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Visual Resource Stewardship Conference Proceedings:

Landscape and Seascape Management in a Time of Change

Forest Service | Northern Research Station | General Technical Report NRS-P-183 | December 2018

Abstract

Contains 27 papers, 5 abstracts, and 7 visual case studies from the Visual Resource Stewardship Conference: Landscape and Seascape Management in a Time of Change, held at Argonne National Laboratory in Lemont, Illinois, on November 7–9, 2017. The material covers topical themes related to Federal Agency programs and policies, theory and concepts, visual quality assessment, visual impact assessment and mitigation, and visual resource management tools and technology. The visual case studies emphasize visual presentation of material with supporting text descriptions.

This document is being published in electronic format only. Any corrections or additions will be posted to the Website: https://doi.org/10.2737/NRS-GTR-P-183.

Cover Photo

Sunrise view from Bodie Mountain, California, looking south to Mono Lake and the Sierra Crest, summer 2010. Photo by Robert Wick, U.S. Department of Interior, Bureau of Land Management.

The stunning beauty of this scene, captured by BLM Wilderness Specialist Bob Wick, exemplifies the ideas of visual resource stewardship addressed in this Proceedings. Highly intact viewsheds like this do not happen by accident, and represent stewardship efforts by agencies including the BLM (Bodie Mountain Wilderness Study Area), USDA Forest Service (Inyo National Forest, Mono Basin National Forest Scenic Area), USDI National Park Service (Yosemite National Park), California State Parks (Mono Lake Tufa State Natural Reserve) and the City of Los Angeles Department of Water and Power, and nongovernmental organizations such as the Mono Lake Committee. Proactive stewardship of the visual landscape and its related biotic, air, and water resources can sustain the beauty that is vital to human health and well-being, now and for future generations.

Acknowledgments

The Editors thank our fellow Conference Steering Committee members Bob Sullivan, John McCarty, Mark Meyer, and Jim Palmer for their leadership in bringing the original conference presentations into this format where they can be shared with a wider audience. Bob and the entire committee are grateful to Argonne National Laboratory and its Environmental Science Division for hosting the conference, and Denise Fals, Judy Benigno, and Jacque LeBreck for providing excellent conference support. Additional conference sponsorship by Bureau of Land Management, National Park Service, USDA Forest Service, and State University of New York-College of Environmental Science and Forestry further ensured the success of the conference, and special thanks go to John McCarty (BLM), Mark Meyer (NPS), and Matt Arnn and Brad Cownover (Forest Service) for encouraging participation by agency staff and for securing financial support from their offices to help fund publication of the proceedings. The Editors thank Susan Wright, Rhonda Cobourn, Cherie Fisher, Heather May, and Jim Lootens-White of the USDA Forest Service, Northern Research Station for their expert assistance in the editing and layout of the proceedings, and to Station Assistant Director Lon Yeary for approval and support of our efforts. Last but not least, all of the authors deserve credit for meeting deadlines and graciously addressing our criticism in the various redrafts of their submissions. Your efforts are greatly appreciated and together contribute to a document that exceeds the sum of its parts.

Manuscript received for publication 29 May 2018

Published by

USDA FOREST SERVICE
11 CAMPUS BLVD SUITE 200
NEWTOWN SQUARE PA 19073

December 2018

Visual Resource Stewardship Conference Proceedings:
Landscape and Seascape Management in a Time of Change

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FOREWORD

REALIZING AMERICA THE BEAUTIFUL: TAKING THE LONG VIEW IN VISUAL RESOURCE STEWARDSHIP

Mark Falzone, President, Scenic America[1]

In his February 8, 1965, "Message on the Natural Beauty of Our Country," President Lyndon B. Johnson said: "We must not only protect the countryside and save it from destruction, we must restore what has been destroyed and salvage the beauty and charm of our cities. Our concern is not with nature alone, but with the total relation between man and the world around him. Its object is not just man's welfare, but the dignity of man's spirit" (American Presidency Project 2018).

The President concluded his message with a call for a White House Conference on Natural Beauty. Chaired by philanthropist and conservationist Laurence S. Rockefeller, the conference was held in Washington, D.C., on May 24 and 25, 1965. The resulting recommendations provided stimulation and support for a multitude of activities designed to improve the visual environment.

The Governors of 35 states subsequently convened statewide natural beauty conferences. A wave of citizen action followed, dedicated to neighborhood improvement, protection of the countryside, and expanded preservation of historic sites and areas, which, over time, has led to revitalized communities, increased economic activity, and a fundamental appreciation of the value of our built and natural environments. State and Federal legislation, notably the National Environmental Policy Act, bolstered support for protecting visual resources and spurred the development of tools and practices for its stewardship.

These actions have led to substantive changes across some segments of our national landscape. Roadside junkyards, ubiquitous in the 1960s and a prime target of Lady Bird and President Johnson's beautification efforts, have largely disappeared from public view. There is much more concern about the built environment today. Urban renewal is not demolishing whole sections of cities, there is a huge land trust and historic preservation movement, and legislation has been passed to support land acquisition and to regulate outdoor advertising.

And yet more than 50 years later, America the Beautiful remains imperiled. A population that has nearly doubled since 1965 has put pressure on our country's natural resources, open spaces, communities, and highways. The resulting sprawl and the infrastructure needed to support this growth has left indelible and unsightly marks on the American landscape. Telephone poles, overhead wires, and transmission lines are so omnipresent that many people no longer even notice them. Our great system of public lands is threatened by diminished funding and encroaching uses at their boundaries and in their viewsheds. And commercial roadside advertising, strip malls, and corporate logos continue to erode the local character in many communities across America.

A prime example of the continued threat to America's visual resources, and one that has been a chief concern to Scenic America since its founding in 1981, relates to outdoor signage. Fallout from the 2015 Supreme Court ruling in *Reed v. Town of Gilbert* (Scenic America 2018) has caused chaos in the world of sign regulation and sent numerous municipalities scrambling to shore up their sign codes. In reality, the *Reed* ruling simply clarifies that noncommercial speech enjoys an elevated level of protection that commercial speech does not. However, the ruling has resulted in dramatic decisions by courts in Texas and Tennessee to strike down those States' highway beautification laws in their entirety. If lawmakers in those States do not fix their rules to stand up to this new level of legal scrutiny, the result will be a "Wild West" scenario with commercial billboards able to be put up virtually anywhere.

Along with legislative setbacks, trends in technology also pose new threats to our country's visual environment. For instance, the banality of our commercial strips is being further blighted by a

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new generation of digital signage. Many stretches of suburban roadways now resemble the Las Vegas Strip, with signs of all shapes and sizes flashing new advertisements every few seconds, some even showing full-motion video. And still only a few States have effective land use laws to prevent sprawl or to ensure that new development is sited in ways that do not despoil the natural landscape. Even the National Scenic Byways Program, 20 years strong, has been unfunded by Congress. All these conditions mean that the country is, in many ways, uglier than it has ever been. More work needs to be done.

We at Scenic America believe a renewed commitment is needed to address the challenges raised by President Johnson more than 50 years ago and to set a course for action in the next 50 years. In our recent white paper, "Taking the Long View: A Proposal for Realizing America the Beautiful" (Scenic America 2017) we identify five broad areas where attention to the country's visual landscape is most needed:

- Community Character: The distinctive character and individual sense of place of many American communities is threatened by a variety of pressures, including poorly planned urban and suburban growth, misguided community leadership and powerful business forces, and the proliferation of massive chain businesses and their concomitant corporate franchise design.
- Parks and Open Spaces: An increasing amount of evidence suggests that our country's parks, open spaces, forests, wilderness areas, and greenways contribute greatly to the health and prosperity of the American public. But a lack of adequate and sustained public funding, disparate advocacy groups, and increasing development pressures threaten existing parks and open spaces and imperil future additions to current assets. In particular, Scenic America is advocating for full funding and permanent reauthorization of the Land and Water Conservation Fund, an important Federal program that has preserved and enhanced public access to the outdoors in all 50 States.
- Scenic Byways and Gateways: The "open road" is synonymous with modern America, and the most treasured of these roads have received State or Federal recognition as Scenic Byways for their scenic, cultural, historic, recreational, or archaeological value. Studies have proven that Scenic Byways are sources of pride and economic engines for the communities they traverse, yet funding for the Federal program has been eliminated and the door for any new byway designations has been slammed shut. Similarly, gateway roads leading to many of America's iconic parks, monuments, and communities are under increasing threat from visual blight, which diminishes the overall traveler experience.
- Overhead Wires: Overhead utility wires have a tremendous impact on the visual quality of our built environments due to their proximity to the streetscape and their sheer ubiquity. However, overhead wires, unlike billboards, provide the public with tangible benefits: We cannot do without the electricity and other vital services that these wires transmit. So the challenge is how to best limit the impacts of these necessary wires on our visual environments. When feasible, undergrounding of utility wires is the best option. In other cases, there may be ways to mitigate the impact of poles and overhead wires via thoughtful placement.
- Billboards and Signage: A substantial portion of the 1965 White House Conference on Natural Beauty was dedicated to determining how to protect the visual character of the roadsides of America's burgeoning highway system. It produced an early draft of the Highway Beautification Act with a stated purpose to protect the public investment in highways and to preserve the natural beauty of the landscapes they traverse. However, commercial and private interests, particularly those of the outdoor advertising industry, continue to threaten our roadsides and undermine the goals of "Lady Bird's Law."

In many ways, our visual environment can be seen as a metaphor for the health of the country. As the old saying goes: "What you see is what you get." When the built and natural environments are pleasing to the eye, they are usually functioning in ways that are sustainable, resilient, and conducive to public health and safety and economic prosperity.

Scenic values do not just affect where we choose to visit, but also where we choose to live. A recent study by the Knight Foundation called "Soul of the

Community" found aesthetics to be one of the top three factors affecting respondents' attachment to the places they live (Knight Foundation 2018). In a society with an increasingly mobile workforce, the way our communities look is more important than ever. If we fail to protect the beauty of our country, we put essential parts of our economy in jeopardy.

While Scenic America is the only National organization solely focused on the visual environment, we are grateful for the support and good work of allied organizations, many featured at the Visual Resource Stewardship Conference, that share key aspects of our mission: better planning, quality architecture, sympathetic landscape design, historic preservation, contextual and compatible infrastructure, and the protection of parks, open space, and farm lands.

Indeed, at the Visual Resource Stewardship Conference, we renewed old friendships and made some new ones, all with the shared goal of realizing America the Beautiful. The pages that follow lay out important papers, methodologies, and ideas that are all steps along our journey. More importantly, they are authored by people from the public and private sectors, from education and business, from nonprofits and for-profits, on the front lines of caring for the American landscape. These men and women have committed their working lives to preserving and enhancing the scenic beauty of our country. We are all deeply indebted to them, and I am humbled to introduce their work.

Scenic America believes that all Americans deserve to live in, travel through, and visit places that are beautiful and unique. We believe that the many and varied American landscapes are as critical to our country's sense of unity and pride as are the bald eagle, the flag, or the National Anthem.

Investment in scenic preservation and enhancement should be seen as an integral part of our National and local policymaking. In the end, taking pride in our places will affirm our best instincts by integrating beauty into the lives of all Americans. We know that beauty is good for business, but only when the voices of the people are heard as clearly as those of private interests can beauty be allowed to work its magic.

The question posed by these papers from the Visual Resource Stewardship Conference is: Do we want America to be full of homogenized landscapes, tarnished roadsides, and unattractive communities? Or do we want to live in a country that values and honors its natural and built environments? Of course, we know what the answer is. Now we must figure out how to meet the challenges to fully realizing America the Beautiful.

ACKNOWLEDGMENTS

Scenic America would like to thank Paul Gobster of the USDA Forest Service, and Richard "Rick" Smardon, Departments of Environmental Studies and Landscape Architecture SUNY/ESF, for their contributions to this foreword, and to all the organizers of the Visual Resource Stewardship Conference for the opportunity to present at the conference and prepare this foreword to the conference report.

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INTRODUCTION

VISUAL RESOURCE STEWARDSHIP: LANDSCAPE AND SEASCAPE MANAGEMENT IN A TIME OF CHANGE

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Abstract.—This introductory paper to the Visual Resource Stewardship Conference Proceedings describes efforts to develop and maintain professional capacity in the field of visual resource management (VRM). Large-scale energy development over the last two decades has been a major factor in the resurgence of activity in VRM, particularly with respect to visual impact assessment and mitigation. Efforts to capitalize on this activity culminated in a 2017 conference, and 27 papers and seven visual case studies from it are included in this proceedings, covering five broad themes: Federal agency programs and policies; theory and concepts; visual quality assessment; visual impact assessment and mitigation; and VRM tools and technology. The conference was also used as a springboard to launch additional activities aimed at building professional capacity for VRM, which are in progress and are described at the end of the paper.

STEWARDSHIP OF A FIELD

Although change has long been a defining characteristic of the American landscape, the rate, scale, and extent of change during the first two decades of this century have posed formidable new challenges to the protection of our visual resources. The most significant driver of this recent change has been energy, with increased demand, price, and access through fracking, and changes to national policies to seek energy independence that resulted in a surge of oil and gas development in the early 2000s (Pasqualetti and Stremke 2018). The Energy Policy Act of 2005 incentivized a national renewable energy development portfolio that called for approving projects to generate at least 10,000 megawatts of nonhydropower renewable energy on Federal lands by 2015 (Smardon et al. 2017). State and private lands form an essential part of the total energy equation, both directly as sites for development or indirectly for transmission corridors and materials supply (e.g., Walsh 2015). Together with new initiatives for offshore energy development and important urban, cultural, and scenic areas that lie within the viewsheds of project activity, few places in the landscape are not in some ways affected by our energy appetite.

As stewards of the visual resource (Chenoweth 1986), landscape architects and other environmental professionals in the public and private sectors have responded to these challenges with renewed enthusiasm and involvement in the field of visual resource management or VRM. VRM is concerned with the development and application of methods and tools to protect scenic beauty and minimize the scenic impacts of development activities. It emerged as a defined field of practice and research in the 1960s and grew rapidly in the United States in response to legal and policy initiatives such as the National Environmental Policy Act (NEPA) and the National Forest Management Act (Fabos 1974, Zube et al. 1982). Advancements in VRM research and practice slowed in the late 1980s and ’90s as research priorities shifted elsewhere (Smardon 2016). At the Federal level where much of the early innovation had occurred, adoption of improved methods such as the USDA Forest Service’s Scenery Management System (USDA

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Forest Service 1995) was hampered by a decreased in-house capacity and lack of incentive to revise previously developed VRM plans. Together with a growing move toward the integration of scenery issues with broader concerns of ecosystem management, ecosystem services, and other methods, some in the field began to question whether VRM could or needed to be sustained as a distinct field (Daniel 2001, Ribe et al. 2002). But today, in light of the new "energy landscapes" (Pasqualetti and Stremke 2018) and the unique problems they bring for managing the visual resource, any pronouncements about the demise of the field would seem to be premature.

The events leading to the publication of this proceedings are testament to the renewed interest in VRM and commitment to stewardship of its growth and vitality. Spurred by escalated energy development on Federal public lands, the Bureau of Land Management (BLM) experienced a soaring interest by professional NEPA practitioners in its visual resource management training course. Typically offered to Federal practitioners once a year, in 2007 the course was opened to private sector contractors to expand the professional knowledge base and in 2009 was increased to twice a year.

In 2010, Louise Kling, then an environmental planner at URS Corporation and one of the BLM course graduates, organized a support group of visual resource practitioners in the Portland, OR, area to develop more defensible visual impact assessments for BLM-contracted work. The small group of private practitioners and agency visual resource management specialists quickly grew to an informal nationwide network with a broadened range of participants. In 2011, Kling collaborated with Brad Cownover (Pacific Northwest Regional landscape architect for the USDA Forest Service and former Director of Scenic Conservation for Scenic America) to preserve the momentum by seeking opportunities to create a national conference on the topic. This led Kling, Cownover, and several of the authors of this paper to develop a VRM short course as part of the 2012 National Association of Environmental Professionals (NAEP) annual meeting in Portland, OR. The 1-day course was well attended by a diverse range of participants, and in the conference itself, papers focusing on VRM issues accounted for nearly a third of the program.

The network Kling began had now coalesced with a strengthened ambition that continued for several years at the annual NAEP meetings. Yet to sustain VRM as a field, additional steps were needed to establish its identity, build a critical mass of participants, and distinguish it from the broader group of environmental professionals. While some of the steps were a direct outgrowth of the 2012 NAEP conference, others were independent activities that happened to be coincidental to those inspired by the conference.

One such activity was the BLM's Web-based clearinghouse of VRM materials activated in 2016. The BLM's Wyoming State Renewable Energy Coordination Office provided funds to Argonne National Laboratory to build a Website dedicated to visual resource information that specifically targeted wind energy issues. The goal was to better educate the industry about integrating visual resource considerations early into the wind generation project planning process. As other Federal land and offshore management agencies released new initiatives concerning stewardship of visual resources, the focus of the Website shifted from a renewable energy audience to a broader context as a visual resource information clearinghouse. Robert Sullivan of Argonne National Laboratory (Argonne) gathered resources for Federal agency visual resource management and visual impact assessment into one publicly accessible location (http://blmwyomingvisual.anl.gov/). In addition to organizing existing information on agency programs, the site also documents many of Argonne's and others' VRM research and methods development projects conducted for BLM, the National Park Service (NPS), and the Bureau of Ocean Energy Management. These studies focus primarily on renewable energy development, siting, and visual impact mitigation issues.

Other important independent activities were the development of a comprehensive visual impact mitigation guide for renewable energy facilities on BLM lands, the development of guidelines for evaluating visual impact assessments and simulations in environmental impact statements, and the development of a visual resource inventory methodology for NPS; the latter two efforts were joint collaborations between Argonne and staff from NPS's Air Resources Division.

Next was development of a high-profile book aimed at providing a VRM perspective on renewable energy development, particularly on large-scale on- and offshore wind turbines, solar power plants, geothermal power plants, and connecting transmission lines that were creating major visual impacts and vociferous public response. As a long-time leader in the field, landscape architect Dean Apostol observed that the state-of-the-art on visual resource and impact assessment had seen significant advances since the 1990s and a dedicated book was needed to bring together this knowledge in the context of renewable energy development. Drawing on material from several NAEP conferences, the work at Argonne, and the professional experience of a core team of editors and contributors, "The Renewable Energy Landscape: Preserving Scenic Values in our Sustainable Future" was published in 2017 (Apostol et al. 2017). As a resource for practitioners and a textbook for scholars and students, the book establishes the identity and necessity for VRM in the context of the new energy landscape.

The latest step was development of a nationwide conference with a singular focus on VRM. Sullivan secured the use of Argonne National Laboratory's meeting space and accommodations and beginning in 2016 led a conference planning committee made up of the authors of this paper. The result was the conference *Visual Resource Stewardship: Landscape and Seascape Management in a Time of Change*, held in November 2017. This was the largest U.S. conference focusing on scenic resource issues since the *Our National Landscape* conference in 1979 (Elsner and Smardon 1979) and included more than 80 participants from Federal, State, and local agencies, academia, private sector consulting, and nonprofit organizations from across the United States and Canada.

VRM THEMES

While the energy landscape was a main driver for convening the conference, VRM has always been concerned with more than the visual impacts of energy development. The conference planning committee sent out a call for papers suggesting a broad array of topics, and it asked presenters to submit draft papers or slide presentations prior to the conference to share among participants and kick-start discussion. After the conference, the proceedings editors provided feedback to those wishing to further develop their work for publication. In addition to standard papers, we also gave participants the option of submitting their work in a "Visual Case Study" format that emphasizes the visual communication of material along with interpretive text. The resulting proceedings reflects the range of concerns of the conference participants and the field as a whole, with papers organized along five broad themes (plus the visual case studies).

Federal Agency Programs and Policies

Federal land management agencies continue to play a leadership role in developing and implementing VRM methods, and participants from BLM, NPS, the Forest Service, and the Bureau of Ocean Energy Management provide updates of their work. Along with developing improved ways to deal with energy development, agency contributions described in the proceedings cover many issues. These include developing new inventory methods to assess visually and culturally significant viewsheds on a diverse set of properties; exploring ways to incorporate stakeholder perceptions and preferences into management objectives for maintaining scenic integrity; and how VRM issues can be coordinated across multiple scales and jurisdictions.

Theory and Concepts

VRM is an applied field but methods and tools must be developed in ways that ensure they are grounded in relevant theory and concepts of landscape perception and assessment. Their measures need to be reliable, accurate, and useful in answering management questions (Daniel and Vining 1983). Papers in this section examine how VRM approaches can be made more theoretically robust in accounting for landscape aesthetic qualities and perceptions, how VRM fits within the larger conceptual framework of cultural ecosystem services, the importance of scale perception in visual assessments, and how understanding of historical ideals of landscape design can guide management of visual and cultural resources.

Visual Quality Assessment

VRM approaches for addressing large-scale Federal lands have traditionally focused on protecting naturalistic conditions, but the work featured here shows that the cultural landscape is also an integral part of visual quality assessments in many regional and land use contexts. Papers in this section detail the NPS's new approach to visual resources inventory, the integration of crowd-sourced photography in understanding visually important dimensions of the rural landscape, and how ideas of visible stewardship can be integrated into community forestry to build a more robust and acceptable program.

Visual Impact Assessment and Mitigation

The energy landscape drives a wide range of work related to visual impact assessment and mitigation. Work represented in the proceedings examines scale, routing, and color contrast treatment in the design and siting of power transmission facilities. Other papers deal with addressing visual impacts in the context of historic sites and the protection of night skies and naturally dark conditions in National Parks.

VRM Tools and Technology

VRM approaches often depend on advances in technology and tool development, and recent advances in visualization, simulation, and other tools and techniques were well represented at the conference. Two papers detail work on modeling coastal changes under climate change scenarios and the use of three-dimensional (3D) modeling in visualization. Another five abstracts describe a variety of other advances presented at the conference.

Visual Case Studies

Because of their format differences, the visual case studies are presented in a stand-alone section of the proceedings, each accessible by its own link. (accessible through https://doi.org/10.2737/NRS-GTR-P-183) Among the work included in this section are case studies on integrating visual resource and visitor use management in planning for a National historic district, development of a baseline visual assessment approach as applied to a long-distance trail corridor, and the role of the public in visual impact assessment.

BUILDING CAPACITY

While this proceedings serves to extend the reach of work presented at the conference, the conference committee had a broader goal to use the occasion as a springboard to further grow the field. In addition to plenary and workshop sessions, we held a number of general sessions devoted to "guided discussions." These sessions provided an opportunity to ask questions about the field of scenic resource stewardship and, with feedback and interaction, gain an understanding of where we were and where we needed to go.

Especially important was the session on *Building Scenic Resource Professional Capacity* led by Sullivan and James Palmer. They polled the attendees prior to the meeting about their needs for a VRM support group. During the guided discussion, the attendees talked about their needs for professional development, group communication, and how the group might move forward. The group voted to move forward on three fronts with a Web-based networking group, a newsletter, and a conference committee. At the time of this writing the networking group has been launched and we invite participants to join.[2] Preliminary plans are underway for the next VRM conference to be held in 2019.

The organizing group also conducted a post-conference poll of participants about what they liked, did not like, and what they would change about the conference. Things most liked were the opportunity to network and the content of the material presented. Things to work on or improve were the lack of international participation; lack of diversity in terms of gender, race, and age; too many topics competing with each other; and how some subject matter was presented.

We are hopeful that the conference and this proceedings, building on the previous visual resource stewardship activity dating back to 2012, are signs of revitalization in the field of VRM, which we collectively hope to move forward. Managing landscapes such that they provide for the needs and wants of society–including energy and scenic beauty–is a goal we share with many land management professionals across the country and world. We also hope the tools and insights provided here will be useful in meeting the challenges that future technological changes will bring while helping to protect and enhance the enduring qualities of our scenic resources.

[2] To request membership, go to: https://groups.google.com/forum/#!overview and in the search box at the top of the page, enter "Visual Resource Stewardship." Click the group's name, which appears at the top of the list, and then click "contact the owner" to send an email with your name and why VRS interests you. For further information, contact Jim Palmer at palmer.jf@gmail.com.

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NEW DIRECTIONS AND COMMON CHALLENGES IN FEDERAL STEWARDSHIP OF VISUAL RESOURCES

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Abstract.—The need to protect and preserve natural, cultural, and scenic resources is an escalating imperative for those tasked with managing Federal public lands and seascapes. The rise in energy development activities can compromise critical visitor experiences when they encroach on settings and seascapes cherished for their naturalness, scenic beauty, and cultural significance. The role of public land and offshore management agencies involves accommodating the demand for resource development while protecting the visual value and integrity of those resources' natural character. This paper describes how the USDA Forest Service, Bureau of Land Management, National Park Service, and Bureau of Ocean Energy Management address visual resource issues in the context of energy development, and it provides an agency history of managing visual resources, new directions in visual resource stewardship policy, and challenges faced.

INTRODUCTION

The Organic Acts of the USDA Forest Service, National Park Service, and Bureau of Land Management direct the principal Federal land management agencies of our Nation to conserve scenery, consider aesthetics, and protect natural scenic values for the enjoyment of present and future generations. Individuals, friends, and families that venture into the natural settings of our Federal public lands benefit from the many positive personal and social outcomes of their experiences. Among these outcomes, evidence-based medical research continues to reveal undeniable relationships between doses of nature and improvements in health ranging from stress reduction to bolstering the human immune system (Sullivan et al. 2014). In addition, visitation to Federal public lands contributes significantly to the $103 billion American outdoor recreation economy. Visits to Federal public lands reached 889 million in 2016 with visitors spending upwards of 49 billion dollars supporting 826,000 jobs. Local communities and businesses in proximity to these Federal lands significantly benefit from the economic activity and spending associated the outdoor recreation opportunities provided within these locations (Cline and Crowley 2018).

However, national priorities for energy development, which include conventional and renewable energy resources, have placed uncommon pressure on Federal public landscapes and offshore areas that are favorable for solar, wind, geothermal, oil and gas, and other energy-related development. The demand for new transmission and pipeline corridors to carry this energy to market will also contribute to the rising pressures affecting the landscape's visual character. Creative solutions are needed to address the multiple and sometimes conflicting values for which Americans depend upon our Federal land base.

The Forest Service, Bureau of Land Management, National Park Service, and Bureau of Ocean Energy Management are all trying to address the escalating demand for renewables source of energy generation and transmission on public lands and the challenges it presents to management and stewardship of visual resources. These agencies share many similar challenges; however, their approaches to resolving these common issues vary due to the unique circumstances at each agency. Some agencies have approval authority for proposed energy generation developments, and all may have concerns about large-

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scale changes to the viewsheds that are outside of their authority but contribute to the visitor experience within their boundaries. Public agencies with authority and oversight of land use and development are also constantly trying to balance the competing issues of preserving visitor use and the quality of outdoor experiences against the demand for resource extraction, harvesting, and surface development. Each agency has a systematic process to address their particular set of visual resource stewardship issues under the authorities granted by Congress.

