnaire on factors involved with managing scenic roadways and their associated facilities, those questioned responded similarly when asked about the specific issues important in a carrying capacity management model for scenic roadways. However, dividing the group by knowledge did show some trends with regard to the appropriate tactics to be used when implementing that model.

The variables of knowledge had an interesting relationship with responses to the question asking how limiting is the phenomenon that people modify their

expectations to tolerate more people and their impacts as the volume of users of the roadway increases (question 16). Those who were knowledgeable of scenic roadway management perceived it as a more limiting factor than did their less knowledgeable counterparts. Fifty-four percent of those who were knowledgeable saw it as a limiting factor compared to thirty-two who were not knowledgeable. Twenty-nine percent of those who were knowledgeable of scenic roadway management saw it as a non-limiting factor compared to fifty-eight percent who were not knowledgeable.

The opposite relationship was true for respondents based on knowledge of carrying capacity. Those with a knowledge of carrying capacity saw expectation modification as a less limiting factor. Only thirty-nine percent of those knowledgeable of carrying capacity saw it as a limiting factor.

Respondents who considered themselves knowledgeable of carrying capacity were less supportive of the statement that carrying capacity models should mitigate problems of peak use (question 18). Forty-two percent of the knowledgeable respondents responded that a carrying capacity model should mitigate problems caused by periods of peak use. Seventy-one percent (71%) of those less knowledgeable responded the same way. Conversely, more knowledgeable respondents responded that

models should not focus on peak use than respondents who were not knowledgeable.

A high percentage, sixty-one percent, of those respondents who considered themselves unknowledgeable of scenic roadway management disagreed with the statement that the focus of a carrying capacity model should shift from environmental protection to user satisfaction as a roadway shifts from a rural to an urban setting. Of those who considered themselves knowledgeable of scenic roadway management a smaller percentage, forty-eight percent, disagreed. Again the opposite is true with regard to knowledge of carrying capacity. Only thirty-seven percent of those who were unknowledgeable of carrying capacity disagreed with this statement, while fifty-four percent of those who were knowledgeable of carrying capacity disagreed.

Differences in responses point out trends which show those with a high level of knowledge of carrying capacity disagreeing with those who have a high level of knowledge of scenic roadways on the proper tactics for implementing a carrying capacity management model for scenic roadways. While it is clear that there are differences on these issues it should be remembered that both groups of respondents value the concept for managing scenic roadways and support a broad based approach, one that

addresses many issues, to managing the carrying capacity of scenic roadways.

Professional Orientation:

Responses to the questionnaire were analyzed according to two variables of professional orientation. First, respondents were asked to classify themselves as one of the following: (1) roadway planner or designer; (2) roadway manager; (3) researcher with interest in carrying capacity; (4) researcher with interest in scenic roadways; or (5) recreation resource manager or planner. Second, respondents were asked to report the type of agency or organization they worked for according to the following divisions: (1) federal park or resource management agency; (2) state or federal transportation agency; (3) educational institution; (4) independent resource protection organization; or (5) private consulting or design firm. With regard to the first demographic question (question 29) on professional interest only three respondents classified themselves as researchers with interest in scenic roadways. For this reason this group will not be compared statistically, but will be addressed as part of larger trends. With regard to organization or agency fifty-nine percent worked for a federal park or resource management agency. Both state and federal transportation agencies and educational institutions accounted for seventeen percent of the

respondents. There were no respondents working for independent resource protection organizations and only six working in private consulting or design firms. As a result this study can only report trends among the first three groups mentioned above.

Professional orientation corresponded with some notable differences in the section of the questionnaire on perceived value. When asked if carrying capacity has strong potential for managing scenic roadways (question 5) all groups of respondents responded similarly. Sixty percent or more of the respondents in each group except carrying capacity researchers thought the concept had strong potential for managing scenic roadways. Surprisingly, among carrying capacity researchers only forty-seven percent felt the concept had strong potential. This unusual response by carrying capacity researchers might suggest that current thinking related to carrying capacity has moved away from the concept of managing to a carrying capacity for a resource toward concepts of managing visitor impacts.

The concept was seen as having stronger potential among federal park and resource employees than among their counterparts in state and federal transportation agencies and educational institutions. Sixty-two percent of the federal park and resource management workers rated the concept as having strong potential for managing

scenic roadways while only forty-four percent of respondents in the other two groups gave it a strong rating. This could suggest that those respondents in federal parks are more familiar with the concept or that there might be a stronger mandate to address the issues of carrying capacity in these agencies.

There were also differences in the ways groups with differing professional orientations perceived the limitations of the carrying capacity concept (questions 6-9). As would be expected far fewer, forty-three percent, carrying capacity researchers saw lack of information about carrying capacity as a factor limiting its usefulness in scenic roadway management (question 6). Fifty-eight to seventy-eight percent of respondents in other categories saw lack of information as a limiting factor.

Fewer scenic roadway planners, designers, and researchers viewed lack of good environmental and social baseline data as a problem than did roadway managers, carrying capacity researchers and recreation resource managers. Eighty to ninety-five percent of roadway managers, carrying capacity researchers, and recreation resource managers rated lack of good baseline data a problem. Fewer, sixty-three and sixty-seven percent, roadway designers and planners and roadway researchers saw lack of good baseline data as a problem.

On the question of whether an adequate carrying capacity management program for a scenic roadway would impose unbearable costs on an agency a large portion of respondents gave a neutral response. One group diverging from that neutrality was the group of carrying capacity researchers. Sixty-eight percent of carrying capacity researchers thought that an adequate program would cost no more than usual management techniques. See table below for percentages.

