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Evaluating Methods for Measuring and Managing the Cumulative Visual Effects of Oil and Gas Development on Bureau of Land Management National Conservation Lands in the Southwestern United States

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EVALUATING METHODS FOR MEASURING AND MANAGING THE CUMULATIVE
VISUAL EFFECTS OF OIL AND GAS DEVELOPMENT ON BUREAU OF LAND
MANAGEMENT NATIONAL CONSERVATION LANDS IN THE SOUTHWESTERN
UNITED STATES

A Thesis Presented

by

TARA L. GERMOND

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DEDICATION

This thesis is dedicated to my parents, Henry and Roxanne; sister, Yvonne; and grandparents, Robert and Blanche. I am indebted to them for their consistent support, acceptance, and encouragement.

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ABSTRACT

EVALUATING METHODS FOR MEASURING AND MANAGING THE CUMULATIVE VISUAL EFFECTS OF OIL AND GAS DEVELOPMENT ON BUREAU OF LAND MANAGEMENT NATIONAL CONSERVATION LANDS IN THE SOUTHWESTERN UNITED STATES

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The public lands of the United States administered by the Bureau of Land Management (BLM) are used for multiple purposes, like conservation, recreation, grazing, mining, logging, and oil and gas development. Many of these activities have the potential to disturb the surface of the landscape, which can negatively impact scenic values. While the BLM has a system for managing visual resources and mitigating the potential impacts of development on visual quality, it does not adequately consider cumulative visual effects, which are the combined impacts of the same type of activity on the environment over space and time. This paper studies the challenges and opportunities faced by managers of Canyons of the Ancients National Monument in southwestern Colorado, a landscape particularly affected by oil and gas development, at measuring and managing cumulative visual effects. This paper also reviews the results of a series of interviews conducted with experts in the field of cumulative visual effects and of a visual preference survey that highlight the strengths and limitations of existing methods for assessing cumulative visual effects. This research paper concludes with a list of recommendations for the BLM to incorporate cumulative visual effects into its existing visual resource management system and details directions for future research on this subject.

CONTENTS

	PAGE
ACKNOWLEDGEMENTS.....	iv
ABSTRACT.....	v
LIST OF TABLES	x
LIST OF FIGURES.....	xi
CHAPTER	
1. INTRODUCTION.....	1
1.1. Research Purpose, Goals, and Objectives	3
1.2. Research Questions	5
1.3. Limitations to Research.....	6
1.4. Chapter Outline	6
2. LITERATURE REVIEW	8
2.1. Historical and Theoretical Context for Evaluating Visual Landscape Quality	8
2.1.1. Public Preference Methods	9
2.1.2. Descriptive Inventory Methods.....	12
2.1.3. Quantitative Holistic Methods	13
2.2. Visual Resource Management of Federal Landscapes.....	14
2.2.1. Visual Resource Management Challenges	15
2.2.2. Federal Legislation	15
2.3. Visual Resource Management Systems	17
2.3.1. USFS Scenic Management System	17
2.3.2. BLM Visual Resource Management System	19

2.3.3. Shortcomings of the SMS and VRM	22
2.4. Cumulative Effects Assessment	24
2.4.1 Defining Cumulative Effects	24
2.4.2 History of Cumulative Effects Analysis	25
2.5. Challenges to cumulative effects assessment	26
2.5.1 Spatial Scale.....	26
2.5.2. Temporal Scale	27
2.5.3. Establishing a baseline.....	28
2.5.4. Lack of Quantitative Data.....	29
2.6. Strategies to Overcome Challenges	29
2.7. Methods for Cumulative Effects Assessment	30
2.7.1. Tools for Assessing Cumulative Effects	31
2.8. Cumulative Visual Effects Assessment.....	32
2.9. Conclusion.....	33
3. METHODOLOGY	34
3.1. Case Study: Canyons of the Ancients National Monument	35
3.2. Informal Interviews	36
3.3. Visual Survey	38
4. CASE STUDY – CANYONS OF THE ANCIENTS NATIONAL MONUMENT	41
4.1. Background Information	41
4.2. Site Analysis	43
4.3. History of Oil and Gas Development on the Monument	50
4.4 Threat to Visual Quality	52

4.4.1. Impacts of Oil and Gas Development on Visual Quality	54
4.5. Visual Resource Management for the Monument	56
4.6. Considering Cumulative Effects	63
5. INFORMAL EXPERT INTERVIEWS	66
5.1. Methods for Conducting Cumulative Visual Effects Assessment	68
5.1.1. Visual Inventorying	68
5.1.2. Visual Contrast Rating System	69
5.1.3. Visual Simulations	70
5.1.4. Geographic Information Systems and Remote Sensing	71
5.1.5. Council of Environmental Quality Guidelines.....	73
5.1.6. Setting Boundaries	74
5.1.7. Past, Existing, and Reasonably Foreseeable Actions	74
5.2. Strengths and Limitations of Cumulative Visual Effects Assessment Methods	76
5.2.1. Lack of Data	76
5.2.2. Lack of Trained Professionals	77
5.2.3. Limited Public Review Process	78
5.2.4. Professional Bias	80
5.2.5. Lack of Guidelines	81
5.3. Incorporating Cumulative Effects Assessment into the VRM	81
6. VISUAL PREFERENCE SURVEY	84
6.1. Survey Design.....	84
6.2. Survey Results	93

6.3. Summary of Visual Preference Study	98
7. CONCLUSIONS & RECOMMENDATIONS	100
7.1. Recommendations	102
7.1.1. Update the Visual Resource Management System	102
7.1.2. Increased Training and Education	104
7.1.3. Create and Maintain Database of Visual Resource Information.....	105
7.1.4. Increase Use of Visual Models and Simulation Software.....	105
7.1.5. Identify Visual Impact Thresholds	106
7.1.6. Create Guidelines for Cumulative Visual Affects Assessment.....	107
7.2. Directions for Future Research	107
APPENDICES	
A. VISUAL PREFERENCE SURVEY	109
B. VISUAL PREFERENCE SURVEY RATING FORM.....	112
C. EXPERT INTERVIEW COVER LETTER AND QUESTIONS	114
BIBLIOGRAPHY	116

LIST OF TABLES

Table	Page
1 Canyons of the Ancients Scenic Quality Rating Units.....	58
2 Canyons of the Ancients Visual Sensitivity Analysis	59
3 Visual Resource Inventory Class Matrix.....	60
4 Canyons of the Ancients Visual Resource Management Inventory Classes	61
5 Canyons of the Ancients Visual Resource Class Objectives.....	62
6 Development Scenario Photograph Scores.....	94
7 Additional Photograph Scores	94

LIST OF FIGURES

Figure	Page
1. Canyons of the Ancients Public Visitation Sites.....	46
2. Locations of Oil and Gas Wells on Canyons of the Ancients.....	53
3. Development Scenario Matrix	86
4. Foreground / Panoramic Development Scenario	87
5. Middleground / Panoramic Development Scenario	88
6. Middleground / Non Panoramic Development Scenario	89
7. Foreground / Non Panoramic Development Scenario.....	90
8. Additional Photographs	91
9. Highest Rated Photograph	97
10. Lowest Rated Photograph.....	98

CHAPTER 1

INTRODUCTION

Preserving the quality of the visual environment and reducing the visual impacts of development activities on the landscape have long been important considerations in the planning and management of public lands (Department of the Interior, 2005). While these lands serve as places to enjoy the beauty of nature, some are also used for multiple purposes, like recreation, mining, logging, and grazing. Many of these activities have the potential to disturb the surface and character of the landscape, which can negatively impact scenic values and in turn, impact visitors' experience of protected lands.

Since the passage of influential environmental legislation such as the National Environmental Policy Act (NEPA) of 1969 and the Federal Land Policy and Management Act (FLPMA) of 1976, Federal agencies have developed systems for managing visual resources and for assessing the visual impacts of proposed and existing land use activities. Although these systems have proven to be effective at managing the direct visual impacts of specific land use activities, they are often too narrow in scope and fail to fully consider indirect and cumulative effects.

Visual impacts are assessed based on an individual project's immediate and foreseeable future impact on the surrounding area, whereas, cumulative effects are the combined impacts of the same type of activity on the environment occurring either too frequently in time or too densely in space (Zeimer, 1994). To date, there are no officially sanctioned guidelines for conducting cumulative effects assessment and the guidelines or methods that do exist are limited in number. Existing guidelines are especially limited for

assessing the cumulative effects (i.e. past, present, and future impacts) of development on visual resources (U.S. Council on Environmental Quality, 2007).

The task of understanding and managing the visual aspects of alterations to the natural landscape is particularly important for federal land management agencies like the Bureau of Land Management (BLM), as many of the activities taking place on their expansive and well-visited lands involve some degree of alteration (Ross Jr., 1979). The BLM is responsible for the management and conservation of resources on 258 million surface acres, as well as 700 million acres of subsurface mineral estate. These acres comprise 13% of the total surface area of the United States and are mostly located in the western part of the country.

Many outstanding scenic landscapes are provided by these lands, which are characterized primarily by extensive grassland, forest, high mountain, arctic tundra, and desert landscapes. In addition to scenic beauty, numerous resources and land uses occur here, including mining for energy and minerals; logging for timber; forage; recreation; wild horse and burro herds; fish and wildlife habitat; wilderness areas; and archaeological, paleontological, and historical sites (Bureau of Land Management, 2008).

The BLM has a long history of leasing its land for energy development, in particular for oil and gas drilling. One landscape particularly impacted by energy development is Canyons of the Ancients National Monument (CANM), which encompasses 165,000 acres of the San Juan Public Lands in the Four Corners region of the west. Each year, a large number of visitors are attracted to the Monument for its wealth of significant cultural and visual resources. It contains the highest known archaeological site density in the United States and approximately 25,000 acres of CANM fall within three designated wilderness study areas.

However, approximately 85% of this land, which is largely managed by the BLM, has been leased for energy production and remains open to continued oil and gas development under existing leases, lease restrictions and BLM regulations. Three hundred active and abandoned oil and gas wells have been inventoried on the Monument and none have achieved successful rehabilitation (Colorado State Bureau of Land Management Office, 2007).

Although the visual impacts produced by mining for oil and gas can be significant, leases and proposed projects for oil and gas drilling continue to be permitted because of the BLM's multiple use mandate and because only the direct impacts of proposed projects are typically measured. Currently, the BLM does not have a system for measuring the potential cumulative visual impacts. For example, an additional gas well may have minor impacts on its immediate area but can have a major impact on the visual resources of its surrounding landscape, which may have hundreds of existing wells and be the future location for hundreds more (Bureau of Land Management, 2008). Without a system for mitigating and managing the cumulative impacts of proposed oil and gas projects, they will continue to be permitted, and their large-scale effect on important scenic resources will remain unknown.

1.1. Research Purpose, Goals, and Objectives

The purpose of this thesis is to develop a set of recommendations for Federal land managers on how to incorporate cumulative effects assessment into existing visual resource management systems and resource management planning. The research also seeks to improve the NEPA permit review process by providing a more advanced understanding of the strengths and limitations of current methods for assessing cumulative visual effects. To accomplish this purpose I researched existing cumulative effects assessment procedures and interviewed experts, who have experience measuring and analyzing cumulative visual

effects. Canyon of the Ancients National Monument, which is a Bureau of Land Management (BLM) National Conservation Land Area located in southwestern Colorado, was used as a study site for examining how the BLM currently manages visual resources and for better understanding the visual impacts imposed by oil and gas production on federally managed landscapes. A visual preference survey was conducted to help identify the point at which the visual quality of the study site is lost to surface-disturbing land use activity. The results from these interviews and survey were used to devise recommendations for federal land managers, specifically Bureau of Land Management National Conservation Land Area managers, on how to incorporate cumulative effects assessment into existing planning and management procedures.

My work analyzes existing and potential methodologies for measuring visual resource cumulative effects of land use activities such as, oil and gas development on protected landscapes that contain important natural, visual, and cultural resources. Through this research, I am adding to the limited body of knowledge on this topic and providing federal land management agencies with information and suggestions as to how these impacts might be assessed. A reliable system for measuring cumulative effects could provide land managers with greater control regarding which projects are permitted on these landscapes or what alternatives / mitigation might be proposed for those projects that produce less significant impacts on visual resources.

The goals of this project are to:

- To deepen the understanding of methodologies for analyzing visual resource cumulative effects.

- To better understand how the Bureau of Land Management (BLM) can incorporate cumulative effects analysis into its existing Visual Resource Management system.
- To make recommendations for CANMs landscape regarding the development of visual impact thresholds and for monitoring cumulative effects of oil and gas development on the visual quality of the landscape.

The goals listed above were accomplished by:

- Conducting an in depth literature review of existing visual resource management models, methods for cumulative effect analysis with a focus on protected landscapes in the western United States.
- Becoming knowledgeable of visual resource management systems, particularly, the BLM's VRM.
- Interviewing experts in the field (e.g. landscape architects, social scientists, and firms that conduct visual preference analyses)
- Visiting the case study site, Canyons of the Ancients, to better understand how VRM is applied in the field and assess the landscape character.
- Conducting a visual preference survey to a random sample of the population using visual imagery to gauge potential visitor reactions to visual impacts of energy production on protected landscapes in the western United States.

1.2. Research Questions

The research framework of this thesis is organized in an effort to answer the following questions:

- What are the strengths and limitations of existing methods for assessing the cumulative visual effects of land use activity on federally owned and managed landscapes?

- What cumulative effects assessment methods are the most effective for Federal land management agencies and NEPA practitioners to apply for assessing the cumulative visual effects of development activities, like oil and gas drilling, on federally owned land?
- How can the BLM's Visual Resource Management system be updated to include guidelines for assessing the cumulative effects of development on visual resources?

1.3. Limitations to Research

The findings of this research are limited to the Bureau of Land Management's Visual Resource Management (VRM) system and to areas that are part of the Bureau of Land Management National Conservation Land System in the southwestern United States. While the recommendations produced in this document are general enough to apply to many types of surface-disturbing activities, the overall findings of this research are focused on the visual impacts produced by oil and gas production.

1.4. Chapter Outline

This thesis consists of seven chapters. Chapter 1 presents research on cumulative visual effects on public lands, and establishes the research strategy, including the purpose, goals, objectives and research limitations. Chapter 2 sets a foundation of historical and theoretical knowledge through a review of relevant literature involving various methods for analyzing the visual quality of landscapes, a comparison of visual resource management systems used by federal land management agencies, an overview of methods for conducting cumulative effects assessment, specifically visual effects. Chapter 3 outlines the research approach, which includes a case study, expert interviews, and a visual survey. Chapter 4 provides a detailed overview of the case study site, Canyons of the Ancients National Monument and addresses the challenge faced by this site as they relate to the topic of this thesis. Chapter 5 reviews key findings and observations from a series of interviews conducted with experts in the field of visual resource management about the strengths and limitations of existing methods for cumulative visual

effects assessment. Chapter 6 summarizes the results of a visual survey created to gauge the level of preference for the Canyons of the Ancients National Monument landscape as it is affected by varying densities of development. Chapter 7 includes a list of recommendations for the Bureau of Land Management to improve its ability to analyze cumulative visual effects and concludes with the author's final assessments and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

2.1. Historical and Theoretical Context for Evaluating Visual Landscape Quality

Support and interest in the systematic analysis of landscape aesthetics arose in the 1960s and 1970s with the advent of the environmental movement and passage of NEPA (Ryan, 2005; Kennedy, Sell and Zube, 1988). During this time there was an emphasis on producing objective and quantitative methods for evaluating ‘subjective’ responses to aesthetic or scenic quality (Daniels and Vining, 1983). Researchers from a variety of fields, including but not limited to landscape architecture, psychology, sociology, art criticism, and computer science, worked to develop models that could produce reliable and consistent information about individual’s responses to landscape quality (Ryan, 2005).

Public land managers also began to take an active interest in visual resource management and landscape assessment during this period of time. As scenic values became recognized as important public resources, federal land management agencies like the Bureau of Land Management and United States Forest Service began to develop expert based methods for protecting visual quality and for managing the visual impacts produced by development (Kaplan, 1985).

From such diverse contributors and the need for a scientific process to assess landscape aesthetics, came the development of a number of unique systems and methods for analyzing factors like visual quality, scenic integrity, visual impact, visual absorption capability etc. These methods have been classified by some as either subjective or objective or more appropriately, quantitative versus qualitative. Quantitative methods primarily

analyze the physical, visual aspects of the landscape and do not incorporate human perception and values into the analysis. Conversely, qualitative methods seek to derive understanding and meaning about the landscape from a human point of view. Qualitative methods support the notion that landscape values are based on the experience of human landscape interactions and that humans and the landscape are changed by the transactions between them (Kennedy, Sell, and Zube, 1988). Qualitative models are typically categorized as Public Preference methodologies, whereas more quantitative models usually fall under the category of Descriptive Inventories (Arthur et al., 1977). Methods that involve a combination of both are classified as Quantitative Holistic (Daniels and Vining, 1983). While each of these methods possesses strengths and limitations, some are better suited for particular types of visual analysis than others.

2.1.1. Public Preference Methods

Public preference evaluation methods support the notion that the best source of data for assessing landscape quality is the general public and that the visual attractiveness of a landscape is ultimately a product of the aggregated opinions of all the individuals concerned with that landscape (Briggs and France, 1980). With this method, the visual quality of a landscape is rated on the basis of an observer's individual preference of the whole landscape and is often applied via questionnaires or verbal surveys (Arthur et al., 1977).

The cognitive / psychological approach to landscape assessment applied by Kaplan and Kaplan is an example of a Public Preference methodology. A basic procedure of this approach is to identify relevant psychological variables for photographs of landscapes. Randomly sampled observers then rate their level of preference for each of the landscape images they are shown (Daniel and Vining, 1983).

Another landscape preference researcher is Roger Ulrich, who studied human affective response to visual stimuli by showing people scenes of natural and built environments and measuring their physiological responses such as brain waves or heart rate (Ryan, 2005; Kennedy, Sell, and Zube, 1988). He supported the idea that visual stimuli change people's emotional response and can lead to a particular behavior.

In a study examining the public attitudes towards urban naturalistic landscapes in contrast to more formal designs of urban green spaces, Ulrich used a site based questionnaire survey to measure public perception and preferences of contrasting green spaces (Ulrich, 1981). A number of surveying techniques including open ended, pre-coded, and scale format questions were used in a logical order to determine whether people could easily differentiate between landscape styles, identify any differences or similarities between the values and benefits experienced at survey sites, and to see if individual's preferences would associate with formal or naturalistic features and if this varied between study sites.

To reduce the likelihood that preference differences were attributed to sample differences rather than site differences, Ulrich organized sample groups based on similar demographics and visit related characteristics. He found that demographics and visitor related characteristics did not differ between respondent groups and that differences could be reasonably attributed to differences of landscape styles. By recognizing which indicators people use when judging the overall attractiveness of a forest, managers could have a more comprehensive understanding of how the public perceives and interacts with federally managed land (Merrick and Vining, 2006).

In a study conducted by Merrick and Vining (2006) that examined the characteristics people consider when evaluating forest attractiveness, participants were asked to make

decisions about their preferences of different forest management scenarios. Using a self-guided computer-based questionnaire, participants had to choose their preferred scenario of two different forest management options based only on visual changes in the forest. The participants were shown five sets of two images. These 5 sets represented separate points in time of the forest's 80-year management history. By analyzing transcripts from these participants, who were asked to think aloud while choosing between the different computer-generated forest management depictions, researchers were able to examine the observations, knowledge, feelings, and emotions by which participants were making decisions regarding forest scenarios.