FOREST SERVICE: SCENERY MANAGEMENT PAST, PRESENT, AND FUTURE

The Forest Service has a long history of managing for scenery resources, dating back to the early 20th century. The agency hired Frank Waugh in 1916 to evaluate the potential uses of the National Forests for outdoor recreation and hired its first landscape architect, Arthur Carhart, in 1919, demonstrating an early commitment to maintaining and enhancing the visual qualities of the outdoor environment (USDA Forest Service 1995). As our National Forests became a primary source of timber, helping to feed the growth of suburbia after the World War II, the agency began to lose touch with those important values. In 1976, public outrage at the visual impacts from Forest Service clear cutting practices led, in large part, to passage of the National Forest Management Act, which requires National Forests to create management plans to protect natural resources while providing for multiple uses.

With this foundation, the agency began to craft a systematic approach to managing for scenery. The effort was guided by Burton Litton's landmark publication, "Forest Landscape Description and Inventories" (1968), which introduced terms and concepts that later evolved into our Visual Management System or VMS (USDA Forest Service 1974). While timber harvests increased in size and scope through the 1980s, VMS became an integral method for protecting scenery values through visual mitigation. A large workforce of trained landscape architects was hired to implement this system, summiting at 300 in the mid-1980s. The 1990s saw changes in forest management and greater attention to environmental protection, including increased opportunities for public involvement in management decisions. This opened the door to updating VMS to the current Scenery Management System or SMS (USDA Forest Service 1995), which incorporates a more social and ecological context to establishing desired conditions for scenery.

More recently, the Forest Service updated the guidance and direction for how land and resource management plans (Forest Plans) are created and revised. Within this guidance, referred to as the Forest Service 2012 Planning Rule (36 CFR Part 219, USDA Forest Service 2012), the role of scenery has been reinforced by making stronger connections between desired conditions for scenic character and sustainable recreation. The rule makes it mandatory to address scenic character on par with other resources. Along with guidance for recreation settings under the Recreation Opportunity Spectrum or ROS framework (USDA Forest Service 1982), the SMS guidance is key to the way the agency is addressing sustainable recreation (Brunswick, this proceedings). Because plan components for scenery and recreation must be balanced with other resource considerations, there is an opportunity to create integrated goals and desired conditions for National Forest landscapes, which in turn can help create more shared ownership of scenic character outcomes.

The opportunities for broadening shared stewardship of scenery resources are apparent in light of the increasing multiple-use demands on Forest Service lands. Growing agency focus on restoration and forest resiliency projects requires that scenery management objectives be viewed as part of the purpose and need for sustaining desired character, instead of being viewed as a potential obstacle to ecosystem projects. Increased interest in – and applications on Forest Service lands for – renewal energy projects (geothermal, hydropower, wind, and solar) further reinforce the need to account for the potential cumulative effects to scenery across the larger landscape. This is critical as scenery resources help to define the very landscapes in which people live, work, and play.

Data from National Visitor Use Monitoring and similar research continue to demonstrate that expectations for scenery (driving for pleasure, views from sought after places to live, high-quality outdoor recreation settings) are increasing (e.g., USDA Forest Service 2016). The agency is responding through programs such as

Iconic Places, which emphasizes quality recreation experiences in landscapes with special designations and acute public interest across the Nation – which naturally coincide with highly scenic landscapes. The agency is also starting to protect scenery during both the day and at night via, for example, the first National Forest Dark Sky Sanctuary (Gila National Forest Cosmic Campground) and other dark sky designations at Chimney Rock National Monument and the Sawtooth National Forest.

Finally, in the context of a significantly diminished workforce of landscape architects and others skilled in visual (scenic) resource management, accomplishing these goals in the future will be a challenge. It will be necessary to make concentrated efforts to train others and create champions of the program. Updates to the manuals and handbooks for the agency are forthcoming along with updated protocols for SMS inventories. Efforts will also continue to create formalized training for SMS in order to teach Forest Service land managers and others the roles and responsibilities for inventorying and managing scenic resources.

BUREAU OF LAND MANAGEMENT: VISUAL RESOURCE MANAGEMENT

Unlike the Forest Service and National Park Service, conservation-based land management was not part of the Bureau of Land Management's (BLM) stewardship culture until the 1970s. The BLM's legacy began with the General Land Office (GLO), which was established in 1812 for the sole purpose of using the "public domain lands" to generate Federal revenue. The GLO's primary method for generating revenue was to survey, plat, and sell public domain lands. In 1946, the Truman Administration merged the GLO with the U.S. Grazing Service (created in 1939) to form the BLM.

By the 1960s, the several hundred duplicative, outdated, and conflicting public land laws that directed the BLM were inadequate to address the prevailing issues and social concerns for landscape and natural resource management (Reams 1978). President Kennedy noted that BLM lands were "vital to the Nation's economic well-being, but suffered from uncontrolled use and lack of proper management." Kennedy called upon the BLM to resolve resource conflicts through balanced-use based on an inventory of public land resources (Muhn 1988). To address this, Congress passed the Classification and Multiple Use Act of 1964 and later the Federal Land Policy and Management Act (FLPMA) in 1976 (43 U.S. Code Chapter 35).

FLPMA shaped the BLM's focus to a multiple-use and sustained-yield mandate with the goals of protecting the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values. The law also gives the BLM authority to set aside lands for special levels of protective management to prevent irreparable damage to important scenic values, as well as historic and cultural values and "areas of critical environmental concern."

At the time that FLPMA was passed, the BLM was responsible for administering 451 million acres (Reams 1978). Today, the BLM manages 248 million surface acres, primarily in 13 western states, and 700 million acres of subsurface mineral estate nationwide according to multiple use and sustained-yield principles.

Brief History of BLM Landscape Architecture and Visual Resource Management

Landscape architects have long been interwoven into the administration and operations of the Forest Service and National Park Service; however, this role did not find its place in the BLM until the 1960s. The first BLM landscape architect was hired in Oregon in 1961 to help with planning, site design, site development, and maintenance programming in accordance with the new statewide recreation policy handbook (Muhn 1988). In 1965, outdoor recreation and its dependence on quality settings and natural beauty became a topic of national and White House conversation. Landscape architects and scenery management subsequently gained a more prominent foothold within the agency (Hagan 1998).

In 1975, the BLM issued its first policy manual and handbooks on managing visual resources (Hagan 1998). These directives established the contrast rating process for assessing visual impacts to landscape settings (Bureau of Land Management 1980). While adjusted over time, these procedures still remain at the core of the BLM's visual resource management program.

Landscape architecture is now a scarce skill within the BLM and this will likely remain the case as the trend of shrinking Federal budgets continues. While the total number of BLM employees with the title of landscape architect now rests at six, the BLM VRM program offsets this long-term attrition through support from private sector landscape architecture contractors. The BLM also has other positions occupied by landscape architects who are instrumental in implementing VRM policy and procedures (e.g., planning and environmental coordinators, outdoor recreation planners, natural resource specialists, and lands and realty specialists). Through strategic recruitment and training within the BLM, and collaborating with industry and private sector, the BLM's VRM program continues to build momentum and thoughtful execution of the basic visual design and visual resource stewardship principles.

Recent Activity in the Visual Resource Management Program

National priorities and State energy portfolios have increased the energy industry's pressure to use public landscapes for solar, wind, geothermal, and other energy-related development. The demand for new transmission corridors to carry renewable energy to market also has the potential to alter landscape character (Bureau of Land Management 2015). The BLM is re-evaluating VRM procedures to address the various forms and scales of energy development, as well as a new set of impact phenomena, such as glare cast from solar arrays and heliostats.

The VRM program is also reframing the visual resource inventory during all stages of land use planning, project-level planning and design, and post-development monitoring, creating a more complete picture of scenic resource conditions, changes, and trends. Monitoring changes to the visual character of public lands and updating the visual inventory process to accurately reflect these changes empowers the BLM to be better stewards of the visual environment and make more informed decisions regarding where energy development should occur while being mindful of scenic character that is worthy of protecting or restoring.

Other visual resource-related products from the BLM, several of which were accomplished through an interagency agreement with the Department of Energy's Argonne National Laboratory, include:

- Visual Resource Clearinghouse Website: http://blmwyomingvisual.anl.gov. This Website is an inclusive and comprehensive source of information about visual resource stewardship.
- Visual Resource Inventory (VRI) Data Standard and Geodatabase Management Guidelines. The BLM issued a VRI data standard in 2012 with the aim of establishing a National and publicly accessible data set. While data gaps still exist, the majority of BLM lands have been inventoried and the data will be available through BLM's Navigator portal by the end of 2018.
- BLM Environmental Color Chart. The BLM's Environmental Color Chart CC001 was updated and released in 2013 based on field research. Copies may be ordered via email at BLM_OC_PMDS@blm.gov or fax to 303-236-0845.
- Technical Note 446: The Use of Color for Camouflage Concealment of Facilities. The escalation of oil and gas production triggered the need to look at enhanced means to mitigate the visual impacts of these projects. The BLM collaborated with camouflage pattern consultants, retired military personnel who specialized in camouflage theory and science, and the energy industry to develop suitable patterns and application methods (Bureau of Land Management 2015).

The BLM has also funded a number of visibility research and best management practice publications under an agreement with Argonne National Laboratory including:

- Wind Turbine Visibility and Visual Impact Threshold Distances in Western Landscapes.
- Electric Transmission Visibility and Visual Contrast Threshold Distances in Western Landscapes.
- Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands.

- Visibility and Visual Characteristics of the Ivanpah Solar Electric Generating System Power Tower Facility.
- Visibility and Visual Characteristics of the Crescent Dunes Solar Energy Power Tower Facility, 2017.

Training

The BLM continues to provide courses in visual resource management, which are open to all BLM employees, employees of other federal agencies, private contractors, industry personnel, and others with a stake in the management of visual resources (e.g., academicians, students, state and local government interests, and those representing nongovernment organizations). Courses are coordinated and delivered through the BLM's National Training Center in Phoenix, AZ.

NATIONAL PARK SERVICE: VISUAL RESOURCE PROGRAM

Since its inception, the National Park Service (NPS) has been charged with protecting some of America's most scenically treasured landscapes. However, there has not been a consistent service-wide effort to address scenery protection concerns. The Visual Resource Program (VRP), conceived within the Air Resources Division, has started to change that (Meyer and Sullivan, this proceedings). As with any new endeavor, the program has met challenges; one of the primary challenges is that considering scenery as a resource to measure, manage, and protect is a new concept across most of NPS. While some NPS units, notably Blue Ridge Parkway, have been actively working to protect scenery for many years (Johnson, this proceedings; Noe and Hammitt 1988), many Parks just assumed the scenery would always be there and remain intact.

Since many parks have not dealt directly with managing visual resources, a second challenge has been simply raising awareness of the program within NPS and among other agencies and partners that NPS work with every day. To develop a viable scenery management program, NPS needs to achieve a level of service-wide consistency in approaches and practices that other federal agencies—especially the Bureau of Land Management and Forest Service—have built over the past 40 plus years. Our primary efforts in working toward this goal have been developing an inventory process and incorporating visual resources into park planning.

Despite the initial lack of visibility of the program, we have initiated inventories at 30 NPS units ranging from cultural/historical sites to natural resource or "scenery" parks. The inventory process is also gaining traction with NPS units and programs that work extensively with partners and stakeholders such as the Appalachian Trail and the Wild and Scenic Rivers Program.

As the basic inventory process has become more mature, we have set out to develop additional tools so that parks are able to use the inventory data and provide resources for longer term implementation of the inventory:

- A spatial database has been developed along with basic GIS spatial analysis tools. The database can create summary reports of the data for specific locations as well as overall status reports. In addition to several types of view shed analyses, GIS spatial analysis tools have been developed as open source so that parks are able to customize the analysis to meet their needs.
- We are currently developing a comprehensive training manual for use at our onsite workshops and for future reference so that parks can more effectively continue the inventory beyond the workshop.
- Development of a visual impact assessment (VIA) tool is under way. We were able to bring on a landscape architect intern during the summer of 2017 to jump start the process. Somewhat analogous to the BLM contrast rating process, the VIA tool will correspond directly to the inventory data the parks collect and allow them to assess the potential impacts of projects.

To assure its long-term viability, visual resource management needs to be incorporated into park planning documents. The NPS currently uses a planning framework that consists of developing small resource management plans and strategies based on the fundamental purpose of the park rather than developing a comprehensive general management plan as parks used to do. We have achieved some success in integrating VRP into the park planning components known as Foundations as well as specific activity plans known as resource stewardship strategies. As personnel, management priorities, and landscapes change, having a clear management approach for visual resources will help assure consistency in applying the VRP.

BUREAU OF OCEAN ENERGY MANAGEMENT: CHALLENGES TO VISUAL IMPACT ANALYSIS

The U.S. Department of the Interior Bureau of Ocean Energy Management (BOEM) manages offshore energy resources on the U.S. Outer Continental Shelf (OCS). BOEM coordinates energy development, environmental protection, and economic development through the responsible management of offshore resources. BOEM's regulatory authority includes submerged lands extending from 3 to 200 nautical miles off the coastline of the United States, a total of 1.7 billion acres.

For the BOEM, experience gained from public input and consultation meetings with lessees has brought to light several challenges for visual impact analysis (VIA) in development of offshore wind energy projects. Note that the information summarized here is discussed in more detail in Warner, this proceedings.

Design Envelopes

The United Kingdom has developed an approach to project implementation called a Project Design Envelope (PDE) (Rowe et al. 2017). A PDE allows a project proponent to submit a reasonable range of design parameters in its permit application, and it allows the permitting agency to analyze the maximum impacts that could occur from all potential design parameters. Once the permit application is approved, the sponsors design a project that fits within the approved range of parameters.

BOEM supports voluntary use of the PDE approach for wind energy development projects but the concept does present several procedural challenges for NEPA and National Historic Preservation Act (NHPA) compliance in the United States. Under both of those Acts, assessments of impacts are based on exact (and not flexible) project designs. After the initial approval, the built project is supposed to adhere carefully to the design specifications. Any change in, for example, the number or layout of turbines in a wind energy development project would require redoing the impacts analysis and resubmitting the designs for regulatory approval.

Traditional Cultural Properties

National Park Service-defined traditional cultural properties (TCP) are "eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community" (National Park Service undated; see also Parker and King 1998). TCPs may include large ocean landscapes with historic significance. When this is the case, the historic, current, and potential future conditions of the oceanscapes and the associated views become the subject of analysis in proposed wind energy development projects.

To date, this has only actually happened once (Warner, this proceedings). In that case, Nantucket Sound off the shore of Massachusetts was found to be a potential TCP during the predesign analysis of an offshore wind project.

Mitigation

Under both NEPA and Section 106 of the NHPA, proposed wind energy projects must consider mitigation strategies to reduce or remove adverse effects of the project on marine resources, including visual resources. Because of the limited number of wind energy projects developed to date on the OCS, the implications of these requirements and the possible range of mitigation strategies are still evolving. In some cases, mitigation may include physical design elements such as sensor-controlled lighting on turbines or strategic placement of turbines. In other cases, mitigation may include indirect design elements such as developing educational or interpretive materials that describe the history of the area.

The Role of Simulations

Visual simulations have already proven to be critical components of VIA analyses for offshore wind energy projects. Realistic simulations can provide powerful information for all stakeholders to use and react to during the public engagement, design, and planning stages of project development. Early experience suggests that wind energy project simulations should be created from multiple viewpoints on the landscape (key observation points) and should take into account a range of dynamic factors such as the effects of changing sunlight and weather conditions.

Among the agencies presented in this paper, BOEM is very new to VIA and visual resource stewardship in general. This has allowed the Bureau to build on the long experience and lessons learned by other Federal agencies over the past decades. BOEM is committed to building on this legacy of VIA scholarship and experience and to continuing to learn and adapt as proposed OCS wind energy projects present new challenges and opportunities in the future.

CONCLUSION

Each agency has its own set of methods for managing the public's visual environment. These methods have developed over time and are rooted in and influenced by agency history and legacy. Visual resource management professionals sometimes express a desire for Federal land management agencies to agree on a common and unified process for visual resource impact assessment. While this aim is sound in principle, it is very difficult in practice given the differences between the agencies' mandates and missions.

The basic concepts of visual resource stewardship are the same under the Congressional mandates for different agencies but the nuanced differences among the agencies' administrative responsibilities force variations in procedures. One fortunate outcome from these different approaches is a comprehensive and varied set of methods that enriches the professional practice of visual resource stewardship.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

PROTECTING SCENERY AT MULTIPLE SCALES

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Abstract.—The need to protect scenery and historic properties is explicitly called out by several Federal statutes. By adopting thoughtful and intentional management strategies to implement the statutory direction, Federal agencies can collectively ensure that important scenery endures for the benefit of future generations. This paper summarizes why it is so important to cultivate thoughtful management of public scenic resources, which encompass both natural and cultural settings. It briefly describes current efforts by Federal agencies to advance the consideration and protection of scenery across lands under their jurisdiction. Recommended steps are presented for securing a broader collaboration across Federal agencies, States, industry, private property owners, and stakeholders to advance stewardship of visual resources into the future.

INTRODUCTION

Experiencing breathtaking scenery and culturally significant settings and their surrounding views is important to our National heritage and the human spirit. The protection of scenery and historic properties at the National level has been included in the stated goals and direction of an array of Federal statutes. Private landowners, local communities, and States also protect scenery and iconic scenic views. According to National Park Service visitor surveys, 90 percent of visitors to our National Parks consider scenic views an *extremely* or *very important* resource to protect and preserve (Kulesza et al. 2013). This is across a range of other attributes that provide motivation for visiting our National Parks. In addition, National, regional, and local economies all benefit from this tourism. By adopting thoughtful and intentional management strategies, we can collectively ensure that important scenery across an array of jurisdictions endures for the benefit of current and future generations.

Because of the vision and hard work of others over our country's history, many treasured visual resources across our Nation have already been preserved into the future. Such resources typically fall wholly within protected lands like National Parks, National conservation lands, National Forests, protected cultural sites, and State and local parks. However, many other visual resources and their viewsheds lack such protection. Federal agencies have authority and opportunity to collaborate on safeguarding additional views of natural and cultural scenes of shared importance at multiple scales. Scales may range from the site-specific level in light of particular development proposals, to the landscape-scale level, where strategies can knit jurisdictional boundaries together to address visual resources in a broader and shared context.

Visual resources are defined as visible physical features within the landscape (e.g., land, water, vegetation, structures, and other features), whereas views are geographic areas that contain visual/scenic resources that can be seen from a given viewpoint. Visual resources and views include both natural and cultural settings.

This paper summarizes why it is so important to cultivate thoughtful management of visual and scenic resources at a National and local level. It briefly describes current efforts by Federal agencies to advance the consideration and protection of scenery associated with lands under their jurisdiction. It also explores steps for securing broader collaborations among an array of partners across shared landscapes to forge a collective management strategy for stewarding visual resources into the future. Forging collective management strategies across jurisdictions is key.

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WHY PROTECT SCENERY? WHAT DO WE GET IN RETURN?

Efforts to protect scenery by Federal agencies and others frequently complement other resource management goals, from recreational opportunities to protection of endangered species to promoting ecosystem services to historic preservation. Visible physical features often consist of multiple attributes including landforms, vegetation, cultural landscapes, and water bodies. While there is no single statute that is totally devoted to the protection of scenic viewsheds, statutes that focus on other resources provide the co-benefit of protecting scenery and can be used to protect scenic viewsheds.

In addition to the public's enjoyment of National Parks noted above, research also documents a connection between natural scenic views and health (Seresinhe et al. 2015). The Harvard School of Public Health is exploring this phenomenon in the larger context of the importance of humans interfacing with nature, and the role that getting outdoors plays in our overall health (Harvard University 2018). The mental and physical health benefits from interacting with nature have been known since the 1600s and have been recently validated by evidence-based medical research. Research continues to reveal undeniable relationships between doses of nature and improvement in health from stress reduction to bolstering the immune system. Cities and communities are making large investments to put natural elements back into urban places, particularly where health risks are known to be high, as an effective and affordable public health intervention. With the investments being made to resurrect nature in built environments, the idea of protecting existing natural scenic settings and maintaining important viewshed portals to scenic vistas and natural landscape backdrops is also a very wise investment (Sachs 2014).

Efforts to protect scenery may also yield economic benefits to communities and the Nation as a whole. The literature is replete with studies examining the economic value of scenery and natural resource amenities in general such as the work done on the value of scenic quality to visitors of the Blue Ridge Parkway (Mathews et al. 2004). The National Park Service also annually evaluates the sizable economic contribution that Parks make to surrounding communities (Cullinane and Koontz 2017).

The measured economic value of protecting scenic viewsheds will vary depending on the value that the public places on scenery. This is measured by adding up expenditures the public makes to actually see such views plus the value the public places on knowing such views exist, counter-weighed by the economic value associated with conflicting uses that could be curtailed to protect scenic landscapes. As an example, in 2016 the National Park Service determined that visitors to Parks contributed $34.9 billion in economic activity and created or supported 318,000 jobs across the country (Cullinane and Koontz 2017).

EFFORTS TO DATE AT THE FEDERAL LEVEL

Typically, protecting scenery is the domain of local communities through zoning ordinances, scenic conservation easements, and State governments through creation of State parks, State forests, and other special set asides. At the Federal level, a long history also exists for protecting scenery through special designations, which began with the creation of Yellowstone National Park in 1872 "for the benefit and enjoyment of the people" (16 U.S.C. §21) and extends across a variety of Federal lands under the management of several key agencies including the USDA Forest Service (FS), the Bureau of Land Management (BLM) and the National Park Service (NPS).

Current Systems in Place

At least 12 Federal agencies have varying levels of responsibilities in the visual resources arena. They include: the BLM, NPS, U.S. Fish and Wildlife Service (FWS), Bureau of Energy and Ocean Management (BOEM), Bureau of Reclamation (BOR) and Bureau of Indian Affairs in the Department of the Interior; Forest Service and Natural Resource Conservation Service in the Department of Agriculture; Department of Transportation; Federal Energy Regulatory Commission; United States Army Corps of Engineers (USACE); and National Advisory Council on Historic Preservation. These agencies all have differing missions and authorities governing how they consider and integrate the protection of scenic views into their planning and decision-making processes. These differences are strengths by which existing means for advancing the protection of visual resources get closely examined and new ideas get well vetted, often under the process set forth under the National Environmental Policy Act (NEPA). Six of the Federal agencies (BLM, NPS, FWS, FS, BOR, and USACE) have direct land management responsibilities while a seventh agency, BOEM, has jurisdiction over expansive ocean resources associated with the outer continental shelf, which typically begins 3 miles off shore.

Of the six agencies with land management responsibilities, two of them, the BLM and FS, have had comprehensive programs that address visual resources associated with their lands since the 1970s. Both agencies have direction in their governing statutes that call for accounting for visual resources in their land use planning processes. These agencies have amplified this direction through policies and procedures and made adjustments to their approaches over time. While both programs have the latitude to protect scenic views associated with neighboring lands, the programs have often been implemented in a much more limited fashion. By recognizing the importance of collaborating with local communities and other Federal agencies, both agencies have been increasingly working in a broader context.

For the NPS, its enabling statute dates back to 1916 and specifically calls out the preservation of scenery among the agency's responsibilities. Since 2012, the NPS has had an effort underway to develop a comprehensive approach for inventorying and evaluating the importance of natural and cultural views to Park visitors and their enjoyment of the Parks. This effort includes both views that are wholly within the boundary of lands under the NPS's jurisdiction and those that extend beyond Park boundaries. Prior to this recent effort, unlike BLM and the FS, the NPS took a very decentralized approach (i.e., park by park) to account for Park views in planning and decision making processes. This piecemeal approach included the land use planning and permitting processes of Park neighbors, whether they were other Federal agencies, local government, or individual landowners.

In the case of the FWS, the agency focuses on its management responsibilities related to fish and wildlife. Nonetheless, scenic views are an important component of the experiences of wildlife Refuge visitors. The BOR manages water in the West, covering 17 States. In this capacity, BOR is engaged in water infrastructure projects and in river restoration and reclamation projects, which includes restoring the ecological function of rivers and recovering species. Visual resources fall within the restoration efforts.

The USACE provides outdoor recreational opportunities to the public as an ancillary benefit of its flood damage reduction and navigation projects. This role fulfills its three-part mission to: 1) serve the needs of present and future generations; 2) contribute to the quality of American life; and 3) to manage and conserve natural resources consistent with ecosystem management principles. The USACE provides over 5,000 recreation sites at more than 400 projects on 12 million acres of land and water. The USACE also advances environmental stewardship associated with these lands and waters (U.S. Army Corps of Engineers 2016). As early as 1971, the USCOE issued design guidance in its Engineer Manual (Department of the Army 1971). In this document, the USACE states that: "Incorporating environmental quality in project design involves considerably more than a superficial treatment of aesthetics. It involves designing with nature in all of its dimensions—ecological, visual, and human-cultural—rather than against or onto it" (U.S. Army Corps of Engineers 2016). In 1988, the USACE developed a visual resources assessment procedure for its various water-related projects. The procedure document sets forth a systematic approach for addressing visual resources in the planning process (Smardon et al. 1988).

Other mentioned agencies that do not manage land nevertheless have responsibilities that affect visual resources. In brief, these include:

- Bureau of Indian Affairs: Acts on behalf of Indian Tribes. Scenic resources are important, especially at a cultural landscape level. Tribes have a variety of energy assets that are being developed, and opportunities to mitigate impacts to visual resources are in the mix.
- Natural Resources Conservation Service: Helps rural communities and individual private landowners with agricultural issues, including taking voluntary steps to understand, map, and protect cherished scenic resources on private land. The agency has a series of technical guidance documents on various topics, including the preservation of visual resources plus resource stressors and what can be done to reduce them.

- Department of Transportation: Section 109(h) of Title 23, United States Code, requires that adverse economic, social, and environmental effects are considered in transportation project decision making for any Federally funded project. This includes minimizing adverse effects from the destruction or disruption of humanmade and natural resources, aesthetic values, and community cohesion. In 1981, the agency released guidance on accounting for and protecting the visual environment, which was updated in 2015 in Guidelines for the Visual Impact Assessment of Highway Projects (Churchward et al. 2013). The Department of Transportation is also tasked with formulating a National Scenic Byways program under Section 1047 of the Intermodal Surface Transportation and Efficiency Act of 1991.
- Federal Energy Regulatory Commission: The Commission licenses hydroelectric, gas, and transmission projects. As part of that process, it takes into account how projects will affect visual and aesthetic resources.
- Advisory Council on Historic Preservation: The Advisory Council is an independent Federal agency that promotes the preservation, enhancement, and productive use of our Nation's historic resources, and it advises the President and Congress on National historic preservation policy. It is very involved in energy development issues throughout the West, including the use of Section 106 of the National Historic Preservation Act to understand impacts and secure needed mitigation. The visual resource dimension of historic properties is among the considerations.

Cultivating Thoughtful Management of Visual Resources

There is a range of statutory and regulatory language that provides the basis for Federal agencies to consider and protect scenery in their land use planning and/or site-specific permitting decisions. For example, the Federal Land Policy and Management Act governing the BLM calls for BLM lands to be managed in a manner that will protect the quality of the scientific, *scenic*, *historical*, ecological, environmental, air and atmospheric, water resource, and *archeological values* …" (43 U.S.C. §1701(a)(8), emphasis added). BLM regulations, at 43 CFR Subpart 1610, incorporate this direction into the Bureau's land use planning processes. For visual resources, the BLM has a formal visual resource management framework to fulfill its basic stewardship responsibility by identifying and protecting visual values on public lands under its management (see BLM Manual 8400 - Visual Resource Management 1984).