Table 11. COSTS OF IMPLEMENTING CARRYING CAPACITY PROGRAM FOR SCENIC ROADWAYS

<u>Group</u>	<u>No More Than Usual</u>	<u>Neutral</u>	<u>Unbearable</u>
Roadway Planners and Designers	26%	48%	26%
Roadway Managers	22%	67%	11%
Carrying Capacity Researchers	68%	25%	7%
Scenic Roadway Managers*	0%	67%	33%
Recreation Resource Managers	35%	53%	12%

*Only three responses in this category

On issues relating to the perceived value of the carrying capacity concept for managing scenic roadways, carrying capacity researchers often set themselves apart from their counterparts in other professions. Their responses provided an interesting contradiction.

Fewer carrying capacity researchers rated the concept as having strong potential for managing scenic roadways. However, they found fewer limitations to carrying capacity when asked specific questions about application of concept.

In the section of the questionnaire on roadway management issues professional orientation less clearly divided groups. All groups of respondents agreed on the importance of a number of management concerns (question 14). However, when asked about tactics for implementing carrying capacity responses of the groups varied.

Few roadway planners and designers, thirty-four percent, felt it possible to manage the carrying capacity of a roadway if limiting use is not an option. Over fifty percent of the respondents in all other groups felt carrying capacity management was not dependent on limiting use.

When asked to what extent the phenomenon of people modifying their expectations when the roadway is crowded limits the usefulness of the carrying capacity concept, only carrying capacity researchers diverged from the norm. Sixty-one percent of carrying capacity researchers responded that this phenomenon did not limit the usefulness of the concept. In other groups only thirteen to twenty-six percent rated it a non-limiting factor (see Table 6 below).

**Table 12. EXTENT THAT EXPECTATION MODIFICATION
LIMITS USEFULNESS OF CARRYING CAPACITY**

<u>Group</u>	<u>Not Limiting</u>	<u>Neutral</u>	<u>Limiting</u>
Roadway Planners and Designers	26%	15%	59%
Roadway Managers	13%	25%	62%
Carrying Capacity Researchers	61%	18%	21%
Scenic Roadway Managers*	--	--	--
Recreation Resource Managers	24%	29%	47%

*Only two responses - percentages not reported

Recent carrying capacity models are focusing more and more often on resource conditions rather than more nebulous social questions, like expectation modification. Managers realize the importance of understanding these theories and issues, but also recognize the difficulty of building them into a management model.

When asked if a carrying capacity model should focus on mitigating negative impacts of periods of peak use (question 18) most respondents gave a neutral response or one of disagreement. Only roadway managers responded differently. Seventy percent of roadway managers thought that carrying capacity should have as a primary concern mitigating those problems. Likewise, of those respondents who identified themselves as working for state and federal highway agencies, fifty-six percent

agreed that carrying capacity should manage for periods of peak use.

On the question of whether or not a carrying capacity model should shift its focus from environmental protection to user satisfaction as a roadway shifts from rural to urban settings (question 19) respondents gave a range of responses. Of the groups responding, only carrying capacity researchers (65%) and recreation resource managers (57%) disagreed with the shift. Most other groups had nearly the same numbers agreeing and disagreeing with the statement.

The section of the questionnaire on roadway issues shows agreement on major concerns for carrying capacity of a scenic roadway, but notable differences on tactics for implementing carrying capacity. These differences most often parallel differences in knowledge resulting from professional orientation. Carrying capacity researchers were frequently the diverging group, however, roadway managers occasionally isolated themselves on issues. Understanding the motivation for responses that differ from the group norm could provide additional insights for implementing a successful carrying capacity management program for scenic roads.

On issues of adjacent land management all groups tended to be in agreement on all questions. More carrying capacity researchers (87%) agreed that distance

decreases the impact of development than did other groups (Group responses ranged from 60% for roadway managers to 78% for recreation resource planners.) Aside from that one divergence, there was a great deal of uniformity in group responses to questions on adjacent land management.

Length of Experience:

Responses to the questionnaire were compared on the basis of respondents' years of experience with the concepts of carrying capacity and scenic roadway management. Respondents reported a large number of years of experience with scenic roadways. Thirty-six respondents reported over fifteen years experience. Only two respondents reported under two years experience. However, a large group (29 respondents) reported a "not applicable" response. Comparisons are based on the responses of the seventy-seven respondents who did report scenic roadway experience.

Respondents also reported a high level of experience with the concept of carrying capacity. Thirty-seven respondents reported over fifteen years of experience with carrying capacity. Again, only two respondents reported under two years experience. Twelve respondents reported a "not applicable" response.

Differences in the level of experience of respondents did not correspond to large difference in the respondents' perception of the carrying capacity concept.

Dividing respondents by level of experience resulted in only two notable difference in the section of the questionnaire on how carrying capacity is perceived. As the level of experience with carrying capacity increased the perception that "lack of information about carrying capacity limits it usefulness in scenic roadway management" (question 6) decreased. Seventy-six percent of respondents with ten years or fewer experience with carrying capacity saw lack of information about carrying capacity as a factor limiting it usefulness. Forty-eight percent of respondents with eleven years or more experience responded the same way. Lack of good baseline data on environmental and social problems was perceived as a less significant problem among those with a higher level of scenic roadway experience. Eighty-eight percent of the respondents with ten years or fewer experience with scenic roadways saw lack of good baseline data as a problem in implementing a carrying capacity management program for scenic roadways. Sixty-nine percent of respondents with eleven years or more experience saw lack of information as a problem.