While Public Preference methods can provide significant information about what elements of the landscape people find most visually pleasing or what management alternative is preferred, experts or professionals rather than the general public often make decisions involving visual impacts (Kaplan, 1979). For some, expert based procedures are preferred over public preference methods because there is concern that the personality and background of the observer and the context in which they are being surveyed can significantly affect what they observe (Clay and Daniel, 2000). Some also believe that the public lacks the experience and knowledge that is needed to be fully sensitive to aesthetic quality (Carlson, 1982). To these groups, the lay public can only express aesthetic preferences that are deemed to be idiosyncratic, arbitrary, and attached to emotive and associational influences (Robinson et al., 1976). Others believe that only those trained in design and experienced in visual impact assessment can express judgments of scenic quality and interpret the aesthetic values of the society (Robinson et al., 1976; Jacques, 1980); Craik and McKechnie, 1974 cited in Sanoff, 1991).

It should be noted, however, that while experts may have training and experience in visual assessment procedures they can be a “dubious source of objective judgments about what people care about in the landscape,” according to Kaplan in (Nasar, 1988). The perceptions, values, and motives of land managers and members of the public are derived from different personal and professional backgrounds and are likely to differ significantly (Vining, 1992; Vining and Ebreo, 2002). The public preference method can offer insight into people’s experience of the environment by providing awareness of agency / public mismatch, a mechanism for incorporating public input in visual management decisions, and a method for allowing culturally-appropriate decisions to be made (Kaplan, 1975).

2.1.2. Descriptive Inventory Methods

Most landscape assessment methods, including those based largely on expert procedures, can be categorized as descriptive inventories (Kaplan, 1979). These methods rely on mathematical functions to value, compare, and aggregate landscape components such as, physical landscape elements or design elements, which have been identified and measured by an individual expert or team of experts (Daniel and Vining, 1983). This approach is based on the assumptions that the value of a landscape can be described in terms of the values of its components and that scenic beauty is a physical attribute of the landscape. Critics of this method argue that landscape components are arbitrarily identified and subjectively scored based on the design values of the researcher (Robinson et al, 1976).

One type of model that uses descriptive inventory methods is the formal aesthetic. The formal aesthetic stresses the role of the expert that has formal training with regard to aesthetics and is thus qualified to judge visual landscape quality (Tveit, Ode, and Fry, 2006). The formal aesthetic is based on the theory that aesthetic values are inherent in the formal

properties of the landscape and can be defined as basic forms, lines, colors, and textures, and their interrelationships. These relationships are examined to classify each landscape area in terms of variety, unity, integrity or other complex formal characteristics (Daniel and Vining, 1983).

However, some researchers are concerned that focus on the scenic aesthetic has helped perpetuate a preference for landscapes that are superficial and that visual management systems utilizing the formal aesthetic model might limit the range and depth of aesthetic opportunities afforded to the public (Gobster, 1999). Some, who have examined the connection and conflict between managing for aesthetics and ecological management, argue that the formal aesthetic model fails to include ecology into the assessment phase and that visual management systems should move from a descriptive approach to a prescriptive approach (Daniels, 2001; Schmid, 2001; Gobster, 1999; Steinitz, 1990).

2.1.3. Quantitative Holistic Methods

Quantitative Holistic methods, which combine aspects of the Public Preference and Descriptive Inventory models, are often viewed as the most rigorous and extensive evaluation of the visual landscape (Daniel and Vining, 1983). Models that fall under Quantitative Holistic represent a combination of objective and subjective methods. For instance, a method of this kind might involve both a survey of people's visual preferences as well as an inventory of physical landscape features (Arthur et al., 1977).

The psychosocial model is a Quantitative Holistic method that uses mathematical measurements to correlate the physical features of the landscape and the perceptual judgments of human observers to predict people's preference for the overall visual quality of the landscape (Daniel and Meitner, 2001; Daniel and Vining, 1983). To establish a

relationship between the visual preference ratings of viewers and the physical components of the landscape, researchers often utilize statistical techniques like multiple regression analysis (Palmer, 1983, Daniel and Vining, 1983, Buhyoff et al., 1994, Wherrett, 2000, Real et al., 2000 and Daniel, 2001).

Another example of this type of methodology is the Scenic Beauty Estimation (SBE) model. This system relies upon the observations and judgments of a panel of people, who are representative of a target population (i.e. the general public, land managers, landscape architects, etc), to quantitatively determine the index or rather “Scenic Beauty Estimate” of the aesthetic quality of the landscape (Daniels and Schroeder, 1979).

Although this method is typically utilized to assess the scenic beauty of forested landscapes through the use of color photography or visual simulations that are rated by individuals, it can easily be modified to involve different sampling methods, like field inventories, and to include value ratings that assess factors aside from scenic beauty. SBE can also be a useful decision making tool for land managers. In a study of publicly owned forested landscapes, Daniels and Schroeder (1979) explored how land managers can use SBE to quantitatively predict the perceived scenic consequences of alternative management actions.

2.2. Visual Resource Management of Federal Landscapes

Visual resource management can be a complex undertaking for Federal agencies that manage vast and varied resources spanning across millions of acres of land and diverse landscapes. While these lands are valued for their scenic beauty, they are also used for a multitude of other activities. Any activities that occur on these lands, such as recreation, mining, timber harvesting, grazing, or road development, have the potential to disturb the

surface of the landscape and impact scenic values. The task of managing visual quality on multiple use landscapes is especially difficult as the priorities set for one activity may often conflict with the priorities set for another (Department of Interior, 2008).

Federal public land management agencies like the USFS and BLM rely on visual management systems that employ Descriptive Inventory methods to minimize the visual impacts of surface-disturbing activities and maintain scenic quality (Daniel and Vining, 1983). While Quantitative Holistic methods may be viewed as more rigorous than Descriptive Inventories, they can be very time consuming and expensive to develop. In addition, they are often applied to a particular landscape type and specified population, which limits its applicability to other areas (Arthur et al, 1977).

2.2.1. Visual Resource Management Challenges

For land use managers, decisions about what land uses are acceptable and how visual resources of a landscape are impacted by land use activities need to be made fairly quickly (Turner, 1995). Agencies have limited staff time as well as funding to conduct extensive surveys and analyze the findings. Also, it is difficult to find ways to classify a region in terms of common physiographic and vegetative patterns, especially when these characteristics may only be seen in some parts of the region (Kaplan, 1979). Managers of these varied landscapes need a methodology that is sensitive to the site or region being managed and can easily be applied in a short period of time (Kaplan, 1985).

2.2.2. Federal Legislation

While it may seem easy for visual resources to become lost in the many management objectives of an agency like the BLM, two important pieces of legislation, the National Environmental Policy Act (NEPA) of 1969 and the Federal Land Policy and Management

Act (FLPMA) of 1976 require Federal public land management agencies to consider the protection of visual resources and visual quality in their planning and management activities. NEPA provided the motivation for land management agencies to develop visual managements systems by mandating the consideration of visual resources (Williams and Patterson, 1990). The act calls for the development of procedures to ensure that presently un-quantified values are given appropriate consideration in decision making. It also requires the utilization of a systematic, interdisciplinary approach in planning and decision-making. As a result, visual resource considerations are required to be included in all environmental assessments in all land use planning decisions and in the implementation of all resource projects (Ross Jr., 1979; BLM Manual H1601-1, 2005).

The FLPMA, which set basic policy for the management of public lands, makes protecting scenic and other environmental values an explicit criterion that must be applied throughout the land management activities of federal land management agencies. It states, “the public lands must be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use (43 U.S.C. §§ 1701 et seq., 1982).” The FPLMA emphasizes the role of land use planning by requiring that resource management plans give priority to the designation and protection of areas of critical environmental concern (ACEC). ACECs are areas where special management attention is required to protect and prevent irreparable damage (Ross Jr., 1979; BLM Manual H1601-1, 2005).

2.3. Visual Resource Management Systems

The visual resource management tools adopted by Federal public land management agencies incorporate many important issues, are lengthy and complex, and include a large number of separate evaluations that ultimately cumulate into a decision rule (Kaplan, 1985). Two of the most widely applied and studied visual resource management systems are the Scenic Management System (SMS) of the USFS and the Visual Resource Management System (SMS) of the BLM.

2.3.1. USFS Scenic Management System

The first of federal agencies to develop a system for managing visual resources was the USFS in 1974. This system, originally known as the Visual Management System (VMS), was updated in 1994 and renamed the Scenic Management System (SMS) (Bell, 2001). The purpose of the SMS is to evaluate scenic resources within a land-management framework based on the assumption that scenic quality is directly related to landscape diversity or variety based (Bell, 2001; Bacon, 1979). To accomplish this purpose, landscape evaluation involves assessing scenic quality, visual sensitivity and distance zones.

The SMS first ranks the scenic quality of landscapes through the establishment of variety classes (distinctive, common, and minimal). Variety is based on large areas of land called character types, which are delineated and defined by the visual characteristics of landforms, waterforms, rock formations, and vegetative patterns. The SMS also identifies the potential degree of visual sensitivity (highest, average, and lowest) of areas to public viewing. Sensitivity levels are determined for land areas viewed by those who are traveling through the forest on developed roads and trails; using areas designated for visitors like

campgrounds; or recreating at lakes, stream and other water bodies. Distance zones are used to describe the part of the landscape being inventoried or evaluated. Distance zones are broken into foreground (1/4 -1/2 mile from observer), middle ground (3-5 miles from observer), and background (from middle ground to infinity) (Bacon, 1979).

Information collected from these evaluations (variety class, sensitivity level, and distance zone designations) is eventually synthesized through the planning process to produce a designation of Scenic Integrity Objectives (SIO) for every acre of land administered as national forests. When applied to a specific area, the SIO determines how much modification of the natural appearing landscape should be permitted in resource management activities (McCool et al., 1986). The following are the range of SIOs a landscape can be designated: Very High (unaltered) preservation, High (appears unaltered) retention, Moderate (slightly altered) retention, Low (moderately altered) modification, and very low (heavily altered) maximum modification (Bacon, 1979; Bell, 1991).

The SMS relies on form, line, color, texture and other landscape management principles to produce a landscape modified only to the extent a viewer would find acceptable, that does not violate established Scenic Integrity Objectives (SIO), and is consistent with a Forest Plan (Kaplan, 1985). This method is based on the underlying assumption that viewers are sensitive to modification in the naturally appearing landscape and that areas classified as preservation have the greatest scenic value.

While the setting of visual management objectives or standards is sufficient for the management needs of lands where the visual resource is of incredible importance, some land managers require a measurement of the landscape's ability to absorb change without significantly affecting visual character. This measurement, known as visual absorption

capability (VAC), is analyzes how the scale, configuration, predicted contrast, duration, and frequency of a proposed activity interact with the biophysical (slope, aspect, soil color, vegetative regeneration potential, etc.) and perceptual (sensitivity levels, distance zones) factors of the landscape. It provides the basis from which an interdisciplinary team of field experts can determine the relative costs of and planning considerations for meeting a particular SIO. (Anderson, Mosier, Chandler, 1979)

Visual Absorption Capability (VAC) helps identify areas that are most visually vulnerable and helps managers determine where development can be located with the least visual impact. A landscape with a high VAC will typically accept alteration with less visual impact. Visually tolerant landscapes are usually those that contain considerable variety and can be managed to meet high Scenic Integrity Objectives (SIO) with relative ease (Bacon, 1979). Lands with lower visual absorption capability often need to be managed with increased caution, even in areas with lower SIOs.

Generally, as the size of a land use activity increases, the project area's VAC decreases. Also, as the duration and frequency of the visual impact increases, the VAC decreases. For instance, the impact of a hydroelectric dam may last hundreds of years, whereas, the impacts of a wildlife habitat improvement that destroyed a portion of brush to stimulate secondary growth may last only a year or two. In this comparison, the dam would likely change the VAC completely whereas the other may have no effect on the VAC (Anderson, Mosier, Chandler, 1979).

2.3.2. BLM Visual Resource Management System

Currently, the United States Bureau of Land Management (BLM) manages the scenic value of public lands through its Visual Resource Management system (VRM). This system

is an analytical process, which identifies and sets objectives for maintaining scenic values and visual quality (Ross, 1979). The VRM involves inventorying scenic values, establishing management objectives for those values through the resource planning process, and then evaluating proposed activities to determine whether they conform to the agency's management objectives (Department of the Interior, 2008).

The VRM consists of two stages: inventory and analysis. In the inventory stage, the visual resources of an area are identified and assigned to inventory classes (A, B, or C) using the visual resource inventory process. This process involves dividing a land area into segments based on similar physiographic characteristics and areas that share similar impacts from man-made modifications. The apparent scenic quality of these segments, which are termed scenic quality rating units (SQRU), are then rated by a professional or interdisciplinary team of individuals trained in VRM, who evaluate the area from several important viewpoints using seven factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. Each of these factors is ranked on a comparative basis with similar features in the physiographic province, should reflect the evaluator's overall impression of the area, and is rated in relationship to the natural environment. The points afforded to each category are added together to form a total score for that particular SQRU.

The second part of the inventory process involves measuring the public concern for scenic quality through a sensitivity level analysis. Sensitivity levels (high, medium, or low) are attributed to each scenic quality rating unit based on indicators of public concern like: type of users, amount of use, public interest, adjacent land uses, special areas, and other factors. Distance zone, which is the third component of the inventory process, can also affect

sensitivity level. Landscapes are divided into 3 distance zones based on relative visibility from travel routes or observation points like highways, rivers, and popular viewing locations. These zones include: foreground-middleground (areas seen from highways, rivers, or viewing locations less than 3-5 miles away), background (seen areas less than 15 miles away), and seldom seen (areas not seen in other zones).

The results of the visual resource inventory become an important component of BLM's Resource Management Plan (RMP) for the area. The RMP establishes how the public lands will be used and allocated for different purposes, and it is developed through public participation and collaboration. Visual management classes and corresponding objectives are established for each Scenic Quality Rating Unit (SQRU) based on the information gathered in the visual resource inventory. These classes are ordered from 1 – 4, Class 1 ordering the highest level of protection and Class 4 allowing a high level of change to the landscape.

In the analysis stage, the visual contrast rating system is used to analyze whether the potential visual impacts from proposed surface disturbing activities or developments will meet the management objectives established for an area. Visual contrast rating assesses the predicted contrast of proposed activity against each feature in the landscape to indicate the anticipated severity of visual impact. To assess predicted impacts of a project, the project sponsor must submit a detailed project description, the VRM management classes of the affected area are identified, and contrast ratings are done from Key Observation Points (KOP), which are usually along commonly traveled routes. Visual simulations may also be conducted to graphically illustrate the potential visual impacts a project may produce.

Levels of contrast (none, weak, moderate and strong) often match the four management classes (I, II, III, IV). This correspondence means that a "strong" contrast rating may be acceptable in a class IV area but may not meet the VRM objectives for a class III

area. However, the BLM Handbook for visual contrast rating advises the evaluator to consider the cumulative effect of all the contrast ratings as certain combinations of rating may indicate a stronger overall contrast than is shown by individual ratings (BLM Handbook 8431, 1980). For instance, several moderate ratings may warrant an overall strong rating (BLM Handbook 8431, 1980).

Since each activity proposed for BLM land must pass through this evaluation it has the potential to be useful in order to identify and mitigate extreme contrasts in the planning design stage. VRM standards and techniques and best management practices can be used in the design stage to determine in advance the visual impact of an activity and the extent to which mitigation measures will be required to make a project acceptable (BLM Handbook 8431, 1980; Department of Interior, 2008).

The VRM closely models the SMS in that both classify the visual quality of an area by inventorying features of the natural landscape, determining sensitivity levels and distance zones, and synthesizing this information to determine scenic classes and management objectives for the area. Both are founded upon similar principles and assumptions. For example, in each system, organization of landscape character is primarily determined by the basic elements of form, line, color, and texture. Each assumes that the stronger influence exerted by these elements the more interesting the landscape and that the relative impact of these basic elements is greatest for form and least for texture. These agencies also support the notion that the most varied and diverse landscapes will derive the highest degree of aesthetic pleasure (Kaplan, 1985).

2.3.3. Shortcomings of the SMS and VRM

While the SMS and VRM have been successful at mitigating and preventing the potential negative impacts of many projects, they are not without shortcomings. Common criticisms of these methods include the lack of legal support, staff specialists, funding, and a common language / system across agencies for visual issues. Many, including experts within the field of SMS and VRM, feel that the systems are outdated and need to be reexamined for revisions. In addition, these tools fail to identify and engage stakeholders, like the tribal communities, in the process of determining management classes and proposed visual impacts (Maguire and Gaillard, 1994; Kaplan, 1985).

Although the concerns of the public are identified in the determination of sensitivity levels, there is little room for any public involvement in visual resource management systems, let alone consideration for tribal communities, who have an effect on land management greater than simple demographics suggest (Lane and Hubbard, 2005). Tribal governments, Indian communities and individual Indian people rely on federal lands for exercise of reserved rights, access to traditional resources, ceremonial use, economic development, and land acquisition (Reynolds, 1996).

The federal government is required by law to actively involve these groups in the land use planning process; however, the planning process does not consider the different ways Indian people relate to and use the land from other members of society. Many of the land owned by federal land management agencies are ancestral lands of Tribes, for which they feel a spiritual connection, one that derives from traditional cultural teachings about the use and management of nature (Reynolds, 1996). The mapping and assessment procedures of the SMS and BLM fail to convey experiential, subtle or detailed landscape information that is often critical to the articulation of indigenous perceptions of the land, which can limit the

ability of the process to achieve a fair deliberation on indigenous values in a consultation process (Lewis and Sheppard, 2006).

2.4. Cumulative Effects Assessment

While great strides have been made in acknowledging the landscape as a visual resource and at measuring and modeling visual resources, preference, and impact, more research can and should be done to improve these methodologies. The majority of existing visual landscape assessment models and visual resource management systems only measure direct impacts of activities on scenic resources on a project by project basis or via a public preference survey that determines visual impact thresholds based on a photo-questionnaire. There lacks a substantive process for analyzing how the cumulative effects of proposed activities impact scenic resources (U.S. Environmental Protection Agency, Office of Federal Activities, 1999).

2.4.1 Defining Cumulative Effects

Cumulative effects are defined by the President's Council of Environmental Quality (CEQ) as the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such action (40 CFR 1508.7). In general, cumulative effects can be described as the additive (equal to the sum of individual effects) or interactive effects (greater than the sum of individual effects) of human activities on an ecosystem over space and time (Zeimer, 1992). These effects occur when the same type of activity recurs too frequently through time or too densely through space, and are often the result of combined effects or impacts of successive actions on the environment. There is increasing evidence that shows the most devastating environmental effects may not be from the direct effects of a

particular action but from the combination of individual minor effects of multiple actions over time (US EPA, 1999).

Compared to project specific impacts, cumulative effects are very difficult to assess and can produce significant impacts over time (McCold and Saulsbury, 1996). In the United States, cumulative effects assessment is the process of systematically identifying and analyzing cumulative environmental change as a result of policies, plans, programs, and projects to ensure that incremental effects resulting from the combined influences of various actions are properly assessed. It provides an estimate of the incremental impact of a proposed project or activity and of the total impact to the environment after addition of the increment (U.S. EPA 1999).

Under the National Environmental Policy Act (NEPA) of 1969 federal agencies are required to conduct a cumulative impact analysis of a proposed action that is found to have significant impacts, which should be incorporated into the development of alternatives for an environmental assessment or environmental impact statement. However, to date NEPA has been largely ineffective in addressing or moderating significant cumulative impacts that have continued to accumulate since its inception in 1969 (McCold and Saulsbury, 1996).