Under the NPS Organic Act, the NPS is directed to "conserve *the scenery*, natural and historic objects, and wild life in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (54 U.S.C. §100101(a), emphasis added). The NPS does not have separate regulations governing the management and protection of visual resources. Instead the Service relies on its 2006 Management Policies and the mandates and regulatory processes of other agencies. In the NPS policy document, Park resource managers are directed to "work cooperatively with others to anticipate, avoid and resolve potential conflicts; protect Park resources and values; provide for visitor enjoyment; and to address mutual interests in the quality of life of community residents, including matters such as compatible economic development and resource and environmental protection" (see National Park Service 2006, Section 1.6, p. 13). Emphasis is placed on "cooperative conservation beyond Park boundaries."

In 2012 the NPS began a process of developing a systematic inventorying and management strategy for Park-related visual resources and has drawn heavily on the systems developed by BLM, the FS, and some individual Parks like the Blue Ridge Parkway's Scenery Conservation System (National Park Service 2008).

Traditional Federal approaches for scenery protection have also drawn heavily on the analysis of effects required under NEPA and the National Historic the National Historic Preservation Act (NHPA). The NEPA calls for "the Federal Government to use all practicable means, consistent with other essential considerations of National policy, to improve and coordinate Federal plans, functions, programs and resources to the end that the Nation may... (2) assure for all Americans safe, healthful, productive and *esthetically and culturally pleasing surroundings*;...(4) *preserves important historic, cultural and natural aspects of our National heritage*…" (42 U.S.C. §4331(b), emphasis added). The NHPA also speaks to "(4) the preservation of this irreplaceable heritage is in the public interest so that its vital legacy of cultural, educational, *aesthetic*, inspirational, economic, and energy benefits will be maintained and enriched for future generations of Americans" (Public Law 89-665, as amended by Public Law 96-515, emphasis added). Both statutes provide an overarching basis for considering the protection of the aesthetic environment in Federal agency decision making processes. They also call for the engagement of various interests in those processes.

All efforts to date have tried to take thoughtful approaches to visual resource management with an emphasis on reaching out to a broad array of stakeholders from other Federal agencies, States, private landowners, developers, and various user groups including the environmental community. Efforts have nearly always started by examining statutory and regulatory authorities but agencies have recognized that that is not enough. Stimulating open dialogues with local communities at the onset of any project to identify important views and understand how those views fit into the local fabric of an area is a key first step. It is critical to identify the diverse interests in a community and understand the community's willingness to participate in a process meant to advance collaborative conservation around scenery. The circle of people with interests in protecting scenery is larger than the local community but the voices of local people are sometimes taken for granted or even overlooked.

Importance of Communities and Engagement

Bringing people together is a fundamental and necessary step of regulatory and /or non-regulatory processes to document the overall value of visual resources. Such engagement is and will continue to be central for establishing enduring management strategies for scenery and visual resources. Common ground must be achieved.

In striving for a collective vision for managing visual resources at multiple scales, agencies need to manifest a commitment to effective and sustained engagement with an array of stakeholders from other Federal agencies, State and local governments, Tribes, private landowners, industry, and a range of nongovernmental entities. Doing so includes:

- Engaging in dialogues on multi-scale management of shared visual resources and viewsheds.
- Building consensus on scale, both the need to account for specific visual resources in a given area and then stepping back to look at a regional scale.
- Setting stakeholder-driven goals and objectives related to different scales.
- Scripting a framework and management strategy covering shared visual resources and viewsheds at multiple scales.
- Implementing the strategy and engaging the full range of interest groups and stakeholders with special efforts to engage the local community.
- Taking advantage of existing data bases, inventory efforts, evaluation methods, information on best management practices, and key steps in agency land use planning.
- Remaining mindful that the process needs to be iterative.

NEW DIRECTION AND PRIORITIES

> *There is a delight in the hardy life of the open. There are no words that can tell the hidden spirit of the wilderness that can reveal its mystery, its melancholy and its charm. The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased and not impaired in value.* – President Theodore Roosevelt

The land ethic of the current Administration is still being articulated and solidified by action. In the resource management arena, the U.S. Department of the Interior is off to a fast start with a heavy emphasis on energy development through various Secretarial Orders that tier off of new Executive Orders. Ensuring that breathtaking scenery remains part of the American experience from coast to coast fits squarely in the broad mission framework of the Department, which includes both energy development and conservation. With time, greater clarity will emerge as to how the Department balances its many missions and resources. Protecting scenery does not need to be a "zero sum" game with winners and losers. By taking an inclusive, collaborative approach to the protection of visual resources, we can ensure that they endure over time and across multiple scales for all.

CONCLUSION

The Nation has long recognized the importance of protecting scenic and cultural landscapes as part of the American experience and acknowledged that deliberate steps must be taken to preserve this heritage for future generations. Efforts among Federal agencies to be wise stewards of our Nation's resources echo a 1965 call to action by President Johnson to the United States Congress: "For centuries Americans have drawn strength and inspiration from the beauty of our country. It would be a neglectful generation indeed, indifferent alike to the judgment of history and the command of principle, which failed to preserve and extend such a heritage for its descendants" (White House Conference on Natural Beauty 1965). Differing missions, enabling statutes and agency culture, create both challenges and opportunities related to protecting public resources. Because natural, cultural, and visual resources associated with our Federal lands are finite, it is important that we collectively ensure that viewsheds and associated visual resources that are important to us as a Nation are considered and protected for the future.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

CHANGES AND CHALLENGES IN USDA FOREST SERVICE SCENIC RESOURCE MANAGEMENT UNDER THE 2012 FOREST PLANNING RULE

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Abstract.—In 2012, the USDA Forest Service released a new planning rule that called for fundamental changes in how scenic resources are to be addressed during the forest plan revision process. While the original 1982 rule relied on expert-based assessments of scenic resources described in the Forest Service's 1974 Visual Management System (VMS), the new rule mandates defining valued "scenic character" on the basis of the 1995 replacement for VMS, the Scenery Management System (SMS). In SMS, scenic character is established in part through a constituent analysis that involves assessing stakeholder perceptions of aesthetic quality, landscape values, and an understanding of special places. This paper explores the differences between the two systems and the challenges of integrating expert and stakeholder assessments as forests prepare for plan revision. A process for this change to the new system is outlined based on a 2015 workshop convened in the Forest Service's Intermountain Region. This process specifies essential activities but provides a forest planning team with flexibility with respect to particular needs, personal style, and available resources.

INTRODUCTION

The Forest Service released a new planning rule in 2012 (National Forest System Land Management Planning 2012). This rule calls for fundamental changes in how scenic resources are addressed compared to the original 1982 rule (National Forest System Land and Resource Management Planning 1982) that shaped the forest plans currently being revised throughout the United States. Forest plans guide the management direction for National Forests for a 15-year period. Each plan identifies forest management areas and priorities for resource restoration and conservation, but all forests are also expected to provide a continuous and sustainable flow of benefits, services, and uses.

The 1982 rule used the 1974 Visual Management System to develop direction for scenic resources (USDA Forest Service 1974). VMS was based on assessments conducted by experts (mostly landscape architects) following a defined mapping and valuation process that identified scenic classes. The experts translated biophysical features of the landscape into formal design parameters (Daniel 2001). A basic premise in VMS was that human modifications in a natural landscape detract from scenic quality and that managing the degree of change caused by management activities was critical for establishing "Visual Quality Objectives." After some years of using this system, there was general consensus among professionals and land managers that the focus on degree of change did not adequately address all of the values and features (such as, for example, cultural features) that make individual landscapes special.

The 2012 planning rule instead uses principles from the 1995 SMS to assess and develop management guidance for visual resources (USDA Forest Service 1995). SMS builds on VMS principles but includes fundamental changes to the basic premises and concepts of the earlier system. The 2012 rule mandates defining valued "scenic character" for an area and identifying the desired conditions, objectives, and guidelines for scenic resource management. In order to do this, the system must take into account perceptions and aesthetic judgments by individuals who view and value the landscape (Daniel 2001), including consideration of "special places" (USDA Forest Service 2015). Having to assess and consider special places adds a layer of complexity that involves, for example, the concepts of memories, symbolic meanings, and spiritual values as they apply to the landscape (Daniel 2001).

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This paper explores the change between the two management systems and the challenges of integrating expert assessments with the perceptions and aesthetic judgments of the lay public in making decisions about scenic resource management.

BACKGROUND

Scenic resource management policies for National Forests are based on public reactions to timber harvesting and vegetation management practices dating back to the late 1800s. "Cut and run" practices by early American loggers routinely left large unattractive vistas of tree stumps where forests had stood. Public outcry about this, in part, motivated Federal legislation to designate National Forest Reserves (and later National Forests) to protect the health and beauty of forested landscapes (Ribe et al. 2002).

In the late 1960s and early 1970s, public reaction to extensive clearcutting on the Monongahela National Forest and elsewhere contributed to passage of the National Forest Management Act (NFMA) of 1976. According to Ribe et al. (2002), "The ugliness of clearcutting and claims of what it belies about natural resource damage played a key role" (p. 44). In response to NFMA, the Forest Service initiated forest aesthetics research that led to creation of the VMS and assignment of Visual Quality Objectives (VQOs) to every acre of National Forest. This established a level of scenic protection for all types of management activities, including timber harvests, as a required component of forest plans (Ribe et al. 2002).

Designing and managing timber harvests to reduce scenic impacts is one of the key principles of VMS, and the VQOs define the acceptable degree of change to the visual environment. For example, a "Retention" VQO provides for management activities that are not visually evident to the casual observer. A VQO assignment of "Modification" allows management activities to visually dominate the original characteristic landscape but alterations must still conform to naturally established form, line, color, or texture characteristics of the surrounding area or character type (USDA Forest Service 1974). Table 1 defines the VQOs in VMS.

Table 1.—Visual quality objectives identified in the Visual Management System (VMS) (USDA Forest Service 1974)

Visual quality objective	Definition
Preservation	This visual quality objective allows ecological changes only. Management activities, except for very low visual impact recreation facilities, are prohibited.
Retention	Provides for management activities that are not visually evident. Under retention, activities may only repeat form, line, color, and texture, which are frequently found in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, and pattern should not be evident.
Partial Retention	Management activities must remain visually subordinate to the characteristic landscape. Associated visual impacts in form, line, color, and texture must be reduced as soon after project completion as possible but within the first year.
Modification	Management activities may visually dominate the original characteristic landscape. However, activities of vegetative and land form alteration must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character type.
Maximum Modification	Management activities of vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background, the visual characteristics must be those of natural occurrences within the surrounding area or character type. When viewed as foreground or middleground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middleground.

The SMS that revised and replaced the VMS increased the role of local stakeholders in the inventory and planning processes and explicitly required the Forest Service to consider forest aesthetics along with social and cultural factors (USDA Forest Service 1995). These changes have been retained in the 2012 Forest Plan rule that requires new or revised plans to address "scenic character." This term replaced the SMS term "landscape character" to clarify the definition in terms of visual and cultural identity. Under the new rule, scenic character is defined as "a combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity" (National Forest System Land Management Planning 2012). Table 2 defines the Scenic Integrity Objectives in SMS.

The SMS system retained the basic inventory elements of the VMS with some terminology and process changes. However, including analysis and valuation of user perceptions and experiences of the scenic environment is a fundamental change. The VMS also added a mapping component that focuses on where people view scenery (roads, trails, and recreation areas) and a "sensitivity level" analysis that evaluates the relative importance of scenery to the user experience. SMS had similar inventory and analysis components but carrying the constituent analysis forward into scenic character descriptions to develop goals, objectives, standards, and guides is an important new plan requirement.

Table 2.—Scenic Integrity Objectives identified in the Scenery Management System (SMS) (USDA Forest Service 1995)

Scenic Integrity Objective	Definition
Very High	Unaltered—Valued landscape character "is" intact with only minute if any deviations. The existing landscape character and sense of place is expressed at the highest possible level.
High	Appears unaltered—Landscapes where the valued landscape character "appears" intact. Deviations may be present but must repeat the form, line color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.
Moderate	Slightly altered—Noticeable deviations must remain visually subordinate to the landscape character being viewed.
Low	Moderately altered—Deviations begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles outside of the landscape being viewed.
Very Low	Heavily altered—Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes, or architectural styles within or outside the landscape being viewed. However deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.
Unacceptably Low	Extremely altered—Deviations are extremely dominant and borrow little if any form, line, color, texture, pattern, or scale from the landscape character. Landscapes at this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

ADDRESSING SCENIC RESOURCES UNDER THE 2012 PLANNING RULE

The forest plan revision process under the 2012 rule involves three stages: assessment of forest resource conditions and trends, development of a revised plan, and monitoring the revised plan's implementation and effectiveness. Each phase has a public collaboration component.

To help guide scenic resource and recreation planning for the Intermountain Region under the new planning rule, a workshop was held in December 2015 with forest landscape architects, recreation specialists, and recreation and heritage program managers. The goal was to outline a process for developing and revising forest plans that includes essential activities but allows flexibility in selecting specific approaches and priority issues based on needs, personal style, and available resources. The discussion below presents information and recommendations from the workshop, with an emphasis on the initial assessment stage of forest planning.

Scenic Resource Assessments

As noted above, the assessment stage of forest planning now requires identifying scenic character. This information can be acquired from three basic sources: existing scenic inventory data, literature reviews of the best available scientific information and other key documents, and input gathered from the public.

Scenic Inventory Data

The scenic inventory process usually begins with extracting scenic recourse information from existing inventories and forest map databases. Forest landscape architects, recreation staff, and specialists from other disciplines also provide needed information to develop the inventory. Information gathered from public outreach and stakeholder collaboration are usually sifted and evaluated by forest planning professionals and forest managers.

A variety of questions can help to inform this process. How do people relate to the landscape? How do they identify places? What are the values that may change over time? How can descriptions of valued resources be crafted to inform goal development for resource maintenance and enhancement? How does scenic quality relate to valued character in specific areas? Are there areas or features that have a negative impact on scenic quality? Are there ways to improve scenic quality in those areas?

The following information can help forest planners develop descriptions of landscapes, understand landscape visibility and viewer sensitivity, and establish concern levels that reflect viewers' perceptions of scenic quality.

- Descriptions of landscapes: What are the valued scenic features that will become the basis for scenic character descriptions?
- Definitions of boundaries: What methods are best for defining the boundaries of landscape divisions? Important boundaries might be administrative (e.g., District or forest boundaries), geographic (e.g., vegetation communities, watersheds, mountain ranges, etc.), transportation-related, viewshed-related, or social.
- Identification of important cultural and historic built features: Which features must be considered and what makes them special? This can include agricultural areas like farms, orchards, and rangeland; recreation facilities; transportation resources; and rural communities and residential areas.
- Sense of place: What features, settings, and views contribute to feelings of, for example, naturalness or remoteness?
- Management areas: What are logical "units" of the forest? This may be based on primary recreation activities and attributes (such as motorized recreation compared to non-motorized recreation, or water-based recreation), topography and/or watersheds, or viewsheds.
- Visible and sensitive areas: Where is the landscape commonly viewed from and how important is each view to the public? Related information can be gathered about how people use an area, how they expect specific areas to be managed, how they perceive views of the forest as seen from outside its boundaries, and how people define an area's "sense of place."

Public input and information about visitor usage can be gathered through a variety of direct and indirect methods including historic visitation statistics, research publications, social media reviews, surveys, visitor observations, interviews, and public participation.

Likewise, there are many possible techniques for identifying special places and mapping scenic character. The traditional approach is to make maps available during public meetings and ask attendees to mark special places and comment on scenic characteristics that attract them to those places. More recently, participatory GIS approaches have used Web-based platforms where people share information online about special places. Some GIS systems allow individuals to provide geo-specific data connected with perceptions or reviews of specific places (Smardon 2018).

Special places are usually identifiable locations where people have a concern for scenic quality. This may include iconic landscapes that are adjacent to the forest or important corridors that provide access across the forest. At one workshop, participants developed a list of iconic sites and landscapes that they considered to be of regional, national or international importance that included: roads; trails; recreation facilities and visitor centers; overlooks and other scenic viewpoints; communities, businesses, and residences; water recreation locations; historical or cultural sites; and geological or botanical areas (which may be seasonal).

For each special place or landscape, it is important to determine the relative importance of scenic quality for visitors. In SMS, this is referred to as "concern levels" as described below.

- Concern Level 1 – High concern: Areas of high concern are areas where scenic quality is one of the primary reasons that people visit an area. This category includes routes and places that are officially recognized, designated, and publicized for their scenic resources (such as National Scenic Byways, National Scenic Trails, or Wild and Scenic Rivers) but also nationally or regionally important locations associated with recreation and tourism. Often these areas are a destination for their scenic quality.
- Concern Level 2 – Moderate concern: Areas of moderate concern are usually locally important and are associated with all types of uses including recreation and tourism. Scenic quality is important in these areas but other features related to the visitor experience (such as the challenge associated with a mountain biking trail or the quality of a fishing stream) are equally important.
- Concern Level 3 – Low concern: Areas not in the first two categories.

LITERATURE REVIEWS

Literature reviews should include social science studies on scenic quality preferences and special place considerations with an emphasis on the best available science related to scenic character. These may include general studies that define common characteristics for place attachment as well as place-based research that provides information on a specific local area when available. This information aids in assessing locations where scenic quality is important, or where management could improve or mitigate undesirable changes to the landscape.

A review of descriptive literature such as travel articles, guidebooks, and community promotional materials, in addition to Web searches and social media sites, may also yield useful information about scenic character. While these resources are not traditional subjects of literature reviews, they can provide information about public attitudes toward scenic resources. Some examples of possible resources include:

- Legislation, designation documents, and management plans for Federal and State Scenic Byways, National and Historic Scenic Trails, and Wild and Scenic Rivers. These may be useful for defining scenic character and important travel corridors. It is also important to identify conflicts between current scenic resource management practices and desired conditions as identified in foundational or management-related documents.
- Scenic resource plans from other agencies in the region such as Bureau of Land Management, National Park Service, and State Parks.
- Social media sites such as Pinterest and Instagram. They can help identify landscape locations and features that have value to members of the public.

Public Outreach and Collaboration

Public outreach and collaboration efforts are excellent opportunities for gathering information to help define scenic character and identify special places. Photos can be used in place of viewing scenery in person. A variety of photos with a list of questions displayed at a public workshop or online with a mechanism for gathering feedback can help gather information on scenic character. Requested feedback can include negative attributes and characteristics as well. Some key prompting questions could be:

- Do you think the Forest Service is doing a good job of protecting scenery on the forest?
- Are there places that you would/would not choose to visit on the forest? Why?
- What are the places that are the most/least attractive on the forest?
- Are there particular places where something adds to/detracts from the scenic quality of the forest?

People often attach significant value and symbolic meanings to special places within a forest. These can be formal or informal places of any size and scale. Defining a sense of place and identifying special places can be challenging. It is necessary to identify both the social connection and the landscape connection. There are a variety of methods for gathering this information including:

- Face-to-face, listening to people describe their special places on the forest. This is often very valuable and can help build relationships for other aspects of planning and partnerships.
- Through oral histories, journals, and related information in university special collections.
- Reviewing social media posts including blogs, Instagram photos, Facebook, and Twitter feeds.
- Travel and newspaper articles about specific locations on the forest.
- Marketing materials from visitors' bureaus, chambers of commerce, and recreation providers. It can be useful to see what places or areas these materials focus on as well as how the places are described.
- Interviews with the forest leadership team and other management staff.
- Interviews with frontliners and field staff.

Development of the Revised Plan and Monitoring

Information about scenic character and special places can be used in planning and monitoring in a variety of ways. Special place descriptions can help define the scenic character of landscapes, which in turn can help define desired conditions for scenic resources. This information can also be used to help prioritize landscapes that are suitable for higher scenic integrity assessments and suggest places that are appropriate for education and interpretation opportunities.

CONCLUSION

The Forest Service is required to manage National Forests for a range of goals and outcomes including forest health, biodiversity, clean water, and ecosystem services – but also to serve people and their needs. In the forest management planning process, the requirement to use perceptions and aesthetic judgments about scenic resources from the public adds a level of complexity when compared to the now-outdated VMS system that relied on experts' assessments. However, the new system has the potential to produce forest management plans that are sensitive and responsive to stakeholder values and concerns. In addition, the process of gathering this information can help build a constituency that feels they have a real stake in forest management.

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PROTECTING AMERICA'S TREASURED LANDSCAPES: AN OVERVIEW AND UPDATE OF THE NATIONAL PARK SERVICE VISUAL RESOURCE PROGRAM

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Abstract.—With a central mission to "… conserve the scenery and the natural and historic objects and the wild life therein … by such means as will leave them unimpaired for the enjoyment of future generations," the National Park Service (NPS) has been entrusted with some of the most spectacular and historically significant landscapes throughout the country (National Park Service Organic Act 1916). The NPS has successfully addressed visual resource issues at multiple park units but each had to develop its own approach. Over the last several years, NPS has developed a program that establishes service-wide support to parks for managing visual resources. The program includes: conducting inventory and evaluation of visual resources; providing guidance on assessing the visual impacts of projects; assisting parks with incorporating visual resources in park planning documents; and developing policy and guidance documents to assure consistency of visual resource management across the service.

INTRODUCTION

The National Park Service (NPS) Organic Act of 1916 states that the purpose of the NPS is to "… conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." With this central mission, the NPS has been entrusted with some of the most spectacular and historically significant landscapes throughout the country. Each area in the NPS has special visual characteristics that are often central to the park area's management and visitor experience, and visitors consistently identify scenic views as a major reason for visiting parks. In a review of nearly 100 surveys performed at a wide variety of parks from 1998 to 2011, scenic views were identified as important or extremely important by 90 percent of visitors (Kulesza et al. 2013).

The USDA Forest Service (USDA FS) and the Bureau of Land Management (BLM) are two Federal agencies that developed visual resource programs for managing the scenic values of land that they manage (Bureau of Land Management 1984, 1986; USDA FS 1974, 1995). Other agencies such as the U.S. Army Corps of Engineers and the Federal Highway Administration also have their own systems for assessing the value of the visual landscape and the potential impacts of projects to those values. In each case, the systems were developed to meet the management needs of their respective agency missions.

In recent years, there has been rapid development of energy facilities, especially utility-scale renewable energy projects, electric transmission lines, and oil and gas facilities adjacent to or crossing parks, national trails, wild and scenic rivers, and other NPS areas. The growth of communities and other types of development are likewise pushing ever closer to NPS-administered lands and waters. These developments are changing sometimes previously undisturbed views from park areas. In this context, NPS recognized the need to develop a comprehensive approach for assessing visual landscape qualities in and near park areas, understanding their value to the visitor experience, and determining how best to protect them as a resource for future generations.

The Air Resources Division (ARD) of the Natural Resource Stewardship and Science Directorate has developed a Visual Resource Program (VRP) to help address visual resource issues throughout the NPS. The VRP is a comprehensive inventory, planning,

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and park assistance program covering visual resource management. It helps parks identify and understand their visual resources to better enable them to develop conservation strategies for scenic views through best management practices and collaborative efforts with stakeholders such as Federal, State, and local agencies and private landowners. There are four general components to the program:

- Inventory – A systematic method to describe views, assess scenic quality, and assess other values.
- Planning – Provide support to parks for incorporating visual resources into park planning efforts such as foundation documents and Resource Stewardship Strategies.
- Technical Assistance – Provide assistance to parks in understanding the potential visual impacts of proposed projects and land management actions, and in identifying mitigation measures that may help reduce impacts.
- Policy and Guidance – Develop guidance documents and policy to help ensure consistency across the NPS in addressing visual resource management.

VISUAL RESOURCE INVENTORY

The Visual Resource Inventory (VRI) system is the primary tool in the VRP that helps park areas understand their visual resources and communicate the visual resource values to partners and stakeholders in a consistent and credible way. The inventory process is a systematic description of the visual elements of important views inside and outside National Park System areas (NPS areas), their scenic quality, and the importance to NPS visitor experience and interpretive goals.

The NPS inventory system has been developed specifically to meet the agency's mission. It is based on the fundamentals of VRI developed by the BLM and USDA Forest Service as well as systems developed for particular NPS units such as the Draft Scenery Conservation System for Blue Ridge Parkway (National Park Service 2008). It has been designed to work for many types of NPS areas and in multiple types of landscapes and visual settings. Park areas often encompass specific scenic places or historic settings and are also part of the broader landscape that includes areas outside park boundaries. The inventory considers the context of a park area's visual setting and provides a framework for understanding and protecting the scenic values within that context.

NPS areas range from nearly pristine wild landscapes to intensely developed urban areas, and park landscapes often have cultural and historic values in addition to scenic quality. Any or all of these values can be diminished if a park is subject to management or development activities that affect the condition of scenic resources and the quality of visitors' scenic experience. While NPS does not own or manage adjacent lands in shared viewsheds, this does not diminish the value of the adjacent lands for the park visitor or the park area. Numerous park resources including air quality, water quality, night skies, soundscapes, wildlife corridors, and cultural landscapes have documented cross-boundary impacts from development, and scenic resources may be impacted as well. The inventory approach of assessing the overall landscape both within and beyond park boundaries helps conserve scenic values for park areas and their visitors while retaining NPS support for the economic health of nearby communities, and providing for the responsible development of energy and other resources.

Goal and Guiding Principles

The VRI was developed to enable the NPS, its partners, and other stakeholders to better understand and protect scenic resources both within the park and within view but beyond park boundaries. The VRI capitalizes on elements of existing visual resource inventory and management systems but includes procedures suited to the unique mission of the NPS. The following principles served as a frame of reference for the overall VRI process as well as the individual inventory components.

- The inventory process should help parks answer three key questions:
    - o Where are the important views?
    - o What are visitors looking at and what are the characteristics of the view?
    - o Why is the view important?

- The process should be able to include inventory of park views regardless of whether the viewed lands are inside or outside park boundaries.
- The inventory should incorporate cultural and historic values.
- The scenic values of a park area should be considered in the context of the park area and its regional surroundings and landscapes; park areas should not be compared to one another.
- The process should be suitable for wide application in NPS without the need to rely on visual resource specialists for implementation. With proper training, the system should be implementable at the park level using available staff and volunteers.

In the NPS approach to VRI, the concept is to capture the scenic values from the visitor perspective. To accomplish this, the unit of inventory is a view as perceived from a specific viewpoint. The inventory identifies key information about a view including a description of the visible components, its aesthetic values (scenic quality), and the value (view importance) of the view to NPS and its visitors. The inventory process leads to the determination of a Scenic Inventory Value (SIV) that can then be used to develop protection strategies. The information gathered in the inventory process is stored in a geospatial database available to parks along with other natural resource data.

Determining the scenic value of important views and identifying views at risk for loss of scenic values are core components of developing protection strategies that preserve the views' valued characteristics. Scenic values of views are based not only on the aesthetic attributes of the landscape, but also on their value to the overall visitor experience and the NPS mission. A more detailed discussion of the VRI process and the specific elements considered in scenic quality and view importance can be found in Peters et al. (this proceedings) and Sullivan and Meyer (2016a, 2016b). When the results of the VRI are combined with the planning component of the VRP, the two become integrated into an overall process for understanding and protecting scenic views.