Examining responses according to length of experience of respondents produced few differences with regard to issues of managing scenic roadways and their associated facilities. The only notable difference was on the issue of "limiting use" . When asked if it is

possible to use the carrying capacity concept to manage a scenic roadway if limiting use is not an option (question 15) seventy-one percent of respondents with ten years or fewer experience with scenic roadways thought it was possible to use carrying capacity. Only thirty-five percent of those with eleven years of more experience thought carrying capacity concepts could be used if limiting use is not an option.

On issue of adjacent land management dividing respondents according to length of experience produced a few more notable differences. Seventy-six percent of respondents with ten years or fewer experience with scenic roadways disagreed that a carrying capacity management tool should limit itself to lands controlled by the managing agency (question 21). A smaller percentage, fifty-eight percent, of those who had eleven years or more experience with scenic roadways disagreed. Conversely, a smaller percentage of those respondents who had ten years or fewer experience with carrying capacity, fifty-eight percent, disagreed with the statement. Seventy-three percent of those with eleven years or more carrying capacity experience disagreed that a carrying capacity management tool should be limited to lands controlled by the managing agency. Evidence that more experience with scenic roadways produces a greater resistance to managing land outside the control of the

managing agency suggests that there is a need for study and improvement of techniques for managing those lands.

An increase in carrying capacity experience corresponded to an increased level of agreement with the statement that the impact of development decreases as distance from the scenic roadway increases (question 22). Eighty percent of respondents with eleven years or more carrying capacity experience agreed with the statement. A smaller percentage, sixty-six percent, of those with ten years of fewer experience agreed that impact decreases as distance increases.

An increase in scenic roadway experience corresponded to a decrease in agreement with the statement that "there is a positive relationship between the amount of public involvement in managing a scenic roadway and the level of support for roadway management objectives" by adjacent landowners (question 24). Sixty-two percent of respondents with eleven years or more scenic roadway experience agreed with the statement. Eighty-three percent of those with ten years or fewer experience agreed.

Although respondents were in general agreement about issues and perception of carrying capacity when examined according to length of experience trends showing differences in the strength of agreement surfaced from this examination. There was less support for managing adjacent lands not controlled by the agency and there was

a less agreement that public involvement creates greater support for management objectives as length of experience with scenic roadways increased. As carrying capacity experience increased the opposite was true. Though the numbers report that these differences are minor, working out agreement could produce a stronger carrying capacity model for scenic roadways.

Analysis of the responses by the variables of knowledge, professional orientation, and length of experience all show that the differences in responses correspond to differences in the sample based on knowledge and experience with carrying capacity verses knowledge and experience with scenic roadways. Greater knowledge and experience with carrying capacity corresponded with fewer perceived limitations for implementing a carrying capacity program for scenic roadways. It also showed a positive relationship to a more inclusive approach to managing lands adjacent to a scenic roadway. Those with greater knowledge and experience with scenic roadways tended to support the concept of carrying capacity for managing scenic roadways, but they were more skeptical of its limitations.

Summary and Conclusions

Respondents were generous with comments on the questionnaire. These comments help to highlight the common

ground and the differences that are the current state of thought on carrying capacity for scenic roadways.

Comments in the questionnaire indicated support for the Visitor Impact Management and Limits of Acceptable Change approaches because they both begin by looking at the management objectives for the resource. One of the most common objections to several questions in the questionnaire was that reasonable assessment of the validity of some statements could not be judged without knowing the management objectives for the particular roadway in question. This was recognized as a problem when creating the questionnaire. Seeing comments that carrying capacity management must start with management objectives supports conclusions from the literature review.

The issue of defining carrying capacity for scenic roadways is still a touchy one. Several respondents warned against using the term "carrying capacity" to discuss the breadth of issues presented in the questionnaire. A frequent complaint about the term, carrying capacity, was the "implied limit." One respondent said that carrying capacity implies an absolute environmental limit when in fact it is used to avoid or disguise unpopular management decisions that might require limiting use. Another respondent said that carrying capacity seems pertinent "only to issues in which changes in visitor numbers affect the quality of experience." Others

said that the carrying capacity of a scenic roadway is in fact an absolute based on design or facilities, design speed, and safety. They said this limit or capacity should not be confused with quality of recreation experience. This is the character of the debate surrounding carrying capacity. Several responses applauded the Visitor Impact Management model and Limits of Acceptable Change model for moving away from numeric capacities and focusing on resource and experience conditions. It should be noted that those respondents quoted above valued the concept and supported a broad approach to carrying capacity management despite their unwillingness to accept the term carrying capacity.

The other debate that surfaced in the comments was whether carrying capacity's value was as a concept or as a tool. Several respondents argued that carrying capacity was valuable as a concept, but had limits as a tool for broad management applications. Some respondents warned that carrying capacity was too fraught with value judgements to be useful while others commented that it was a good instrument for gauging values necessary to manage scenic resources, particularly roadways. This debate typifies the "chicken or egg" discussions surrounding carrying capacity.

It was suggested that in order to fully understand carrying capacity, differing management strategies such

as limiting use or allowing visitors to over-burden the system and "top out," would have to be applied to scenic roadways. Monitoring environmental impacts and visitor enjoyment in these situations would provide a basis for making real carrying capacity decisions about scenic roadways.

Issues of transition and sequencing surfaced with regard to managing adjacent lands. It was suggested that visitor perception of development could be adjusted or manipulated by sequencing events or by slowly introducing urban elements as the landscape changes from natural to urban.

The problem of managing for a public, but which public, is still a large concern. The political issues surrounding carrying capacity and especially carrying capacity of scenic roadways are still in need of study.