2.4.2 History of Cumulative Effects Analysis

The CEQ first issued its regulations on cumulative effects in 1978 but it was not until its publication of *Considering Cumulative Effects Under the National Environmental Policy Act* in 1997 that general principles of cumulative effects analysis were established (U.S. Council of Environmental Quality, 1997). Prior to this publication, environmental managers, scientists, and NEPA practitioners were left to their own devices to develop the appropriate approach and scope for assessing a specific project's cumulative effects. Many of the CEA's

conducted revealed little technical or scientific support for the findings presented in the EA or EIS (Deverman, 2003).

This publication identified important guiding principles and action steps to be taken in a CEA. It describes five impacts and actions to be included in a CEA: 1. the area in which the effects of the proposed project will be experienced; 2. the impacts that are expected in that area from the proposed action; (3) other past, present, and reasonably foreseeable actions that have or are expected to have impacts in the area; (4) the impacts or expected impacts from these other actions; and (5) the overall impact, either beneficial or adverse, that can be expected if the individual impacts are allowed to accumulate.

Another important consideration is that CEA should be conducted within the context of each resource's threshold (Deverman, 2003). A threshold denotes the level of stress that can be potentially imposed on a resource beyond which the current condition of the resource may degrade. How much of an effect is imposed on a resource is dependent on whether the cumulative effects exceed the capacity of the resource to remain productive.

2.5. Challenges to cumulative effects assessment

The charge of assessing cumulative effects is difficult because geographic and temporal boundaries must be appropriately and objectively established (Council on Environmental Quality, 1997). In addition, most cumulative effects analyses incorporate a variety of complicating aspects and the lack of quantitative data and well-tested, modeled research only further complicates the process for conducting these analyses (Swenson and Ambrose, 2007). Also, the absence of scientific guidelines or technical regulations for conducting cumulative effects assessments makes it easier for managers and agencies to avoid addressing cumulative effects entirely.

2.5.1 Spatial Scale

An important albeit challenging determination to be made when researching cumulative land use effects of development on visual quality is the geographic scale of a study area. While it is important for researchers to determine the extent of a project or activity's area of impact, this task can be exceptionally difficult, especially when trying to analyze the extent of impacts produced by multiple land use activities across an entire landscape or region.

Historically, cumulative effects analyses have been deficient because the spatial scale was too small (Zeimer, 1994). Too narrow a study range can limit how well spatial variation is monitored. For example, in a watershed, the downstream transport of water, heat and other watershed products may lead to accumulation of physical changes along stream networks (Harvey and Railsback, 2007). A small spatial scale may prevent the examination or inclusion of important contributing factors to changes in water quality or ecosystem function.

Models for managing cumulative effects should also take into account the political jurisdictions and map scales, which might influence the choice of study / management area boundaries (Gosselink et al., 1990). Agencies tend to limit the scope of their analyses to those areas over which they have direct authority or to the boundary of the relevant management area or project area. This is often inadequate because it may not cover the extent of the effects to the area or resources of concern (US EPA, 1999).

2.5.2. Temporal Scale

In addition to selecting the appropriate spatial scale, the assessment of cumulative effects also relies on important temporal considerations. Many research studies are often limited by the availability of long-range data. Most environmental evaluations cover a short

period of time and data are almost always insufficient to identify even trends or trajectories of change until the impact is very large or has been occurring for some time (Zeimer, 1994).

Another issue of studying cumulative effects is there is often a lag between an action and its observed effect. This temporal variation produces a great deal of uncertainty that researchers must take into account in their assessment. This variation is important to consider, because significant cumulative effects may be undetectable until triggered by rare events such as extreme weather and environmental changes separated in time (Harvey and Railsback, 2007).

2.5.3. Establishing a baseline

It is difficult to make predictions about the future and how mixed land use activities impact resources over time (Council on Environmental Quality, 1997). It is for this reason that it is important to establish an appropriate baseline for measuring the past and future effects of an activity on the landscape being studied. Using the existing environment as a baseline is not always appropriate for conducting cumulative effects analysis. This method makes the effects of past and present actions part of the baseline rather than contributors to cumulative impacts. Because, past and present actions may have already occurred, this inclusion might preclude some future actions that would only have minor impacts by themselves to be viewed as significant contributors to cumulative impacts (McCold and Saulsbury, 1996).

Some argue that the appropriate baseline for considering the significance of cumulative impacts is the time in the past when the valued environmental attribute was most abundant (McCold and Saulsbury, 1996). If it is not feasible to establish the “naturally occurring” condition to use as a baseline, the Council on Environmental Quality advocates

for using a description of a modified but ecologically sustainable condition. In this context, ecologically sustainable means the system supports biological processes, maintains its level of biological productivity, functions with minimal external management, and repairs itself when stressed (Council on Environmental Quality, 1997).

2.5.4. Lack of Quantitative Data

Cumulative effect analysis has suffered from lack of statistical analysis leading to relatively subjective and qualitative cumulative impact assessments. Even when quantitative data are collected the spatial aspect or locational context of the data has rarely been analyzed or analyzed properly (Swenson and Ambrose, 2007). While there is an unarguable need for cumulative effects assessments methods that are quantitative, scientifically defensible and logistically feasible over a broad extent (i.e. watershed), it is likely that there will be many cases where cumulative effects cannot be quantified in any meaningful or reliable way (Callahan and Sexton, 2007).

Qualitative approaches may be the only practical means to overcome the problems of complexity and data deficiencies and provide some insight into the nature and magnitude of cumulative risks (Callahan and Sexton, 2007). Although qualitative results may be converted to semiquantitative findings and they can be used as supplementary material for quantitative assessments, (by adding a descriptive index), in some instances it may be neither feasible nor desirable to quantify cumulative effects (Callahan and Sexton, 2007).

2.6. Strategies to Overcome Challenges

To move from cumulative impact assessment methods that are general and filled with uncertainty to a more narrow and quantitative assessment requires selecting appropriate scales. There is no one scale appropriate for all issues or cumulative effects assessment.

Rather, relevant spatial and temporal scales for each analysis are dependent on the specific issue being addressed (Zeimer, 1994).

Both geographic boundaries and time periods need to be defined on a case-by-case basis. Determining the boundaries and periods depends on the characteristics of the resources affected, the magnitude and scale of the project's impacts, and the environmental setting. In practice, a combination of natural and institutional boundaries may be required to adequately consider both potential impacts and possible mitigation measures (US EPA, 1999).

Ultimately, how well cumulative effects are assessed and analyzed depends on an understanding of how the effects are occurring in the assessment area and the consideration given to developing a model that applies the appropriate spatial and temporal scales, and provides a method for quantifying data as well as embracing uncertainty.

2.7. Methods for Cumulative Effects Assessment

Currently, there are three general categories that most cumulative effects methodologies fall under. There are those that describe or model the cause and effect relationships of interest through matrices and flow diagrams. Others analyze the trends in effects or resource change over time through the use of indicators such as acres impacted or miles of road constructed. Other analyses are used to overlay landscape features to identify areas of sensitivity, value, or past losses. While these methods are effective at addressing the importance of considering multiple actions and effects on resources of concern, including visual resources, they hardly constitute a complete approach to cumulative effects analysis (Council on Environmental Quality, 1997).

The frameworks established for addressing the problems of cumulative effects by federal agencies like the U.S. Army Corp of Engineers, U.S. Fish and Wildlife Service, and the U.S.

Environmental Protection Agency are grouped into two basic approaches: impact assessment and planning approach (Council on Environmental Quality, 1997). The impact assessment views cumulative effects as an extension of environmental impact assessment. With this approach responsibility for conducting the assessment is assigned to individual project proponents. In the planning approach, the government is responsible for assessment as CEA extends beyond the scope of a single project or the reasonable capacity of a single proponent to gather and analyze information on environmental conditions and past, present, and reasonably foreseeable projects. However, there is no clear cut answer as to which approach is more appropriate. Each must consider a number of variables in examining cumulative effects; however, having clear understanding of the purpose, scale, and span of competing interests of a project can help determine which approach and/or if both approaches should be utilized.

2.7.1. Tools for Assessing Cumulative Effects

Technology like Geographic Information Systems (GIS) can be useful in developing more comprehensive and effective methods for cumulative effect analysis. GIS can be used to manipulate and display location specific data and can be used to manage large data sets, overlay data, analyze development and natural resource patterns, analyze trends, perform aesthetic analysis, etc. (McCold, 1996). GIS can also be used to conduct viewshed mapping. Viewshed maps show areas of potential project visibility based on digital-elevation modeling. This modeling can also be used to determine the type and density of development that would be visible from a particular viewpoint. Once a GIS has been developed it can drastically reduce the effort needed to analyze the effects of future projects (McCold, 1996). In other words, each new development proposal can be readily overlain on existing data

layers to evaluate cumulative effects.

2.8. Cumulative Visual Effects Assessment

While few well-researched methodologies exist for cumulative visual effects assessment in the United States, European research on the cumulative visual impact of wind farms on the scenic quality is fairly common (Stanton, 1995). Of those in the United States, most are focused on western landscapes (Thayer and Hansen 1989). While such studies are useful in understanding public reactions generally, visual impacts are largely site-specific (Pasqualetti 2005).

One study conducted by van de Wardt and Staat in 1988, used semantic differentials to investigate the impact of wind turbines on scenic quality in Holland (Wolsink and van de Wardt, 1989). This study found that size and placement were important considerations for measuring the cumulative visual effects of turbines. Smaller turbines were found to have less of a negative impact than larger turbines. However, size was found to be less of an influence when compared to the number of units. In addition, it was found that placement of turbines impacts scenic preference directly. After examining three placement patterns (rectangular, multiple clusters, and lines), it was determined that turbines in a line were rated more favorably than the other arrangements tested (Wolsink and van de Wardt, 1989).

A study conducted by the National Research Council in 2007 on the environmental impacts of wind energy projects postulated a list of questions to help evaluate the potential for undue cumulative aesthetic impacts (Committee on the Environmental Impacts of Wind-Energy Projects. 2007). Some of the questions included:

- Are projects at scales appropriate to the landscape context?
- Are turbine types and sizes uniform within the wind resource area and over time?
- How great is the offsite visibility of infrastructure?
- Have areas that are inappropriate for wind projects due to terrain or important scenic, cultural, or recreational values been identified and described?
- If the project is built as proposed, would each region retain undeveloped scenic vistas?
- Would any one region be unduly burdened with wind-energy projects?

While this study did not outline methods for cumulative effects assessment, it did offer suggestions for conducting CEA for wind energy projects. Some of the guidance included assessing cumulative effects from a regional or statewide perspective, to use computerized viewshed analyses to provide project visibility information, and to focus on the characteristics of the landscapes in which the projects will be located over evaluating whether people find them attractive.

2.9. Conclusion

The cumulative effects arising from a range of land use activities and their combined visual envelopes can lead to an unacceptable degree of adverse visual effects on the scenic quality of the landscape. Although little research or tested methodologies exist to appropriately and accurately measure the combined and cumulative visual effects of certain land use activities, it is clear that these effects may be subtle, far-reaching and irreversible and that a better system needs to be developed and incorporated into visual resource management systems.

CHAPTER 3

METHODOLOGY

Currently, minimal research exists on methods for measuring the cumulative effects of land use activities on scenic resources. Although the National Environmental Policy Act of 1969 mandates that Federal Agencies analyze indirect and cumulative effects in the environmental assessment process, there is no defined method for analyzing cumulative effects, especially for visual impacts.

While some research exists on managing the cumulative visual impacts of alternative energy production in Europe, the majority of these studies is fairly recent and may be difficult to apply to the United States landscape and legislative framework. Even Federal agencies like the Bureau of Land Management (BLM) who have systems in place for managing visual resources and assessing the visual impacts of proposed and existing land use activities, lack clear guidelines and methods for considering and incorporating cumulative effects into the decision making and planning process.

This thesis seeks to derive a more advanced understanding of approaches to analyzing the cumulative effects of land use activities on the scenic resources of federally owned and managed landscapes by researching examples of how cumulative visual effects are currently measured and by interviewing professionals who are familiar with the strengths and limitations of cumulative effects assessment. To better understand how the visual quality of a landscape is impacted by cumulative effects, this thesis focuses on the example of Canyon of the Ancients National Monument in southwestern Colorado, which is a well-visited site managed by the BLM that has experienced extensive oil and gas development over the past sixty years. It examines how the past and present visual impacts of energy production on a

southwestern, open, arid, canyon landscape have affected visitor experience of public lands. In addition, a survey was administered to three participant groups evaluating their perception of how land use activities at varying densities and geographic scales impact the overall visual quality of a landscape.

The final product of this thesis is a set of recommendations for Federal land managers about how to incorporate cumulative effects assessment into existing visual resource management systems, the resource management planning, and the NEPA review process.

3.1. Case Study: Canyons of the Ancients National Monument

Canyons of the Ancients National Monument (CANM) was selected as a case study to highlight the need for measuring, analyzing, and managing the cumulative effects of land use activities such as, energy production, on the visual quality of protected Federal Landscapes. CANM encompasses approximately 165,000 acres on the San Juan Public Lands in southwestern Colorado. Approximately 85% of this land, which is owned and managed largely by the Bureau of Land Management (BLM), has been leased for oil and gas production and there are currently 300 oil and gas well pads developed within CANM's boundaries. The monument contains a wealth of archeological and cultural resources and attracts a large number of visitors yearly. Without a system for mitigating and managing the cumulative impacts produced by oil and gas related projects, these projects will continue to be permitted, and their large-scale effect on cultural and scenic resource will remain unknown (<http://www.blm.gov/co/st/en/nm/canm.html>).

The CANM case study is used to demonstrate how visual resource management systems can be modified to better incorporate cumulative effects assessment (CEA) in both the inventory and analysis stages. CANM will be used to demonstrate how the BLM

currently incorporates VRM into its resource management process. The CANM study site also explores how the visual impacts produced by land use activities, like fluid mineral leasing and drilling operations, are managed on protected multiple use Federal landscapes.

The problems experienced by this study with regard to visual resource management are representative of similar challenges faced by agencies like the BLM, United States Forest Service (USFS) and National Park Service (NPS) on other lands in the surrounding region. The information gathered from this study site will provide an example of common problems experienced by the BLM, as well as how the VRM process can be updated and modified to better protect visual resources and incorporate cumulative effects assessment.

CANM is the only case study examined in this thesis. Conducting a comparison of two case study sites that share similar management schemes, landscape character, and types of development activity would be the preferred method for examining challenges and opportunities for conducting cumulative effects assessment. However, comparative case studies would require more time and financial resources than possible within the constraints of this Masters thesis.

3.2. Informal Interviews

To better understand the methods used by Federal agencies to assess the cumulative effects of development projects on visual resources, I conducted informal interviews with professionals and researchers who work for or with Federal land management agencies, including the Bureau of Land Management, the United States Forest Service, the Natural Resource Conservation Service, and the Environmental Protection Agency that:

- Have experience with the process for conducting cumulative effects assessment,

particularly for visual resources.

- Can offer insight into the benefits and limitations provided by CEA procedures.
- Represent a variety of disciplines.

These interviews were used to gain more knowledge about the methods employed by Federal land management agencies to conduct cumulative effects assessment both in the resource management planning process and in the NEPA review of a proposed project. A total of four professionals were interviewed via telephone. Each of these professionals has extensive experience (ranging from 12 to 32 years) working for a Federal land management agency (Natural Resource Conservation Service, United States Forest Service, Bureau of Land Management) and with conducting cumulative effects assessment through the NEPA review process. Interview subjects received a cover letter and list of questions prior to their interview that described the purpose of the study and what questions would be asked. Answers from these interviews were transcribed by hand on a computer.

Interview subjects were identified based on their position within a Federal agency, degree of experience, and willingness / ability to answer the questions listed below.

- What is your experience with conducting cumulative effects assessment?
- What type of projects have you evaluated? Where were these projects located? What Federal agency did you work with or for?
- How are cumulative effects currently considered in your system for managing visual resource?
- Does your agency incorporate cumulative effects assessment into the resource management and planning process?
- How can the visual resource management system (SMS or VRM) be modified to incorporate cumulative effects in the inventory and analysis stages?
- What are potential limitations to incorporating cumulative effects into the VRM or SMS? What are potential advantages?
- Please describe from your experience how the cumulative effects of a proposed project on visual resources or scenic quality are considered and / or analyzed in the NEPA review process?
 - What methods are used to conduct these assessments?
 - How are past, existing, and potential future effects on visual resources considered?

- How are geographic and temporal scales as well as baseline conditions determined prior to conducting the assessment?
- What are the strengths, weaknesses, opportunities, and threats of this method(s)?
- From your experience, do you find the cumulative effects assessment procedure you used accurately identified cumulative effects? Also, was this procedure reliable at predicting potential impacts?
- Is the method you used easy to conduct? Is it practical?
- If time and money were not a consideration what suggestions do you have for improving methods for conducting cumulative effects assessment?

Following each interview, I analyzed the answers provided by each subject and grouped their responses based on common themes or shared information. These grouped responses were then categorized under three topic areas: methods for conducting cumulative effects assessment (CEA) and strengths and limitations of existing CEA methods, and strategies for including cumulative effects assessment into the visual resource management system.

3.3. Visual Survey

To gain an understanding of how and at what level development activities, particularly oil and gas drilling, impact visual quality of the landscape, a visual survey was administered to three participant groups. Due to time and financial constraints, existing group settings like university classes and a university residence hall were utilized to conduct the survey. The size of each group ranged from 15 - 25 participants.

Survey participants viewed a series of 24 color photographs that are characteristic of the study site, a southwestern canyon and mesa landscape (see Appendix A). Four photographs taken at the study site were manipulated using Adobe Photoshop to display four different densities of development (from no development to dense development) that modeled the degree of development allowed the Bureau of Land Management's 4 visual

resource management classes. Of these manipulated photographs:

- Four were panoramic with the image in the foreground (0-0.5 miles away)
- Four were panoramic the image in the middleground (0.5-3 miles away)
- Four were non-panoramic with the image in the foreground (0-0.5 miles away)
- Four were non-panoramic with the image in the middleground (0.5-3 miles away)

The remaining eight photographs were photographs taken in different locations of the study site of development and vistas located in different management classes.

Participants received a paper-scoring sheet to complete the survey (see Appendix B). On this sheet they were asked questions about their familiarity with the study region and of their level of knowledge of certain subjects like landscape architecture and natural resource management. Other questions were asked of participants including age, gender, academic major, place of residency, and the type of area they grew up in. However, the survey remained completely anonymous.

Each photograph was projected onto a large screen using a digital projector. The participants had ten seconds to rate each displayed photograph on a Likert Scale to determine the level of visual quality of that landscapes; 5 equaled a very high quality rating and 1 equaled a very low quality rating. The completed surveys were collected and analyzed using statistical analysis to determine:

- At what distance zone does development have a greater impact on the landscape?
- At what density of development is visual quality impacted?

Having randomly sampled and uninformed observers rate their level of preference for photographs of landscape images is a method frequently utilized by Kaplan and Kaplan

(1989) to identify relevant psychological variables about each landscape. While the Kaplan studies involve larger, randomly sampled groups and employ sophisticated statistical analysis, the survey conducted in this project will involve smaller sample populations and less rigorous analytical procedures. It will only capture the opinions and perceptions of a small sample of the population and will not account for other factors that influence a visitors experience like sound and movement.