The results of the inventory form the foundation for protecting scenic views in park planning documents. With an inventory in hand, parks will have critical information needed to guide management of the visual landscape in conjunction with other park resources and values. Additionally, park areas that use the NPS methodology gain a systematic and defensible dataset of scenic values that can be a valuable tool when working with local partners and stakeholders in collaborative efforts outside of a formal planning process.

Status

NPS has initiated VRIs in over 30 parks to date and additional parks continue to inquire about scheduling an inventory. While not intended to be a stand-alone product, the inventory information has immediate value and it is not necessary to "complete" the inventory for the park to use the information. For example, Gates of the Arctic National Park and Preserve and the Mojave National Preserve quickly used their inventories to develop more detailed studies and to engage with other agencies to address potential visual impacts of proposed projects. Gates of the Arctic inventoried a very small portion of the park where an industrial mining road was planned. The inventory information was subsequently used for a detailed viewshed analysis by Argonne National Laboratory that will serve as the basis for developing the visual impact analysis for the road. Mojave also completed an inventory for only a small portion of the park and immediately used the information to engage with the BLM regarding the potential for wind development on the boundary of the park.

One of the primary purposes of developing the inventory is to provide the basis for determining the potential visual impacts of projects. To further this goal, the NPS and Argonne recently began developing a visual impact assessment (VIA) methodology that will be incorporated into the NPS process. Similar to the inventory, the VIA process will provide a standardized approach to evaluating visual impacts and result in consistency across the NPS in how we communicate those impacts. In its early draft form, the VIA methodology directly ties to the information collected during the inventory, including a visual contrast assessment based on components such as form, line, color, and texture. It also assesses changes in the qualitative components of the inventory such as landscape character and vividness. Testing and rollout of the NPS VIA process is planned for mid- to late-2018.

PLANNING

Park planning helps define the set of resource conditions, visitor experiences, and management actions that, taken as a whole, will best achieve the mandate to preserve resources unimpaired for the enjoyment of present and future generations. The planning component of the VRP includes assisting parks in recognizing and understanding their unique visual resources so that they can incorporate them into planning documents.

Similar to the inventory process, the planning component should also assist parks in addressing key questions.

- From an NPS perspective, what is an appropriate visual resource management objective?
- How could NPS promote protecting the characteristics of important views, especially on lands it does not own, manage, or administer?

The wide variety of NPS unit types requires a flexible approach to planning in order to meet the many individual missions of resource protection, interpretation, and visitor use. The NPS has adopted a framework for parks to develop a portfolio of planning documents to meet specific needs and plan for long-term park management (Fig. 1). The NPS planning division describes the approach in the following way:

> "Each unit of the National Park System is required to have a formal statement of its core mission that provides basic guidance for all planning and management decisions, the park foundation document. A foundation document establishes the basis for all future planning and is the core element of each park's planning portfolio. The planning portfolio is the assemblage of individual plans, studies, and inventories, such as climbing management plans, general management plans, visitor use studies, and cultural landscape inventories, which guide

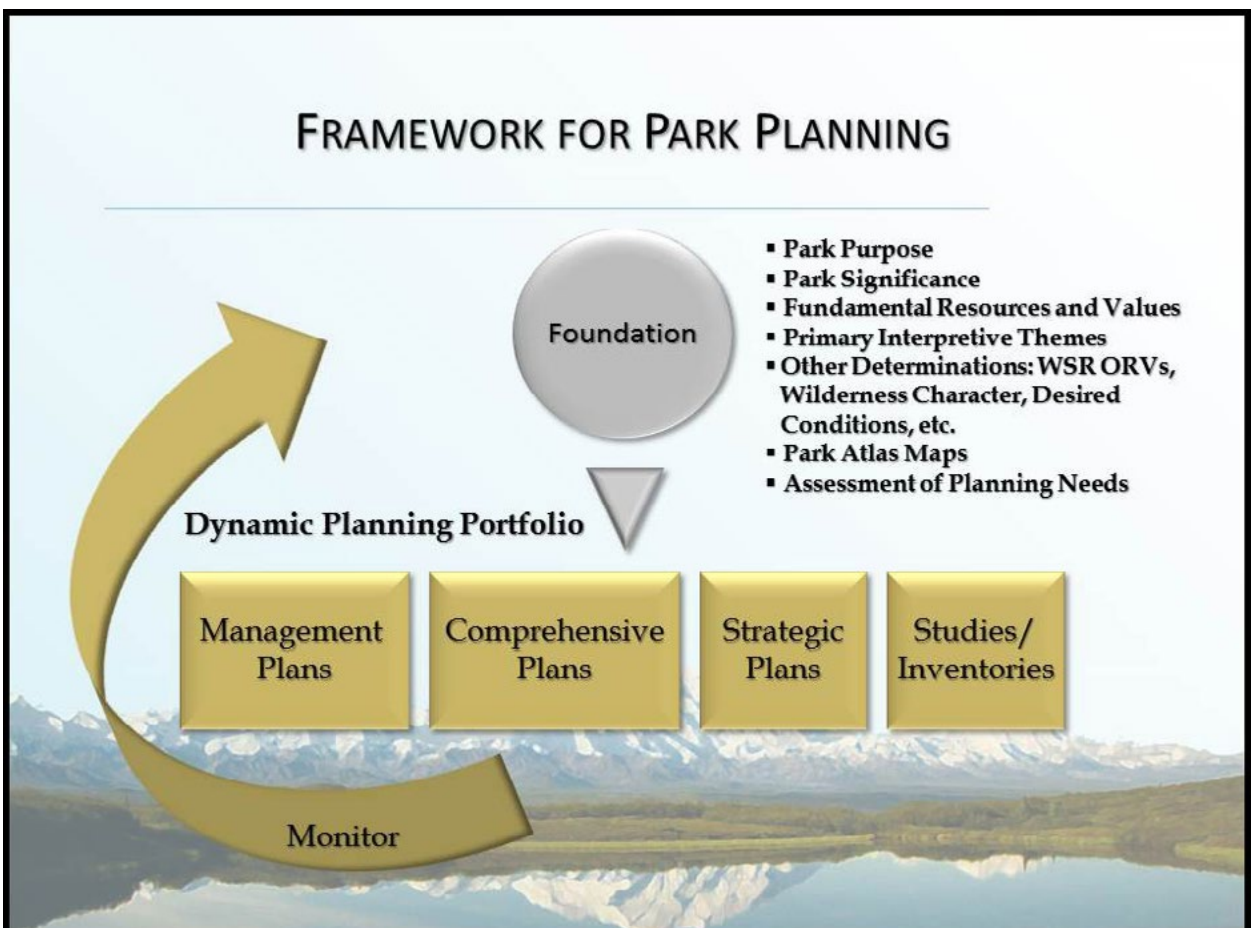

Figure 1.—National Park Service planning framework.

> park decision making. The portfolio structure encourages the use of targeted, small-scale planning products to meet a broad range of park planning needs" (National Park Service 2018a).

The VRP has concentrated its efforts to assist parks in incorporating visual resources into their planning processes during development of foundation documents and resource stewardship strategies (RSS). As noted, foundation documents identify the fundamental resources for which a park is established. By providing information to parks during preparation of the park's foundation document, the VRP has been successful in getting multiple parks to include visual resources as a resource to manage into the future.

For parks that have identified visual resources as a fundamental value in their foundation documents, the VRP has continued to work with them to plan inventories and develop management actions for inclusion in their RSS. Park units use the RSS as a long-range planning tool to achieve their desired natural and cultural resource goals as derived from relevant laws and NPS policies identified in a park's foundation document, general management plan, or other park plans. As part of a park's planning portfolio, the RSS serves as a bridge between the park's foundation document and everyday management of its natural and cultural resources.

To date, staff at over 140 parks have expressed their intent to include some level of visual resource assessment in foundation documents and almost 40 parks have indicated that this as a high priority. In addition, nearly 100 parks have identified a need for some level of visual resource management across the various types of planning documents in their planning portfolios.

Stakeholder Collaboration

While the Organic Act directs the NPS to manage and protect park areas so as to "leave them unimpaired for current and future generations," many aspects of NPS policy and guidance speak to the value of developing integrated, collaborative approaches to accomplishing this goal. The NPS mission specifically states that the agency "cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout the country and the world" (National Park Service 2018b).

Often, the protection of important views might require conserving a visual landscape that is beyond the park's boundary, and collaboration will be key to developing planning strategies to achieve that goal. As directed by the NPS mission and driven by the desire to be an integral part of the community, many parks already engage with multiple partners and stakeholders to cooperatively address a wide variety of issues concerning protection of park resources. In these cases, developing a collaborative group that focuses on protecting important park views within these existing relationships may be the best way to integrate this aspect of resource protection into the ongoing management of the park. Having sound inventory information and clear planning strategies for protecting valued resources can better inform these efforts and serve as the primary tools to support collaborative conservation.

Monocacy National Battlefield was one of the first parks to initiate a VRI to help address ongoing development pressure. The park subsequently developed a Visual Resource Protection Plan and used the inventory data to develop guidance and recommendations for working with stakeholders to protect the valued characteristics of the landscape surrounding the park.

TECHNICAL ASSISTANCE

The VRP began with a central focus on helping parks address concerns about the potential visual impacts of large-scale renewable energy projects on nearby areas. Currently, the VRP continues to provide support to assess the potential visual impacts from a wide variety of threats beyond a park unit's boundaries. This support can range from document review and preparation of comments to participating in multi-agency meetings and conference calls at the park, regional or National level. Examples of support efforts include:

- Reviewing environmental documents, preparing comments, and assisting with agency coordination for potential renewable or conventional energy development, mining, transportation, and other land use changes or projects near parks.
- Reviewing visual simulations of offshore or on-shore wind development, utility-scale solar facilities, conventional power plants, transmission

lines, and other facilities that could affect the visual setting of parks.

- Reviewing and commenting on visual resource aspects of programmatic or regional planning documents such as the Desert Renewable Energy Conservation Plan.
- Preparing draft scopes of work for parks to use in requesting visual impact assessments, simulations, and other analysis of proposed projects.

To date, the VRP has helped over 40 individual parks review projects that could have impacts on visual resources. Proposed projects have included pipelines that could affect the scenic values of the Blue Ridge Parkway and Appalachian National Scenic Trail, oil and gas development that could affect the cultural landscape at Chaco Canyon National Historical Park, and transmission lines that could affect the cultural landscape settings at Pea Ridge National Military Park in Arkansas and Captain John Smith Chesapeake National Historic Trail and Colonial National Historical Park in Virginia. Staff at Pea Ridge and at Chaco Canyon National Historical Park subsequently initiated the VRI process to better inform the engagement and discussions with other agencies and project proponents.

POLICY AND GUIDANCE

The first VRP guidance document produced in response to the proposed development of large renewable energy projects in the last few years is the "Guide to Evaluating Visual Impact Assessments for Renewable Energy Projects" (the Guide) (Sullivan and Meyer 2014). The Guide was authored by Argonne National Laboratory and NPS and can be found on the BLM Wyoming Visual Resource Clearinghouse Website, along with many other NPS VRP/VRI documents, at http://blmwyomingvisual.anl.gov/. The Guide presents detailed information to assist park and regional resource managers in evaluating the adequacy of VIAs covering proposed utility-scale renewable energy projects, and it helps NPS managers identify and understand the potential impacts those projects may have on nearby scenic views.

Beyond the grassroots efforts to establish credible visual programs and a consistent inventory methodology, ARD also continues to try to preserve the visitor experience through protection of scenic resources as a service-wide policy. An NPS Director's Order (DO) establishes service-wide direction on resource management based on current Management Policies. ARD is in the very early stages of developing a DO for visual resources and has sought input from regions and various parks that have participated in the inventory process.

CONCLUSION

Visitors have consistently identified scenic views as major reasons for visiting America's National Parks and historically NPS has successfully worked to protect important visual resources in multiple situations. Because the NPS has not had a comprehensive approach to managing visual resources, individual parks have had to develop their own approaches for assessing scenic values and potential impacts. The visual resource program developed by ARD provides a comprehensive and consistent approach to protecting parks' important scenic views through inventory, planning, and engagement with stakeholders. As a result, park managers will be better able to conserve important park scenery for the enjoyment of current and future generations.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

AN OVERVIEW OF VISUAL IMPACT ANALYSIS FOR OFFSHORE WIND ENERGY

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Abstract.—This paper presents a brief overview of the Bureau of Ocean Energy Management's regulatory framework for offshore renewable energy and summarizes the status of offshore wind energy projects in U.S. waters. The paper also discusses how visual impact analysis (VIA) will be integrated into the environmental analysis of proposed wind energy projects, the unique characteristics of VIA for offshore wind energy development, and the challenges encountered thus far. The conclusion describes lessons learned and summarizes the future of VIA at BOEM.

INTRODUCTION

The Bureau of Ocean Energy Management (BOEM) within the U.S. Department of the Interior is responsible for managing offshore energy resources on the U.S. Outer Continental Shelf (OCS). The Bureau coordinates energy development, environmental protection, and economic development through the responsible management of offshore resources based on the best available science. BOEM achieves these goals by balancing the needs of multiple interests for the OCS with the development of offshore wind energy facilities.

Regulatory Framework for Offshore Renewable Energy

The Submerged Lands Act (43 USC 1301-1315) and the Outer Continental Shelf Lands Act (43 USC 1331) define BOEM's responsibility to include lands of the OCS. In a March 1983 Presidential Proclamation, the United States claimed an Exclusive Economic Zone up to 200 nautical miles from the coastline. BOEM's regulatory authority currently includes submerged lands, subsoil, and seabed extending from 3 to 200 nautical miles off the coastline of the United States, a total of 1.7 billion acres.

Since the Energy Policy Act of 2005 (EPAct) (42 USC 15801), BOEM has been responsible for issuing leases, easements, and rights-of-way for activities that support production and transmission of renewable energy on the OCS, including offshore wind, ocean wave energy, and ocean current energy. The regulations and statutes governing BOEM's OCS Renewable Energy Program (30 CFR 585) describe authority and responsibilities within four distinct phases of renewable energy development: planning, leasing, site assessment, and construction and operations (Bureau of Ocean Energy Management 2014).

This paper does not describe the entire offshore wind project authorization process, but a summary of the goals of the process may be useful. The planning and analysis stage seeks to identify appropriate wind energy areas through intergovernmental task force coordination, public notices, and public comment. Following environmental analysis and consultations, BOEM may issue a lease on a competitive basis (e.g., lease sale) or, if it is determined that there is no competitive interest, issue a lease noncompetitively (Bureau of Ocean Energy Management 2016a).

There are three types of leases that authorize the use of the OCS for renewable energy projects: limited leases, research leases, and commercial leases. Limited leases are for activities that do not produce electricity for sale, beyond a very limited threshold. Research leases are for State or Federal agencies conducting renewable energy research on the OCS. Commercial leases do not grant construction rights but rather allow a lessee to use an area to develop two required plans. A Site Assessment Plan describes how an applicant plans to collect resource data, typically through the construction of a meteorological tower and/or installation of meteorological buoys on the leasehold. A Construction and Operations Plan describes how an applicant proposes to carry out the construction, operations, and conceptual decommissioning of a renewable energy facility.

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Although BOEM's regulations apply to all forms of renewable energy, the rest of this paper will address offshore wind energy, which is the main type currently under development in the United States. Ocean wave energy is a potentially important future source of energy and demonstration trials are underway on the Northwestern coast of the United States. The technology that harnesses energy from submerged water turbines is also being explored. There are no active leases in Federal waters focusing on hydrokinetic energy technologies at this time but the potential does exist for future development. For a comprehensive view of on- and offshore renewable energy development in the United States, Canada, and Australia, see Smardon et al. (2017).

AN OVERVIEW OF OFFSHORE WIND ENERGY IN EUROPE AND THE UNITED STATES

The offshore wind energy industry is most mature in Europe. At the end of 2016, there were 3,589 turbines in 10 countries with the potential to produce 12,631 megawatts (MW) of electricity annually (Wind Europe 2017). A total of 338 new offshore wind turbines from six wind farms was added to the European grid in 2016 (Wind Europe 2017). It is likely that wind development will continue to play a leading role in electricity production in Europe. Technological innovations include floating turbines, and even artificial islands, are being considered as wind turbine platforms (Moccia et al. 2014).

In contrast, the only offshore wind facility currently in the United States is the Block Island Wind Farm that began operations on December 12, 2016. The project consists of five 6 MW turbines located 3 miles offshore from Block Island, Rhode Island. The structures are 180 m high with a hub height of 100 m and a rotor diameter of 150 m. The electricity from these turbines replaces about 1 million gallons of diesel fuel oil per year, which was once needed to run electric generators on Block Island (http://dwwind.com/project/block-island-wind-farm/).

BOEM is following public reactions to this important first project. Several studies are underway to evaluate the economic and social outcomes of the Block Island Wind Farm, including a study on the economic effects on tourism to the island. The study will be completed in the autumn of 2018.

The Block Island Wind Farm itself was not permitted by BOEM. It lies entirely in the State waters of Rhode Island and was subject to regulation by that State and the U.S. Army Corps of Engineers. A part of the transmission cable to the mainland did cross Federal waters, for 9 miles, for which a right-of-way was granted by BOEM.

Current Status of BOEM's Lease Areas in the United States

Numerous large-scale projects, on a scale comparable with European counterparts, are in the planning stage in the United States and BOEM anticipates receiving multiple Construction and Operations Plans over the next year. BOEM has issued 13 commercial wind energy leases off the coasts of Delaware, Maryland, Massachusetts, New Jersey, New York, North Carolina, Rhode Island, and Virginia, totaling over 1.3 million acres as of June 2018.

INCORPORATING VIA INTO THE BOEM PLANNING PROCESS

BOEM provides guidance to lessees about what information the Bureau needs to assess potential project effects under the National Environmental Policy Act (NEPA) (42 USC 4321) and the National Historic Preservation Act (NHPA) (16 USC 470). This guidance recommends completing a visual impact analysis (VIA) to identify and assess effects for both Site Assessment Plan and Construction and Operations Plan applications.

A Site Assessment Plan (SAP) contains the lessee's detailed proposal for the construction of a meteorological tower and/or the installation of meteorological buoys on a lease area. This includes critical information on wave heights, wind speeds, and currents. As of June 2018, six SAPs have been approved for implementation.

To date, the review of SAP applications has found that meteorological buoys have little to no likelihood of having visual impacts. They are rarely visible from shore due to the type of structures and distance from shore. A common type of meteorological buoy proposed by lessees has a mast height of about 13 feet, while others float even lower in the water; studies indicate that these are indistinguishable from vessel traffic. Meteorological towers are larger than buoys, are fixed to the seabed, and may be visible from shore. A meteorological tower proposed for a wind energy lease area off the coast of Maryland has a planned tower height of 328 feet. BOEM's NHPA review for this facility, which included a VIA, resulted in a finding of no historic properties affected. The Maryland and Delaware State Historic Preservation Offices (SHPO) agreed with the finding. BOEM does not anticipate that many lessees will propose meteorological towers as the trend is for the installation of meteorological buoys for site assessment data collection.

The final stage of the process for applying to construct and operate a wind energy project is submitting a detailed Construction and Operations Plan (COP). At this time, COP guidelines for VIA are very basic and do not provide specific instructions on how to conduct a VIA. Instead, BOEM and potential lessees hold collaborative consultation meetings to outline approaches for environmental and technical topics, including a VIA. The Bureau provides guidance on VIAs to lessees if requested, with the goal of integrating VIAs into the COP process. In practice, both BOEM and the lessees are learning from each other's experiences as COPs are being developed. That experience is being used to develop plans that will meet BOEM's regulatory needs and the needs of the lessee for developing offshore wind energy projects.

BOEM staff review COPs as they are submitted and use the information from the COP in a NEPA analysis, likely an environmental impact statement (EIS), which will include multiple opportunities for public involvement. Visual analysis is part of the NEPA and 106 analyses and includes a broad look at the potential impacts to recreation, economics, historic resources, and other resources. Following completion of a NEPA analysis and consultations, BOEM has the authority to approve, approve with modifications, or disapprove a COP in its entirety.

UNIQUE CHARACTERISTICS OF VISUAL IMPACT ANALYSIS FOR U.S. OFFSHORE WIND

Insights From Europe: Design Envelopes and the Danish Experience

European countries have extensive experience in constructing and operating offshore wind energy projects. The United Kingdom has developed an approach to project implementation called a Project Design Envelope (PDE). The PDE approach allows a project proponent to submit a reasonable range of design parameters within its permit application. The permitting agency then analyzes the maximum impacts that could occur within the range of design parameters. If approval is granted, the project proponent can move forward with a final design that is within the approved ranges for all parameters.

BOEM supports the voluntary use of the PDE approach and has developed draft guidance for its use in COPs. Comments on this draft guidance are now being assessed with plans to finalize the guidance by the end of 2018. Under these guidelines, VIAs for proposed projects could require analyzing a range of scenarios as discussed in the Challenges section below.

BOEM is also party to a Memorandum of Understanding (MOU) with the Danish government to strengthen cooperation on offshore wind energy projects. This MOU promotes the sharing of information, best practices, and policy initiatives to support development and regulation of offshore wind energy, including the possible effects of these projects on marine mammals, migratory birds, and cultural resources. There is also ongoing information sharing on supply chain grid integration and strategies for achieving cost reductions (Bureau of Ocean Energy Management 2016b).

The insights gained from this relationship are helping BOEM understand the technological development trends for offshore wind. This includes critical factors for VIA such as turbine design and size and the development of floating offshore wind energy generation projects.

CHALLENGES

Public meetings, SAP review and consultation meetings with lessees have highlighted several challenges related to VIAs for potential offshore wind energy projects.

National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA)

The PDE concept, while successful in the United Kingdom, does present several procedural challenges for NEPA and NHPA compliance.

The goal of the design envelope approach is to allow flexibility in the scheduling and design of an offshore wind energy project. Developing a final project design is complicated for a long-term, complex undertaking such as an offshore wind energy project, yet the goal of an EIS under NEPA is a detailed disclosure and analysis of environmental impacts. This includes technical details such as the size, location, and type of turbine foundations, construction noise, and the exact number of turbines among many other factors.

Changes in the location, type, or number of turbines, for example, may require additional analysis of environmental impacts, if outside the scope of the previous NEPA analysis. Additional consultation with Federal agencies as well as consulting parties relating to Section 106 of the NHPA may be necessary.

Compliance with the NHPA also requires careful planning. A change in the number, location, size and/or pattern of turbines could require determining a new area of potential effects (APE), which may in turn require additional analysis of effects to historic buildings, districts, and landscapes. Consultations with SHPOs, Tribal Historic Preservation Offices (THPO), and other affected parties would have to be re-opened to allow for comments on effects to historic resources and eligibility for the National Register of Historic Places.

Traditional Cultural Properties

The National Park Service defines a traditional cultural property (TCP) as "one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (National Park Service undated).

On April 2, 2010, the Advisory Council on Historic Preservation (ACHP) commented on a proposed TCP for Nantucket Sound as part of the Section 106 compliance for a proposed Cape Wind offshore wind project (National Park Service 2012). The ACHP agreed that Nantucket Sound is eligible for inclusion in the National Register as a TCP as both a historical and archaeological property due to the presence of significant archaeological sites. In addition, Nantucket Sound is an integral feature of Mashpee and Aquinnah Wampanoag Tribal culture and history. In that case, the Secretary of the Interior terminated Section 106 consultations once it became apparent that the consulting parties could not reach an agreement but it is possible that other offshore wind energy projects may affect other TCPs in the future. The criteria for TCPs are meant to be broad and could include other Native American and non-Native American groups on the coasts of the United States.

Information about effects for any TCP will become part of the overall compliance process for the NHPA and NEPA (see Sullivan et al., this proceedings). Mitigation for any TCP could include the types of strategies discussed below with input from the affected public, SHPOs, THPOs, and lessees.

Mitigation Strategies

Both NEPA and Section 106 of the NHPA require mitigation strategies to reduce or remove adverse effects from proposed actions. Any mitigation strategy must weigh a variety of factors including cost, practicality, and support from the affected public and lessees. One example of mitigation under NEPA is incorporating aircraft detection lighting systems (ADLS) to reduce visual impacts. These are sensor-based systems that detect aircraft as they approach an obstruction and automatically activate lights until the aircraft passes. This reduces the visual impact of nighttime lighting for people and reduces the potential impacts for migratory birds.

Mitigation to reduce or remove adverse effects to historic properties is also part of the Section 106 process but devising a way to effectively reduce visual effects to large-scale areas is challenging. One possible strategy is to create historical interpretation materials for an area that would not otherwise have them. This approach is consistent with the definition of "mitigation" as used in the Council on Environmental Quality's NEPA-implementing regulations and with Section 106 of the NHPA. For example, in one case where an early 20^{th} century mill dam was being removed in South Carolina, several Federal agencies helped develop a mitigation strategy that included preserving detailed engineering drawings and photographs of the dam. The strategy also included creating five roadside interpretive plaques that document the history of the mill and the adjacent village.

THE ROLE OF SIMULATIONS

Visual simulations have proven to be the most significant component of VIA analysis for offshore wind energy projects since they give viewers a way to directly experience the visual effects of a proposed project. Simulations are part of the NEPA scoping and analysis process and are used for determining the APE under the NHPA.

Past experience suggests that simulations for offshore wind should be as realistic as possible. Modeling should include good key observation points and account for the effects of changing sunlight and weather conditions. BOEM's simulation of a hypothetical wind project near New York, for example, shows that visibility from shore depends as much on sun position, fog, humidity, and general atmospheric conditions as distance from shore. Seasonal variation is also an especially important factor on the East Coast of the United States where the weather and visibility patterns of the four seasons are distinct. Simulations that incorporate these factors can be found on the BOEM Website (Bureau of Ocean Energy Management undated).

The developmental pace of each wind lease area will vary. Some will be developed in one phase while others will be developed over a longer period of time, depending on a variety of factors. This means that it may be both practical and effective to do multiple simulations, each with a projected level of development over time. While adding to the cost of a project, accurate simulations of effects over time could be an effective approach to accurately informing the public about potential visual impacts.

THE FUTURE OF VISUAL RESOURCE STEWARDSHIP AT BOEM

Visual resource stewardship is playing a vital role in achieving BOEM's mission for balancing the diverse factors related to offshore wind energy projects. One important step has been creating a cultural resource staff position to work primarily on VIA issues. BOEM's goal is not only to assure compliance for individual projects, but also to develop an approach to visual stewardship that is adaptive and improves over time. This means maintaining close, involved contact with lessees and learning from experience. Offshore wind power is a dynamic, evolving industry and the technology and tools of VIA are also constantly changing.

Another key step is funding an interagency agreement with Argonne National Laboratory to develop draft guidelines and methodologies for VIAs of proposed OCS wind projects by late summer of 2018. The contract with Argonne specifies that SHPOs, THPOs, wind industry representatives, interested members of the public, and BOEM staff will all have the opportunity to review the proposed guidelines. The contract has a 5-year full performance clause and a third of the budget is reserved for making revisions to the guidelines as projects are actually developed.