The findings of this study support a broad based approach to carrying capacity management for scenic roadways. It confirms that a carrying capacity model for scenic roadways should address not only number of roadway users, but also type of roadways and facility use. Responses also indicate that a carrying capacity model for a scenic roadway should address adjacent land uses. Finding that those with a knowledge of carrying capacity and those with a knowledge of scenic roadways differ in their perception of how carrying capacity for a scenic

roadway should be approached suggests that there is still information that needs to be gathered and dispersed to those trying to implement carrying capacity programs for scenic roadways. The findings of this study while broad and often general provide a necessary base for asking more specific questions about how carrying capacity could be implemented for scenic roadways.

CONCLUSIONS

As the demands of our nation's scenic roadways continue to grow, the importance of a system for wisely managing the scenic resources and user experiences becomes increasingly important. Clearly, there is agreement among carrying capacity researchers and scenic roadway managers and planners that the carrying capacity concept provides an option for managing the impacts associated with increasing use.

One objective of this study was to examine the perception of carrying capacity among those who might develop and implement a carrying capacity tool for scenic roadways. Carrying capacity was perceived as having strong potential for managing scenic roadways by a majority of those questioned. Evidence that carrying capacity does not have an insurmountable image problem among those responsible for managing scenic roadways suggests that a well conceived model might have good chances for success.

However, differences of opinion do exist on the limitations of carrying capacity for managing scenic roadways. These differences point to the need for future research on proper techniques for implementing carrying capacity and overcoming these limitations. The section of the questionnaire seeking direction for future research efforts found a clear need for more predictable

links between increasing use and the social and physical conditions created by increasing use. The National Park Service, which has mandated carrying capacity studies for all National Park units, must be prepared to take the lead in pushing forward the research efforts needed to understand the intricacies of carrying capacity for scenic resources.

Fields of landscape architecture, forest resource management, engineering, environmental psychology, recreation resource planning and other related fields must begin to work together and share information about resource protection and behavior management so that professionals charged with protecting scenic roadway resources will have the information and skills to accomplish their tasks. The questions on sources of knowledge indicate a great need for on the job training with carrying capacity concepts. Many questionnaire respondents listed work experience as a primary source of their knowledge. It should also be noted that universities were rated low among sources of information on carrying capacity. This points to real opportunities for increasing knowledge among professionals and future professionals by adding carrying capacity management to the curricula of resource management fields. Universities provide a likely setting for pulling together the diverse resources and information needed to address the

broad concerns of carrying capacity for scenic roadways. Finding better links between knowledge storehouses and practitioners of roadway management is clearly an avenue for further exploration.

There was a consensus in the group participating in this study that carrying capacity models for scenic roadways must extend beyond the physical boundaries of the scenic roadway. Although the mandate for going beyond the roadway is clear understanding the political and financial implications of expanding the model to include adjacent lands needs research.

There needs to be a formal and systematic process for incorporating public input into a carrying capacity management program. Scenic roadway managers with the highest level of experience were the group indicating the least support for the notion that public input increases public support. This group made a statement about the difficulty of garnering that important public support. Finding the appropriate means to gather and channel support takes the good judgement of resource managers, but the opportunity to train resource managers to be better advocates for carrying capacity management should not be by-passed as an option for increasing that public support.

Managers of scenic roadways must begin to recognize the problems of over use and crowding when establishing

management objectives. Good management objectives are the driving force behind recently developed models for implementing carrying capacity (VIM and LAC). Recognition of the specific problems created by over use helps resource managers visualize both the preferred condition for the roadway and the problems that a carrying capacity management tool would have to address. Respondents to the questionnaire echoed the literature in supporting the notion that carrying capacity must begin with management objectives.

This thesis also points out the problem that boundaries between carrying capacity and other resource management concepts are often unclear. Respondents repeatedly urged that attempts at scenic roadway management include a broad range of management activities. Finding the appropriate role for carrying capacity among the resource management tools of visual resource management and environmental management will be an endeavor worthy of further study.

Developing a carrying capacity management model for scenic roadways is a decidedly difficult task, but one supported by researchers, planners, and managers alike. This study airs many important issues and management techniques associated with carrying capacity of scenic roadways. As Shelby and Heberlein (1984) suggest carrying capacity has both a scientific and a judgmental

component. This study has delved into both of those components, but has been more closely allied with judgement issues. By reviewing the opinions of experts future roadway planners and managers can make better informed judgments about managing the carrying capacity of their roadway. These opinions should aid resource managers as they formulate management objectives allowing them to see more clearly the scope of management addressed by a carrying capacity management tool. Also by allowing roadway resource managers to move through setting exercises more quickly, more energy can be directed toward resource capabilities and user needs.

The respondents indicated that the work of carrying capacity must not stop at establishing a working model for carrying capacity of scenic roadways, but should continue to collect information and monitor change so that more accurate predictions about user/resource relations can be made.

This thesis clarifies some of the issues surrounding the formulation of a carrying capacity model for a specific scenic roadway. It begins to set bounds for a carrying capacity management model for scenic roadways. With these bounds established scenic roadway managers, planners, and researchers can begin to develop lists of important issues and information sources about resource

conditions for specific roadways. These issues should fuel good management objectives with measurable ends.

The efforts of this study and others that must follow should clarify the options for carrying capacity management so that roadway resource managers can focus greater energy on making the proper judgments to save our nation's scenic roadways from spoil.

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Appendix A. Cover Letter

APPENDIX A: COVER LETTER

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

Landscape Architecture

Blacksburg, Virginia 24061

November 3, 1988

Ms. Questionnaire Respondent
P.O. Box X19
Blacksburg, Virginia 24060

Dear Ms. Respondent

Over the past several years there has been a marked increase in the use of scenic roadways as recreation outlets. At the same time there has been increased pressure to develop lands adjacent to these roads. These problems of increased use have spawned talk of the "carrying capacity", or appropriate level of use, of scenic roadways. This study is an attempt to gain a better understanding of how the concept of carrying capacity can be used to manage and plan scenic roadways.