CHAPTER 4

CASE STUDY - CANYON OF THE ANCIENTS NATIONAL MONUMENT

4.1. Background Information

As part of the Bureau of Land Management's National Landscape Conservation System, Canyons of the Ancients National Monument represents a complex management scenario faced by Federal land managers of multiple use landscapes, who must balance the conflicting interests of preservation and exploitation. It serves as a prime case study for examining the impacts that surface disturbing land use activities such as, oil and gas development, have on the scenic quality of protected landscapes and highlights the challenges faced by the Bureau of Land Management officials at effectively measuring and monitoring cumulative visual impacts.

In early February of 2009, I visited Canyons of the Ancients National Monument (the Monument) for a period of eight days to meet with the managers of and professionals who work in the Monument, interview the Monument's visual resource expert and gain a better understanding of the Monument landscape, particularly how it has been impacted by oil and gas development. As part of my trip I spent three full days exploring all of the public visitations sites within Monument (Hovenweep National Monument, Lowry Pueblo, Painted Hand, Sand Canyon Pueblo and a 3.5 mile hike of the Sand Canyon Trail). At each of these sites I took extensive photographs and notes to document my experience as a visitor moving throughout the landscape.

Throughout the course of my trip I met with the following professionals who helped provide me with a deeper understanding of the challenges faced by managers of this landscape

and how they have been working to overcome them. The information that I received from these professionals and from other data sources collected on my trip is synthesized and documented in the case study listed below.

My primary contact for this project was Ms. Jennifer Burns, former Landscape Architect for San Juan Public Lands Center, which is a Colorado BLM field office that shares the management responsibilities of the Monument with the BLM field offices in Dolores and the BLM's Anasazi Heritage Center. Ms. Burns has worked extensively on developing the alternative Visual Resource Management Classes for Canyons of the Ancients' Resource Management Plan. Ms. Burns had been the only landscape architect for the San Juan Public Lands field office and has since left this position.

Ms. Burns spent a great deal of time walking me through the Visual Resource Management process and what steps have been taken by the BLM to date for managing and measuring visual impacts at the Monument. Ms. Burns, along with Mr. Tom Rice, *Natural Resource Specialist, San Juan Public Lands Dolores Office*, took me to sites within the Monument where large CO₂ and oil and gas projects are proposed for development. Mr. Rice primarily works on monitoring the surface compliance of oil and gas operators with the stipulations and guidelines currently laid out for the Monument.

Ms. Burns and Mr. Rice also took to me to existing sites and well pads within the Monument, including abandoned / reclaimed sites. At each site Ms. Burns explained how a landscape architecture might apply the Visual Resource Management system to inventory the surrounding landscape. Mr. Rice answered many of the questions that I had regarding the leasing of land for oil and gas development and about how operators are required to comply with the BLM's oil and gas standards.

Also during my visit, I met with Ms. Linda Farnsworth, *Archeologist for the Anasazi Heritage Center and Canyon of the Ancients Cultural Resource Specialist*. Ms. Farnsworth explained how the oil and gas industry works with the BLM to protect many significant cultural resources located on the Monument. Ms. Farnsworth is highly knowledgeable about the National Environmental Policy Act review process and has been working to improve how cumulative effects assessments are conducted for cultural resources.

In addition to the professionals listed above, I was able to meet briefly with Mr. Matt Janowiak, *Assistant Center Manager for Physical Resources* and Mr. Thurman Wilson, *Assistant Center Manager for Planning*. Together we discussed what they believe the primary issues are with measuring visual impacts within the Monument.

This visit to Canyons of the Ancients National Monument provided me with a plethora of information regarding the management of the Monument's visual resources and of the many challenges faced by managers in planning and monitoring the visual impacts produced by surface disturbing development like oil and gas production. It also highlighted the difficulty managers of vast tracts of land might have in first measuring and then analyzing cumulative visual effects. Much of the information that I gathered from my trip is reflected in the following case study.

4.2. Site Analysis

Canyons of the Ancients National Monument (the Monument) is located in the Four Corners area of southwestern Colorado, approximately 50 miles west of Durango, 10 miles west of Cortez, and 12 miles west of Mesa Verde National Park in Dolores and Montezuma Counties. The boundaries of the Monument encompass 182,876 acres of land. Of this total acreage, the Bureau of Land Management (BLM) administers approximately 165,000 acres,

19,000 are private land and 400 are managed by the National Park Service as Hovenweep National Monument (Colorado State Bureau of Land Management Office. 2007). Roads within the monument are few and most of these roads are unpaved and primitive.

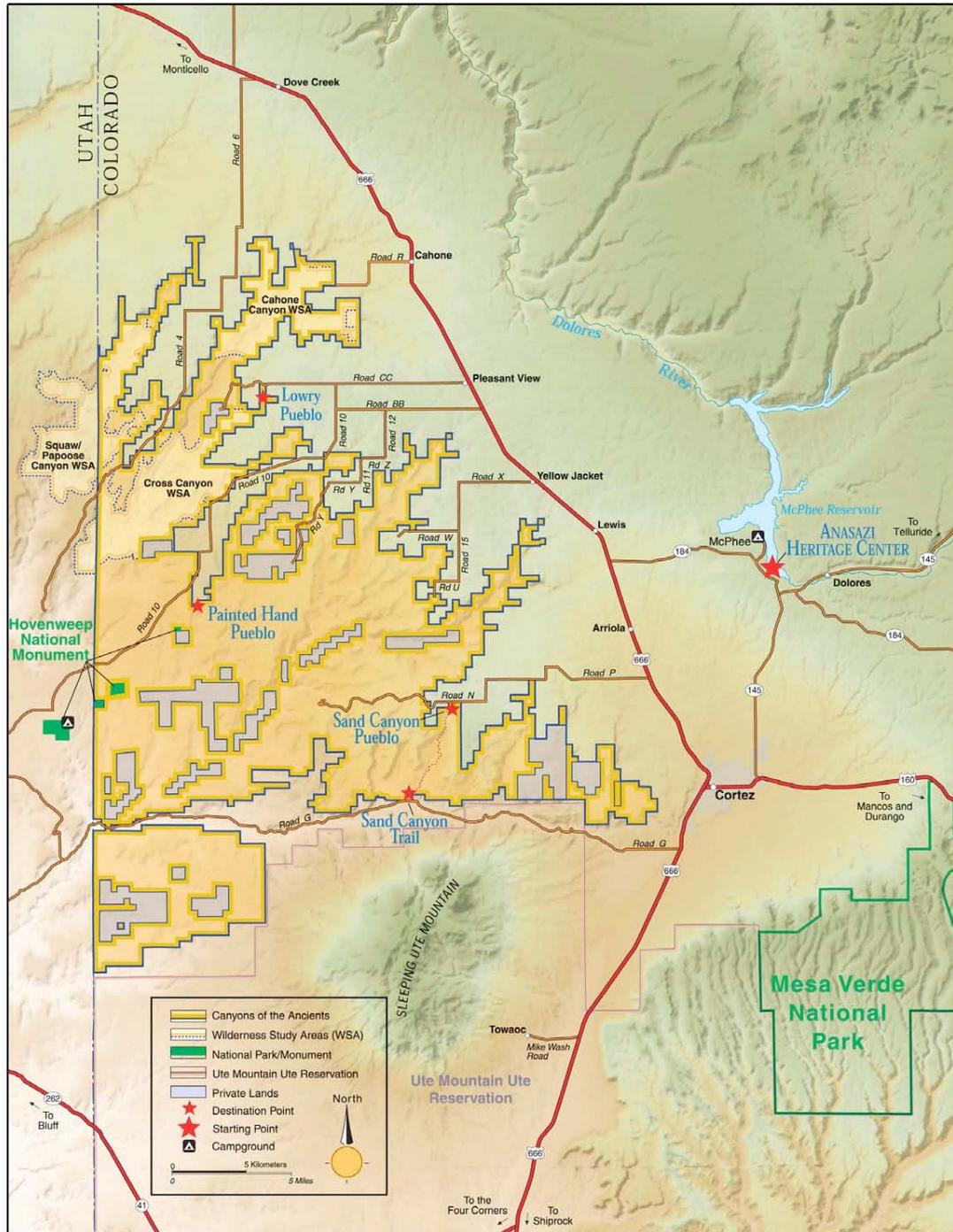
The Monument is treasured for its rich natural landscape and cultural heritage, hence its designation as a National Monument in 2000. Within its boundaries, more than 6,000 archeological sites representing Ancestral Puebloan and other Native American cultures have been recorded, in some places up to 100 per square mile (Colorado State Bureau of Land Management Office. 2007). It is estimated that as many as 30,000 sites are located in the Monument, which contains the highest known density of archaeological sites in the nation (Colorado State Bureau of Land Management Office. 2007). Humans have inhabited and used the Monument for 10,000 years and it continues to be used by humans today for recreation, hunting, livestock grazing, and energy development (Cohn, 2005).

To share the experience of this unique landscape with the public, the Monument is managed as an “outdoor museum.” While there are no official campgrounds within the Monument and motorized travel is restricted to existing roads, visitors are welcome to freely explore the many trails and pathways that span its vast land area. However, no motorized or mechanized vehicles are allowed in the Monument’s three wilderness study areas, which include Cross Canyon, Squaw/Papoose Canyon and Cahone Canyon (Colorado State Bureau of Land Management Office. 2007).

The areas of the Monument most frequented by visitors are Lowry Pueblo, Painted Hand Pueblo, Sand Canyon Pueblo and the Sand Canyon Trail (Cohn, 2005). Figure 1 highlights the locations of these public sites in the Monument and a brief description of each is listed below:

- Lowry Pueblo is a National Historic Landmark and is the only developed recreation site within the monument. At Lowry, there are parking lot and restroom facilities and educational signage.
- Painted Hand Pueblo is a more remote site with no services or facilities. It has never been excavated but a standing tower perched on top of a boulder is visible.
- Sand Canyon Pueblo has interpretive signs and diagrams of the site layout that illustrate what the area might have looked like in the mid 1200s, when it was inhabited by Ancestral Puebloan tribes.
- Lowry Pueblo is a National Historic Landmark and is the only developed recreation site within the monument. At Lowry, there are parking lot and restroom facilities and educational signage.
- Painted Hand Pueblo is a more remote site with no services or facilities. It has never been excavated but a standing tower perched on top of a boulder is visible.
- Sand Canyon Pueblo has interpretive signs and diagrams of the site layout that illustrate what the area might have looked like in the mid 1200s, when it was inhabited by Ancestral Puebloan tribes.
- Sand Canyon Trail is a popular destination for tourists and for local residents. Visitors use this six-mile route, which extends one way between Sand Canyon Pueblo and McElmo Canyon with 700 feet of elevation change, as a place to hike, horseback ride, and mountain bike. The Trail loops by many archeological sites. Although most are difficult to see, there are some very close views of 13th century masonry walls built into natural alcoves.

Figure 1: Canyons of the Ancients Public Visitation Sites



Source: Colorado State Field Office, Bureau of Land Management, 2007

The rugged high desert landscape of Canyon of the Ancients National Monument can be characterized as semiarid mesa and canyon country speckled with pinon, juniper, and sage (Cohn, 2005). There are no rivers or lakes within the Monument boundaries but springs and intermittent streams can be found. Pinon-juniper woodlands and Sagebrush are two predominate plant communities within the Monument. Mesa tops and canyon slopes are textured predominately by Pinon pine and Utah juniper. These trees may grow up to 20 feet tall, a height that can take 150 years to reach (Cohn, 2005). From a distance, these trees appear bushy and somewhat unruly. Sagebrush is also found scattered on mesa tops and canyon slopes. Big sagebrush is the dominant plant found in the area. This plant is a grey-blue shrub with small, slightly furry three-lobed leaves (Cohn, 2005).

Low lying vegetation allows for expansive views of the surrounding landscape. From higher elevations within the Monument there are clear views of Sleeping Ute Mountain to the South, which rises nearly 10,000' above sea level, and the ridges of Mesa Verde to the East, which range from 6,100 to 8,400 feet above sea level. Depending on where one is located in the Monument, Utah and New Mexico can be clearly visible. Elevations within the Monument range from approximately 4,900 feet to approximately 7,500 feet above sea level.

Many areas of the Canyons of the Ancients landscape are highly diverse and contain outstanding features that are visible from many key-viewing points. High scenic quality in many areas of the Monument is a result of scenically diverse topography of vistas and canyons, unusual geological formations, colorful and contrasting sandstones, and numerous pieces of rock art and historic structures. These areas also possess a high level of visual sensitivity due to the increasing number of visitors that come each year for recreation and sightseeing and to the high degree of concern the public has for this valued landscape. Areas

with both high scenic quality and high visual sensitivity include parts of Hovenweep National Monument, Sand Canyon Pueblo, Sand Canyon road, Painted Hand Pueblo, Lowry Pueblo, and the three Wilderness Study Areas (Colorado National Landscape Conservation Areas, 2007). These areas also include main travel corridors like McElmo Canyon; the Trail of the Ancients Scenic and Historic Byway; and, the upper Sand Canyon Trailhead.

Canyons of the Ancients became a National Monument in June of 2000 by a Presidential Proclamation to protect its unique natural and cultural resources on a landscape scale. As a National Monument, Canyons of the Ancients is part of the BLM's National Landscape Conservation System. These areas are unique portions of public land that are designated by the President or by Congress. The purpose of the System is to increase the public's awareness of and appreciation for public land treasures and to focus more management attention and resources on these areas (Colorado National Landscape Conservation Areas, 2007). These designations supplement the multiple use mandate of the Federal Land Management Policy Act and provide more specific guidance for resource management and protection of the area's nationally significant values.

The Proclamation contains several important components. Two significant aspects of the Proclamation are that it only applies to the federal lands in the area and it is subject to valid existing rights. The Proclamation states that "...to the extent a person or entity has valid existing rights in the federal lands or resources within the area, the Proclamation respects their rights (President of the United States Bill Clinton, 2000)." It stipulates, "...the exercise of such rights, however, can be regulated in order to protect the purposes of the monument (President of the United States Bill Clinton, 2000)."

Managers of the Monument are currently in the process of drafting a Resource Management Plan specific for the Monument that will determine how objects of scientific and historic interest identified in the Proclamation (i.e. archaeology, geology, biology, etc.) will be protected and how historic uses will be managed (Colorado State Bureau of Land Management Office, 2007). A Resource Management Plan (RMP) designates land uses over large areas of public lands and is the basis for all actions taken by the BLM that affects federally owned lands and mineral resources. An RMP is typically in place for 15-20 years subject to revisions or amendments as a result of changes to laws, changes in management issues, public demands, new technology or data, etc (Bureau of Land Management Website, 2008).

An RMP includes the creation of Environmental Impact Statements (EIS) to identify sensitive resources that might be impacted by land use activities. An EIS is required by NEPA whenever the Federal Government takes a major Federal action significantly affecting the quality of the human environment. An EIS is conducted for different resources including visual and it examines the condition of the affected environment, lists a range of alternatives to the proposed action, and analyzes the environmental impacts of each of the possible alternatives (Bureau of Land Management Website, 2008).

In the absence of a completed Resource Management Plan, the Secretary of the Interior and BLM National and State Directors have provided the Monument managers with a set of interim guidelines (Colorado State Bureau of Land Management Office, 2007). These guidelines direct the BLM to maintain existing policies, designations and allocations, except where changes are necessary to comply with the Proclamation. Clear management and

planning objectives are needed for this landscape, which continues to support and manage for conflicting multiple uses such as energy development and conservation.

4.3. History of Oil and Gas Development on the Monument

The Monument is located within a geologic region called the Paradox Basin, which is a mature oil and gas province that covers portions of southwestern Colorado, southeastern Utah, northwestern New Mexico, and northeastern Arizona. This area has high oil, natural gas, and CO₂ potential and contains the largest CO₂ containing reservoir in the country (Colorado State Bureau of Land Management Office, 2007). Discovery of these oil and gas resources occurred in the early 1900s. Initial exploration began in McElmo Canyon between 1908 and 1913 and continued throughout other areas of the Canyon through the 1920s. Although large tracts of land were leased from the 1920s to the middle of the 1930s, it was not until the late 1940s that oil and gas exploration surged (Horn, 2004).

Since the 1940s, oil and gas development has continued on the Monument (Horn, 2004). According to the Colorado Oil and Gas Conservation Commission, 185 oil, natural gas, and CO₂ wells have been drilled in the Monument since the 1940s. Of these wells, 125 are currently active, and 60 have been plugged and abandoned. From 1950 through 2003, the average number of wells drilled per year was four. The highest number of wells drilled in a year was nineteen, and there have been several years of no drilling activity (Colorado State Bureau of Land Management Office, 2007).

Approximately eighty-five percent of the federal lands within the Monument have already been leased for oil and gas (including carbon dioxide). Of the 182,876 acres within the Monument's boundaries, 143,503 acres are leased for oil and gas development under 334

leases, of which 31 are private (non-Federal minerals); 39,373 acres are not leased (Colorado State Bureau of Land Management Office, 2007). Under existing leases, current lease restrictions, and BLM regulations, land in the Monument remains open to continued oil and gas (including carbon dioxide) development. However, lease operators are required to exercise due care and diligence to ensure that leasehold operations do not result in undue damage to surface and subsurface resources.

For the most part, the management of oil and gas resources is guided by the Proclamation and by the 1991 Oil and Gas Leasing Amendment to the San Juan / San Miguel Resource Management Plan (BLM 1985). The Proclamation allows new leases to be issued, but only for the purpose of protecting against drainage or promoting conservation of oil and gas resources in a common reservoir now being produced under existing leases (President of the United States of America Bill Clinton, 2000). The 1991 Oil and Gas Amendment prohibited additional leasing inside the Monument's three Wilderness Study Areas and set forth stipulations about surface occupancy, timing of operations, lease notices, and conditions of approvals that applied to all new leases issued after 1991. These stipulations apply to only 15 of the 334 leases in the Monument.

In addition, the Proclamation directs that development be managed, subject to valid existing rights, so as not to create any new impacts that interfere with the proper care and management of the historic and scientific objects protected by the Proclamation. Except for oil and gas leasing, the Proclamation reserved and appropriated all Federal lands and interests in the Monument and withdrew them from all forms of entry, location, selection, sale, leasing, or other disposition under the public land laws (Colorado State Bureau of Land Management

Office, 2007).