The end result will be a set of guidelines and methodologies that promote overall visual stewardship. In practice, each VIA will be completed through a contract between a lessee and a consultant, following the guidelines and methods provided by BOEM.

BOEM is also committed to enhancing coordination and stakeholder engagement. The Bureau is evaluating the structure of relevant intergovernmental task forces with the goal of improving their effectiveness at the State and regional levels. Effective stakeholder engagement allows the public to identify important issues in their communities including the potential visual impacts to tourism and historic properties.

CONCLUSIONS

The goal of VIA at BOEM is to integrate the consideration of visual impacts into orderly, safe, and environmentally responsible renewable energy development activities on the OCS. Achieving this goal will take some time and will depend on the Bureau learning and adapting as offshore wind energy takes its place as an important new source of energy in the United States.

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CAN PROFESSIONAL AESTHETIC LANDSCAPE ASSESSMENTS BECOME MORE TRULY ROBUST? CHALLENGES, OPPORTUNITIES, AND A MODEL OF LANDSCAPE APPRAISAL

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Abstract.—Diverse objections have been raised to the prevailing North American practice of performing aesthetic landscape assessments via expert descriptions of formalist pictorial qualities. This paper explores compelling reasons for this situation such as constraints imposed by legal definitions and due process, as well as pragmatic and political issues. Examples from the United Kingdom, New Zealand, and the European Union show how these constraints and issues need not limit the form and content of assessments. Formalist pictorial aesthetics are noted as a safe and fundamental basis for public perceptions. Hazards with more robust approaches to landscape aesthetics are discussed as potentially usurping political decision authority. A more robust, clear, and distinctive definition of landscape aesthetics is suggested from neuroscience. A model of landscape appraisal is proposed that explains how more diverse but distinctively aesthetic values may be incorporated into assessments. An alternative solution would be an American Landscape Convention.

NATURAL AND INEVITABLE CONTROVERSIES OVER LANDSCAPE AESTHETICS

There is hope and promise in official assessments of the aesthetic merits of landscapes that are worthy of conservation. Visual stewardship has become a significant land planning and management activity, particularly in directing the design of landscape changes to minimize losses in scenic quality. Since this practice became established and took on particular foundational theories, definitions, and methods, its concepts and measures of environmental aesthetics have been contested. Very particular and narrow assessment theories and methods have become established and entrenched in professional practice. These employ expert descriptions of scenery via formalist, pictorial analysis and sometimes content-type-identifications. A variety of objections to these approaches has been voiced, some more fundamental than technical, such as the following:

- Any kind of objective, as opposed to subjective, assessments are inappropriate (Lothian 1999).
- Quantification cannot be validly involved in assessing landscape aesthetics (Carlson 1984).
- Assessments should not be limited to pictorial or formalistic descriptions of scenery (Gobster 1999).
- Assessments should be founded on thick, normative aesthetic epistemology (Carlson 1977).
- Assessments should better include ecological meanings and interpretations (Gobster 1999).
- Assessments should track changing social norms and meanings, not stable criteria (Antrop 2006).
- Assessments should capture "invisible qualities" that contribute to landscape aesthetics (Dakin 2003).
- Assessments should focus on community identity and place attachment (Scannell and Gifford 2010).
- Assessments should focus on exhibited landscape narratives of healthy stewardship (Sheppard 2001).
- Assessments should capture local/visitor social and cultural values/needs (Cats-Baril and Gibson 1986).
- Assessments should employ public participation/surveys not experts (Cats-Baril and Gibson 1986).
- Visual resource management is dishonest in hiding the truths of resource management (Wood 1988).

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UNAVOIDABLE AND IMPORTANT CONSTRAINTS UPON PROFESSIONAL ASSESSMENTS

These objections have in common a desire to make visual landscape stewardship more robust in many potent, inclusive, and complete ways. They all have intrinsic merit in attending to the socio-cultural, ecological, and public participatory dimensions and nuances of landscapes' perceptible aesthetic qualities. But they fail to adequately understand, and fundamentally and technically address, why professional planning practices such as environmental impact analysis and assessment methods produce landscape assessment procedures so narrow in scope. Professional planning practices are constrained by:

- Constitutional limits on planning (police) powers
- Laws, case laws and legislative histories
- Rules of evidence
- The need to weather adversarial contestation
- Financial and time budgets (i.e., a Ph.D. researcher-led team cannot be hired to do a robust, comprehensive, and sophisticated research project every time a particular professional landscape evaluation is needed in its unique political and regional context).

THEORETICAL QUESTION

The central question addressed by the following argument is: *When and how might professional aesthetic landscape assessments overcome these constraints to be more robust in the ways listed above?* Before an answer can be sought, an exploration is needed of the ways that the constraints listed just above effectively narrow the scope of landscape assessments.

LEGAL LANGUAGE THAT AUTHORIZES SCENIC ASSESSMENTS

It is important to note how legal language specifies or limits the scope and nature of aesthetic values that landscape assessments are authorized to consider and evaluate. Much of the narrow scope of professional scenic stewardship derives from laws and the legal frameworks that make such laws effectively operable. Some examples that favor an emphasis on scenic beauty follow.

United States

In the United States, local ordinances directly or indirectly regulated aesthetic impacts in urban landscapes starting in the 1920s, specifically through nuisance ordinances, zoning, and attendant case law (Duerksen and Goebel 1999). The National Park Service's Organic Act listed scenic resources as its first responsibility but only within its limited domain of management (Nagel 2017). Congress massively extended the reach and intended rigorousness of aesthetic protection and regulation in 1969 when it passed the National Environmental Policy Act (NEPA) with provisions protecting scenic quality only with administrative procedures. The Act states:

> "[I]t is the … continuing responsibility of the Federal government to use all practicable means to … assure for all Americans … aesthetically … pleasing surroundings (42 USC § 4331(b) Section 101(2))"and "to … identify and develop methods and procedures … which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making" (42 USC § 4332 Section 102 (2)(b)).

NEPA was a break with the past in explicitly applying national policy requiring aesthetic assessments within planning analyses and subsequent project and management decisions. Congress thus created an evidentiary conundrum in planning procedures as well as in judicial and administrative proceedings that are discussed below.

In compliance with NEPA, similar provisions followed in the National Forest Management Act of 1974, which states that "(timber) cuts ... shall be … shaped and blended to the extent practicable with the natural terrain" (16 USC § 1604 (f)(iii)). Similarly, the Federal Land Policy and Management Act of 1976 states that "public lands [must] be managed for protection of quality of scientific, scenic, historical, ecological, and archeological values … to reconcile competing demands; to provide for fish and wildlife; and to provide for outdoor recreation" (USC 43 § 1701(a)(8)).

British Columbia

The British Columbia Ministry of Forests policy authorizing it to require and use scenic assessments in plan and project permitting states: "Scenic quality is a major factor in the public's enjoyment, for residents and visitors alike. … [The] objective will be to address the visual impacts of logging activity on the landscape and incorporate measures to harmonize such impacts" (British Columbia Ministry of Forests 1981).

United Kingdom

The United Kingdom's most relevant law also focuses on scenic beauty but with a bit of broadening in the direction of ecological aesthetic. The preamble of the United Kingdom National Parks and Access to the Countryside Act of 1949 as amended refers to "an extensive area of beautiful and relatively wild country in which, for the Nation's benefit and by appropriate National decision and action, (i) the characteristic landscape beauty is strictly preserved." Section 5(1) identifies as a goal "the conservation of the natural beauty of an area," and Section 114(2) provides a definition: "Conservation of the natural beauty of an area shall be construed as including references to the conservation of the characteristic natural features, flora and fauna and geological and physiological features thereof" (Selman and Swanwick 2010).

New Zealand

New Zealand's Resource Management Act of 1991 seeks "to promote the sustainable management of natural and physical resources … [and] shall have particular regard to … the maintenance and enhancement of amenity values ... The term 'amenity values' is defined as 'those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes'" (Preamble and Sections 7 and 2(1), as cited in Barrett 2012). This rather broad language has led to many complex challenges, innovations and controversies centered on aesthetic landscape assessments (Barrett 2012).

European Union

Aesthetic landscape assessments reach their greatest robust potential in planning that conforms to the European Landscape Convention. It contains extensive provisions pertaining to the form, content, and use of aesthetic landscape assessments (Déjeant-Pons 2006). Wording from Article 5 (as cited in Déjeant-Pons 2006) illustrates how comprehensive the aesthetic is:

- "'Landscape protection' consists of measures to preserve the present character and quality of a landscape which is greatly valued on account of its distinctive natural or cultural configuration. Such protection must be active and involve upkeep measures to preserve significant features of a landscape. …"
- "To recognize landscapes in law as an essential component of people's surroundings, an expression of the diversity of their shared cultural and natural heritage, and a foundation of their identity. …"
- "To establish and implement landscape policies aimed at landscape protection, management and planning. …"
- "To establish procedures for the participation of the general public, local and regional authorities, and other parties with an interest in the definition and implementation of landscape policies. …"
- "To integrate landscape into its regional and town planning policies and in its cultural, environmental, agricultural, social and economic policies, as well as in any other policies with possible direct or indirect impact on landscape. …"

REQUIREMENTS OF CONSTITUTIONAL AND DEMOCRATIC GOVERNANCE

In the United States (and other similar democracies), assessing the aesthetic value of landscapes and changes therein presents constitutional challenges related to the U.S. Bill of Rights' Fifth Amendment requirement of due process as a prohibition against arbitrary governance. Aesthetic evaluations intuitively seem by their very subjective nature to be capricious hearsay but there they are required by law. This creates unusual evidentiary challenges for aesthetic landscape assessments.

The American government's tradition of accountable regulation and management of the public domain lies principally on four pillars (Schiavo-Campo and

Sundaram 2000, Smith 2007): 1) attendance to and engagement with the popular mandates and discourses that elect and reelect those with legitimate power; 2) the objectivity of science; 3) clear rules and procedures; and 4) reasoned argumentation founded on the first three. The need to make aesthetic landscape assessments legally defensible therefore entails four basic requirements:

- Aesthetics must be defined in accordance with common socio-cultural perceptions;
- Aesthetics must reflect public perceptions and opinions, and probably those of a majority;
- Aesthetics must be validly and reliably assessed in a way that is consistent with its definition and context; and
- Aesthetic definitions and measurements must be reasonable and subject to contested argument.

LEGAL *DEFINITION* OF AESTHETICS IN U.S. SCENIC ASSESSMENTS

Most U.S. Federal land management agencies, through rule making, adopted or sanctioned procedural manuals, or case law recognized "best professional practices," have interpreted "aesthetically pleasing surroundings" as referring to "scenic quality." Courts have interpreted the intent of this language in light of Lady Bird Johnson's Conference on Natural Beauty in 1966, which is widely regarded as the antecedent "legislative history" of this statutory language (Nagel 2017). The conference's bipartisan report tended to describe "scenic quality" in landscapes as those that produce first-impression, pictorially formalistic, pleasing public perceptions, consistent with a then just-preceding leading tradition in American environmental aesthetics (Huth 1990).

Such pleasing first scenic impressions are what the aesthetic philosopher Roman Ingarden (1990) relates as "the primary aesthetic" that grabs a particular kind of affective attention and instigates an aesthetic state of mind. More nuanced, interpretive, and cognitively complex aesthetic experience may follow. Simon Bell (2013, p. 8-9) argues that such first blush aesthetic-experience-instigating "universal factors" of beautiful landscapes tend to dominate other personal and cultural factors in explaining scenic quality perceptions, justifying an emphasis on formalistic descriptions as the method of choice for landscape assessments. Parsons and Daniel (2002) offer a similar, more evidence-based argument. A 1993 public survey by Komar and Melamid found widely shared preferences for certain formalist, pictorial "ideal" landscape elements and combinations, as reported by Wypijewski (1997) and Dutton (2003). Magill (1992) reports findings that support the existence of widely shared scenic preferences for scenes with descriptively natural qualities.

DESCRIPTIVE FORMALISM IN RELATION TO PUBLIC OPINION AND DUE PROCESS

Prevailing professional, as opposed to academic, landscape assessment methods under NEPA typically make little use of public participation other than through *proforma* meetings and hearings. They rarely use research findings pertinent to the relevant landscape's socio-cultural context or visual impact types that have been investigated in studies of public perceptions of similar landscapes elsewhere.

Professional assessments instead almost always rely on accepted methods limited to evaluative descriptions of landscapes and proposed changes against largely formalist, pictorial standards (Bureau of Land Management 1980, USDA Forest Service 1995). Adoption of these expert-based descriptive methods of scenery assessment in the United States and elsewhere arose for many reasons including the following:

- Formalist, pictorial assessments are intuitively consistent with authorized legal aesthetic definitions.
- Formalist, pictorial assessments are intuitively consistent with broadly shared, basic cultural aesthetics.
- Federal law makes it very difficult for agencies to conduct formal, locally relevant public surveys.
- Writing and adopting assessment manuals using narrowly descriptive methods was acceptably tractable.
- NEPA's puts prescribed emphasis on the use of objective and expert analysis in assessment of all impacts.

- Budgetary constraints (mentioned above) prevent public perception research in every assessment.
- Staff and consultant landscape architects with robust assessment capacities are not available.
- Agency cultures emphasize essentially descriptive science-based decision processes.
- Legal and administrative rules of evidence favor the use of experts supported by visual evidence.
- No established alternative methodological models of scenery assessment are available tailored to the key time and place.
- Agencies have adopted or sanctioned established methods and big changes would be a major hassle.
- Judges and hearing examiners have accepted pictorial descriptive methods as the only de facto option.
- No alternatives have been offered that are as inexpensive, intuitively right, and as broadly applicable.
- Researchers have not produced public perception derived findings consistent across many landscapes.

LANDSCAPE ASSESSMENTS AS ADVISORY FACTS TO DECISION MAKERS' CHOICES

In most constitutional democratic governance, a key distinction is made between those who have elected or appointed authority to make policy and permitting decisions versus those who serve them as staff analysts and advisers. Planners and landscape assessors typically fall into the latter category. They are normally limited to finding facts, analyzing them, and offering options to those with decision authority.

A key problem for scenery assessments is that they tend to be unavoidably and explicitly evaluative and therefore easily tend to be burdened with implicit or explicit normative and not analytic "decision content." The professional landscape assessor must not stray outside of legally authorized "technical" aesthetic analysis and usurp the political authority of the decisionmaker. Some authors who advocate for more robust landscape assessments, at least outside of New Zealand or the European Union, may be insufficiently aware of this limitation. Proposed methods may require professional staff to cross the line into political ground by in effect "commanding" decisions within the formulation of overly broad and choice-presumptive assessments. Two examples are:

> We refer to this integrated set of concerns collectively as issues in landscape ecological integrity. … An opportunity exists to combine issues of landscape ecological integrity with issues of aesthetic appeal, including appeals to the senses, to our emotions and feelings, and finally to our sense of symbolic meaning invoked by perceptions of caring and stewardship. … Because the heart of landscape ecology is the evaluation of spatial configuration and temporal sequencing as they affect landscape ecological integrity and aesthetic appeal, we believe it is the logical discipline within which to elaborate the union of these issues. We have called this union the *landscape ecological aesthetic* (Thorne and Huang 1991, p. 61).
>
> In the context of ecosystem services, we suggest a definition of cultural heritage as features within landscapes significant in some way to the present, including not only historical objects or landscape features (cultural and natural) but also intangible aspects such as stories, knowledge systems and traditions; implying that an inclusive approach is crucial for sustainable management of landscapes. Both tangible and intangible heritage within the landscape help to maintain meanings and a sense of collective identity, emphasizing the intimate linkage between cultural heritage and identity (Tengberg et al. 2012, p. 17).

These are both examples of well-conceived proposals for robust landscape assessments. The first would require new law. The second would require a new definition within the law, except in the European Union.

In the case of NEPA impact assessments, an unconventionally robust landscape assessment that considers socio-cultural and ecological aspects risks becoming a political statement rather than an impact assessment. Political decisions belong to the author of an environmental impact assessment's record of decision, not the landscape architect who must not presuppose or constrain the political biases and choices of that author's authoritative discretion in making key value judgments. A key problem in making NEPA-compliant landscape assessments more robust therefore revolves around how to keep them truly and legally aesthetic, not essentially political.

THE CRITICAL DISTINCTION BETWEEN AESTHETIC VERSUS OTHER PERCEPTIONS

Neuroscience offers an approach to clarifying the distinction between aesthetic judgments and other kinds of choice or decision judgments. If aesthetic landscape assessments are to become more robust in capturing actual public perceptions in many of their socio-cultural, ecological, and aesthetic-theoretical nuances, a key question arises: *When is a perception or assessment genuinely "aesthetic" and when is it political or something else*? Recent neurological research, employing brain scans of people making aesthetic appraisals versus other kinds of judgments, suggests that there is little difference between these (Chatterjee and Vartanian 2016). Both entail activation of the same emotional centers and networks in the brain, albeit differently between perceptions of beauty and ugliness (Kawabata and Zeki 2004). This may explain why researchers, professionals, judges, decisionmakers, and members of the public have a hard time distinguishing aesthetic perceptions from other kinds of judgments, even though NEPA and its derivative laws and assessment methods presume and prescribe such a difference. There is no obvious distinction that allows people to easily "know" or define whether they are making an aesthetic judgment or not. Aesthetic landscape perceptions and appraisals, and broader non-aesthetic normative judgments, bleed into each other. They may fall along a spectrum between obviously pure cases at either end.

Other neurological research does suggest that there are important, if subtle, distinctions between aesthetic and non-aesthetic experiences or judgments. These differences appear to reside in the activation of the brain's task networks—not its emotional networks—that are always simultaneously activated with emotional networks. Aesthetic experience more strongly activates task networks employed to assess one's internal state (i.e., spiritual condition) than other kinds of experience (Ishizu and Zeki 2011, Jacobs et al. 2012). Other studies similarly find that task networks more strongly activated in aesthetic experience focus on meaning-knowledge networks that attend to sensed or contemplated objects, rather than outcomes of expected or contemplated processes or events (Chatterjee and Vartanian 2016).

These neuroscience findings are consistent with Kant's (1780) theory of aesthetics and begin to suggest a basis for distinguishing aesthetic assessments from other types. Some kind of sensed or contemplated "object"—i.e., a landscape, or a representation of a landscape, or a thought or idea or memory of a landscape—must be foremost in mind, and self-awareness in that contemplation must also be equally foremost. The latter must preempt contemplation of value-centric interests (Perry 1914) such as choice tradeoffs, personal or social goals, analytic or conscientious forecasting of the future, or other tasks that focus on other people or social processes and relationships as *problems* of outward-looking concern. These outward-looking phenomena can be disinterestedly and thereby aesthetically contemplated typically apart from landscape assessments.

Such self-aware contemplation of sensed landscapes is a key quality of the kind of aesthetic experiences observed by Gobster and Chenoweth (1990) and Williams and Harvey (2001) and ecological aesthetic experiences described by Gobster (2008). It can also be characteristic of the disinterested, sublime contemplation of properties of landscapes rather than the landscapes themselves (Kiester 1996). A challenge for landscape assessors is to find diverse ways to adhere to this broad definition of aesthetics, which well exceeds pictorial formalism. At the same time, they must produce valid and reliable measurements of their occurrence in landscapes that can stand as legal evidence (Palmer and Hoffman 2001, Ribe 1982) while also assuring that those landscape incidences correspond to majority- or culturally-held public aesthetic perceptions.

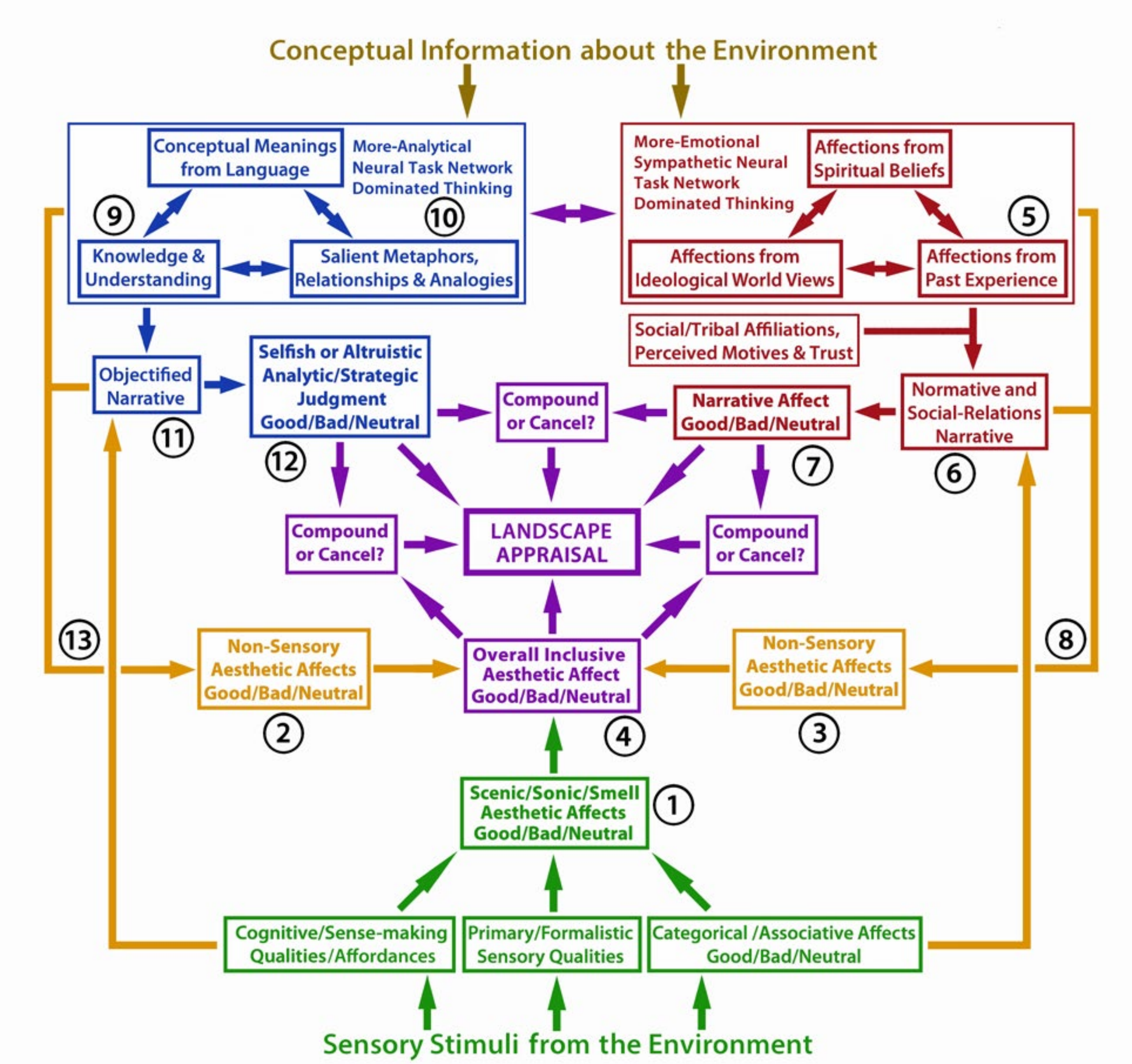

Figure 1.—A conceptual model of the relationship between environmental stimuli and an appraisal of the landscape or environment.

A CONCEPTUAL MODEL OF LANDSCAPE APPRAISAL

The flowchart in Figure 1 is a conceptual model that describes ways by which environmental stimuli and/or information can lead to any appraisal of a landscape or environment. Any individual or set of individuals in any circumstance may make such appraisals, and they might follow any simple or complex path through the flowchart. Most judgments of landscapes involve many or all bits of the flowchart, at least indirectly or subconsciously. But any particular landscape appraisal may mainly follow a dominant path due to people's need to simplify their understanding or articulation of their perceptions, or for groups to make the process by which they make formal appraisals tractable and transparent. People find their own dominant path to landscape appraisals according to their biases and learned modes of thinking. Groups do so according to their own learned approaches to analysis, cultural traditions, or methods written in official manuals.

The purpose here is to help distinguish between more official, professional, or objectively evidence-based landscape appraisals versus more political, conjectural, anecdotal, or fleeting ones, and to explore the roles that aesthetic perception and experiences play in these. Put another, simpler way: The model in Figure 1 can be thought of as containing either a pathway describing how a formal planning or environmental impact analysis might evaluate an alternative future environment for implementation, or a pathway by which an individual lay person or political process might evaluate the same. The model is complex because individual mental and social processes of judgment are complex. It is not proffered here as a demonstrably valid model of social-psychological or neural processes but as a useful means of distinguishing aesthetic perceptions or assessments from other types and determining when and how they get mixed together. Accordingly, the circled numbers in Figure 1 correspond to where they are parenthetically noted in the explanations of the model below.

Aesthetic Affects Within Bigger Overall Landscape Appraisals

There are four kinds of specifically aesthetic perceptions or judgments in boxes in Figure 1 where they are called "aesthetic affects." They are clustered together in the second and third rows up from the bottom. The green one (at 1) represents aesthetic affects derived from landscapes' describable sensory attributes, including auditory and olfactory ones not required by the U.S. adopted assessment manuals. Visual components of these affects can include conventional formalist descriptions, scenic affordances (Kaplan 1979), or categories of landscape content (Magill 1992). The left-hand orange box (at 2) represents aesthetic experiences and perceptions derived from contemplation of more factual or scientific ideas and stories, as when a scientist finds a theory to be elegant or beautiful (McAllister 1999) or a biologist finds the idea of biodiversity to be sublime (Kiester 1996). The right-hand orange box (at 3) represents aesthetic effects derived from more subjectively value-centric ideas or stories that arise from cultural, social, religious, political, and civic discourse, as when an environmentalist finds a wilderness to be beautiful *sui-generis* or a businessman finds a thriving industrial park to be admirable. The purple box (at 4) represents a synthetic aesthetic affect that may result when one to three of the above types of effects are combined in the contemplation of a single landscape, as when the businessman also smells the sweet smell of bread baking while seeing the admirable industrial park and recalls the elegance of the theory of economic multiplier effects learned in college.

Each of these types of aesthetic affect could be fair game in more robust NEPA landscape assessments. Both the conceptual and operational measurement definition would need to be arguably aesthetic, as per the discussion above. The measurement in a landscape would need to demonstrate that the aesthetic quality there is not anecdotal or conjectural but perceived or valued by many or most relevant people. Such evidence might be made through public surveys, observations of behaviors, persuasive expert testimony, or pertinent academic research.

Sympathetic Narratives Within Overall Landscape Appraisals

The red part of Figure 1 describes the normal socio-cultural and political activities of people, communities, and nations that influence environmental appraisals (Turner 1991). People have various spiritual, ideological, and way-of-life affections, some derived from past aesthetic experiences (at 5). These are influenced by interactions with the social and cultural reference groups that they most intensively interact with. People also constantly "read" the motives, beliefs, and values of others in relation to their own values and purposes. All these combine to produce social narratives by which people normatively understand the world (at 6). These narratives produce emotional reactions (at 7) that are not specifically aesthetic, although many people will not understand so. This is because such narrative affects are not self-aware and disinterestedly contemplative, but instead are outward-looking, value-interested narratives that deal with forecasting change, making value tradeoffs, and "reading" other people rather than oneself.