You are one of a small group of researchers, resource managers, or roadway planners who is being asked to give opinions on these matters. You have been identified by your peers as having interests and knowledge pertinent to these questions.

Participation in this survey is voluntary. Please be assured that your responses will remain completely confidential. If you complete the questionnaire your responses will not be reported as linked to you or your agency.

Please return the questionnaire in the postage-paid envelope which has been provided.

The results of this research will be used to write a masters thesis in Landscape Architecture. You may receive a summary of results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please *do not* put this information on the questionnaire itself.

Should you have any questions regarding the survey or its intent, please contact me or my graduate advisor, Dr. Patrick Miller at (703) 961-5583.

Thank you for your assistance.

Sincerely,

Warren E. Wise

Encl: Questionnaire

VIRGINIA TECH

Appendix B. Questionnaire

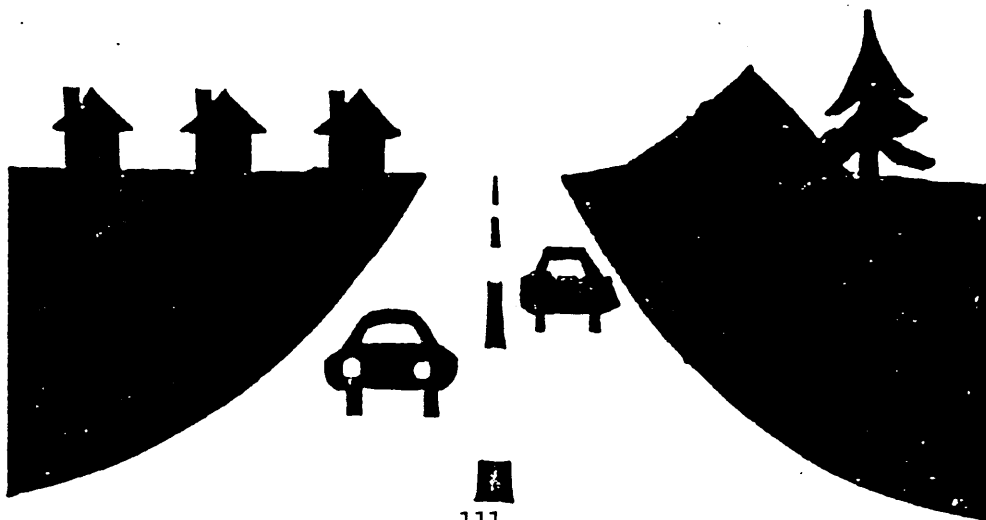
APPENDIX B: QUESTIONNAIRE

CARRYING CAPACITY FOR SCENIC ROADWAYS

A 1987 Study to Better Understand the Role
of Carrying Capacity as a Tool for Managing
Scenic Roadways

Please answer all of the questions. If you
wish to comment or qualify your answers
please feel free to use the space in the mar-
gins. Thank you for your help.

Landscape Architecture Department
Virginia Polytechnic and State University
Blacksburg, Virginia 24061



APPENDIX B: QUESTIONNAIRE

First, we would like to ask some questions about your knowledge of carrying capacity and scenic roadways. (Please circle your response.)

1. How knowledgeable do you consider yourself about scenic roadway management?

(NOT AT ALL) (VERY KNOWLEDGEABLE)
 1.....2.....3.....4.....5

2. To what extent have the following experiences influenced your knowledge of scenic roadway management? (Circle one response per category.)

	(NOT AT ALL)			(VERY MUCH)
A. WORK AS A SCENIC ROADWAY MANAGER.....	1	2	3	4 5
B. WORK AS A SCENIC ROADWAY PLANNER OR DESIGNER.....	1	2	3	4 5
C. RESEARCH ON PROBLEMS OF SCENIC ROADWAYS.....	1	2	3	4 5
D. READING ABOUT SCENIC ROADWAYS IN PROFESSIONAL OR SCHOLARLY JOURNALS... 1	2	3	4	5
E. READING ABOUT SCENIC ROADWAYS IN AGENCY LITERATURE.....	1	2	3	4 5
F. PERSONAL EXPERIENCE AS A USER OF SCENIC ROADWAYS.....	1	2	3	4 5
G. READING ABOUT SCENIC ROADWAYS IN POPULAR MAGAZINES.....	1	2	3	4 5

3. How knowledgeable do you consider yourself about the carrying capacity concept?

(NOT AT ALL) (VERY KNOWLEDGEABLE)
 1.....2.....3.....4.....5

4. To what extent is your understanding of the carrying capacity concept based on: (Circle one response per category.)

	(NOT AT ALL)			(VERY MUCH)
A. RESEARCH ON CARRYING CAPACITY.....	1	2	3	4 5
B. APPLICATION OF CARRYING CAPACITY CONCEPTS IN MANAGEMENT.....	1	2	3	4 5
C. READING ABOUT CARRYING CAPACITY IN PROFESSIONAL OR SCHOLARLY JOURNALS....1	2	3	4	5
D. READING ABOUT APPLICATIONS OF CARRYING CAPACITY IN AGENCY LITERATURE1	2	3	4	5
E. EXPOSURE TO CARRYING CAPACITY THROUGH UNIVERSITY COURSES.....	1	2	3	4 5

APPENDIX B: QUESTIONNAIRE

One purpose of this survey is to determine how carrying capacity is perceived and where additional information is needed. (Please circle the response most closely related to your view.)

5. The carrying capacity concept has strong potential for managing scenic roadways.

(DISAGREE) (AGREE)
1.....2.....3.....4.....5

6. To what extent does lack of information about carrying capacity limit its usefulness to scenic roadway planners and managers?