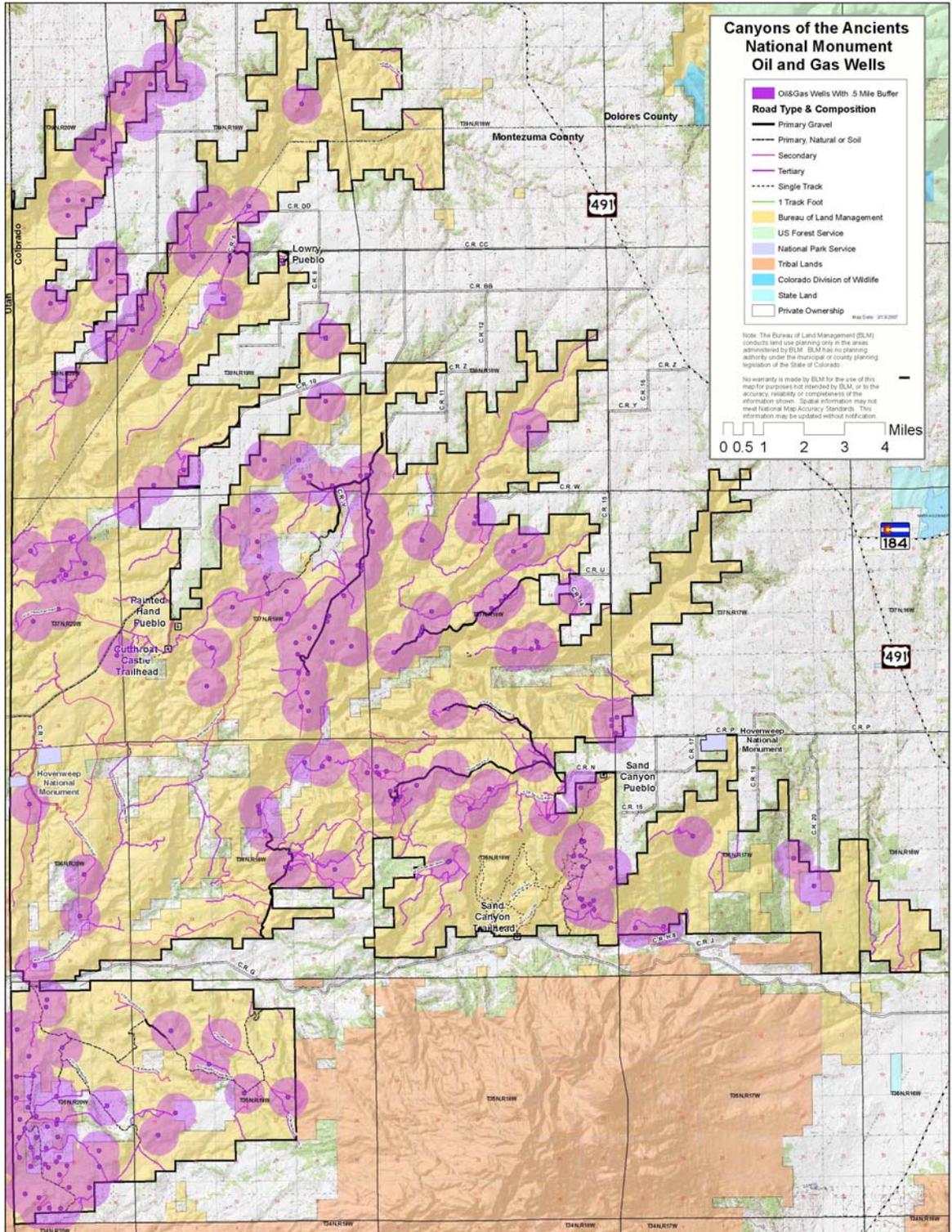
According to the Draft Resource Management Plan (2007) for the Monument, most oil and gas fields have produced to near their estimated capacity and are now considered near depletion. It estimates that there are only a few years of production remaining at historic production levels. However, this draft plan also predicts in its Reasonable Foreseeable Development Scenario that there could be 150 additional wells on existing leases in the Monument over the next 20 years, including 69 CO₂ wells and 81 oil and natural gas wells along with almost 70 miles of new roads. Figure 2 illustrates the locations of existing oil and gas well pads on the Monument.

4.4. Threats to Visual Quality

Although the Monument has retained much of its wild, remote, and rugged character, it currently faces many threats to visual quality, especially from oil and gas exploration and development. The task of managing the visual impacts of oil and gas development is particularly challenging in the Monument for a number of reasons. A few of these reasons are explained in more detail below:

- The Monument operates as an open museum and visitors are allowed to travel freely throughout its boundaries making it difficult to control what development is and is not apparent to visitors.
- The location of oil and gas leases and facilities has historically depended on the location of the resource, without regard for surrounding visual quality. Many of the existing facilities lack the application of Best Management Practices and few, if any, of the abandoned well pads have been rehabilitated.

Figure 2: Location of Oil and Gas Wells on Canyons of the Ancients



Source: Colorado State Field Office, Bureau of Land Management, 2007

- Monument managers have little to no control over the visual impacts produced by development that occurs on private land surrounding the Monument landscape. As a visitor driving into the Monument, it is not uncommon to see oil and gas facilities and other types of surface disturbing activities located immediately adjacent to the roadway. These facilities may be located on privately owned land but a visitor may not be able to distinguish this development from the Monument's landscape. In some areas within the Monument, private land development is visible in the middleground and background zones.
- The Monument currently has no process for analyzing the cumulative visual effects produced by oil and gas production or an established method for reasonably predicting the impacts that future development might have on scenic quality.

In spite of these challenges, Monument managers have been working to develop ways for these visual impacts to be better managed and mitigated. The success of the management and mitigation approaches has yet to be clearly determined.

4.4.1. Impacts of Oil and Gas Development on Visual Quality

A significant threat to highly scenic and sensitive areas in the Monument is the visual impact produced by oil and gas development. The infrastructure and activity associated with exploration for oil and gas and with the development of production facilities can cause visual scarring to the Monument's wild and landscape. In many instances, the development of an oil and gas production facility involves the installation of an access road, pipeline right-of-way, well pad, heavy equipment, industrial vehicles, and the above ground facilities for extracting and producing oil and gas including but not limited to pump jacks, compressor stations, CO₂ wells, and holding tanks. Although much of this development usually

diminishes after a facility is installed (right-of-ways are re-vegetated, access roads and well pads are reduced in size, and surface equipment and vehicle traffic is reduced or removed), the developed area can continue to have a significant impact on the visual resources of the surrounding protected area due to the dry climate, low vegetation, and compaction of soils (Horn, 2004). These oil and gas facilities can also be a source of noise pollution, which can negatively impact a visitor's experience of the Monument landscape.

In 2006, the BLM began the process of surveying and documenting the environmental conditions at oil and gas well sites located within the Monument. Included in this inspection was a report of the visual impact that many (more than half) of the ninety-five sites inspected contributed to a degradation of the visual resource within the Monument (Salter, 2006). This visual impact was attributed primarily to the color contrast between the onsite production equipment and the adjacent natural ground color. In addition to color mismatch, the equipment used for oil and gas production was found to be unsightly, with high profiles that cause it to sharply stand out from the Monument's scenic landscape. Low profile tanks and other production equipment can be used to decrease the amount of attention brought to a site. To minimize color contrast, this equipment can be painted a neutral color that blends in with the surrounding landscape.

Most of the Monument's landscape contains vast vistas of a landscape undisturbed by human development. The artificial and industrial appearance of an oil or gas field can sharply contrast with the natural appearing landscape and attract the attention of the casual observer. While Best Management Practices, some of which are described below, can be administered to decrease the amount of visual contrast a facility produces, many of the

Monument's existing development came before the BLM offered guidance on minimizing visual impacts. The BLM's Gold Book (United States Department of the Interior and United States Department of Agriculture, 2007) provides companies with comprehensive guidance on the design, construction, maintenance and reclamation of oil and gas sites and access roads.

Companies must utilize Best Management Practices in all operations including:

- Applying Gold Book standards to all new development;
- Retrofitting existing development using Gold Book standards to the extent possible;
- Minimizing visual impacts from new and existing oil and gas facilities;
- Using the landscape in a sustainable manner without degrading natural and cultural resources;
- Reclaiming impacted landscapes, including areas still in production, while providing for safe access to equipment;
- Conducting plug and abandon activities in a timely manner.

In addition to oil and gas development, other sources of visual impacts to the Monument landscape include vehicle and recreational use and the damage to plant communities caused by livestock grazing (Horn, 2004). The increasing number of travel roads in the Monument has indirect effects on visual resources. An increase in the number of visitors to the Monument, vehicular traffic, tourism and sightseers is creating changes in foreground views, middle ground views, and visual sensitivity. The increasing number of user made roads is expanding surface disturbances that impact visual resources. These disturbances primarily include the development of utility corridors and communication towers (Colorado State Bureau of Land Management Office, 2007).

4.5. Visual Resource Management for the Monument

The Bureau of Land Management (BLM) primarily manages visual quality through its Visual Resource Management (VRM) system. The VRM ensures that visual resources are considered in all aspects of planning, management and decision-making. Through the VRM,

visual design considerations are incorporated into all surface-disturbing projects occurring on public lands regardless of the size or potential visual impact of the projects. The VRM also analyzes the quality of view, sensitivity of the visual resource, and the impacts that development would have at different distances for all public lands to help aid the determination of a management class for these areas as part of the Resource Management Planning process.

Although a visual resource inventory was completed for the Monument under the 1985 San Juan / San Miguel Resource Management Plan (RMP) (BLM 1985), there were no management objectives identified for VRM and no management classes were established for the resource area. Currently, impact and site specific mitigation for visual resources are being implemented on a project-by-project basis. As part of the planning process for the Draft RMP and to provide a basis for current and future management, a team of professionals was organized out of the San Juan Public Lands BLM field office in Durango, CO to complete a visual resource inventory of the Monument.

Inventorying typically involves 4 steps: 1. Outlining and numerically evaluating scenic quality 2. Outlining visual sensitivity levels 3. Delineating distance zones 4. Assigning VRM inventory classes. To inventory the landscape, the Monument was broken into five Scenic Quality Rating Units. The team of professionals conducting the inventory went to key observations points located in the five Scenic Quality Rating Units (SQRU).

After numerically rating seven key landscape characteristics (landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications), a score was tallied for each unit. Scores were averaged among the team members and this average was used to

determine the scenic quality rating for the unit (A-C). High numerical scores of 19 or more led to a rating of A for high scenic quality, whereas low ratings of 11 or less led to a rating of C, which insinuates low scenic quality. Table 1 below shows the scenic quality ratings determined for each unit.

Table 1: Canyons of the Ancients Scenic Quality Rating Units

Unit	Location in Monument	Rating
1	WSAs in the northwestern part of the Monument: Squaw/Papoose Canyon WSA, Cross Canyon WSA, and Cahone Canyon WSA.	A
2	Yellow Jacket Canyon area – deep canyon and tablelands	B+
3	Sand Canyon and East Rock Creek Canyon	A
4	Hovenweep Canyon and Cannonball Mesa areas, including the 443-acre McElmo Research Natural Area (RNA)	B+
5	Bowdish/Rincon area in the southwestern portion of the Monument	C

Source: Colorado State Field Office, Bureau of Land Management, 2007

The second consideration in the visual inventory was determining the level of visual sensitivity for each SQRU. Depending on the type of user, amount of use, public interest, adjacent land use, special areas, and other factors each unit was assigned a sensitivity level of high, medium, or low. A high sensitivity level was determined for 4 of the 5 SQRUs. Table 2 contains notes that were made concerning Key Observation Points in the 5 SQRU in the monument.

The third step of the inventory process involved the mapping of distance zones to determine general visibility of the landscape. Distances were measured from primary or secondary roads and important vista points. Every time a scenic quality rating was made for a key observation point, the rater marked the distance zone and location. The BLM has distinguished the following distance zones: Foreground, Middleground, and Seldom-Seen.

Table 2: Canyons of the Ancients Visual Sensitivity Analysis

Unit	Location	Notes	Uses and sensitivity levels of the users	Overall Sensitivity Rating
1	WSAs, McLean Basin, Lowry Historic District	High public interest in maintenance of visual quality.	Hunting = moderate; Hiking = high; Lowry visitors = high	High
2	Yellowjacket Canyon Area	Changing land uses from agricultural to residential along County Road P to Cannonball Mesa Road.	Hiking = high; Grazing = low; Cultural resource values = high; Outfitters and guides = low	High
3	Sand Canyon and East Rock Creek Canyon, Goodman Canyon	Cultural Resource Management Plan and National Historic Register Districts, Goodman Point (Hovenweep National Monument), and Sand Canyon Pueblo. Used by outfitters and guides and visual concerns by Sand Canyon road users.	Hiking = high; Horse riding = high; Biking = high; Off road vehicles riding = low	High
4	Hovenweep Canyon, Hackberry Canyon, Negro Canyon, Mockingbird Mesa	Large number of users due to access via Cannonball and Mockingbird Mesas, Bridge Canyon, Painted Hand Pueblo, and Mockingbird Mesa; cultural Resource Management Plan; and, adjacent land use concerns for visual quality by Hovenweep National Monument and McElmo Canyon Road users. Trail of the Ancients Scenic and Historic Byway (Colorado, Utah, and Arizona) in unit.	Outfitters and guide = low; Grazing = low; Biking = moderate; Off road vehicle riding = moderate; Hiking = high; Cultural resource interest = high	High
5	Bowdish, Rincon, Hamilton Mesa	Hamilton Mesa views have some interest	Grazing = low; Outfitters and guides = low; Off road vehicle riding = moderate	Moderate

Source: Colorado State Field Office, Bureau of Land Management, 2007

- **Foreground zone:** The detailed landscape found within 0 to 0.5 mile from the viewer.
- **Middleground zone:** The space between the foreground and background zones, from 0.5 mile to 3 to 5 miles from the viewer.
- **Background zone:** The space from the middle-ground zone outward to approximately 15 miles (5 to 15 miles).
- **Seldom-Seen zone:** The area not visible within the foreground, middleground, or background zones, and areas beyond 15 miles from any observation points.

The information from these different steps was compiled to determine a visual resource inventory class for each of the units using the following matrix (see Table 3).

Table 3: Visual Resource Inventory Class Matrix

		High			Medium			Low
Special Areas		I	I	I	I	I	I	I
Scenic Quality	A	II	II	II	II	II	II	II
	B	II	III	III*	III	IV	IV	IV
				IV*				
	C	III	IV	IV	IV	IV	IV	IV
	f/m	b	s/s	f/m	b	s/s	s/s	
DISTANCE ZONES								

Source: U.S. Bureau of Land Management (BLM), Handbook H-8410-1 Visual Resource Inventory, 1980

By inputting the information listed in the first three columns of Table 4 below into the matrix above the Visual Resource Management Inventory Class listed in the fourth column was determined for SQRU 1-5.

Each of the Visual Resource Inventory Classes has a different purpose and objective. These objectives are listed in Table 5. Table 5 also lists the amount of the Monument’s acreage that

is in each class. Although these landscape units may be inventoried at a specific visual resource inventory class, this does not mean that this class is the management class that will be applied to the unit in the Resource Management Plan (RMP). A visual resource management class is assigned based on the management decisions made in the RMP. All actions proposed during the RMP process that would result in surface disturbances must consider the importance of the visual values and the impacts the project may have on these values. For example, a landscape may receive a visual resource inventory class of III but managers may decide that it should be managed as II to protect important cultural and scenic resources in the area and to preclude future surface disturbing activities.

Table 4: Canyons of the Ancients VRM Inventory Classes

<u>Rating</u>	<u>SQRU Sensitivity</u>	<u>Visual Zones</u>	<u>Distance Class</u>	<u>VRM Inventory</u>
Unit 1:	A	High	all	I
Unit 2:	B+	High	Foreground	II
			Middleground	II
			Background	III
			Seldom Seen	III or IV
Unit 3:	A	High	F	II
M	II			
B	II			
S/S	II			
Unit 4:	B+	High	F	II
M	II			
B	III			
S/S	III or IV			
Unit 5:	C	Medium	F	IV
M	IV			
B	IV			
S/S	IV			

Source: Colorado State Field Office, Bureau of Land Management, 2007

Table 5: Canyons of the Ancients Visual Resource Class Objectives

Class	Purpose	Objective	Estimated Acres In Class
1	Manage VRM Class I areas to protect natural scenic quality. Design surface construction projects with low visual contrast standards.	Preserve the existing character of the landscape. This class provides for ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.	40,223
2	Manage VRM Class II areas to preserve natural scenic quality. Design surface construction projects with low to moderate visual contrast standards.	To retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.	87,334
3	Manage VRM Class III areas to preserve natural scenic quality. Design surface construction projects with moderate visual contrast.	To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.	34,798
4	Manage VRM Class IV areas to preserve natural scenic quality. Allow strong visual contrast in project design. No special standards needed.	To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.	20,992

Source: Colorado State Field Office, Bureau of Land Management, 2007

Currently, the preferred management scenario listed in the Draft RMP has all Wilderness Study Areas and the McElmo Resource Natural Area managed as Class I. All

units of Hovenweep National Monument within the Monument boundaries and the Trail of the Ancients Scenic and Historic Byway are designated as Class II. Under this proposed alternative, there would be a total of 38,598 acres as Class I, 126,643 acres as Class II, 94 acres as Class III and 0 acres as Class IV. This preferred alternative proposes that the majority of the Monument's land area be managed as Class II, which would significantly limit the types of projects that could be built.

Many representatives from the oil and gas industry, including Questar and Kinder Morgan, have recommended that the BLM reconsider this decision since the majority of the area proposed for designation as Class II is already under lease for oil and gas. These groups feel the fact that decisions to issue leases have already been made, which conflicts with the management elements of a class II and that a class III designation is more appropriate for already leased areas (Moseley, 2008; Matheny, 2008; Havens, 2008). In turn, groups in support of conservation and preservation of the Monument, like the San Juan Citizens Alliance, The Wilderness Society, Colorado Wild, Rocky Mountain Chapter of the Sierra Club to name a few, feel more areas should be classified as Class I under the preferred alternative (Pearson, 2008).

Once management classes and objectives are completed and approved for the Monument, managers can make more informed decisions when reviewing project proposals and proposed activities. The process that the BLM has in place to review the potential visual impacts of proposed projects and activities is the Visual Contrast Rating System. This system is described in more detail in Chapter 2 of this document.

4.6. Considering Cumulative Effects

One of the greatest concerns expressed about the Draft Resource Management Plan

for the Monument, from both the oil and gas industry and environmental organizations, is its failure to adequately analyze the cumulative impacts of new or ongoing activities. The National Environmental Policy Act requires that the BLM assess impacts and effects that include: “ecological...aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. (40 C.F.R. Section 1508.8)” According to NEPA, a failure to include a cumulative impact analysis of actions within a larger region will render NEPA analysis insufficient. The Draft RMP forecasts as many as 150 new wells and 70 miles of new roads but there is no description of the cumulative impacts, particularly cumulative visual impacts, that these new wells will have or of what mitigation measures are possible to minimize the negative impacts of this cumulative development.

Currently, the Monument does not have a structured system in place for monitoring the cumulative visual impacts imposed by oil and gas development or by any kind of development. Although some measures have been taken to begin to quantify the existing cumulative impacts of oil and gas development activities, lack of guidance and information on how to accurately analyze these effects has prevented managers from moving forward with this analysis.

Measures taken by monument managers and BLM professionals to begin to monitor cumulative effects include: the completion of the visual resource quality inventory; viewshed mapping and analysis; and, photographic documentation of popular visitor destinations. The visual resource quality inventory provides managers with information about the existing, or rather, baseline visual conditions of the Monument. It highlights which areas of the monument contain sensitive and / or threatened visual resources and can be used to help guide and inform decisions about future projects and activities.

A view-shed analysis was completed in 2008 using GIS for all of the main travel ways and important destinations in the Monument. This analysis took into account elevation, topography, and vegetation to determine how much of the surrounding landscape can be seen by a visitor. This analysis shows that most sites in the Monument offer vast and expansive views of the surrounding area. However, this is not to say that all of this viewable land area is within the sight range of the viewer. When overlaid with a map of existing and abandoned well pads, this analysis provides managers with idea of how much development is potentially within view of highly sensitive or highly scenic parts of the Monument.

Another measure taken by managers to document the existing visual conditions of the Monument was a photographic inventory. Two photographers were contracted to document via color photographic imagery, 360 degrees views at every 0.5 mile of the roads leading into and of main tourist destinations in the Monument. These photographers stitched their photographs together to create a full panoramic of these 0.5 mile vistas and documented the visual conditions present at each stop. They also documented the geographic coordinates of where each photo and survey was taken. Managers can also use this inventory as a baseline for existing visual conditions. It can help managers better understand how visual quality improves, decreases or stays the same while traveling in the Monument and is represents how the public might experience this landscape.