The sympathetic mental and social activities in red are not free of aesthetics. Disinterested contemplation of one's various affections (including of memories involving landscapes), spiritual beliefs, or personally deeply meaningful social narratives can all produce aesthetic affects that can bear upon (at 8) aesthetic landscape assessments as they contribute to combined landscape affects (at 4). They would need to meet the same tests of definition, measurement, and justification —as not conjectural or anecdotal—described above.

Task Analytic Narratives Within Overall Landscape Appraisals

The blue part of Figure 1 describes the kind of scientific or technical analyses that government agencies undertake in conducting landscape planning and assessments. These more objective and evidence-based analyses are necessary to avoid arbitrary and capricious regulation of citizens or management of the public estate. In the particular case of scenic assessments, evidence about the descriptive qualities about the four boxes at the bottom of Figure 1 would be "input" into the "knowledge and understanding" box (at 9). More generally regarding all manner of environmental appraisals, the objective analyses in the upper-left blue box must be normatively meaningful in relation to the legal and social issues and problems that have instigated an environmental appraisal. The resulting policy interpretations of an objective analysis can derive from relationships, metaphors, analogies, etc. (at 10), which produce an "objective" narrative or argument (at 11) to justify a policy judgment or prescription (at 12). These are not aesthetic by virtue of their objectivity and primary attention to socially defined policy goals and objectives. They are framed in regard to collective, measurable goods and not to values centered on self-aware and disinterested contemplation.

The task analytic activities in blue are also not free of aesthetics. The linguistic meanings of concepts, salient metaphors, analogies, and relationships embedded in technical analyses, as well as the narratives they produce, can elicit aesthetic experiences (at 13). These can bear upon (at 8) aesthetic landscape assessments as they contribute to combined landscape affects (at 4). If these are explicitly distilled out of the analytic argument narratives (at 11) and reframed as separate aesthetic phenomena, they might be included in more robust aesthetic landscape assessments. They would need to meet the same tests of definition, measurement, and justification—as not conjectural or anecdotal—described above.

The Final "Stew" of Landscape Appraisal

The purple part in the middle of Figure 1 represents how all the normatively meaningful "products" of the green, red, and blue landscape appraisal-related activities come together. There are arrows directly from the three affects or judgments (at 4, 7, and 12) to the final landscape appraisal. Any one of these might be the singular determinant of the final appraisal without regard to the others, according to the incident institutional, political, or cultural circumstances. If that one determinant happens to be the aesthetic one (at 4) then the final landscape appraisal happens to correspond to its aesthetic assessment, however narrowly or robustly it might have been made. In such a rare case, the landscape architect is as powerful as they might wish to be, or as aggressive advocates for robust and "true" aesthetic assessments wish them to be.

Two or three of the final determinants (at 4, 7, and 12) can instead affect a final appraisal without interacting with each other if they are all in agreement in their normative valence (good/bad/neutral), narrative content, and psychological framing. In such cases, the aesthetic "reasons" for a landscape appraisal would be indistinguishable from the others. People, lawyers, and decision makers might think the whole landscape appraisal is just aesthetic and this is not an unusual kind of confusion.

Perhaps the most common instance is when social affects (at 7), technical judgments (at 12), and overall aesthetic affects (at 4) conflict with each other in normative valence, narrative content, or psychological framing. That is when the other three purple boxes in Figure 1 that say "compound or cancel" come into play.

If any two or three determinants (at 4, 7, and 12) are substantially in accord, they compound each other in producing a strong case for, or perception of, the final landscape appraisal. In these cases, people, lawyers and decisionmakers might think the appraisal is substantially aesthetic because the "flavor" of the aesthetic affects are so well mixed up with the other affects and judgments in the overall appraisal stew; but landscape assessment professionals, their bosses, and relevant policy advocates should take care not to get caught up in this confusion and overreach in understanding the actual standing and power of aesthetics.

If any two or three determinants (at 4, 7, and 12) are substantially in conflict (i.e., if one favors the value of preserving a landscape and the other[s] favors major changes), they likely will cancel each other in affecting the final appraisal. In such cases the third or most powerful determinant will likely hold sway. In such instances the standing and power of aesthetic affects may often be found wanting, unless there is powerful evidence of their importance to the affected people. In such instances it is usually easy to distinguish the "flavor" of aesthetic affects from the other ingredients in the bigger overall landscape appraisal. Whether that flavor is critical in delivering the final decision is likely a matter for either the red socio-cultural and political narratives to decide, outside of aesthetic assessments, or that depends on the skillfulness and robustness of the aesthetic landscape assessment.

An American Landscape Convention?

The complexity of Figure 1 and its interpretation are only important because of the narrow legal definition and role of landscape aesthetics in NEPA and its derivative laws and sanctioned scenic assessment methods. The result is a set of difficulties that impede and make improbable more robust landscape assessments, which might more fully and truly identify their merit in contributing to people's happiness and welfare. An improbable alternative would be new law, such as that of the European Landscape Convention.

NEPA is a weak law, primarily procedural, and not prescriptive (Lockhart 1994), and its scenic provisions are arguably the weakest (Brooks and Lavigne 1985). It might be augmented or replaced by more prescriptive national policy directing local jurisdictions to identify the landscape attributes that local people most cherish in affecting the quality of their ways of life, work, recreation, and place attachment for retention or careful management by locally supported and effective measures. Evidence suggests that people deeply care about immediate issues affecting their local landscapes (Cheng et al. 2003, Sheppard 2001), which are now often threatened by larger extra-local forces that NEPA sought to mitigate. Perhaps a National program of attention to contemporary local landscape affections and concerns would gain more support and cooperative engagement toward sustainability than current actual and proposed policies directed to abstract, long-term, large-scale, "elitist" concerns such as climate change, ecosystem services, and biodiversity (Olwig and Mitchell 2007).

A widespread planning focus on contemporary, highly salient landscape services shared by local residents could enable widespread robust and accountable aesthetic landscape assessments of great relevance and potency to people (Opdam 2013). All the activities in Figure 1 would be centered on a more-than-just-aesthetic shared and enacted concept of landscape as the tangible and perceptible evolving social narrative of people's collective relations with each other and nature (Olwig 2005).

ACKNOWLEDGMENTS

This article was significantly influenced by conversations with and writings from Paul Gobster, Joan Iverson Nassauer, Terry Daniel, Jim Palmer, Dean Apostol, Kathryn Williams, Rick Smardon, Rick Chenoweth, Rebecca Ford, Adrienne Grêt Regamey, Warren Bacon, Roger Ulrich, Shelley Egoz, Steve Sheppard, Ulrike Wissen Hayek, Ben Niemann, Steve Daniels, Bruce Murray, Ian Bishop, Mark Eischeid, and Bernard Bormann.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

CULTURAL ECOSYSTEM SERVICES AS PART OF SCENIC RESOURCE MANAGEMENT?

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Abstract.—Smardon (1983) and Gobster et al. (2007) proposed development of a theory of ecological aesthetics whereby individuals could learn to value landscapes such as wooded wetlands for their intrinsic ecological value versus more surface artistic and culturally ingrained aesthetic values (Smardon 1983). The Millennium Ecosystem Assessment Project (2005) proposed the valuation of ecosystem services, defined as regulatory, provisional, ecosystem support and cultural services provided for us by nature, free of charge. The challenge here is: How can we use cultural ecosystem services derived from scenic landscapes and seascapes for scenic resource management and assessment? This paper reviews the work done to date on assessing ecosystem cultural services related to water-based scenic landscape resources and then applies it to an Upstate New York lake landscape.

INTRODUCTION

As part of the Millennium Ecosystem Assessment Project (2005), cultural ecosystem services have received international recognition along with the more established regulatory, provisional, and supporting services. For this paper, the author is particularly concerned with those cultural services most closely related to scenic resource management, which include aesthetics and recreation as well as science/education and spiritual/historic services (Daniel et al. 2012).

Along with these services identified in the Millennium report, de Groot et al. (2002) and Farber et al. (2006) describe a progression of cultural ecosystem services summarized in Table 1 below. Note that within all three descriptions of cultural ecosystem services there are four categories but also great potential for overall assessment and difficulty with quantification. Smardon (1975, 1978, 1983, 1988a) first addressed visual-cultural values with a rating system for freshwater wetlands in the northeastern United States that included the use and value of wetlands for aesthetic, recreational, and educational purposes and also noted the interconnection and overlap of these ecosystem services.

Recently there have been efforts to develop standardized indicators or measurement units for ecosystem service accounting purposes (Boyd and Banzhaf 2007, Ringold et al. 2013). Scientists at the U.S. Environmental Protection Agency (U.S. EPA) have been working on a classification system for landscape ecosystem services for beneficiaries of such services (Landers and Nahlik 2013, Ringold et al. 2013). The U.S. EPA has been particularly focused on water-based ecosystems, including oceans, estuaries, fresh water wetlands, rivers/streams, and lakes (U.S. EPA 2009).

Measurement of ecosystem services by traditional economic means is sometimes problematic, especially for cultural ecosystem services. Particular challenges from the ecological economics literature include:

- Unquantifiable values (Boyd and Banzhaf 2007, Kumar and Kumar 2008, Reimold et al. 1980, Turner et al. 2008)
- Double counting and overlap of services (Bennett et al. 2009, Chan et al. 2012)
- Addressing tradeoffs between ecosystem services for land management decision making (Farber et al. 2006, de Groot et al. 2010, Martín-López 2013, Smardon 2009)
- Lack of stakeholder engagement (Haase et al. 2014, Smardon 2009)
- Lack of consideration of ethical issues (Jax et al. 2013, Smardon and Moran 2016)
- The need to address spatial scale relationship to ecosystem service beneficiaries (Hein et al. 2006, Smardon 2009)

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Table 1.—Cultural Ecosystem Service Classification & Description

Services[a]	Comments and examples	
Aesthetic	Finding beauty or aesthetic value	
Recreation	Opportunities for recreation activities	
Educational	Opportunities for formal & informal education & training	
Spiritual & inspirational	Source of inspiration, religious attachment	
Information functions[b]	**Ecosystem processes**	**Example goods & services**
Aesthetic information	Attractive landscape features	Enjoyment of scenery
Recreation	landscape variety for recreational uses	Travel for ecotourism and outdoor sports
Cultural/artistic Information	Natural feature variety with Cultural/ artistic value	Use of nature in books, film, painting, folklore, symbols, +
Spiritual & historic information	Natural feature variety with spiritual & historic values	Use of nature for religious & historic purposes plus heritage value
Science & education	Natural variety with scientific & education value	Use of natural systems for school exercises and scientific research
Functions and services[c]	**Description**	**Examples**
Aesthetic	Sensory enjoyment of functioning ecological system	Proximity to scenery, open space
Recreation	Opportunities for rest, refreshment & recreation	Ecotourism, bird watching, outdoor sports
Science & education	Use of natural areas for scientific & educational activities	Natural field lab and reference areas
Spiritual & historic	Spiritual or historical Information	Use of nature as symbol or natural landscape with significant religious value

[a]Millennium Ecosystem Assessment Wetlands Report (2005, p. 2)
[b] De Groot et al. (2002, p. 397). Information functions—providing opportunities for cognitive development.
[c] Farber et al. (2006, p.123). Cultural functions and services—enhancing emotional, psychological and cognitive well-being.

Despite these challenges, there has been interesting work by ecological economists and social scientists to assess cultural ecosystem values. Traditional econometric methods such as hedonic analysis, travel cost, and contingent valuation have been used for valuing ecosystem services for coastal recreation (Johnston et al. 2002, Wilson et al. 2005) and wetlands (Boyer and Polasky 2004, Brouwer et al. 1999, Ghermandi et al. 2010, Turner et al. 2008).

WATER VALUE STREAM LITERATURE REVIEW

There are a number of studies that address water-related "benefit streams." Meta-analysis studies that pull together economic and ecosystem service literature can be divided into water recreation studies, waterfront property valuation, aesthetic view valuation, water quality valuation, and water ecosystem valuation.

Water Recreation Value Stream

Wilson and Carpenter (1999) reviewed the use of the travel cost, hedonic, and contingent valuation methods as applied to water-related freshwater services. For water-related recreational activity measured by the travel cost method, Bouwes and Schneider (1979) reported that recreational trips to Pike Lake, Wisconsin, were valued at $7,300. Young and Shortle (1989) reported recreational benefits associated with water quality improvements in St. Albans Bay, Vermont, as $5,990 per season. Other water recreation studies include those by Cordell and Bergstrom (1993) regarding water level management and recreation benefits and Johnston et al. (2006), which assessed willingness to pay for recreational fishing resources.

Waterfront Property Values

There are many economic studies using hedonic analysis for assessing the value of waterfront or near waterfront property. Lansford and Jones (1995a, 1995b) looked at property values near the Highland Lakes chain near Austin, TX. They calculated that the market value of residential recreational benefits equaled $690,000. Young and Shortle (1989) valued the increase in property values for the St. Albans bay area due to water quality improvement at $1.8 million. The European MARS (Meta-Analysis Reporting Standards) study found that for studies using a hedonic price approach, the mean value of lake benefits was equal to $769 per property per year (Reynaud and Lanzanova 2017). From other studies they found the lake benefit equaled $348 per resident per year. The United States was on the top end with mean annual value of lake benefits per property valued at $816 (2010 U.S. dollars).

There are a few papers that address waterfront property characteristics, including Colwell and Dehring (2005), Conner et al. (1973), and David (1968). David (1968) regressed land improvement against site attributes and found that swampy or steeply sloped banks were negatively correlated with value whereas water quality, proximity to population centers, and presence of other lakes in the area were positively related to value. Conner et al. (1973) attempted to analyze the relationship of water frontage values to other factors in the Kissimmee River basin. They looked at the year of sale, size of lot, and presence or absence of houses and found that lake frontage contributed 65 percent of the total value of a vacant residential lot and 48 percent of the total value of a lot with a house.

Water Aesthetic View Values

There have also been specific studies of lakefront residential property values related to aesthetic views. Bourassa et al. (2004) reviewed a database of 5,000 residential property sales in New Zealand and found that wide views of water added 59 percent to the value of waterfront property, but this percentage diminished rapidly with distance away from the waterfront. Corrigan et al. (2009) used willingness to pay (WTP) to sample local residents and visitors about improved aesthetic water quality of a eutrophic natural lake in Clear Lake, Iowa. The hypothetical options included a ballot initiative for higher taxes for water quality improvement; the study found that the ballot initiative, if actually offered, would have passed.

Hansen and Benson (2013) analyzed 25 years of data for 20,000 home sales in Bellingham, WA, for the effect that premium water views had on sale prices over different phases of the housing cycle. Real dollar premiums associated with water views actually moved with the housing cycle, rising when housing demand and overall market prices increased and falling when the price of housing declined. In addition, the relative value of the view fluctuated as well, possibly due to the scope and quality of the view plus distance from the water.

In a hedonic property value study of a central Texas lake, Lansford and Jones (1995a, 1995b) found that waterfront property commanded premium prices but that the marginal assessment price fell rapidly with increased distance from the water. Kauko et al. (2003) looked at the effects of water proximity and water use factors on residential property prices in the Netherlands. The price premium for lakeside property was +25 percent but was partially offset by flood risk. Schultz and Schmitz (2008) utilized hedonic and GIS analysis to document the value of water views for homes in Omaha, NE, and determined that lake views increased home values by 7.5 percent to 8.3 percent.

Water Quality Values

Many studies have shown that water quality and transparency are major determinants of shoreline property values (Leggett and Bockstael 2000). Steinnes (1992) found that a 1-meter increase in Secchi disk transparency raised lakeshore lot prices by an average of U.S. $235 in northern Minnesota. Michael et al. (1996) studied the selling prices of over 900 properties on 34 lakes in Maine and found that a 1-meter decrease in Secchi disk transparency over 10 years correlated with a decline in property value ranging from $3,000 to $9,000 per lot.

Campbell et al. (undated) linked a phosphorous loading model, a lake trophic state index model, and a property value model to estimate how changes in lake water quality would affect property values in Michigan and Minnesota. Their research showed that an increase in the trophic state of the lake decreased the value of properties near the lake. Carpenter et al. (1999) also looked at eutrophication of lakes and lake management. They recommended managing phosphorous levels in lakes in order to maximize property values. Parsons and Kealy (1992) used a random utility model to look at lake recreation in Wisconsin and estimated how water quality improvements would influence the recreation behaviors of boaters, anglers, swimmers, and viewers.

Walsh et al. (2011) looked at the effects of enhanced water quality on both waterfront and non-waterfront property values in Florida using hedonic models. They found that the value of increased water quality depended upon the property's location and proximity to the waterfront, plus the surface area of the water body. They also found that in urban places with high housing density, water quality improvements could cause higher aggregate property value increases for non-waterfront homeowners than for the relatively small number of waterfront homeowners.

There has been a number of studies on WTP for cleaner water for recreational uses such as boating, fishing, and swimming (Carson and Mitchell 1993, d'Arge and Shogren 1989). They conclude that there are many factors affecting WTP for cleaner water and that bringing water up to swimmable standards may not have a net economic benefit.

Cultural Ecosystem Valuation Methods

Some newer approaches have been used specifically for assessing cultural ecosystem services. Milcu et al. (2013) reviewed 107 publications to extract 20 key attributes describing the types, context, methods, scales, drivers, and tradeoffs between cultural ecosystem services. The authors stressed that cultural services can link gaps between researchers and disciplines. Chan et al. (2012) warned about conflation of services values and benefits as well as failure to address diverse value. They also demonstrated the interconnected nature of benefits and services and the ubiquity of intangible values.

Given these challenges, Brown et al. (2012) and Raymond et al. (2009) used participatory community mapping to identify community values for ecosystems services. Brown et al. (2012) used Internet-based public participation GIS (PPGIS) to identify ecosystem services in Grand County, Colorado. They found that cultural ecosystem service opportunities were the easiest to identify while supporting and regulatory services were most challenging. Most participants were highly educated about nature and science and the research found that some geographic locations were strongly spatially associated with specific ecosystem services. Finally, the PPGIS method proved to have high potential for identifying ecosystem services in general. Raymond et al. (2009) utilized in-depth interviews and mapping to quantify and map values and threats to natural capital assets and ecosystem services in the Murray Darling Basin region of southern Australia. The most highly valued ecosystem services were recreation and tourism, bequest, intrinsic and existence, freshwater provision, water regulation, and forest provision services, in that order.

Palmer and Smardon (1989a, 1989b, 1989c) used group meetings and fieldwork followed by a mail questionnaire to assess aesthetic (visual) and recreational uses and values of wetlands in Juneau, Alaska. This work was part of a regional Wetland Management Plan for the City/Borough of Juneau (LaRoche and Associates 2008). They found that the value assessments for the cultural ecosystem service component were more consistent than for the biological and hydrological components.

There have also been assessments of wetlands as heritage, historical, and/or archaeological sites. Reimold et al. (1980) cited traditional use of wetlands on the Atlantic coast for grazing. Smardon (2006) looked at the historic use of wetlands by Mayans in Mexico, and Baptiste and Smardon (2012) studied traditional subsistence use of the Nariva Swamp in Trinidad-Tobago.

AESTHETIC VALUE ASSESSMENT THEORY

There are economic methods for quantifying some cultural ecosystem services as itemized above, but these methods may not capture all of the value streams. The next section of this paper will focus on aesthetic value assessment theory, again focusing on water shoreline and wetland landscapes. Wetlands are intriguing landscapes that are historically perceived as evil and dangerous places (Fritzell 1978, Neiring 1978, Smardon 1978, Vileisis 1997). So the question is, do people's understanding of landscape ecology modify their aesthetic perceptions of landscapes (Gobster et al. 2007)?

Zube et al. (1982, p. 8) provided four principal approaches to assessing the aesthetics of landscape:

1) The expert paradigm. This involves evaluation of landscape quality by skilled and trained observers. Skills evolve from training in art and design, ecology or in resource management fields where wise resource movement techniques may be assumed to have intrinsic aesthetic effects.
2) The psychophysical paradigm. This involves assessment through testing general public or selected populations' evaluations of landscape aesthetic qualities or of specific landscape properties. The external landscape properties are assumed to bear a correlational or stimulus-response relationship to observer evaluations and behavior.
3) The cognitive paradigm. This involves a search for human meaning associated with landscapes or landscape properties. Information is received by the human observer and, in conjunction with past experience, future expectation, and socio-cultural conditioning, lends meaning to landscape.
4) The experiential paradigm. This considers landscape values to be based on the experience of the human-landscape interaction, whereby both are shaping and being shaped in the interactive process.

The Expert Paradigm

The expert paradigm is illustrated by Smardon (1975) and Smardon and Fabos (1983) in the visual-cultural model. Here, aesthetic, recreational, and educational values of freshwater wetlands can be assessed using the factors of landform contrast, surrounding landform diversity, associated water body size, associated water body diversity, wetland edge complexity, surrounding land use contrast, land use diversity, internal wetland diversity, internal wetland contrast, and wetland size. These variables are augmented by educational proximity, physical accessibility, and ambient (water, air, and solid waste) quality.

The recreation-related activities plus use of settings and benefits from the landscape can be assessed with the U.S. Department of the Interior (USDI) Bureau of Reclamation's Water and Land Recreation Opportunity Spectrum (WALROS) system (USDI Bureau of Reclamation 2011). This expert system can assess the kinds of activities that benefit from either direct water presence or visual proximity to water bodies.

The Psychophysical Paradigm

There have been several studies using psychophysical methods and three will be reviewed here. Cottet et al. (2013) administered a photo questionnaire with a sample of riverine wetland photos along the Ain River (France) to 403 lay people and self-identified experts in order to: 1) identify the different parameters (visual or ecological) influencing perceptions of value of the ecosystems; and 2) compare the experts' and lay people's perceptions of value. The criteria that most strongly influenced people's perceptions of ecological and aesthetic values included water transparency and color, the presence and appearance of aquatic vegetation, and the presence of sediments and trophic status (oligotrophic to eutrophic).

Dobbie (2013) did a psychometric study involving Likert scale preference ratings made by 241 participants for 70 photos of wetlands in Victoria, Australia. Her statistical analysis related preference to socio-demographic variables and familiarity with wetlands. The major preferences, categorized from least to most, were: brown grasslands, wetlands with emergent vegetation, wetlands with open water, and wetlands with trees. Wetland preference attributes included presence of trees, amount of water, and perceived wetland health. Wetland health was related to water quality, vegetation lushness, and proportion of land to water. Overall predictors of preference were perceived wetland health, complexity, orderliness, and perceived naturalness.

Lee's (2017) research proposed some 13 factors influencing the ecological assessment of wetlands within three categories:

- Ecological health and aesthetic value of wetlands were related to nutrients, transparency, aquatic plants, sediment, water color, water shoreline, terrestrial vegetation, and surrounding vegetation.
- Factors affecting disassociation between ecological health and aesthetic value included overall landscape context and the visible area of open water. Openness was seen as better and corresponded to preference for open, savanna-like landscapes (Appleton 1984).

- Open marshes were perceived as more simple and legible compared with scrub and shrub wetlands, which were seen as more complex and less legible.

The Cognitive Paradigm

There have also been a number of cognitive studies of wetland aesthetic cultural attributes. Manuel (2003) surveyed residents in three urban communities in the Halifax Regional Municipality in Nova Scotia, Canada. He found that the residents were generally aware of the urban wetlands and identified them as assets because they were natural features in the landscape and habitat for urban wildlife. Nassauer (2004) compared restored and more natural reference wetlands using several measures including land use context, cultural perceptions, and management practices for six metropolitan wetlands in Minnesota. Cultural measures were drawn from surveys of visitors, neighbors, planners, and managers of these areas. Sites that were perceived as well-cared-for and good places to enjoy nature were perceived as more attractive. Cultural cues, natural landscape context, and bird species richness were also related to perceived attractiveness.

Two early studies of the cognitive attributes of riverine wetlands assessed the roles of coherence, complexity mystery, and legibility in landscape preferences. Ellsworth (1982, summarized in Kaplan and Kaplan 1989, p. 220-222) examined the landscape units, setting units, and waterscape units of the Cutler Reservoir and tributaries in Cache County, Utah. He asked people to use color slides and a five-point rating scale to assess the coherence, complexity, mystery, and legibility of rivers and marshes. Research participants found high coherence when there was similar vegetation with strong horizontal edges in marsh scenes and edge definition in rivers. They also found mystery in riverbeds and river bends, complexity in rivers and marshes when there was diversity in vegetation and visual depth, and legibility in straight river corridors and simple spaces as well as with fine textured marsh vegetation and spatial definition. Similarly, Lee (1983, 1979) did a study of Louisiana river landscapes and found that preference values for river scenes often included one or two characteristics (legibility, complexity, spatial definition, mystery, distinction, or disturbance) but no factor was found to be more significant than the others.

Also under the cognitive paradigm, Lee (2017) has proposed that there is cognitive appreciation of a landscape's ecological functions, which naturally arouses emotions. Others have supported this thesis (Callicot 2003, Cottet et al. 2013, Dobbie 2013, Rolston 2000, Sheppard 2001) while studying landscape preferences (Korpela et al. 2002, Ulrich 1983).

The Experiential Paradigm

Experiential assessments relate to the actual landscape as people perceive and experience it in situ (Zube et al. 1982). Such assessments also relate to engaging in specific recreational and other activities in the landscape. While no experiential studies were identified for this review, this type of assessment could be done with onsite interviews, questionnaires, or observation as well as user photography and video to capture the experiential qualities of the recreational, aesthetic, and educational experience.

Whether we are using an expert, psychophysical, cognitive, or experiential approach, a key question is how stable or accurate such assessments are over time. Palmer (2004) investigated perception of scenic quality of the Cape Cod community of Dennis Massachusetts from the 1970s to the 1990s. The original views in his 1975 study (Palmer 1983) were re-photographed and another sample of Dennis residents was surveyed. Results showed that most of the variation in scenic perceptions was explained by spatial landscape metrics indicating blocked views or changes in land use area rather than a temporal shift in resident preferences. This led Palmer to conclude that his model retained predictive efficacy after 20 years (Palmer 1983, 2004).

CASE STUDY APPLICATION: CAZENOVIA LAKE, NEW YORK

The research reviewed above laid the foundation for a recent value stream application undertaken by the author for Cazenovia Lake in New York. This town and village of the same name lie on the eastern edge of the Finger Lakes Region in central New York (Fig. 1). Cazenovia Lake itself is a dominant natural and cultural feature affecting the history, culture, economics, and land use of the surrounding community for both residents and visitors.