(NOT AT ALL) (VERY MUCH) (DON'T KNOW)
1.....2.....3.....4.....5 9

7. To what extent is the lack of good baseline data on environmental and social conditions for scenic roadways and land adjacent to scenic roadways a problem in implementing a carrying capacity management program?

(NOT AT ALL) (VERY MUCH) (DON'T KNOW)
1.....2.....3.....4.....5 9

8. Does an adequate example exist for using carrying capacity concepts to manage scenic roadways?

(NOT AT ALL) (A VERY GOOD EXAMPLE) (DON'T KNOW)
1.....2.....3.....4.....5 9

Please list any good examples.

9. Please indicate to what extent you feel that an adequate carrying capacity management program would impose costs on a scenic roadway managing agency.

(NO MORE THAN USUAL) (UNBEARABLE COSTS) (DON'T KNOW)
1.....2.....3.....4.....5 9

WHY?

APPENDIX B: QUESTIONNAIRE

10. Are you familiar with the National Parks and Conservation Association's Visitor Impact Management or the Forest Service's Limits of Acceptable Change models for using carrying capacity?

	(NOT AT ALL)	1	2	3	4	(VERY FAMILIAR)	5
A. VISITOR IMPACT MANAGEMENT MODEL.....	1	2	3	4	5		
B. LIMITS OF ACCEPTABLE CHANGE MODEL.....	1	2	3	4	5		

11. Do you currently use carrying capacity concepts in managing any scenic roadways under your control?

A. NOT APPLICABLE → If not applicable, please skip to question 14.

B. YES

A. NO → If no, please skip to question 13.

(If yes)

→ 12. Which of the following statements best characterizes your use of carrying capacity concepts?

- A. A FORMAL CARRYING CAPACITY MANAGEMENT MODEL IS IN PLACE.
- B. CARRYING CAPACITY CONCEPTS ARE BEING APPLIED AS PART OF OTHER MANAGEMENT PRACTICES.
- C. CARRYING CAPACITY STUDIES ARE UNDERWAY, BUT NOT YET BEING APPLIED.
- D. OTHER (please explain)

(If no)

13. Is carrying capacity an issue being discussed for scenic roadways managed or designed by your agency?

- A. NO
- B. YES

APPENDIX B: QUESTIONNAIRE

Another purpose of this survey is to gain a better understanding of the role of carrying capacity in managing scenic roadways. Please respond to the following questions which help to establish the bounds for a management tool based on carrying capacity. (Circle the response most closely related to your view.)

14. The following list presents some major concerns for managing scenic roadways. How important is each of the following to the carrying capacity of a scenic roadway? (Please circle one response for each item.)

		(NOT AT ALL)			(VERY IMPORTANT)
A. NUMBER OF USERS OF THE ROADWAY.....	1	2	3	4	5
B. NUMBER OF USERS OF FACILITIES ASSOCIATED WITH THE ROADWAY (PICNIC AREAS, OVERLOOKS, ETC.).....	1	2	3	4	5
C. TYPE OF ROADWAY USE (PLEASURE (DRIVING, BICYCLING, COMMUTING, ETC.)....)	1	2	3	4	5
D. AMOUNT OF DEVELOPMENT ON LAND WITHIN VIEW OF THE ROADWAY.....	1	2	3	4	5
E. TYPE OF DEVELOPMENT ON LAND WITHIN VIEW OF THE ROADWAY.....	1	2	3	4	5
F. DEVELOPMENT ON LAND ADJACENT TO THE ROADWAY, BUT NOT WITHIN VIEW OF THE ROAD.....	1	2	3	4	5
G. OTHER _____.....	1	2	3	4	5

15. To what extent do you feel it is possible to use the carrying capacity concept in managing a scenic roadway if "limiting use" of the roadway is not an option?

(NOT POSSIBLE)	(VERY POSSIBLE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

16. As the volume of users of a scenic roadway increases, users tend to modify their expectations of the roadway experience to tolerate more people and their impacts. To what extent does this phenomenon limit the usefulness of carrying capacity as a management tool?

(NOT AT ALL)	(VERY MUCH)	(DON'T KNOW)
1.....2.....3.....4.....5		9

APPENDIX B: QUESTIONNAIRE

17. How important is controlled access to managing the carrying capacity of a scenic roadway relative to other management tools?

(NOT IMPORTANT)	(VERY IMPORTANT)	(DON'T KNOW)
1.....2.....3.....4.....5		9

18. Some scenic roadways are subject to intense periods of seasonal use. Assume a particular roadway is subject to intense use two weeks out of the year. The primary concern of a carrying capacity model for this roadway should be to mitigate negative impacts caused by this period of peak use.

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

19. Studies of carrying capacity have focused most often on either environmental protection or user satisfaction. As the setting for a roadway shifts from natural to urban the focus of a carrying capacity model should shift from environmental protection to user satisfaction.

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

APPENDIX B: QUESTIONNAIRE

Now, we would like to ask some questions about managing the land adjacent to scenic roadways. (Please circle the one response that most closely reflects your opinion.)

20. The amount and type of development on land adjacent to a scenic roadway should be addressed as part of the carrying capacity of a scenic roadway.

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

21. A carrying capacity management tool should limit itself to lands controlled by the managing agency (i.e. fee simple ownership or scenic easements).

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

22. Generally, the impact of development decreases as distance from the scenic roadway increases.

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

23. Distance as a factor in determining acceptable land uses will differ greatly between an urban setting and a largely undisturbed natural setting.

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

24. There is a positive relationship between the amount of public involvement in managing a scenic roadway and the level of support for roadway management objectives by landowners within view of the scenic roadway.