Despite these initials efforts, there is much more that can be done at Canyons of the Ancients to assess, monitor, and manage cumulative visual effects, especially those from oil and gas development. The following chapters highlight methods that can be taken to advance cumulative effects assessments and address challenges that BLM professionals should be expected to face in adopting these methods.

CHAPTER 5

INFORMAL EXPERT INTERVIEWS

To gain a broader and deeper understanding of the types of methods for measuring the cumulative effects of resources on public lands and for the challenges faced by professionals in applying these methods, I conducted a series of informal, expert interviews. These interviews were tailored to professionals who have experience conducting cumulative visual effects assessment and / or have experience working with the visual resource management systems applied by Federal land management agencies like the Bureau of Land Management or the USFS.

A total of four professionals were interviewed via telephone. Each of these professionals has extensive experience (ranging from 12 to 32 years) working for a Federal land management agency (Natural Resource Conservation Service, United States Forest Service, Bureau of Land Management) and with conducting cumulative effects assessment through the NEPA review process. Interview subjects were identified based on their position within a Federal agency, degree of experience, and willingness / ability to answer the questions listed below.

- What is your experience with conducting cumulative effects assessment?
- What type of projects have you evaluated? Where were these projects located? What federal agency did you work with or for?
- How are cumulative effects currently considered in your system for managing visual resource?
- Does your agency incorporate cumulative effects assessment into the resource management and planning process?
- How can the visual resource management system (SMS or VRM) be modified to incorporate cumulative effects in the inventory and analysis stages?
- What are potential limitations to incorporating cumulative effects into the VRM or SMS? What are potential advantages?
- Please describe from your experience how the cumulative effects of a proposed project on visual resources or scenic quality are considered and / or analyzed in the NEPA review

process?

- What methods are used to conduct these assessments?
- How are the past, existing, and potential future effects on visual resources considered?
- How are geographic and temporal scales as well as baseline conditions determined prior to conducting the assessment?
- What are the strengths, weaknesses, opportunities, and threats of this method(s)?
- From your experience, do you find the cumulative effects assessment procedure you used accurately identified cumulative effects? Also, was this procedure reliable at predicting potential impacts?
- Is the method you used easy to conduct? Is it practical?
- If time and money were not a consideration what suggestions do you have for improving methods for conducting cumulative effects assessment?

Following each interview, I analyzed the answers provided by each subject and grouped their responses based on common themes or shared information. These grouped responses were then categorized under three topic areas: methods for conducting cumulative effects assessment (CEA), strengths and limitations of existing CEA methods, and methods for including cumulative effects assessment into the visual resource management system. To ensure that the confidentiality of the individuals interviewed is protected, interview subjects will be referenced as Subject A, Subject B, Subject C, and Subject D.

Subject A has 32 years of experience working for the Bureau of Land Management as a team leader and team member of interdisciplinary teams analyzing the effects of a variety of actions on various elements of the environment, including visual resources. Subject A analyzed the impacts of both small and large scale projects, including oil and gas development, pipelines and power lines, for both land use plans and Environmental Impacts Statements. Subject A currently conducts trainings on conducting cumulative effects assessment for a private consulting firm.

Subject B has been in the environmental assessment field for twelve years and has worked on cumulative effects assessment for this same period of time. Subject B has worked

on projects involving oil and gas development and mine developments. While working for the Environmental Protection Agency, Subject B addressed and evaluated the potential impacts from development on visual aesthetics by surveying local stakeholders on their views of the area and preparing visual models of potential development.

Subject C works closely with the Director for the National Environmental Policy Act to oversee all policies and procedures around the environmental impact analyses required through NEPA. Subject C has direct experience doing cumulative visual assessments for the United States Forest Service.

Subject D has extensive experience working with the Bureau of Land Management's visual resource management system. Subject D is a trained landscape architect and has instructed classes on visual resource management and visual simulation for the past six years.

5.1. Methods for Conducting Cumulative Visual Effects Assessment

From each interview I was able to gain insight into the most commonly applied tools and techniques used by professionals for conducting visual impact analysis and for assessing cumulative visual effects. Each of the tools described in the interviews is listed and explained in more detail below.

5.1.1. Visual Inventorying

While the system for visual resource inventorying used by the Bureau of Land Management and the United States Forest Service does not explicitly analyze cumulative impacts, professionals in the Bureau of Land Management and Forest Service use visual inventorying to gather baseline information about the existing visual conditions of landscape. Evaluating the existing level of scenic quality for a landscape provides a snapshot for the present status of visual quality, which managers can use to predict the visual impact the

future development will have on the landscape. Managers can use the information and the data collected on visual resources through the inventory process to help identify potential cumulative effects.

The process used by the BLM to inventory the visual quality of a landscape is described in more detail in Chapter 2 and in Chapter 4.

5.1.2 Visual Contrast Rating System

According to Subject A, the Bureau of Land Management uses the Visual Contrast Rating System (VCRS) to identify changes to the landscape, including the land and water, vegetation and existing structures, as measured by changes in form, line, color, and texture. The VCRS is used as a guide to measure the potential impacts a proposed project might have on visual resources and to provide suggestions for mitigating these potential impacts. VCRS is based on the understanding that the degree to which a management activity affects the visual quality of a landscape depends on the visual contrast created between a project and the existing landscape. Contrast is measured by comparing the project features with the major features in the existing landscape. More detailed steps to conducting the VCRS are described in Chapter 2.

When a professional completes the visual contrast rating for a proposed project he or she must determine if the project meets the management class objectives for the project area. Part of this determination requires that professionals examine the cumulative effect of all contrast ratings. Some combinations of ratings may indicate that there is an overall contrast that the individual rating would not show. For instance, several “moderate” ratings, when viewed in combination of each other, may lead to an overall “strong” rating. This provides

managers with a way to identify potential existing or potential future cumulative effects and to mitigate these effects before they occur.

Visual contrast rating also encourages professionals to select a timeframe for which the impacts will be examined. Timeframes are either short-term (first five years of a project) and / or long-term (through the life of the project). For long-term projects, managers must assess the potential future impacts that a project will have and offer suggestions for minimizing these impacts. This method provides managers with information on the potential, long-term impacts for individual projects that can then be utilized in comparison with other contrast ratings. This combined analysis can offer more insight to managers on the types of cumulative visual effects that might arise in the future.

Subject A noted that this method is easy to apply for managers with experience and practice and that has been standard practice of the Bureau of Land Management. According to the subjects interviewed, one of the greatest strengths of the visual resource management system is that it adds a degree of objectivity to a subjective process. Subject A states that *“the visual contrast rating process takes what could be a subjective process and introduces an objective consideration of changes to the landscape.”* There seemed to be agreement amongst the subjects that the more quantitative the analysis, the greater its strength.

5.1.3. Visual Simulations

Visual programming and simulation software can be used to graphically illustrate the projected impacts of a proposed project. Visual simulation software allows individuals to edit a scanned photograph or a digital image. Simulations are created by duplicating elements from within the image and by adding elements from other images. Objects are

edited to create realistic looking simulations that can visually show the outcomes of proposed changes to the current landscape.

There was agreement that visual simulations and models can be very helpful tools at confirming direct and indirect impacts and thus helpful at assessing the potential cumulative changes to the landscape as a result of these impacts. Subject A feels that visual simulations are very effective in assessing visual impacts and cumulative visual effects and should be utilized for all proposed projects. However, time and money often restrict the application of visual simulations to larger scale projects or actions that are controversial or located in visually sensitive settings.

5.1.4. Geographic Information Systems and Remote Sensing

Geographic Information Systems (GIS) and other spatial mapping software are helpful tools for resource managers or Cumulative Effects Assessment (CEA) analysts that need to monitor changes to the landscape over a broad period of time and land area. GIS makes it possible to manipulate large amounts of data and it provides a mechanism for continuously updating changes in resource distribution and character. The ability to manipulate spatial data, including satellite imagery and aerial photographs, provides the manager or CEA analyst with a mechanism for examining alternate action scenarios and to forecast the sustainability of the environment in response to land use changes commonly associated with proposed projects (Blaser, et al, 2004). This type of analysis would be very difficult and time consuming without GIS.

Geographic Information Systems (GIS) are computerized systems that are used to store and manipulate geographic information. GIS offers specialized analysis capabilities that are directly linked to the spatial realm (Blaser et al, 2008). What is unique about GIS is its

overlay operation, which allows the user to overlay multiple data themes. This overlay function would give a land use manager or CEA analyst the ability to create a map that shows location of oil and gas wells in proximity to heavily traveled routes and destination points. This map could also display the boundary of the BLM management classes, the year that each oil and gas well was developed, and an aerial photograph of the study site. The managers of Canyons of the Ancients have used GIS to complete this type of mapping. Other GIS functions include networks and connectivity operations, terrain analyses, statistical interpolation, functions for spatial database development and maintenance, as well as viewshed mapping (Blaser et al, 2004).

Subject B spoke about the experience of a BLM field office that has relied on new GIS technology to conduct viewshed analyses for large-scale projects. This office wanted to see how many utility corridors would be visible from key observation points and to get a better understanding of potential visual impacts from a larger scale perspective. They were able to input information about elevation, topography, vegetation, and the proposed projects into the viewshed analyst in GIS to see where the utility corridor would not be visible. Subject B mentioned that viewshed analysis is a helpful tool for evaluating current project proposals, but also for examining past approvals that have occurred to determine what percentage of this development is visible from sensitive areas. Managers at Canyon of the Ancients National Monument also conducted a viewshed analysis using GIS to identify what the views are like from key observation points in the Monument.

This technology allows the manager or analyst to determine where on a landscape objects can be viewed as well as what land areas can be viewed from these objects. If there are several observation points, it can be used to determine which observers can see each

observed location. It also allows the person doing the analysis to control the view-shed by manipulating different data inputs (Blaser et al, 2004).

In addition to view-shed mapping, there are many other ways that GIS can be a helpful tool for conducting cumulative effects assessment. GIS can be used for consolidating a large amount of data on different features (ex. soils, habitat, development, water, vegetation, wildlife habitat); assessing the physical and biological effects of human impacts; performing analyses at a variety of map scales; identifying locations where impacts are greatest or least; and, calculating additive effects (Blaser et al, 2004). In addition to these functions, GIS can be used to perform periodic data updates and it provides excellent visual representation.

In spite of its many strengths and applications, GIS does come with limitations. It requires good computing power, specialized software, skilled technical staff, and time, all of which can be expensive. With GIS, the data that is projected can often differ from actual results and it necessary to calibrate models (Blaser et al, 2004). It is limited to effects based on locations and does not explicitly address indirect effects or cumulative effects. However, it is still a very effective and useful tool to be used for mapping and storing data and performing spatial analysis.

5.1.5. Council of Environmental Quality Guidelines

Subject C commented that the primary tool that has been helpful for conducting cumulative effects analysis has been the guidelines produced by the Council of Environmental Quality (1997). These guidelines are described in Chapter 2 of this document. They were meant to help guide CEA analysts and Federal agencies through the steps that should be taken and considerations that need to be made in conducting cumulative

effects assessments for any type of resource, including visual resources. Subject C appreciates the general approach taken by the CEQ, which is not specific to any one resource or concern. According to subject, *“It has provided a general approach to think through any CEA. It provides a common language for professionals conducting CEA but allows flexibility and room for them to put their own expertise in.”* While these guidelines have been helpful, others feel that more specific guidance or guidelines should be created for conducting cumulative effects assessments for visual resources.

5.1.6. Setting Boundaries

Two of the most difficult decisions to make while analyzing cumulative effects are setting the spatial boundaries and temporal limits of the analysis. According to the subjects interviewed, these boundaries are established primarily by the leader of the team conducting the analysis with the visual resources member of the team or NEPA specialist on the team. The decisions made to establish boundaries are based on professional experiences and judgment (Subject A).

Interview subjects noted that the temporal and spatial consideration of the assessment might vary for each resource that is being measured (A and C). Subject B noted that the boundaries selected are dependent on the resources examined. For visual resources the temporal limits are typically the project life. According to Subject C, how the boundaries are determined and how variant these boundaries may be for different resources is less of a concern than if the process for setting these boundaries was not transparent and explicitly described in the final assessment.

5.1.7. Past, Existing, and Reasonably Foreseeable Actions

It is typical to examine the effects of past actions on present conditions in a cumulative effects assessment. This can be done with the help of GIS by measuring the acres of landscape changed caused by past and present actions. Examining how the landscape has changed over time can help analysts better understand what areas of the landscape have been particularly impacted by development. Analysts can also map reasonably foreseeable actions on top of past and present actions to identify potential cumulative visual effects.

For determining reasonably foreseeable actions, analysts need to look at the future plans of the lead agency or plans of other entities like private industry that own land in the view shed. Having a general idea of the plans a private industry might have for a land area over a certain period of time into the future can help with the development of an Environmental Assessment or Environmental Impact Statement. It can be helpful to know if an industry is planning to develop the area over the next five to twenty years and to know the type and density of development they are anticipating to build. Subject C noted that while industry and other entities such as, private landowners, may not be willing to share this information or may not have knowledge of future development yet, it is important to gather as much information as possible as it pertains to the resource being assessed.

Another idea for assessing reasonably foreseeable actions is to create a dynamic database that stores data about the landscape and is updated regularly. The type of information collected and stored in this bank of data would be from any type of landscape assessment including information about the landscape gathered from visual inventorying, visual contrast rating for individual proposed projects, and the Environmental Assessment / Environmental Impact Statement created for the Resource Management Plan. According to subject C, *“If you are designing a project over a ten to twenty year period, you want to*

constantly analyze the impacts of a project and put that information into a database. This way, you always have an updated bank of effects, instead of relying on outdated information. Some would say redo the environmental impact statement but that would take into account all kinds of analysis, more than cumulative effects assessment requires.”

To be effective, it is imperative that this database is kept up to date. Anytime a project is being permitted, information from that project analysis should be put into the database. Having this information stored in a central location and having up-to-date information can be very helpful for trying to analyze future patterns or trends of development as well as for analyzing the effect of past actions on present conditions.

5.2. Strengths and Limitations of Cumulative Visual Effects Assessment Methods

Many of the subjects interviewed did not specifically talk about the strengths of existing CEA methods. Overall, there seemed to be more focus on the limitations of existing methods and ways in which the process can be improved. The limitations discussed in each interview are listed below.

5.2.1. Lack of data

“On the whole, CEA is difficult to address given the lack of empirical data often for most resources and in defining an appropriate temporal and spatial scale for resources analyzed.” –Subject B

Many BLM offices do not have the data they need to conduct cumulative effects assessment. According to Subject D, the BLM has had a massive data gap. Up until recently there has been a huge void in visual resource data that is only just beginning to be filled. *“Contractors would go to the BLM to ask for inventory classes and that office would not have any completed inventories (Subject D).”* These offices should have completed

inventories, as it is required that the BLM produce Resource Management Plans, which includes an environmental impact statement and visual inventory, for the public lands it manages. In order to develop management classes, an inventory of the landscape must first be completed.

For many of the offices that have completed inventories, this data has not been updated regularly and is often out of date. Visual resource management classes are established in the process for creating a Resource Management Plan. While these plans can be revised, it is typical that they will not be redone for 15-20 years. A great deal of change can happen to a landscape during this period of time. To predict cumulative effects, it is important to have information regarding the history of a landscape's visual resource quality and of how development has impacted visual quality over time.

The BLM should also be careful about storing the information collected during the process for completing the visual resource inventory. The notes and scoring sheets of the team members conducting the inventories, the geographic coordinates of the Key Observation Points used, the reasoning for selecting these Key Observation Points, and the overall method for determining the inventory class are all important pieces of information that should be stored and collected.

5.2.2. Lack of Trained Professionals

For a long time, the BLM was the only venue offering training in the area of visual resource management. Historically, this training was limited to BLM employees but as private offices were conducting more large-scale projects it became apparent to the BLM that training needed to be offered to the private sector as well. It is not uncommon for the BLM to hire a private firm or third party contractor to do the visual analysis for proposed projects or

to complete the visual resources section for an environmental assessment or environmental impact statement.

According to Subject D, most of these private firms do not have individuals on staff trained in visual analysis or visual resource management, which can significantly affect the type of data collected and the quality of the analysis. Up until 2006, when the BLM opened its training to private contractors, most of the private sector has been self-taught or “winging it.” Subject D notes, “now that the class has been opened to the private and more training has been offered, more than half of the students who take the class are from the private realm.”

In addition to the lack of trained private contractors, there is a deficiency of trained visual resource management (VRM) experts from within BLM field offices. The BLM’s visual resource management program is structured so that the National Office oversees the state VRM lead for each BLM state office. These leads oversee the lead professional for VRM at each of the state’s field offices. According to subject D, not all of the field offices in Utah have leads and that only 50% of the VRM leads in the country have been trained.

The BLM trains 30 people a year in VRM out of an organization of 600-900 employees. While they have a goal to offer more short courses on VRM and get more BLM professionals as well as private contractors trained, only a little more than half of the staff are trained. Even if individuals wanted to receive more training outside of the BLM’s program, it would be very difficult as there are only one or two university programs in the country that offer training in visual resource management.

5.2.3. Limited Public Review Process

Although the public are involved in the Resource Management Planning process as a requirement of NEPA, it is difficult for the public to accurately weigh in on the proposed alternatives if they cannot visualize how the landscape is impacted over time. NEPA facilitates a public involvement process by having the Bureau of Land Management publish an Environmental Impact Statement (EIS) or Environmental Assessment (EA) showing what the environmental impacts of a proposed action will be or showing “no significant impact,” and asking the public to participate in the planning process by providing information and comments about its proposed action (Bureau of Land Management Website, 2008). Visual simulations are not usually included in these documents, which primarily consist of text, tables, and graphs. Without visually illustrating the conditions of the landscape, depicting how it is predicted to change over time, it can be very difficult for the public to understand the proposed actions listed in an EIS or EA.

Subject D commented that it would be helpful to start utilizing the modern technology available such as GIS, watershed analysis, and aerial photography, to display the potential future modifications of different management scenarios in the Resource Management Plan. In a Resource Management Plan there are usually three different alternatives proposed: the commodity alternative, in which activities like oil and gas and grazing are maximized; the conservation alternative, in which surface activities are minimized; and, the balanced alternative. Subject D suggests using three dimensional computer modeling or computer animations to graphically illustrate these different alternatives, so the public can easily visualize potential changes rather than read how a project might impact visual resources.

One of the criticisms to descriptive inventory methods like the BLM's Visual Resource Management system is that they are based solely on professional or expert judgment (Kaplan, 1979). The public comment period required through NEPA offers the public the opportunity to weigh in on proposed visual management scenarios. However, if the public cannot fully understand the current landscape conditions and the changes that will potentially be made to it, they may be unable to offer comments or address their concerns.

5.2.4. Professional Bias

A challenge faced with any kind of professional analysis is individual bias. For many, their initial reaction to the landscape is not entirely aesthetic; it is also partly ideological or ethical (Subject D, 2009). According to Subject D, to be good at visual resource management you cannot allow personal bias to affect analysis. A key component of the visual resource management is that analysis is conducted from the perspective of the casual observer. Putting oneself in the place of the casual observer can be difficult for professionals trained to analyze the landscape. Often conclusions about a project are drawn but not as casual observers.