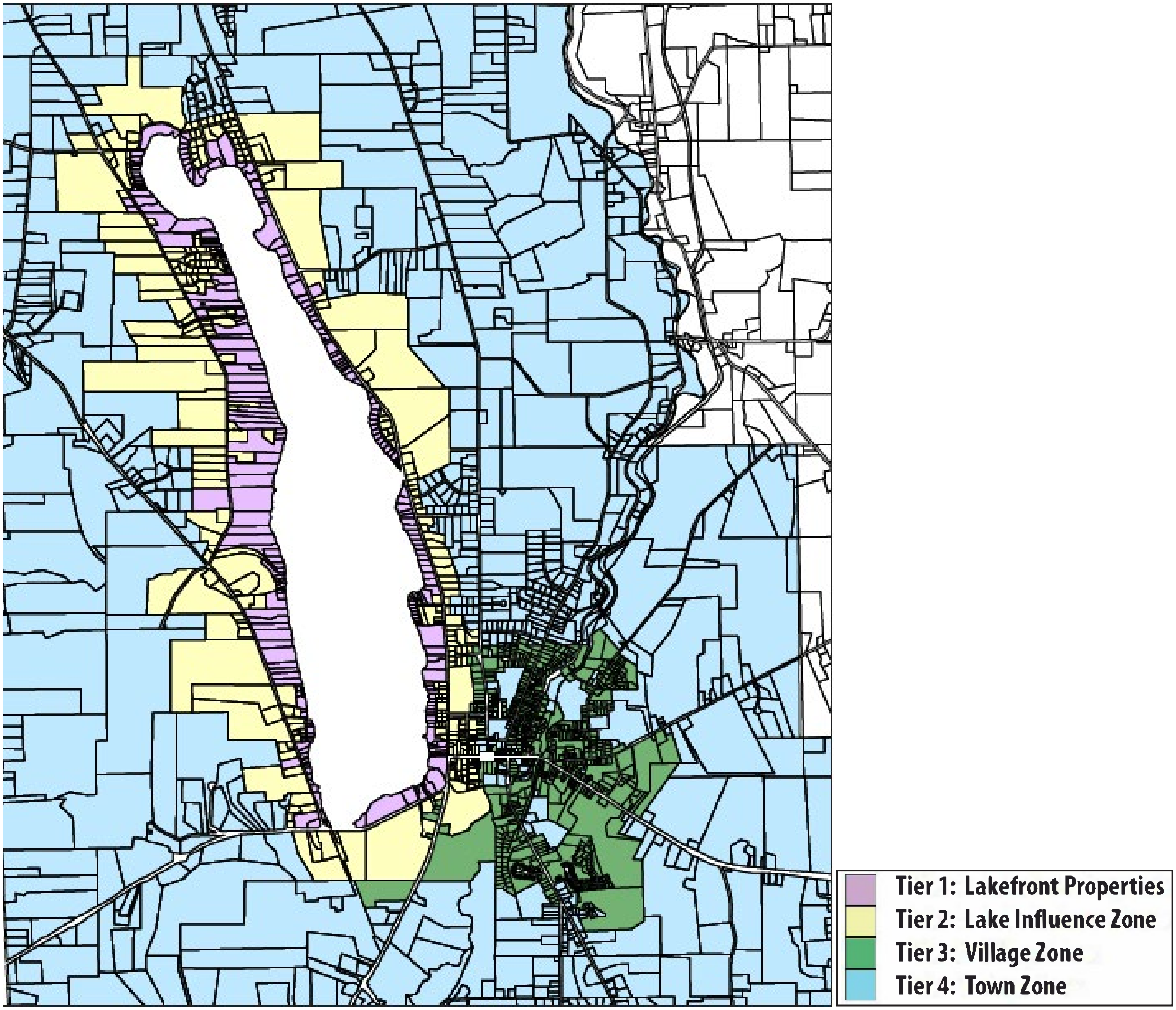

Figure 1.—Area map of Cazenovia Lake showing major land use zones.

For this case study, the author created a lake-related benefit matrix shown in Table 2. The matrix incorporates information from the U.S. EPA's Final Ecosystem Goods and Services Classification System (Landers and Nahlik 2013) to classify activities. Information on settings and benefits was incorporated from the U.S. Department of the Interior Bureau of Reclamation's WALROS system (USDI Bureau of Reclamation 2011) to represent the kinds of activities that benefit from direct lake presence, visual proximity to the lake, or proximity within the lake watershed. The matrix is a work in progress and will be further refined.

Overview of Cazenovia Lake Benefit Streams

The matrix summarizes the benefit flows to the Greater Cazenovia township/watershed area from Cazenovia Lake. Some of these benefit flows, like resource-dependent businesses and recreational activities, have quantifiable economic benefits. Others, such as inspiration, learning activities, and ecosystem services, are more difficult to quantify or translate into economic benefits. Let us start with the more direct economic benefit streams and move to the more indirect or less quantifiable.

Table 2.—Preliminary matrix of Cazenovia Lake cultural service benefits

Activity category	Setting	Beneficiary experience	Benefit	Economic indicator
Resource-dependent business				
Marina	Lakeside presence	Water access	Water access	Sales +
Restaurant	Lakeside presence	Water views	View access	Expenditures
Agritourism	Lakeside presence	Water views	View access	Sales +
Recreational activities				
Motor boating	Dock/launch	Water experience	Water experience	Expenditures
Personal water craft	Launch point	Water experience	Water experience	Expenditures
Sailing	Launch point	Water experience	Multi-sensory	Rental cost
Paddleboard	Lake access	Water experience	Multi-sensory	Travel cost
Kayak/canoe	Lake access	Water experience	Multi-sensory	Travel cost
Swimming	Beach access	Water experience	Multi-sensory	Travel cost
Fishing/ice fishing	Water access	Water/ice experience	Multi-sensory	Expenditures
Wildlife viewing	Lake access	Viewing wildlife	Multi-sensory	Travel cost
Lake edge cultural activities				
Picnicking	Lake edge parks	Water views	Relaxation	Travel cost
Tennis/volleyball	Lake edge location	Water edge views	Relaxation	Rental cost
Foot races	Lake edge course	Water edge views	Relaxation	Travel cost
Bicycling/touring	Lake edge roads	Water edge views	Relaxation	Travel cost
Festivals	Lake edge location	Water edge views	Relaxation	Travel cost+
Inspirational activities				
Weddings + other events	Lake edge location	Water edge views	Presence	Event cost
Art related activity	Lake edge location	Aesthetic inspiration	Inspiration	Travel cost
Learning activities				
Historic interpretation	Lorenzo State Park	Historic understanding	Historic experience	Travel cost
Educational trips	Lake location	Educational understanding	Educational experience	Travel cost
Research	Lake location	Research opportunities	Educational experience	Travel cost
Municipal operations/revenue				
Residential owners	Lakeside	Lake environment	Lake access	Property value
Ecosystem services—regulatory				
Maintain water quality		Water related activities above		Water quality treatment
Nutrient retention		Downstream water quality		Water quality treatment
Sediment retention		Downstream water quality		Water quality treatment
Carbon storage		Reduced CO_2		Climate change mitigation
Ecosystem services—production				
Water supply	Lakeside residences	Drinking water		Replacement cost
	Erie Canal (historic)	Water level		Replacement cost
Ecosystem services—support				
Aquatic habitat		Fish and wildlife		Enhancement
Food chain		Sustain fish and wildlife		Enhancement
Ecosystem services—cultural				
See recreational-cultural-inspirational-educational activities above plus				
Public views of the lake		aesthetic enjoyment		Viewer numbers
Existence value		Knowledge of existence		Option value

Resource dependent businesses are activities such as lakeside marinas, restaurants, and agritourism facilities that are located on or near the lake and draw users because of location and/or views. Economic indicators are sales and expenditures from consumers who visit the area because of the lakeside location, views, or both.

Similarly, recreational activities are a benefit stream because of physical and sensory lake access; this may have a seasonal aspect. Lake edge cultural activities do not require physical access to the lake but are a draw because of their visual proximity to the lake. Both of these activity sets can be quantified by onsite expenditures and/or travel cost.

Inspirational activities are special events such as weddings or other celebratory events that occur near the lake edge and/or rely upon visual access to the lake. Onsite expenditures and/or travel costs can be used to quantify this benefit flow.

Learning or educational activities are also place-connected to the historical heritage of Cazenovia Lake. The major draw in this regard is Lorenzo State Park, but there are other cultural, historical (Environmental Design & Research 2008) and ecological attributes connected to the lake. Travel cost of visitors can be used to calculate these benefit flows.

One of the major benefit flows for lakeside property owners includes amenities of being on the lake. The literature reviewed above suggests that increased physical proximity and water view access will increase property values near the lake. This translates to higher assessed value for these properties and higher real estate tax revenue for the Village and Town of Cazenovia.

Arrays of benefits flow from ecosystem services, which in the context of the lake ecosystem includes regulatory (improving water quality), provisional (providing drinking water), ecosystem support (habitat for fish and wildlife), and cultural (aesthetic, education and recreation benefits) services. It also includes the amenity values gained by lake edge property owners, plus lake-related recreational, cultural, inspirational, and learning activities previously covered.

Existence value could also be considered a cultural ecosystem value. Existence value is the knowledge by village, town residents and others in the region that Lake Cazenovia exists in case one wants to visit or engage in any of the cultural activities previously covered.

In addition, there are public viewsheds or significant views of the lake that are enjoyed by both residents and visitors (see Figs. 2-4). These are documented in the Village and Town of Cazenovia Comprehensive Plan (Environmental Design & Research 2008, p. 50-51) and include the following:

- View from center of Cazenovia Lake: View from lake showcases the water and lakefront homes and parks in the foreground, the Village rooftops and steeples in the middle ground and the rolling agricultural landscape in the distance. This serene view captures the essence of a quaint, rural lakefront community.
- View from Lorenzo: One of the few places that community residents and passersby may experience a significant, open view to the lake. This view of the lake (which is often painted by local artists) acts as an announcement that one has arrived in or is exiting Cazenovia. Coupled with the historic Lorenzo estate, it establishes a historic atmosphere and sense of timelessness. The view of natural scenic beauty of the water nestled among rolling hills anchors the quaint and unique character of the town.
- Village Center looking west toward Cazenovia Lake: The view from the center of the Village towards the Lake is significant. U.S. Route 20 creates a visual axis to the Lake. This visual framing of the Lakeland Park is essential to the identity of Cazenovia. Attention should be paid to maintain or enhance this relationship. If the intersection at Lakeland Park is reconfigured for safety purposes, the framed view to the lake should not be compromised and if possible, accentuated.

Figure 2.—View from Lorenzo State Park. Photo by R. Smardon, used with permission.

Figure 3.—View from Route 20 in Cazenovia looking toward the lake. Photo by R. Smardon, used with permission.

Figure 4.—View from Route 20 on the eastern entrance to Cazenovia. Photo by R. Smardon, used with permission.

In addition, there are visual corridors (Environmental Design & Research 2008, p. 51-52) such as the following:

- View from U.S. Route 20 West, driving eastward into Cazenovia: This is one of the most historically presented entrances into the community. Late 19th century paintings and photographs exist of this view to the lake with the lake in the mid-ground and the Presbyterian Church steeple in the background. Looking to the east one can see U.S. Route 20 East and the Romagnoli homestead, built in late 1700s and patterned after Mount Vernon as well as the CPF/Ambrose farms and the fields behind South Cemetery. The Town should consider a scenic byway lookout stop at this site near Lorenzo Farms. (See William G. Boardman, Cazenovia from West Hill, 1848 and Dwight Williams, Cazenovia Lake, 1910. Both oil paintings are on display at Lorenzo State Historic Site.)

Both viewsheds and scenic corridors add quality of life benefits for residents and are part of the draw for visitors.

DISCUSSION AND SUMMARY

In this paper, the author addressed the questions: How do we incorporate cultural ecosystem services as a method for scenic/visual/aesthetic landscape assessment/valuation? And should we? Answers, based on the literature review and a case study, include the following:

- We can use a mixed methods approach for quantifying economic benefit streams and tracking more intangible benefit streams.
- We can address the overlapping nature of aesthetic, recreation, education, and inspirational cultural ecosystem services.
- We can engage stakeholders via multiple means such as focus groups, surveys, workshops, public participation GIS (PPGIS), and social media to yield data, which substantiate different benefit streams.
- We can address tradeoffs and ethical issues related to benefit flows (e.g., some residents are closer to high value aesthetic landscapes than others but could benefit from greater access).
- We can address the scale of the relationships between resources and ecosystem services (e.g., some scenic resources are regional while others are more community or local scale).

Such assessment and valuation approaches open the door for more research and application of cultural ecosystem services as part of visual scenic resource assessment and management. Similar approaches have already been used for the Lake Champlain Management Conference (Smardon 1996).

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ECOLOGY OF SCALE IN VISUAL ASSESSMENTS

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Abstract.—Background readings on scale plus 21 visual landscape assessment studies were examined to understand the nature and use of scale and its relationship to the visual environment. The objectives of this study were to: 1) describe the concept of scale as applied to visual assessments, 2) review scale use in selected visual assessments vis-à-vis landscape ecological scale, and 3) identify issues that need further research to better integrate scale into visual landscape assessments and landscape ecological theory. It recommends further research for defining, recognizing, and incorporating scale into visual landscape studies should: 1) explicate use of absolute and relative scale; 2) compare traditional and multi-scalar, hierarchical approaches; 3) examine and revise reliance on substitution of distance for extent or scale; 4) compare space/mass interactions, not simply masses, to determine visual grain; and 5) design research protocols in which psychophysical metrics correlate more logically with eco-physical metrics.

INTRODUCTION

Scale is a familiar term to landscape architects. One of many visual relationships taught in introductory studios, it helps designers perceive, order, and explain how they structure landscapes. Zube (1984) has noted that moving between scales such as the region and the site is one of four requirements for a general theory of landscape assessment. Scale also emerges as a central organizing theme in landscape ecology (Turner et al. 2001, Wu and Li 2006). As studies (e.g., De la Fuente de Val et al. 2005, Dramstad et al. 2006, Palmer 2004) attempt to connect visual quality of landscapes with their ecological structure, it becomes more important to understand the role of scale.

Wu et al. (2006) note that environmental planners and designer rarely apply scale theory. Visual assessment studies, however, continually find present a spatial (and hence an implied scale) component (Gobster and Chenoweth 1989, Kaplan 1979). Furthermore, Gobster (1993), Gobster et al. (2007), Nassauer (1997), and Tveit et al. (2006) have suggested understanding scale is a variable that produces visual and aesthetic qualities of and impacts on landscape.

The objectives of this study were to: 1) describe the concept of scale as applied to visual assessments, 2) review scale use in selected visual assessments compared to landscape ecological scale, and 3) identify issues that need further research to better integrate scale into visual landscape assessments and theory. Together, the objectives examine scale as a set of distinct relationships between humans and their physical and visual environment that emerge as a kind of "ecology of scale."

BASIC CONCEPTS OF SCALE

Forman and Godron (1986) define scale as "the level of spatial resolution perceived or considered." Grinde and Kopf (1986, p. 329) distinguish two types of scale: absolute and relative. Absolute scale compares size to a standard such as a human, whereas relative scale relates entities and their context (Fig. 1). Relative scale best captures dynamic aspects of human scale perception, but several factors such as boundary visibility, hierarchical structure, spatial grain, and extent must also be considered.

Bounding Visibility

Perceiving land results in landscape. *Not* seeing land due to darkness or fog or some opaque occluding barrier, one is blind to landscape surfaces (Gibson 1986). So visibility is a basic ingredient of assessing landscapes and their scale (Felleman 1979 and 1982, Higuchi 1983, Tveit et al. 2006).

Landscape ecologists explicitly and deliberately determine the boundaries of a study area and the size of the units measured with in it. The overall boundary has been called variously scope or extent and the measured units have been called resolution

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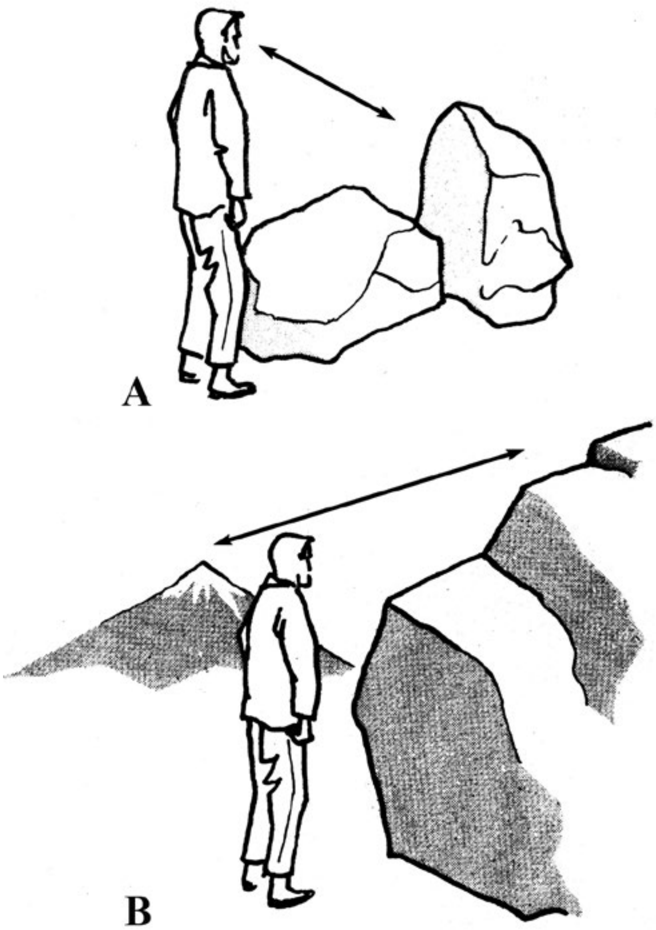

Figure 1.—Example of A) absolute scale—where comparison is to a known standard (e.g., human body); and B) relative scale—where comparison is to its context. Image from USDA Forest Service 1973.

or grain (Ahl and Allen 1996, Turner and Gardner 1991). Boundary and scale also become basic to visual landscape studies. Litton (1968) observed that our sense of scale is directly attributed to the boundaries or extent of what we see. In a corollary to Litton's observation, De Veer and Burrough (1978) note that arbitrary, fixed boundaries are important. Boundaries get our attention (Kaplan and Kaplan 1989, Litton and Tetlow 1978).

Perceiving Scale

Coeterier (1996) investigated the relationship of spatial size and spatial distance in perceptions of space in Dutch landscapes. Importantly, the number and quality of the relationships both contribute to perceiving size and distance. Coeterier concluded that human size and depth, or distance clues, represent unique processes and use different cues or the same cues differently. Space perception integrates distance and size (Coeterier 1994). This occurs because our perceptual faculties appear to automatically integrate visible landscapes (Gibson 1986) and scale is one of those integrative mechanisms (Watzek and Ellsworth 1994). Humans readily and easily make judgments about the perceived sizes of individual parts or features of landscapes and have adapted to quick, perhaps subconscious, reaction to our physical context to survive in an uncertain world.

Seeing Hierarchically

Gibson (1986) explains how we see hierarchically in a hierarchical world using what he called "invariants in the visual array" to find our way around. To Gibson (1986), a place is contained within a larger place and differs from a Cartesian coordinate point. He describes surfaces of boundaries that affect visibility, controlling and filtering information from the surrounding ambient array. These surfaces can be detailed as to their textures and "… units of texture are generally nested [e.g., hierarchical] within one another at different levels of size" (p 28). Accordingly, we innately see hierarchically and derive information about the landscape by interpreting and nesting optical angles. He states, "Equal amounts of texture for equal amounts of terrain suggests that both size and distance are perceived directly" (p. 162). We apply scale hierarchically, so seeing in scale must include surrounding objects or spaces as context.

Hierarchy theory attempts to describe and explain relationships between objects, spaces, time, and processes in the context of their complex human, ecological, and physical systems (Whyte 1969). Landscape ecologists (Allen and Hoekstra 1992, Allen and Starr 1982, Turner and Gardner 1991) are concerned with scale and hierarchies because the objects and processes may vary with scale. Setting the scale for an investigation or sampling of physical landscape is an important step and must be explicit.

Researchers who use scale to investigative landscape ecological analyses apply hierarchy theory to order scale changes (Allen et al. 1993, Wu and Li 2006). Tveit et al. (2006) propose a nested, hierarchical scheme of visual scale, dimensions (visibility, openness, and grain size), attributes (topography, vegetation, and human-made obstacles), and indicators (viewshed size, viewshed form, depth of view, degree of openness, grain size, and number of obstructing objects). Because human perception of landscape is an ecological, hierarchical, multi-scaled process, it requires us to constantly scale up and scale down.

Visualizing Grain and Extent

Since landscape ecologists must be explicit about the scale at which they study a phenomenon of interest, they carefully select grain and extent. For example, to sample whales and plankton, the size of the overall net is the extent and the size of the net's mesh is the grain. For plankton, a 1-meter by 1-meter net may be an adequate extent, but a 1 cm opening in the net is a grain size that would not allow you to collect such a small organism. On the other hand, the net would not be nearly large enough to capture something like a whale. In both cases, an improper hierarchy of relationships between net size and mesh size or extent and grain gives little hope of meaningful sampling and study.

This analogy holds with human observation of the landscape because our moment-to-moment views are visual samples. In visual studies, Gibson (1986) supports the idea of choosing grain and extent because he explains that no fixed unit works in every situation. He proposes that we vary the scale of investigation to fit the entity of interest and be explicit when we describe the relationships between parts at a lower level.

Using the relative concepts of grain and extent, the complexity of a landscape view and its visual scale become more than an absolute, background-middleground-foreground triad (e.g., Shafer et al. 1969) or nested view windows (e.g., De la Fuente de Val et al. 2005). For each separate view, different indicators of grain and extent occur and observers directly and automatically distinguish a hierarchy of grain and extent.

LINKING LANDSCAPE ECOLOGY, SCALE, AND VISUAL STUDIES

Landscape ecologists have clearly defined scale and explicitly used it in structuring their studies. Because visual assessments are often used alongside other environmental or ecological studies, it is useful to compare how scale is used. Landscape ecologists Wu and Li (2006) summarize and organize the concepts of scale. Those concepts will be covered here in abbreviated form, but the reader is encouraged to see the original work for more detail. Wu and Li discuss three aspects of scale: characteristic scale, scale effects, and scaling where characteristic scale is part of a phenomenon's essential nature. As observed by humans, scale effects are changes in outcomes based on changes in scale, and scaling extrapolates information from one scale to another. Wu and Li (2006) break scale into a hierarchy of 1) dimensions, 2) kinds, and 3) components. The discussion below reframes Wu and Li's concepts for the visual landscape.

The most general level of their conceptual hierarchy deals with the dimensions of scale, that is, space, time, and organizational level. Space and time scale studies (e.g., Delcourt and Delcourt 1988) are straightforward, connected, and widely used and understood. An organizational level perceived by a researcher has inherent time and space scales associated with it. Large events cover more space and have a slower return time, whereas smaller events are contained within and often constrained by larger events in time and space (Whyte 1969) as nested hierarchies such as those described above by Gibson (1986).

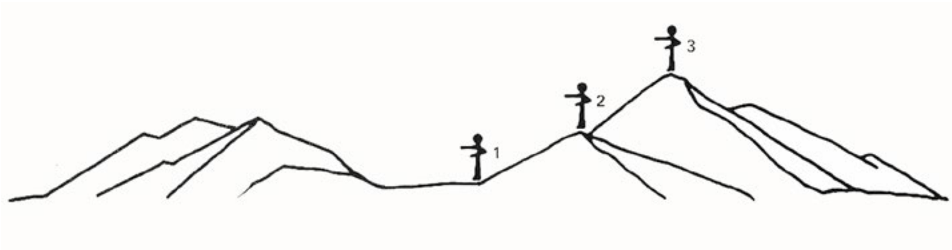

Figure 2.—Observer positions affect a viewer's understanding of scale. Elevated position (3) allows the observer to view a larger area of landscape thus moving the observer to a higher hierarchical level than observers 1 or 2. Image from Litton 1968, used with permission.

When an individual confronts landscape, selection of organizational level would also probably occur quickly and with minimal deliberation. For example, moving down a hierarchical level brings more detail and smaller temporal or spatial units. Movement, whether it is the scanning eye or the walking human, essentially activates and links humans, their perceptive minds, and the environment. Assuming an elevated view (what Litton [1968] calls "observer superior position") (Fig. 2) shifts the observer up in level and thus scale, allowing comprehension of larger units of landscape. In short, moving up in a landscape increases the area of one's view scale and scale (Bell 1993).

Next, Wu and Li (2006) describe what they call kinds of scale. First, intrinsic scale is "the scale on which pattern or process actually operates." In the case of visual landscape studies, intrinsic scale may closely match their second kind of scale, observational scale, because, "... the observed scale of a given phenomenon is the result of the interaction between the observer and the inherent scale of the phenomenon" (p. 7). "Selection of the strata [levels] in which a given system is described depends upon the observer, his [or her] knowledge and interest in the operation of the syste ... stratification is an interpretation of the system" (Whyte 1969, p. 32).

Although hierarchies can be conceptualized as levels that decompose into subordinate levels or compose to super-ordinate levels, they are not mere aggregations but holistic, identifiable units interpreted or defined by the observer. In their view, ecologists Allen and Hoekstra (1992) explain the hierarchical role of the observer as first deciding what the structure may be then applying that decision to what is seen in the environment. The role of the observer is central to understanding scale. His or her decision may be long and deliberate in a research study or quick and subconscious as an observer.

Wu and Li's (2006) observational scale often coincides with the scale at which samples are measured or data is modeled or analyzed. Of importance to visual landscape studies is what they call the policy scale that acknowledges the context of local, regional, and National planning regulations. For visual landscape studies, it might be a region (e.g., Litton and Tetlow 1978, Zube 1970) or a discrete public land management unit (e.g., USDA 1995). Summarizing these ideas about kinds of scale, Wu and Li (2006) note a sequence in which proper observation and analysis allow detection of the phenomenon's characteristic scale in turn allowing appropriate scale of experimentation and modeling resulting in planning and management at a scale of the problem at hand.

Finally, at a more detailed, basic level Wu and Li (2006) discuss components of scale that include: cartographic scale, grain, extent, coverage, and spacing. Cartographic scale is familiar as a ratio of a map's distance to that same distance in the real world and applies absolute scale (Silbernagel 1997). Wu and Li (2006, p. 9) define relative scale as "the relationship between the smallest distinguishable unit and the extent of the map, which can be expressed simply as the ratio between grain and extent." However, sole reliance on map extent unnecessarily restricts the concept of relative scale as previously described by Bell (1993) and for visual landscape studies compromises observational and intrinsic scales.

Coverage and spacing have to do with sampling in time and space and may affect capture of the appropriate characteristic scale. Grain and extent are basic elements of scale represented by the net size and mesh size described earlier. Wu and Li (2006) note that the grain size must be smaller than the phenomenon of interest yet include its range. Observation of an environment can be thought of as a quick, subconscious, and ongoing visual sampling.

REVIEW OF LANDSCAPE ASSESSMENT STUDIES

What might be considered a visual landscape study? Some refer to them as landscape assessments (Daniel and Vining 1983, Sutton 2011), scenic assessments (Schauman 1988) scenic resources (Zube et al. 1975), scenic analyses (Litton and Tetlow 1978), visual resource analyses (Brown 1994), view quality (Germino et al. 2001), visual quality assessments (Schauman and Pfender 1982), visual preferences (Dramstad et al. 2006, Kaplan and Kaplan 1989), aesthetic preferences (Gobster and Chenoweth 1989), landscape perceptions (Palmer 2003), or scenic beauty estimates (Daniel 2001). Simply put, visual landscape studies examine the landscape as an environment visible to and valued by humans. A scene is seen; a vista is viewed and, most importantly, humans perceive the quality of their physical landscape.

Human reactions may be functional (way-finding, Kaplan and Kaplan 1989; sustenance or safety, Appleton 1975); ethical (stewardship, Nassauer 1995) or aesthetic (Gobster and Chenoweth 1989, Hammitt et al. 1994, Sutton 1997), and they may imply an interest in quality (Palmer 2003).