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

APPENDIX B: QUESTIONNAIRE

We would like to know more about what you perceive as the proper direction for future carrying capacity efforts in terms of models for using carrying capacity with scenic roadways and for future research.

25. To what extent should a carrying capacity management tool play a role in achieving the following goals for scenic roadways? (Circle one response for each category.)

	(NOT AT ALL)			(VERY IMPORTANT)
A. PRESERVING SPECTACULAR VIEWS.....1	2	3	4	5
B. PRESERVING CULTURAL LANDSCAPES.....1	2	3	4	5
C. MAINTAINING A LEISURE ATMOSPHERE..... 1	2	3	4	5
D. MONITORING VISITOR ENJOYMENT.....1	2	3	4	5
E. EDUCATION OF THE PUBLIC				
ABOUT THE ENVIRONMENT.....1	2	3	4	5
F. OTHER _____.....1	2	3	4	5

26. The carrying capacity of a scenic roadway is not absolute, but should shift as public opinion and expectations change.

(DISAGREE)	(AGREE)	(DON'T KNOW)
1.....2.....3.....4.....5		9

27. How important is it that future carrying capacity research establish more predictable links between the level of use of a resource and its: (Circle one response for each.)

	(NOT AT ALL)			(VERY IMPORTANT)
A. IMPACT ON ENVIRONMENTAL CONDITIONS..1	2	3	4	5
B. IMPACT ON USER SATISFACTION.....1	2	3	4	5

28. Please identify other topics that need further research to better understand the carrying capacity of scenic roadways.

APPENDIX B: QUESTIONNAIRE

Finally, we would like to ask a few questions to help interpret the results.
(Circle the number of your answer.)

29. Which of the following best characterizes you?

1. ROADWAY PLANNER OR DESIGNER
2. ROADWAY MANAGER
3. RESEARCHER WITH INTEREST IN CARRYING CAPACITY
4. RESEARCHER WITH INTEREST IN SCENIC ROADWAYS
5. RECREATION RESOURCE MANAGER OR PLANNER
6. OTHER _____

30. How long have you been working with scenic roadways?

1. UNDER 2 YEARS
2. 2-5 YEARS
3. 6-10 YEARS
4. 11-15 YEARS
5. OVER 15 YEARS
6. NOT APPLICABLE

31. How long have you been working with carrying capacity?

1. UNDER 2 YEARS
2. 2-5 YEARS
3. 6-10 YEARS
4. 11-15 YEARS
5. OVER 15 YEARS
6. NOT APPLICABLE

32. In your experience with scenic roadways do you more frequently deal with:
(Please circle as many as are required to show your background.)

1. ROADWAYS IN URBAN SETTINGS
2. ROADWAYS IN RURAL SETTINGS
3. ROADWAYS IN LARGELY UNTOUCHED NATURAL AREAS
4. NOT APPLICABLE

33. With what type of agency or organization do you work?

1. FEDERAL PARK OR RESOURCE MANAGEMENT AGENCY
2. STATE OR FEDERAL TRANSPORTATION AGENCY
3. EDUCATIONAL INSTITUTION
4. INDEPENDENT RESOURCE PROTECTION ORGANIZATION
5. PRIVATE CONSULTING OR DESIGN FIRM
6. OTHER _____

APPENDIX B: QUESTIONNAIRE

34. In what region of the country do you most frequently work?

1. PACIFIC NORTHWEST
2. PACIFIC SOUTHWEST
3. ROCKY MOUNTAINS
4. SOUTHWEST
5. PLAINS
6. GREAT LAKES
7. SOUTH
8. APPALACHIA
9. MIDDLE ATLANTIC
10. NEW ENGLAND
11. ALASKA
12. NATIONWIDE

APPENDIX B: QUESTIONNAIRE

Your contribution to this effort is very greatly appreciated. If you would like a summary of the results, please print your name, address, and "copy of results" on the back of the return envelope (NOT on this questionnaire). We will see that you get it.

Appendix C. Visitor Impact Management Process

APPENDIX C

Visitor Impact Management Process

The first step, Preassessment Data Base Review, involves gathering existing base-line information so that the nature of impact problems can be determined. This data base could include management policies, visitor surveys, and previous studies. Establishing boundaries or management zones is another important part of this first step (Graefe, Vaske, Kuss, 1987).

Graefe, Vaske, and Kuss set reviewing management objectives as the second step in the process. Existing management objectives should be refined to include clear definition of the ecological and social conditions appropriate for the area.

The third step is to select key indicators that measure the impacts targeted in the management objectives. To be useful an indicator must be observable, measurable, directly related to the management objectives, and sensitive to the changes or impacts of importance.

Once the indicators themselves have been selected the fourth step requires setting standards for the ideal or allowable state of the indicators. The units and measures for the standards should reflect existing data so that there will exist a base-line for comparison.

The fifth step compares the existing condition to the standard set. Graefe, Vaske, and Kuss emphasize that these need not be costly researched comparisons. The comparison need only provide a reasonable comparison of existing conditions and their

standards. Quality of information can be upgraded as time and funding permit.

Sixth, causes need to be identified for discrepancies between the standard and existing condition. They stress the importance of identifying the full range of possibilities allowing for temporal and locational differences.

Step seven involves identifying management strategies to overcome those impacts created through recreational use. They stress the importance of identifying alternative strategies should one fail or prove politically unpopular.

The final step is implementation. The key to successful implementation is a good program for monitoring results and providing a process for adjusting baseline data and management objectives to reflect new information (Graefe, Vaske, Kuss, 1987).