Subject D described an experience where the BLM had been asking a private oil and gas company to mitigate their visual impacts by setting back activities from the road and changing the color of machinery to match the landscape. However, in the same location, ten to fifteen small RVs were consistently parked on the road. The BLM had not required anything of the RV owners, even though they were creating as much of a visual impact as the oil and gas company. Overtime the BLM was able to manage the visual impacts created from both situations but their disparate treatment was indicative of bias towards the private recreationialist.

The visual resource management system is meant to be purely analytical. If professionals who conduct VRM have received the proper training and utilize the forms that are provided, the subjectivity of their observations might be significantly reduced.

5.2.5. Lack of Guidelines

While the generality of the CEQ guidelines for conducting Cumulative Effects Assessment is seen as a strength by some (like Subject C), others would prefer more detailed guidelines that are tailored to analyzing visual impacts. According to Subject C, many professionals who conduct cumulative effects assessment do not know how to apply the guidelines. The Council of Environmental Quality may say to set geographic boundaries, but many do not know what this means.

Subject C feels that in absence of more detailed guidelines, professionals must marry principle with practice. Analysts should review the CEQ guidelines and apply them as best they can to their field of expertise.

5.3. Incorporating Cumulative Effects Assessment into the VRM

Currently, there is no method or stage in the planning process to analyze cumulative effects in the BLM's Visual Resource Management system. The inventory stage of the VRM assesses the landscape by determining its overall character, but only past actions and their effects on scenic quality are considered in the inventory. While the visual inventory can be used to develop baseline conditions for a landscape, some existing landscape conditions are so polluted it would be difficult to identify a significant impact on visual quality. It may be useful to set baseline conditions at a level prior to intense development for these landscapes.

While proposed and reasonably foreseeable actions are not evaluated in the inventory, they are considered in the development of management objectives for a particular area. After

the landscape is inventoried to determine aesthetic qualities the decision is made as to whether or not the objective can be met in conjunction with other multiple use activities that occur in plan.

Although the Visual Contrast Rating (VCR) system considers cumulative effects by asking professionals to examine proposed projects in contrast to the existing landscape, the process does not explicitly measure cumulative effects. There is no question on the VCR form that asks about how frequently the landscape is interrupted, or about the relationship of the proposed project to other types of surface disturbing activities in the area. The VCR relies on the judgment and experience of professionals to combine the information provided by VCR on potential impacts of a proposed project, knowledge of the existing landscape conditions, and the relationship of the project to the surrounding area to determine if the project meets the objectives of the management class.

The Visual Contrast Rating form should be updated to include questions about the surface disturbing activities on the surrounding landscape to encourage the professional doing the analysis to consider the potential cumulative effect the proposed project might have. It should also include questions about frequency of disturbance to the landscape over time. This information can help Cumulative Effects Assessment analysts determine temporal boundaries and gain a better understanding of how far into the past the landscape has been impacted. This information could also be used to help predict future development trends and potential visual impacts as a result of densely located development occurring frequently in time.

In addition to limitations with the visual inventory and visual contrast rating system, the BLM's visual resource management system does not identify visual impact thresholds; it only distinguishes management classes. For most resources being analyzed in a cumulative effects assessment there is a set threshold, beyond which the resource becomes polluted. For visual resources there are no known visual impact thresholds that can be used to help managers determine when a landscape's visual quality is negatively affected by development. For a landscape like Canyons of the Ancients, managers could benefit from knowing how much development is too much or at what point does adding another well pad move a visual inventory class from a class III to a class IV.

While there is information and research about conducting visual impact analysis and about visual impact thresholds, little has been done by land use managers to apply these methods to their specific landscape character and development type. This knowledge could be very helpful for conducting cumulative effects assessment because it would help professionals identify the types of cumulative visual effects that are occurring and predict when they might occur.

If the visual resource management system were to be updated to more explicitly consider cumulative effects, there would be stronger analysis of landscape change and compliance with visual objectives. It would also lead to a stronger NEPA analysis. While it may seem like these changes can easily be made, it will take a long period of training, interagency cooperation, and further research before the Bureau of Land Management will be ready to update the VRM and before many of the limitations listed in section 5.2 are overcome.

CHAPTER 6

VISUAL PREFERENCE SURVEY

To gain an understanding of how and at what level development activities, particularly oil and gas drilling, impact the visual quality of the landscape, a visual survey was administered to a small sample population. The purpose of this survey was to gauge a basic understanding of how people visually experience the cumulative effects of development, specifically oil and gas development, on protected public lands, like Canyons of the Ancients National Monument. It was also developed to help identify potential methods for identifying visual impact thresholds that could be used in assessing cumulative effects and for incorporating public input into visual management decisions of the Bureau of Land Management (BLM) (Kaplan, 1975).

Currently, the BLM's Visual Resource Management System does not identify visual impact thresholds in their Resource Management Plan. To determine whether or not an activity will have a significant effect it is important to have a standard or threshold of concern. These thresholds help managers decide when the effects of an action are unacceptable. Thresholds can be defined in two ways. The first is as a standard using reference conditions that were obtained from a less altered period or location. The second is by assessing whether specific values of concern are at risk based on modeling. It is important to note that the usefulness of thresholds based on modeling depends on the quality and assumptions of the model used.

6.1. Survey Design

After studying various methods used to conduct visual impact assessments, I decided to create a pilot survey that would identify patterns in people's preference for the Canyon of

the Ancients landscape at various stages of alteration due to different densities of development. Twenty-four photographs of the Canyons of the Ancients National Monument were included in the survey. Each photograph had some degree of existing oil and gas development and is characteristic of the Monument's landscape, providing a clear view of its canyon bottoms, walls, and mesa tops. Using Adobe Photoshop, I was able to modify the level of development in sixteen of the twenty-four photographs included in the survey to resemble each of the four management classes of the Bureau of Land Management's Visual Resource Management system. The remaining eight photographs represent various stages of alteration from different areas of the Monument.

The sixteen modified photographs are derived from four photographs of Canyon of the Ancients National Monument. Of the four photographs selected, two are focused on the landscape in the foreground (0-0.5 miles away from viewer) and two provide a middleground (0.5-3 miles away from viewer) perspective. Two photographs are sized as panoramic and two are taken from what appears to be the perspective offered at approximately 55 mm. Each photograph selected had some degree of existing oil and gas development. The landscape in each photograph was modified to resemble the following development scenarios:

Scenario 1 No Development: This scenario is equivalent to management Class 1. The management objective for Class 1 landscapes is to preserve the existing character of the landscape and any development should not attract attention of the casual observer.

Wilderness Scenic Areas and Research Natural Areas are managed as Class 1 and no new development is allowed on these lands.

Scenario 2 Minimal Development: This scenario resembles a landscape managed at a Class 2. The management objective for Class 2 is to retain the character of the existing landscape.

Some surface disturbing activity is allowed but it does not attract the attention of the casual observer.

Scenario 3 Partial Development: This scenario is representative of management Class 3 landscape. The management objective for Class 3 is to partially retain the existing character of the landscape. A moderate degree of development is allowed and it may attract the attention of the casual observer.

Scenario 4 Maximum Development: This scenario is meant to reflect a landscape managed as Class 4. Maximum modifications are allowed to landscapes managed as Class 4 and development may dominate the view of the casual observer.

Figure 3: Development Scenario Matrix

	Foreground (0 – 0.5 miles from viewer)	Middleground (0.5 – 3 miles from viewer)
Panoramic	Photo 17 = No Development Photo 23 = Minimal Development Photo 10 = Partial Development Photo 5 = Max Development	Photo 21 = No Development Photo 11 = Minimal Development Photo 18 = Partial Development Photo 6 = Max Development
Non Panoramic	Photo 3 = No Development Photo 12 = Minimal Development Photo 16 = Partial Development Photo 24 = Max Development	Photo 8 = No Development Photo 15 = Minimal Development Photo 2 = Partial Development Photo 22 = Max Development

In addition to the sixteen edited photographs, I also included eight photographs taken of the Monument’s landscape at various stages of alteration. The twenty-four images selected were randomly ordered and included in the survey, which was projected on a large screen for three groups of graduate and undergraduate students at the University of Massachusetts (see Appendix A). These students received a paper survey (see Appendix B) on which they rated how much they liked each photograph on a scale of one to five, one being the least and five being the most. Participants had ten seconds to view and score each photograph. Figures 4, 5, 6, and 7 represent the development scenarios displayed in the

survey. Figure 8 displays the other photographs that were included in the survey.

Figure 4: Foreground / Panoramic Development Scenario



Foreground / Panoramic

Scenario 1:
No Development

Mean: 4.59

Photograph #: 17



Foreground / Panoramic

Scenario 2:
Minimal Development

Mean: 3.94

Photograph #: 23



Foreground / Panoramic

Scenario 3:
Partial Development

Mean: 2.75

Photograph #: 10



Foreground / Panoramic

Scenario 4:
Max Development

Mean: 2.13

Photograph #: 5

Figure 5: Middleground / Panoramic Development Scenario

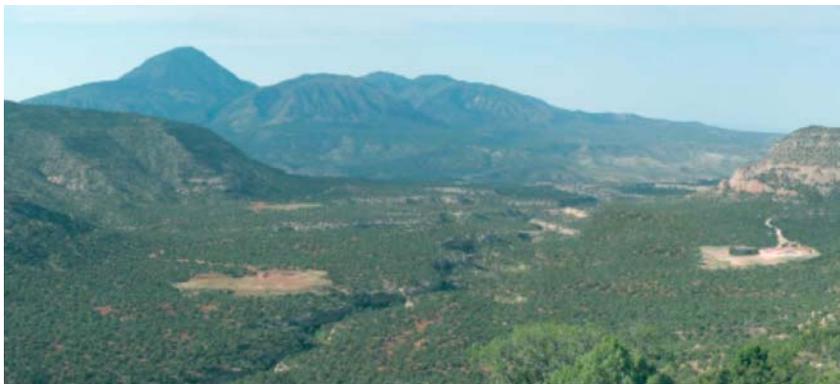


Middleground /
Panoramic

Scenario 1:
No Development

Mean: 4.16

Photograph #: 21

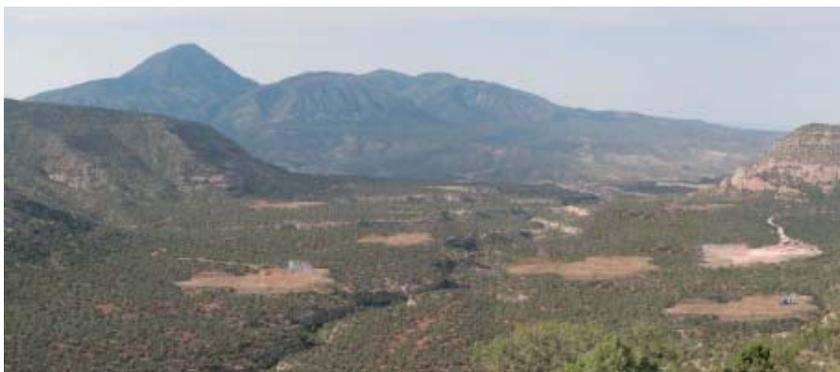


Middleground /
Panoramic

Scenario 2:
Minimal Development

Mean: 3.8

Photograph #: 11



Middleground /
Panoramic

Scenario 3:
Partial Development

Mean: 3.58

Photograph #: 18



Middleground /
Panoramic

Scenario 4:
Max Development

Mean: 3.44

Photograph #: 6

Figure 6: Middleground / Non Panoramic Development Scenario



Middleground / Non Panoramic
Scenario 1:
No Development
Mean: 2.62
Photograph #: 8



Middleground / Non Panoramic
Scenario 2:
Minimal Development
Mean: 2.41
Photograph #: 15



Middleground / Non Panoramic
Scenario 3:
Partial Development
Mean: 2.79
Photograph #: 2



Middleground / Non Panoramic
Scenario 4:
Max Development
Mean: 2.22
Photograph #: 22

Figure 7: Foreground / Non Panoramic Development Scenario



Foreground / Non Panoramic

Scenario 1:
No Development

Mean: 3.47

Photograph #: 3



Foreground / Non Panoramic

Scenario 2:
Minimal Development

Mean: 2.84

Photograph #: 12



Foreground / Non Panoramic

Scenario 3:
Partial Development

Mean: 2.48

Photograph #: 16



Foreground / Non Panoramic

Scenario 4:
Maximum Development

Mean: 2.16

Photograph #: 24

Figure 8: Additional Photographs



Middleground / Non Panoramic

Scenario 2:
Minimal Development

Mean: 3.17

Photograph #: 1



Foreground / Panoramic

Scenario 3:
Partial Development

Mean: 2.20

Photograph #: 4



Foreground / Non Panoramic

Scenario 3:
Partial Development

Mean: 1.94

Photograph #: 7



Foreground / Non Panoramic

Scenario 4:
Maximum Development

Mean: 1.92

Photograph #: 9



Foreground / Panoramic

Scenario 4:
Maximum Development

Mean: 1.96

Photograph #: 13



Foreground / Non Panoramic

Scenario 3:
Partial Development

Mean: 2.58

Photograph #: 14



Middleground / Panoramic

Scenario 1:
Partial Development

Mean: 3.63

Photograph #: 19



Foreground / Panoramic

Scenario 4:
Maximum Development

Mean: 2.05

Photograph #: 20

6.2. Survey Results

A total of 64 individuals took the survey. The three survey groups consisted of 25, 17, and 22 students, respectfully. The first two groups were conducted in University classes and the third was conducted among student staff in a University residence hall. The two classes surveyed were primarily composed of regional planning (15 students), landscape architecture (14 students), environmental design (6 students) and architecture students (6 students). These students can be considered the expert group, as most of students in these classes are skilled in landscape design principles and analyzing features of the landscape. These students may examine the landscape from a different perspective than a casual observer with no training in visual or landscape design. The students surveyed in the other group represented the following majors: social justice; political science; operations; management; nursing; neuroscience; business; economics; communication; biology; and, accounting.

Of all the students surveyed, 34 were female and 30 were male. The ages of the survey participants ranged from 40-49 years (7.8% of the survey population), 30-39 years (12.5%), 20-29 years (66.6%) and 17-20 years (14%). The majority of the survey population was raised in a suburban area (44%) or small town (34%). While 11% of the population has visited southwestern Colorado 2-3 times, only 1.5% is very familiar with this area. The majority of the population (70%) has never been to southwestern Colorado, and 61% of the population is not familiar at all with the landscape.

After calculating the mean and mode of the scores for each photograph, I was able to gain a general idea of how much people liked each type of landscape. I used SPSS version 16.0 (Statistical Package for the Social Sciences) to analyze the survey results. I decided to

compare the mean and mode for all photographs surveyed. The mean is calculated by adding all of the scores for each photograph and dividing by the total number of scores. The mode indicates the value scored most often. The results are tabulated in Table 6 and Table 7 below. The photo # corresponds to how the photograph was ordered in the visual survey, which can be found in the appendix of this document.

Table 6: Development Scenario Photograph Scores

	Foreground (0 - 0.5 miles)			Middleground (0.5 - 3 miles)		
	Scenario #	Photo #	Mean	Scenario #	Photo #	Mean
Panoramic	1	17	4.59	1	21	4.16
	2	23	3.94	2	11	3.80
	3	10	2.75	3	18	3.58
	4	5	2.13	4	6	3.44
Non Panoramic	Scenario #	Photo #	Mean	Scenario #	Photo #	Mean
	1	3	3.47	1	8	2.62
	2	12	2.84	2	15	2.41
	3	16	2.48	3	2	2.79
	4	24	2.16	4	22	2.20

*Note: Scenarios are approximately equal to VRM visual inventory classes.

Table 7: Additional Photograph Scores

Photo #	Scenario #	Mean
19	1	3.63
1	2	3.17
14	3	2.58
4	3	2.20
7	3	1.94
20	4	2.05
9	4	1.92
13	4	1.96

Since this survey was conducted to such a small sample size, it is difficult to draw conclusions about the data that was collected and analyzed. However, based on the patterns that emerged with the scores of this survey population, I have made the following inferences:

Based on initial observations, it appears that, overall, the more development on the landscape the less the survey participants liked the landscape. For development that occurred in the foreground there was a steady and apparent decline in individual's preference for the landscape as density of development increased. This inverse relationship is apparent in both the mode and median scores for the panoramic and non-panoramic scenarios. Survey participants gave the highest ratings to the panoramic photographs representative of Scenario 1 landscapes (photographs 17 and 21). Photograph 21, which is a middleground panoramic, received a mean of 4.16 and photograph 17, which is a foreground panoramic, received the highest rating of all the photographs with a mean of 4.59. Photograph 19, which is a middleground panoramic of a scenario 1 landscape, received a mean of 3.63, the fifth highest rating. The six highest rated photographs were all panoramic. The photographs that received the lowest ratings were the scenario 4 landscapes (photographs 5, 6, 24, 22, 9, 13, and 20). The mean scores for these photographs ranged from 1.92 to 2.20, with the exception of photograph 6, a middleground panoramic, which received a mean of 3.44.

Participants seemed to have a strong preference for Scenario 1 landscapes without development in both the foreground and middleground panoramic photographs. Both of the Scenario 1 panoramic landscapes (photographs 17 and 21) received a respective mean of 4.59 and 4.16, whereas, the Scenario 1 non-panoramic landscapes (photographs 3 and 8) received a mean of 3.47 for the foreground image and 2.62 for the middleground image. The difference in scores between the panoramic and non-panoramic landscapes may be attributed to a general preference for the landscapes selected in the panoramic photographs. This difference could also be a result of people preferring to look at the broader, more expansive vistas provided by a panoramic photograph to the 50 mm images.

While individual preference also decreased for photographs when development was located in the middleground, this decline for both the panoramic and non-panoramic images was not as steady or as gradual as it was for the foreground images. In the middleground photographs, participants attributed the highest score to the photographs representing a Scenario 1 landscape. However, the decrease in mean for photographs representing the Scenario 2 through Scenario 4 landscapes was more gradual than in the foreground photographs. For example, in the middleground panoramic development scenario, Scenario 2 received a mean of 3.80, which is 0.36 less than Scenario 1. Scenario 3 received a mean score of 3.58, which is 0.22 less than Scenario 2. Finally, Scenario 4 received a mean of 3.44, which is 0.14 less than Scenario 3. The most significant decrease in mean was between Scenario 1 and Scenario 2. In the foreground panoramic development scenario, Scenario 2 received a mean of 3.94, 0.65 less than Scenario 1. Scenario 3 received a mean of 2.75, which is 1.19 less than Scenario 2. Scenario 4 received a mean of 2.13, which is 0.62 less than Scenario 3. This difference between foreground and middleground ratings is similar in the non-panoramic photographs.

These differences between the foreground and middleground might mean that the casual observer is more likely to notice changes to development that occur in the foreground than in development that occurs in the middleground or background. Participants were more sensitive to changes occurring in the foreground and did seem to rate the middleground landscapes as critically as the foreground images.

The pattern that occurred in the middleground scenarios might also be indicative of a potential visual impact threshold. The viewers level of preference for the landscapes represented in the middleground panoramic and non-panoramic images, seemed to plateau

after any man made, surface disturbing activity was added. This observation could be interpreted to mean that once a landscape managed as a class 1 is altered in any way, the visual quality of that landscape has been permanently altered and will not increase or decrease with the addition of more development.

Conversely, this observation could also mean that the landscape of Canyons of the Ancients is able to absorb the visual impacts produced by development in such a way so that a visitor might not notice a difference in visual quality between a minor and major alteration to the landscape.

The photograph rated the highest was the foreground, panoramic class 1 scenario (mean = 4.59) see in figure 9 and the photograph rated the lowest was of a non-manipulated, non-panoramic photograph with maximum development in the foreground (mean =1.92), see figure 10.

Figure 9: Highest Rated Photograph



Figure 10: Lowest Rated Photograph



The scores for each photograph were fairly consistent between survey participants. I compared the means of each photograph within different demographic groups to see if characteristics like age, gender, academic major, and type of area people were raised might have an effect on how people scored. Overall, I did not notice any significant differences or patterns that arose.

6.3. Summary of Visual Preference Study

This survey serves primarily as a pilot method for determining potential visual impact thresholds on the Canyons of the Ancients National Monument. The survey, which produced some findings about the indications of the cumulative impacts to visual quality, helped me gain a deeper understanding for visual preference patterns and affirmed some of the generally accepted principles about visual preference within the Bureau of Land Management's Visual Resource Management system. It also helped identify a potential way to incorporate public input into the Visual Resource Management system.

In Chapter 2, the differences between various methods for analyzing the visual

quality of a landscape were compared. It was noted in section 2.1.1. Public Preference Methods that descriptive inventory methods, like the Visual Resource Management system, rely on the judgment of professionals to measure visual quality and do not incorporate the opinion of the public. The reasons for not including the public in this process ranged from concern about bias of the observer to lack of experience or knowledge with visual impact assessment (Robinson et al., 1976; Carlson, 1982; Clay and Daniel, 2000). In spite of these concerns, a strong argument has been made for including the public's opinion into descriptive inventory methods. According to Kaplan in (Nasar, 1988) experts can be a "dubious source of objective judgments about what people care about in the landscape." It was also noted that the perceptions, values, and motives of land managers and members of the public are derived from different personal and professional backgrounds and are likely to differ significantly (Vining, 1992; Vining and Ebreo, 2002).

The Visual Resource Management system is based on the viewpoint of the "casual observer." There is no explicit definition of casual observer but it can be assumed that this is not a professional or expert perspective. If there is no method for incorporating the public's opinion into the process for inventorying the landscape and for analyzing potential visual impacts there is increased risk that visual quality ratings will be influenced by expert bias.

By including public preference methods like the visual survey created for this research paper, in the process for assessing landscape quality insight can be offered into people's experience of the environment by providing awareness of agency / public mismatch, a mechanism for incorporating public input in visual management decisions, and a method for allowing culturally-appropriate decisions to be made (Kaplan, 1975).

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

Each of the methods taken to study the problem of identifying methods for measuring and managing the cumulative visual effects of oil and gas development for this project has significantly contributed to the development of final conclusions and recommendations for the Bureau of Land Management. These methods, which included a literature review, case study, expert interviews, and visual surveys, proved to be complementary in that the findings and analysis derived from each approach helped to improve or expand upon the overall findings for this project.

The literature review helped me to better understand the most commonly used methods for measuring visual landscape quality and how they differ. It provided insight into the historical development of and process for administering the visual resource management systems applied by Federal agencies like the United States Forest Service and the Bureau of Land Management. The research included in this literature review also served to define cumulative effects and identify methods for conducting cumulative effects assessments, particularly for cumulative visual effects. The most significant finding of this literature review was the lack of research and studies that have been done on this topic to date. It highlighted the need for me to visit and speak with experts in the field to see how these effects are currently being analyzed and identify how these methods can be improved.

The Canyons of the Ancients National Monument case study helped me identify the specific challenges faced by managers and visual resource experts with first measuring and managing visual resources and second identifying the appropriate method to assess cumulative visual impacts of development on these resources. I was able to visit a landscape

that is experiencing challenges characteristic of many other federally managed multiple use landscapes, especially within the southwestern United States. Oil and gas development has had a significant impact on the total land area of the Monument, particularly on visual quality. I learned that the application of the Visual Resource Management system and the introduction of visual resource management classes can help control and manage the impacts of both existing and future development on this landscape. However, without consideration of cumulative effects, which are effects that result when past, present, and reasonably foreseeable actions are combined, these management classes might be inadequately established. This case study provided a real-world example of the problem at hand and enabled me to have a fuller understanding of the limitations faced by BLM managers and professionals. It also underscored the opportunity and need for future research on conducting cumulative effects assessment, especially for visual resources.

After visiting the case study site, I realized that I needed more information about the current methods for conducting cumulative visual effects assessment. The interviews conducted with experts in this field provided me with invaluable information on the strengths and limitations of existing methods for managing visual resources and for identifying and predicting cumulative effects. Although, only four experts were interviewed, their extensive experience with and institutional knowledge of visual resource management and impact assessment provided for an in-depth analysis and understanding of the strengths and limitations of methods for analyzing cumulative visual effects. The information gathered from these interviews largely contributed to the development of recommendations, which are listed in the following section. However, I would never have been able to arrive at the questions developed for these interviews if I had not completed a full review of existing

literature of the topic or had I not visited the study site to meet with professionals and see the problems faced by managers firsthand.

The visual survey, which produced some preliminary findings about visual impact thresholds, served to highlight a potential method that managers can use to increase public input into the Visual Resource Management system and to identify the point at which the landscape visual quality is significantly affected by development. The survey results affirmed many generally accepted principles about visual preference, which supports the argument that consistent patterns exist among people's rating of visual landscape quality that can be quantified and measured. This survey can be modified and developed for future research on the differences in opinion between expert judgment and the perspective of the casual observer. It can also be used as a potential tool to better understand the preferences and opinion of native tribes that might have stake in a landscape but are not likely to offer their input and opinion to land managers via the formal process for public comment.

7.1. Recommendations

From the information and findings that I have gathered as a result of researching the case study of Canyons of the Ancients National Monument, conducting expert interviews, and administering a pilot visual preference survey I have been able to derive the following recommendations for both the National Bureau of Land Management (BLM) and for BLM fields offices to improve their ability to measure and manage the cumulative visual effects of surface disturbing activities like oil and gas development.

7.1.1. Update the Visual Resource Management System

The Bureau of Land Management should evaluate its Visual Resource Management System, which has experienced few if any modifications since its inception in the early

1980s, to identify how the process can be improved to incorporate methods for measuring and managing cumulative visual effects. The existing Visual Resource Management system does not have a placeholder for analyzing cumulative effects nor does it adequately encourage professionals to consider cumulative effects in their analysis of the landscape.

Two areas of the Visual Resource Management system that could easily be updated to incorporate the analysis of cumulative effects are the process for inventorying scenic quality rating units and the visual contrast rating form. Currently, the process for creating visual quality inventory classes does not examine reasonably foreseeable development nor does it consider cumulative effects. It only provides an assessment of existing landscape conditions, which include the impact the past actions have had over time.

This process can be updated to include a section in the analysis that involves examining existing cultural modifications on the landscape (i.e. any human development) in relationship to the surrounding landscape and other types of development. The visual inventory forms can be modified to include a place for analyzing the impact that viewing varying levels of development from different key observation points can have on scenic quality.

The Visual Contrast Rating system currently encourages professionals to consider the cumulative effect of development on visual resources by examining proposed projects in contrast to the existing landscape; however, no where in the process are cumulative effects explicitly measured. There is no question on the Visual Contrast Rating form that asks about how frequently the landscape is interrupted, or about the relationship of the proposed project to other types of surface disturbing activities in the area. This form can be updated to include questions about the surface disturbing activities on the surrounding landscape to

encourage the professional doing the analysis to consider the potential cumulative effect the proposed project might have.

In addition, the VRM should be updated to include public input. While it is important to have trained professionals applying the VRM and determining the management objectives for the landscape, how the public or rather casual observer, who is not trained in VRM, observes the landscape can significantly differ from the perspective of an expert. The BLM can conduct workshops displaying visual simulations or administer visual surveys to various types of public including Native American tribes, nearby residents, and visitors to gauge the preference of these different groups for different parts of a landscape and to identify how these different types of observers perceive visual landscape quality.

7.1.2. Increased Training and Education

There is a strong need for increased professional training and education on conducting both the Visual Resource Management (VRM) system and on conducting cumulative effects assessment for both employees of the Bureau of Land Management and the private sector. With only a little more than half of the VRM leads in the BLM trained in VRM, there is an incredible dearth of skilled professionals in the field. Currently, the BLM is expanding the number of two day short courses that are offered to professionals on VRM. However, despite the increase of course offerings the demand for this training continues to outweigh the supply.

The BLM should consider partnering with a private consulting firm to expand the number of trainings that are offered to both BLM staff and the private sector. Having training on VRM and on Cumulative Effects Assessment should be a requirement for both private and agency staff that are conducting these analyses. The BLM should also consider

updating its training on VRM to include guidance on how to monitor for and critically analyze the cumulative visual effects of surface-disturbing activities.

7.1.3. Create and Maintain Database of Visual Resource Information

One of the most significant hindrances in conducting a cumulative effects assessment is lack of data. In order to predict reasonably foreseeable impacts, information on past and present impacts and existing landscape quality is necessary. While some BLM offices lack any information on visual resources, other offices are in need of a method for storing and analyzing the disparate amounts of data they have.

These offices should establish a database that can allow them to input and easily update information about the visual quality of the landscape as it is analyzed over time through the visual inventory, visual contrast rating system, Resource Management Plan and any Environmental Assessments or Environmental Impact Statements. Having a database that can organize and store data in a comprehensive manner would be an incredibly helpful tool for analysts trying to identify trends and patterns in the impacts of development on visual resources. In order to be effective, this database would have to be updated on a regular basis to include the information gathered from new projects and developments and from ongoing planning and visual management.

7.1.4. Increase Use of Visual Models and Simulation Software

The ability to visually represent different development scenarios over time can be an incredibly useful tool to understanding how proposed development might impact the visual quality and visual resources of a landscape. Rather than describing in text or charts how a landscape might change due to increases in surface-disturbing activities, BLM professionals should include visual simulations or visual models of these changes. The BLM should

consider making it a requirement for private industries to submit visual simulations in their proposals for new projects.

To increase the application of this technology and of other technology such as, GIS and viewshed analysis, the BLM should offer training on how professionals can apply and analyze these tools for managing visual resources and for monitoring potential cumulative visual effects. The BLM should work with professionals and researchers in the visual aided design and software industry to create standards for how real world data is inputted and analyzed to create visual simulations. The BLM should also consider creating a list of resources, including private contractors that can offer assistance in the process of creating these visual simulations.

In addition, the visual quality rating determined by professionals through Visual Resource Management (VRM) system for a landscape should be compared with the results of public preference survey conducted for the same landscape. Individuals taking this survey would rate on a numeric scale the degree of scenic quality of various images taken from that landscape. By comparing the results of the two groups, the BLM can identify any possible discrepancies or mismatches between expert opinion and the non- expert or rather public opinion. These results can be used to help calibrate the VRM and with the categorization of the landscape.

7.1.5. Identify Visual Impact Thresholds

While the pilot survey created for this document may not be the most appropriate or scientific method for identifying visual impact thresholds, more research should be conducted on Canyons of the Ancients National Monument to determine at what degree of development is visual quality lost. More research should be conducted on methods for

identifying these thresholds and at incorporating visual impact thresholds into the Visual Resource Management System and the process for assessing cumulative visual effects.

7.1.6. Create Guidelines for Cumulative Visual Affects Assessment

The Bureau of Land Management should consider producing a set of general guidelines for how professionals should conduct cumulative visual affects assessments. These guidelines should offer information on the basic steps that should be taken in a cumulative effects assessment, methods for establishing geographic and temporal boundaries for visual resources, a review of commonly applied methods and technology for analyzing direct, indirect and cumulative visual effects, and information regarding the collection and analysis of data.

While the Council on Environmental Quality offers guidance on the process for conducting cumulative effects analysis it does not address how to approach the analysis of visual resources. For many professionals, having general guidelines is not helpful unless it is related to the resource or landscape type that they are charged with analyzing.

7.2. Directions for Future Research

The Bureau of Land Management should continue to research methods for incorporating cumulative effects analysis into its system for Visual Resource Management. The recommendations provided in this research study are still very general in nature. For the future, more experts in the field of visual resource management and visual simulation should be contacted and interviewed to gain a broader understanding of the various methods that can be applied for cumulative effects assessment. In addition to more interviews, there should be a comparison of case studies of Bureau of Land Management sites and field offices that have been successful in identifying and managing potential cumulative effects.

The visual preference survey that was conducted could be improved to better reflect future development scenarios and should be administered to a much larger sample population, including native tribes that have a stake in the landscape being analyzed. It might be helpful to conduct the survey between Bureau of Land Management professionals with experience in Visual Resource Management and nonprofessionals to see if there is a significant difference in how the two groups rate the visual quality of the landscape.

More research should also be conducted to identify visual impact thresholds. It is incredibly difficult to conduct a cumulative effects assessment without an understanding of potential thresholds at which development begins to significantly impact visual resources.

Overall, the Bureau of Land Management and other Federal land management agencies should continue to consider methods for measuring and managing cumulative visual effects. This information is incredibly important to the development of management alternatives and objects for important natural landscapes with high scenic quality and visual sensitivity that are obligated to lease land for surface disturbing activities like oil and gas development.

APPENDIX A
VISUAL PREFERENCE SURVEY





9



13



10



14



11



15



12



16



17



21



18



22



19



23



20



24

APPENDIX B

VISUAL PREFERENCE SURVEY RATING FORM

Survey on Four Corners Region of Southwestern United States (CO, UT, AZ, NM)

How familiar are you with Southwestern Colorado?

Scale:	1 = not at all	2 = slightly	3 = moderately	4 = very	5 = extremely
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How many times have you visited Southwestern, CO?

1. never	2. once	3. 2-3 times	4. 4-10 times	5. over 10 times
----------	---------	--------------	---------------	------------------

The projected photographs are typical scenes from the San Juan Public Lands.

Please indicate how much you like each picture.

- | | | |
|--------------|---------------|---------------|
| 1. 1 2 3 4 5 | 9. 1 2 3 4 5 | 17. 1 2 3 4 5 |
| 2. 1 2 3 4 5 | 10. 1 2 3 4 5 | 18. 1 2 3 4 5 |
| 3. 1 2 3 4 5 | 11. 1 2 3 4 5 | 19. 1 2 3 4 5 |
| 4. 1 2 3 4 5 | 12. 1 2 3 4 5 | 20. 1 2 3 4 5 |
| 5. 1 2 3 4 5 | 13. 1 2 3 4 5 | 21. 1 2 3 4 5 |
| 6. 1 2 3 4 5 | 14. 1 2 3 4 5 | 22. 1 2 3 4 5 |
| 7. 1 2 3 4 5 | 15. 1 2 3 4 5 | 23. 1 2 3 4 5 |
| 8. 1 2 3 4 5 | 16. 1 2 3 4 5 | 24. 1 2 3 4 5 |

How much knowledge do you have with respect to each of these subjects below?

1 = none at all	Natural Resource Management	1 2 3 4 5
2 = very little	Urban Studies	1 2 3 4 5
3 = some knowledge	Landscape Architecture	1 2 3 4 5
4 = quite a bit	Tourism / leisure studies	1 2 3 4 5
5 = high level of expertise	Archeology / Anthropology	1 2 3 4 5

Please tell us a bit about yourself:

Age: 1. under 20 2. 20 - 29 3. 30 - 39 4. 40 - 49 5. 50 - 59

Gender: 1. Male 2. Female 3. Other

What is your major now?

- | | | |
|---------------------------|----------------------|-------------------------|
| 1. Landscape Architecture | 2. Regional Planning | 3. Environmental Design |
| 5. Engineering | 4. Architecture | 6. Other _____ |

Anticipated degree level: 1. Bachelor 2. Master 3. Ph D

Residency:

1. Mass 2. Other New England states 3. Other states in US 4. Other

Where did you mainly grow up?

1. Rural area 2. Small Town 3. Suburban Area 4. Large City

THANK YOU!!!!!!

APPENDIX C

EXPERT INTERVIEW COVER LETTER AND QUESTIONS

Department of Landscape Architecture
& Regional Planning
University of Massachusetts, Amherst
109 Hills North, Amherst, MA 01003-9328
(413) 545-2255

March 27, 2009

To Whom It May Concern:

I am inviting you to participate in my research project to study approaches to analyzing the cumulative visual effects generated by land use activities like oil and gas drilling on federally owned and managed landscapes. To gain more knowledge about the strengths, limitations, and application of these methods, I have developed a series of questions to be answered by professionals and researchers who work for or with Federal land management agencies and are experienced with cumulative effects assessment (CEA) procedures. My project is not funded by any organization or government entity. It is a regional planning graduate thesis project.

Attached to this letter is a short questionnaire that asks a variety of questions about cumulative effects assessment procedures. I am asking you to look over the questionnaire and, if you choose to do so, complete it and send it back to me. It should take you about 20 minutes to complete.

The results of this project will be used to develop a set of recommendations for Federal land managers about how to incorporate cumulative effects management into existing visual resource management systems, resource management planning and the NEPA review process. Through your participation I hope to understand more about how CEA is applied and can be improved. I hope that the results of the survey will be useful for Federal land managers and environmental planners and I hope to share my results by including them in my Masters of Regional Planning thesis.

I guarantee that your responses will not be identified with you personally, unless I receive a written statement from you requesting to be identified. I promise not to share any information that identifies you with anyone outside my research review committee, which consists of Dr. Robert L. Ryan (Professor of Landscape Architecture), Dr. Elisabeth M. Hamin (Professor of Regional Planning), Prof. Peter Kumble (Professor of Landscape Architecture). If you do not feel comfortable submitting your completed survey via email you may also mail it to the address listed in top right hand corner of this letter, care of Tara Germond.

I hope you will take the time to complete this questionnaire and return it. Your participation is voluntary. Regardless of whether you choose to participate, please let me know if you would like a summary of my findings. To receive a summary, please email me at Taragermond@gmail.com.

If you have any questions or concerns about completing the questionnaire or about being in this study, you may contact me at 401-339-2889 or via email at Taragermond@gmail.com.

Sincerely,
Tara Germond
Masters Candidate, Regional Planning
University of Massachusetts, Amherst

Please review the following questions and try to answer them to the best of your knowledge. If you prefer to answer these questions via a telephone interview, please inform me of this desire. If you prefer to write out your responses, please return them in an electronic format via email.

- What is your experience with conducting cumulative effects assessment?
- What type of projects have you evaluated? Where were these projects located? What federal agency did you work with or for?
- Please describe from your experience how the cumulative effects of a proposed project on visual resources or scenic quality are considered and / or analyzed in the NEPA review process?
 - What methods are used to conduct these assessments?
 - How are the past, existing, and potential future effects on visual resources considered?
 - How are geographic and temporal scales as well as baseline conditions determined prior to conducting the assessment?
 - What are the strengths, weaknesses, opportunities, and threats of this method(s)?
 - From your experience, do you find the cumulative effects assessment procedure you used accurately identified cumulative effects? Also, was this procedure reliable at predicting potential impacts?
 - Is the method you used easy to conduct? Is it practical?
 - If time and money were not a consideration what suggestions do you have for improving methods for conducting cumulative effects assessment?

For Federal agencies and / or BLM or USFS professionals, who have experience with visual resource management systems like the BLM Visual Resource Management system or the USFS Scenic Management System.

- How are cumulative effects currently considered in your system for managing visual resource?
- Does your agency incorporate cumulative effects assessment into the resource management and planning process?
- How can the visual resource management system (SMS or VRM) be modified to incorporate cumulative effects in the inventory and analysis stages?
- What are potential limitations to incorporating cumulative effects into the VRM or SMS? What are potential advantages?

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