Appendix D. Limits of Acceptable Change Process

APPENDIX D

Limits of Acceptable Change Process

The first step of the process identifies features and values of the region that require special attention. This step involves identifying the role of the resource with regard to other resources in the area. This step also requires a review of existing policy and identification of any unique characteristics influencing management of an area.

The second step identifies opportunity classes. Opportunity classes give qualitative descriptions of the activities or management strategies to be used in an area. This step inserts the notion that different areas of a resource can support different types and levels of activities. This step requires managers to focus on the range of suitable activities and conditions for an area. This range of opportunity classes must then be described in physical terms and in terms of management issues that will arise in trying to maintain identified condition.

Step three refines the somewhat ambiguous notion of opportunity class by identifying indicators of resource and social conditions. Indicators are measurable aspects of the opportunity class. Stankey lists examples such as amount of bare ground at a camp site or number of encounters with hikers on a trail (Stankey and McCool, 1984).

After indicators have been selected a baseline for their existing condition must be established in step four. Stankey emphasizes that inventories can use existing data and can use differing levels of detail as long as they are achieved by systematic and replicable means.

Step five sets standards for the indicators selected and inventoried. This is a judgmental process that pulls on what was determined suitable in step two. It is important that these standards not be just idealistic goals, but conditions that can be achieved over time (Stankey, Cole, Lucas, Petersen, Frissell, 1985).

Step six begins to identify alternative strategies for providing the opportunities and resource and social conditions selected as important for the resource. Alternatives might provide for preservation of one area or use for more intensive recreation. This reflects the idea that all areas have more than one possible use and that the decision for best use should consider more than one possibility.

Step seven identifies management strategies necessary to bring about the desired conditions for each alternative for an area. Usually more than one management strategy can bring about the desired quality of experience. Finding areas where existing management strategies have brought quality at or above the standards can help to highlight strategies that might be effective for other areas where management has been less successful.

Step eight requires a political and judgmental step of

selecting the preferred alternatives. At this point public concerns, costs of management options, contribution to a regional or national system that supplies unique opportunities can be brought to the front.

Step nine is to implement actions and monitor conditions. This step again allows adjustments to the system and predicts how well management actions are working to protect or restore desired social and ecological conditions (Stankey, Cole, Lucas, Petersen, Frissell, 1985).

Appendix E. Roadway Carrying Capacity Models

APPENDIX E

Scenic Roadway Carrying Capacity Models

- Scenic highway in Custer State Park, South Dakota.
- Limits of Acceptable Change, U.S. Forest Service.
- Olympic Loop - State Route 101, and North Cascade Loop, both under Washington State Department of Transportation.
- Park road, Denali National Park.
- Studies by VTN Associates.
- George Washington Memorial Parkway, National Park Service.
- Park roads, Yosemite National Park.
- Bob Marshall Wilderness Complex, Montana. LAC Application.
- Great River Road along the Mississippi River.
- Wonderlake Road, Mt. McKinley National Park.
- Maryland Route Two, Maryland Department of Transportation.
- Back Country Research Program, U.S.D.A. Forest Service, North Eastern Experiment Station, 1983.
- Route 201, Wyman Lake (no additional information given)

**Appendix F. Roadway Management Concerns Important
to Scenic Roadway Management Concerns**

APPENDIX F

Roadway Management Concerns Important To Scenic Roadway Carrying Capacity

- Manipulation of the road corridor landscape.
- Type of vehicle permitted on the roadway.
- Alternative routes for people in a hurry.
- Destinations served by the road.
- Views from road overlooks.
- Frequency and volume of traffic relating to impact on roadway users and to wildlife.
- Safety.
- Concept of particular roadway.
- Design of the road and adjacent shoulders.
- Roadside flora and fauna relative to use.
- Management objectives of roadway.
- Type of roadway.
- Condition of roadway.
- Desired user experience.
- Alternative uses for roadway (commuting, commercial traffic)
- Vistas and vegetation blocking vistas.
- Design speed of roadway.
- Political climate.
- Alternative means of transportation for viewers.

Appendix G. Future Direction of Research

Appendix G

Suggested Topics for Future Research

- Management options for maintaining recreation quality under conditions of increasing use.
- Long and short term impacts of road construction on natural communities.
- Wildlife hazards created by roads.
- Effects of roadway amenities - bathrooms, viewing pull outs, etc. - on carrying capacity of scenic roadways.
- Effects of roadway design on carrying capacity.
- Adapting carrying capacity concepts to scenic roadways that are also commuter routes.
- Impacts of creating a sequenced visual and environmental experience; monitoring and adjusting to achieve high user satisfaction.
- Relationship of visitor characteristics to visitor expectations.
- Tendencies of visitors to adjust expectations to match conditions.
- Air and water quality issues in areas adjacent to scenic roadways.
- Carrying capacity as it relates to visitor safety.
- Design speeds.
- Use of scenic easements.
- Temporal qualities of carrying capacity.
- Effects of signage on carrying capacity.
- Ability to regulate without giving the feeling of doing so.
- Establishing boundaries of viewshed for scenic highways.
- More predictable links between numbers of users and adjacent land use.
- Economic impacts of scenic roadways.
- Public perception of appropriate level of development on land adjacent to scenic roadways and changes in that perception over time.
- Impact of social interactions within the car on user satisfaction and perceived carrying capacity.
- Interaction between agency goals and local community.
- Appropriate design standards for scenic roadways to maximize carrying capacity without destroying the resource.
- Establishing better links between resource conditions and user satisfaction.
- Effective media for transmitting management goals to the public.
- Relationship of vehicle types permitted and user satisfaction.
- Resource and cultural attributes most valued by users.
- Vegetation management practices.
- Spacing, type, and numbers of facilities along roadside.
- Effects of interpretation and education along the road.

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