Twenty-one visual landscape studies (Tables 1a, 1b, and 1c) were examined for how they addressed scale linkage and corresponded with Wu and Li's (2006) conceptual structures. Many others were reviewed but not included because of space limitations. Some of those selected are more conceptual than applied; only detailed, published studies that featured scale, hierarchy, or space were used. While the review covers work from an earlier period (1968–2006), it remains relevant to current theory, practice, and technology.

What do the dimensions, kinds, and components of scale tell us about scale when examining visual landscape assessments? Since all of the studies chosen for review had a spatial component, it is not surprising that all had implicit or explicit concepts of space. Eight of the studies implied a connection with time and three specifically controlled for seasonal landscape effects. Eight studies employed hierarchies with some type of nesting: six of the studies used background-middleground-foreground (B-M-F), three used close-far, two used small-transitional-large, one used three unspecified distance zones, and one implied an unspecified hierarchy.

The reviewed visual studies utilized mostly intrinsic, observational approaches though some had an experimental aspect tied to kinds of scale. As applied experiments, 15 of the studies used or tested hypotheses or models and 19 attempted to use their findings for design, planning, or management policies. As with much of biological landscape ecology work, visual landscape studies are strongly applied. While the dimensions and kinds of scale were widely utilized by researchers in the visual studies, components of scale, especially grain and extent, were explicitly used by only a few, though 11 implied grain or extent. European researchers (Coeterier and Dijkstra 1976, De la Fuente de Val et al. 2005, Dramstad et al. 2006) have begun to define and use more specific components of scale that are now spurred on by European Union policies aimed at preserving rural landscape structure and amenities.

TOWARD A BETTER INTEGRATION OF SCALE WITH VISUAL LANDSCAPE ASSESSMENTS

In addition to placing the studies within Wu and Li's (2006) larger framework, this paper also identifies other scale-based issues important for visual assessments of landscape and needing further study.

Research Need #1: Using Relative versus Absolute Scale

Earlier in this paper, while defining scale in ecology and landscape assessments, it became apparent that absolute scale and relative scale need to be explicitly identified by visual researchers as is done by biological landscape ecologists. Gibson's (1986) work as an environmental psychologist confirms that as ecological beings our perception is multi-scalar and nested hierarchically.

In visual landscape studies, absolute scaling (using a set standard) has been applied to perception of distance (Iverson 1985). Litton (1968) used the following standard for distances relating to foreground, middleground, and background but did believe they could be modified: foreground 0.40 to 0.80 km (0 to ¼ or ½ miles), middleground 0.80 to 4.83–8.0 km (½ to 3–5 miles), background 4.83-8.0 km to infinity (3-5 miles to infinity).

Table 1a.—Dimensions of scale compared with 21 visual assessments

Citation	Dimensions of scale		
	Space	Time	Hierarchical org.
Coeterier (1994)	√	√	Small-trans-large
Coeterier and Dijkstra (1976)	√	Implied	Small-trans-large
DeVeer and Burrough (1978)	√	Implied	Nested
Dramstad et al. (2006)	√	√	Nested
De la Fuente de Val et al. (2005)	√	√	Nested
Germino et al. (2001)	√	√	3 Dist. Zones
Gimblett et al. (1985)	√	√	B - M - F
Hammitt (1988)	√	Implied	B - M - F
Hammitt et al. (1994)	√	Implied	B - M - F
Higuchi (1983)	√	Implied	B - M - F
Hull and Buhyoff (1983)	√	√	Close-dist.
Iverson (1985)	√	√	Nested
Kaplan, Kaplan et al. (1979-89)	√	Implied	Close - Far
Litton (1968)	√	Implied	B - M - F
Litton and Tetlow (1978)	√	Implied	Nested
Litton et al. (1974)	√	√	Nested
Palmer (2004)	√	√	Nested
Palmer and Lankhorst (1998)	√	√	Nested
Ruddell et al. (1988)	√	√	Near - Far
Shafer et al. (1969)	√	√	B - M - F
Zube et al. (1975)	√	√	Implied

Table 1b.—Kinds of scale compared to 21 visual assessment

Citation	Kinds of scale				
	Intrinsic	Obs.	Exp.	Model	Policy
Coeterier (1994)	√	√	√	√	
Coeterier and Dijkstra (1976)	√	√	√	Implied	√
De la Fuente de Val et al. (2005)	√	√	√	√	√
DeVeer and Burrough (1978)	√	√	√	√	√
Dramstad et al. (2006)	√	√	√	√	√
Germino et al. (2001)	√	√	√	√	√
Gimblett et al. (1985)	√	√	√		
Hammitt (1988)	√	√	√	√	√
Hammitt et al. (1994)	√	√	√	√	√
Higuchi (1983)	√	√		√	√
Hull and Buhyoff (1983)	√		√	√	
Iverson (1985)	√				√
Kaplans et al. (1972-89)	√	√	√		√
Litton (1968)	√	√	√	√	√
Litton and Tetlow (1978)	√	√			
Litton et al. (1974)	√	√	√		√
Palmer (2004)	√	√		√	√
Palmer and Lankhorst (1998)	√	√	√	√	√
Ruddell et al. (1988)	√	√	√	√	√
Shafer et al. (1969)	√	√	√	√	√
Zube et al. (1975)	√	√		√	√

Table 1c.—Components of scale for 21 visual assessments

Citation	Components of scale				
	Grain	Extent	Cover.	Sample spacing	Map scaling
Coeterier (1994)	Implied	Implied			
Coeterier and Dijkstra (1976)	√	√	√	√	
DeVeer and Burrough (1978)	Implied				
Dramstad et al. (2006)	√	√	√	√	√
De la Fuente de Val et al. (2005)	√	√	√	√	√
Germino et al. (2001)	Implied	Implied	√	√	
Gimblett et al. (1985)					
Hammitt (1988)	Implied	Implied	√	√	
Hammitt et al. (1994)	Implied	Implied	√	√	
Higuchi (1983)					
Hull and Buhyoff (1983)	Implied	Implied			
Iverson (1985)					
Kaplan, Kaplan et al. (1979-89)					
Litton (1968)	Implied	Implied			
Litton and Tetlow (1978)					
Litton et al. (1974)					
Palmer (2004)	√	√	√	√	√
Palmer and Lankhorst (1998)	√	Implied	Implied	√	
Ruddell et al. (1988)			√	√	
Shafer et al. (1969)			Implied		
Zube et al. (1975)	Implied	√	√	√	

Felleman (1982) notes that the USDA Forest Service says that these distance zones are in the West and care should not be applied without thinking. He went on to establish his own distance zone limits at 0.8 km (fore), 1.6 km (mid), and 3.5 km (back), for an eastern Great Lakes visibility study. Higuchi (1983) used 140–360 m (0.08–0.23 miles) and 3,300–6,600 m (2.04–4.1 miles) as the break point between short distance and mid-distance and mid-distance and long distance, respectively, depending on textural cues from deciduous or evergreen vegetation. Texture is scale dependent.

Impacts on relative scaling (object, space, or object/space to their context) (Fig. 1) occur as we move not only laterally in the landscape, but also vertically. When we become elevated above and detached from the surroundings below, two things happen. First, we see farther by now peering over the tops of former boundaries. Second, and coupled with the first, we can view the surfaces below in a revised relationship, seeing more of their tops and sides and less of their bottoms. Central features of elevated viewpoints make horizons more important and reveal and command ground planes. In sum, the observer also sees more of the surrounding landscape context (Fig. 2).

Before enacting visual assessment protocols with variables impacted by scale, it seems reasonable to establish how absolute and relative scale are being used and to see how variability might be apportioned to differing scale relationships. For example, Hull and Buhyoff (1983) examined them in their closely controlled experimental work. Their approach could be expanded to investigate explicit levels of absolute and relative scale, how humans react, and the impacts on perceived visual quality.

Research Need #2: Grain and Extent as Components of Scale

Tveit et al. (2006, p. 242) propose a less detailed definition of visual scale as "the perceptual units that reflect the experience of landscape rooms, visibility and openness." What seems to be missing from most visual landscape assessment methods reviewed (Table 1a, 1b, 1c) is an operational concept for relative scale. It could be adapted from landscape ecology where grain and extent (resolution and scope) are used hierarchically to define scale. What would need to be resolved, however, is that landscape ecologists' interests most often revolve around objects. As long as it is made clear that objects

Figure 3.—Grain, indicated by a small area in foreground and limited extent, results in small grain and small scale. Photo by Richard K. Sutton, used with permission.

cannot be seen without intervening spaces and that spaces result from defining objects, then the care and rigor that biological landscape ecologists bring to defining grain and extent might be applied to visual landscape studies. It also means bringing an observer into the process as done by Kaplan (1979). For example, in visual landscape studies, grain could be conceptualized as the size of the space (however large) occupied by the viewer (Fig. 3). Researchers should answer: Just what is the size range of such a space, if any, that a viewer perceives and how does a study relate that space to the defining boundaries?

Grain and extent linked in a hierarchical relationship might be used to gauge relative scale (Sutton 2011), though it involves careful consideration. For example, selecting 30 square meters as a lot (and grain) size, as Palmer (2004) does, fails to account for other visible landscape boundaries or compartments (De Veer and Burrough 1978, Palmer and Lankhorst 1998). This locks the viewer into an absolute scale of space much like the set distance zones described above. For visual landscape studies, grain might best be put into operation by controlling for and varying the bounded space. Doing so accommodates human multi-scalar perception but violates biological landscape ecologists' need to standardize control grain size.

Extent might be conceptualized as the visible spaces and their boundaries beyond the boundaries of a perceived envelope of space or thought of as the context in which that space is nested hierarchically (Sutton 2011). While these conceptualizations make sense to most landscape architects' understanding of space, they may not be thought of as universal among all humans (Sutton 2011). For visual landscape studies, initial research is needed to examine the efficacy of a dynamic, interacting hierarchy of grain and extent to determine scale.

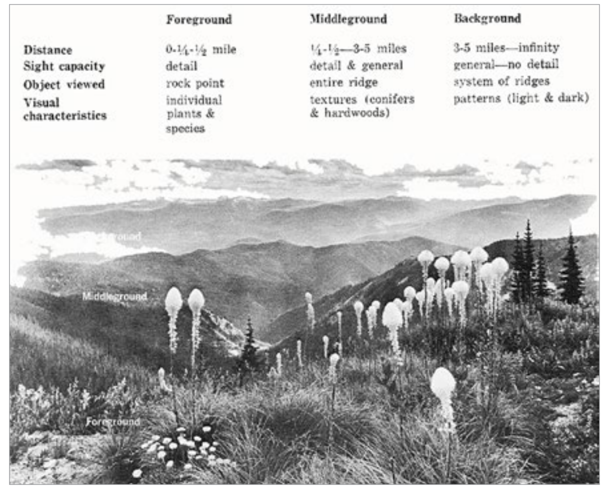

Figure 4.—Distance zones seem reasonable for the western forests, but maybe need rethinking in other contexts. Image from USDA Forest Service 1973.

Research Need #3: Understanding the Relationship of Visual Extent and Distance of View

Many researchers assessing visual landscapes confuse the conception of scale as merely distance or distance of view (Fig. 4). They collect and examine data without stating a net and mesh size. Often, they do not acknowledge that to understand scale in visual landscape studies, there must be some level of extent (context) for comparison with grain and, lacking it, the observer is left simply with the grain he or she occupies.

Hull and Buhyoff's (1983) empirical study concludes that distance of view is a variable; it is not singular and may represent composite effects. Coeterier's (1994) work begins to explain some of the cognitive processing needed to understand spatial configuration's impact on preference for landscape scenes. Coeterier's work surmises that scale integrates distance and spatial size, two aspects of configuration of scale.

Palmer and Lankhorst (1998) struggled with modeling landscape space. When they assume that "landscape enclosure or spaciousness is represented by the sum of the wooded and urban areas or the total area filled with landscape objects" (p. 68), they appear to be using

Figure 5.—Visual assessments must focus on spatial qualities while simultaneously understanding the masses with which spaces interact. Masses create boundaries to spaces but are often not completely opaque or continuous. Photo by Richard K. Sutton, used with permission.

Figure 6.—On this rural stage, does the foreground ditch create a smaller space? As a part of a trompe-l'oeile rural landscape, the viewer decides whether visual grain and extent reach the ditch, the trees, or the horizon. It illustrates the Dramstad et al. (2006) concept of space-grain. Photo by Richard K. Sutton, used with permission.

a percolation model (Turner et al. 2001) based on visibility in which objects within the landscape modify spaciousness. However, simply filling a space (or grid cell) with opaque objects may or may not affect its spaciousness if: 1) the objects are closer or farther away from the observer (i.e., locus of photographed view) in a 250-m × 250-m cell; 2) the objects occur on the cell's perimeter; or 3) there are openings in the array of objects at the edge of the cell. The last situation likely led to their creation of a modified and improved predictive model using what they call a neighbor effect, though Palmer and Lankhorst (1998) offer no explanation tied to any theory about why their modified model was better. The root of the problem is the substitution of spatial distance for scale.

Ruddell et al. (1989) also misunderstand the potential importance of spatial extent. If we conceptualize their work as having both a grain and extent component (which they did not), their study scenes all could be described as small-grained and limited in extent. They found that the degree of spatial enclosure was significantly related to scenic beauty in photos. However, there may not have been great enough range of differing extents to support such conclusions based on the constrained examples of enclosure.

Palmer (2004) uses viewsheds to help delimit boundaries, though he also relies on viewer memory and inference by selecting the political boundary of Dennis, MA, as the extent. While indeed a (political) boundary, the city limits of Dennis, MA, is likely not strongly visible and would thus be irrelevant to visual studies proffering direct visual stimuli as photographs of landscape scenes.

Research on visual qualities that control for differences in grain and extent might eliminate the current use of distance-of-view as a substitute for scale or extent.

Research Need #4: Relevance of Space and Mass in Understanding Spatial Scale

Humans perceive spatial wholes defined by edges of massive patches (Fig. 5) but may not perceive a patch as a whole. This is a difficulty similar to understanding landscape spaciousness (Coeterier 1994) or where landscape objects occupy and dominate a cell for Palmer and Lankhorst (1998). Kaplan (1985, p. 174) notes, "The task of visual assessment and visual resource management, then, must focus on the organization and pattern of *spaces* and on the interpretations of these *spatial characteristics* in terms of human functioning" (emphasis added).

Dramstad et al. (2006) begin to address this issue when they operationalize a concept called "space-grain." Grain-size measures "the number of patches of open land types divided by the total area of open land" (p. 470). The reason given for visualizing grain size in relation to total open area is that "landscape elements such as a narrow hedge or grass bank between two fields (i.e., divid[ing] the landscape into more patches) may change the visual impression of a landscape, even though total area of a more open landscape may be almost identical" (Fig. 6).

Landscape architects are quite familiar with the space versus mass conundrum. If one concentrates on the masses of boundary, one simply sees an object's edge or possibly an object in space. On the other hand, one can be cognizant of the mass while primarily focusing on the shape, size, quality, etc., of the space as Dramstad et al. (2006) begin to do with their "space-grain" concept. Because of its concrete simplicity, the first approach, mass awareness, is inherent in raster-based delineation or becomes embedded in biological landscape ecologists' definition of scale. For example, Turner et al. (2001) say "grain is the finest spatial resolution with in a given data set" (p. 43). Humans with our hierarchical perception (Gibson 1986) (likely evolving in relationship to a hierarchical physical environment) can easily understand and react to space while still remaining cognizant of the embedded masses. If we could not do so, then finding our way around in the world would be difficult if not impossible.

Researchers need to devise concepts, methods, and measures like space-grain that acknowledge, parse, and account for variation in space and mass and its human perception.

Research Need #5: Resolving the Chorological Nature of Visual Landscape Assessments With the Topological Nature of Psychophysical Landscape Metrics

Chorological versus topological is a more generalized problem of the space/mass interaction. While much can be gained from exploring the use of psychophysical measures, researchers should understand and use logical typing so that the metrics are believable. For example, Germino et al. (2001), De la Fuente de Val et al. (2005), Dramstad et al. (2006), and Palmer (2004) all attempt to apply landscape ecological metrics garnered directly from plan views or even remotely sensed sources to directly gauge preference for visual landscapes. Palmer's knowledge of human-landscape perception (Palmer 1986) should be used to translate landscape ecological concepts into visual and spatial terms. Humans require an envelope of space in order to perceive mass (recommendation #4 above). Lacking that space impacts perceptual and preference outcomes (Kaplan 1979, Kaplan and Kaplan 1989, Ruddell et al. 1989).

Visual studies are chorological (Zonneveld 1990), horizontal, subjective, and multi-scaled perspectives (Gibson 1986). Conversely, landscape metrics are topologic, vertical (Zonneveld 1990), objective, single-scaled, and two dimensional. Germino et al. (2001) show there is poor correspondence between landscape metrics from eye level and planimetric views. Therefore, if you attempt to directly correlate landscape preference with such landscape metrics, you may be altering scale effects, scaling up or scaling down (Wu and Li 2006) without knowing it.

Humans have the ability to learn and integrate knowledge about their surroundings. Since most humans (excepting pilots) do not and have not widely experienced the world from above, it stretches credibility to use vertical views to create perceived environmental qualities. Perhaps the way around this would be to create ecological indices from the horizontal perspective scenes. Early studies (Shafer et al. 1969) started in this direction and it might be possible to use viewsheds as samples for metrics created from plan view while correlating them with the scene used to generate the viewshed. This is a technique Dramstad et al. (2006) appear to be using.

CONCLUSIONS

In the last 50 years, visual landscape studies have indeed become more ecological. They are, in fact, simultaneously ecological and psychological, because humans inhabit and respond to landscape structure, function, and change. If citations in Table 1a, 1b, and 1c were ordered chronologically it would show more recent visual studies cover more of Wu and Li's (2006) scale ideas. Future studies and theory must continue to become more cognizant of scale factors because the hierarchical structure of the landscape interacts with our hierarchical system of human sensory perception to create information, much of it dealing with environmental and landscape quality.

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VIEWING THE "LANDSCAPE" OF THE GEORGE WASHINGTON MEMORIAL PARKWAY

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Abstract.—This paper investigates views along the George Washington Memorial Parkway between Washington, D.C., and Mount Vernon, Virginia, especially their role in transforming the Potomac River waterfront from *land* into *landscape*. It discusses the design of a narrative sequence of views by landscape architect Wilbur Simonson and its importance in the commemoration of George Washington, the ideological purpose of the parkway. It places this emphasis on views within the discourse of landscape painting and cultural geographic interpretation of landscape ideology, showing the complexities of landscape values embedded in landscape paintings and revealing a similar complexity in the design of the original segment of the parkway. It concludes with a discussion of the values of a cultural geographic approach for landscape management.

INTRODUCTION

Notice the Washington Monument out the windshield of your car. Rising above the slight elevation of Monument View Hill along the George Washington Memorial Parkway, it is as impressive a view as you get on most urban parkways. Banks of hundred-year-old shade trees border the roadway, allowing just an index finger of sky to touch the road. Right there, on this bit of framed horizon, stands the white obelisk of the monument. It is at once subtle and dramatic. Subtle, because distance diminishes its stature, and dramatic, because when you catch it just right, it really does gleam like a captured ray of sunlight set against a blue sky. The view even lasts for a while since the road runs straight for half a mile at this point, perfectly aligned with it (Fig. 1).

Figure 1.—View of Washington Monument along George Washington Memorial Parkway. Photo by Paul J. Kelsch, used with permission.

Still, the monument can be hard to see. It helps if the weather is clear and humidity low. You need to drive in the left lane to catch more than a glimpse of it and a large SUV can block the view all together. All this points to how delicate a view is and how carefully made were the decisions in its design. For as commonplace as they are, especially along scenic roadways, views are often explicitly staged scenes, as prescribed as the roadway itself even though they seem so inevitable as to be entirely natural.

Critical to the view is the vegetation along the roadway. At the time of construction in 1932 there were almost no trees in this landscape and Monument View Hill afforded a wide sweeping vista of land and water (Fig. 2). The field landscape architect for the parkway, Wilbur Simonson, framed the monument with loosely symmetric clusters of oaks and maples planted along the roadway. These trees transformed this open vista into a framed view of the Washington Monument (Bureau of Public Roads 1932, Sheet 16 of 45; National Park Service 2009). The trees would take decades to grow large, but the seeds of the view were planted with the clusters of saplings on either side of the road.

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Figure 2.—Open vista from Monument View Hill, 1932. Photo from National Archives, 32-534.

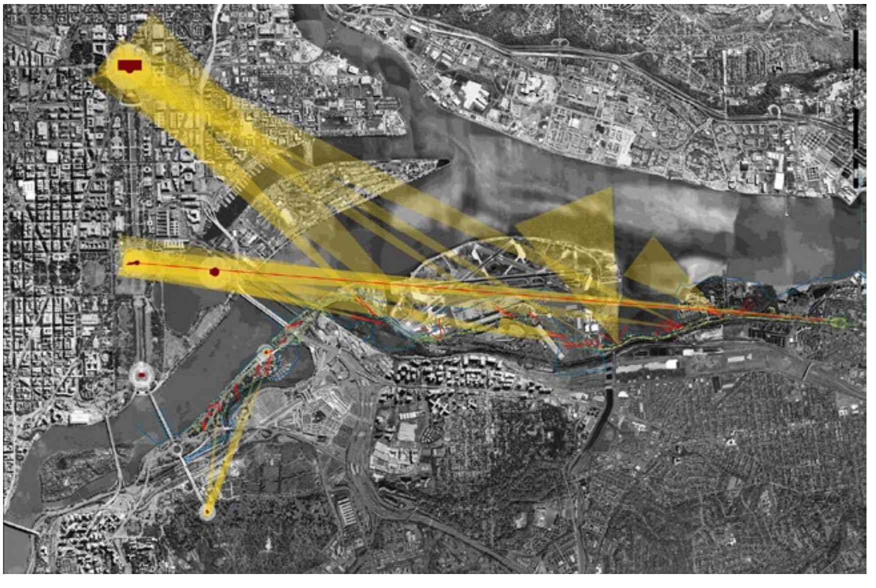

Figure 3.—2007 satellite photo with view cones from 1932 planting plan extended to notable landmarks. Photo from National Park Service #850/100144.

More than 80 years later, it is safe to say that no one knows Monument View Hill by name and few notice its slight rise in elevation. It is too minor a landform. The name only shows up in the original construction drawings for the Parkway, indicating how important this future view was to the landscape architects (Bureau of Public Roads 1932, Sheet 16 of 45). Simonson's planting plans give other clues about the views, too. Among the thousands of circles indicating trees to be planted, there are numerous V-shaped cones indicating important views. The cones are quite accurate. Each begins from a specific point along the road, and each angle is equally precise. Some are quite narrow, directed toward a specific focus, and others are wide arcs, implying broad panoramas.

All this leads to a bit of a mystery. What did Simonson want us to see in the landscape? What was each view of? Here the drawings are mute. Simonson does not indicate the subject of any of the views, only their direction and defining vegetation. Yet because each one is so precise, overlaying his planting plan on a current satellite photograph of Washington, D.C., reveals two recurring subjects—the Washington Monument and the dome of the U.S. Capitol (Fig. 3). The drive north from Alexandria would have been characterized by alternating views of these two major landmarks. (Construction of Reagan National Airport eliminated most of the views so the sequence no longer exists as designed.)

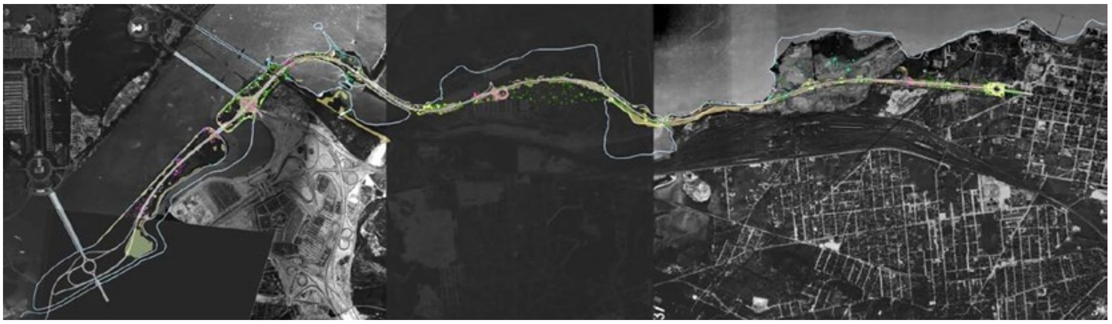

Figure 4.—1937/1943 composite aerial image showing original plan on original terrain, north of Alexandria. Photo from National Park Service #850/100144.

Figure 5.—Dyke Marsh and trolley station, 1930. Photo from National Archives, 30-836.

Figure 6.—Finished parkway near Fort Hunt, VA, 1932. Photo from National Archives, 30 N 32-161, Box 246.

Simonson's emphasis on views is a clue to how the design and construction of the original segment of the parkway transformed the edge of the river into a "landscape" (Fig. 4). Before 1932, people could only get to the river in a few places, most notably in the City of Alexandria and at Dyke Marsh where a handful of small fishing shacks were clustered right on the edge of the river (Fig. 5).

Constructing the parkway changed the riverfront entirely (Fig. 6) (Davis 2001). It allowed people to drive along it for 15 miles between the Lincoln Memorial and Mount Vernon, experiencing it as a nearly continuous shoreline with places to get out of their cars for picnicking, fishing, and other recreation. It literally transformed the shoreline from disused farmland, woodland, mudflats, railroad yards, and gravel quarries into a picturesque natural landscape featuring a series of views that focused on symbols of George Washington's life and legacy along the river. In short, the Parkway transformed the Potomac River shoreline from mere *land* into a *landscape.*

This paper examines the importance of these Parkway views, situating them in a larger conversation about the ideology of landscape. It inspects that ideology by studying previous interpretations of landscape paintings and extending those interpretations to the physical landscape of the Parkway. It relates this ideological emphasis to the more immediate issues of landscape management and uses it to cast flattering light on the parkway's original design, a design that was overshadowed by later parkways. Finally, while acknowledging the baggage that comes with the ideology of landscape, it celebrates the transformation of the muddy banks of the Potomac River into a Capital River, the mythic home of George Washington.

THE IDEOLOGY OF LANDSCAPE

In ordinary conversation the word "landscape" is not a problematic term, but within cultural geography the term is fraught with ideological debate. Understanding the history of the term helps put into context the relationship between the land along the Potomac River and its status as a landscape.

The idea of landscape is rooted in Renaissance painting but, as art historian Henri Zerner notes, there is a fair amount of ambiguity between paintings and actual terrain:

> "A beautiful landscape," I say, and you do not know whether I mean a picture or an actual view. This linguistic ambiguity between a work of art and what it represents does not occur in other instances—between the person and the portrait, the still life and the objects that the artist has staged in it—and it exists in all the major Western languages. This may seem innocuous enough, but it does imply something peculiar about landscape, as though our reaction to the image was exchangeable with our expectations of the world in a way it is not with other kinds of pictures (Zerner 1989, p. 29).

This interplay between paintings and terrain has prompted cultural geographers and other scholars to investigate landscape paintings, studying how they represent the world and uncovering clues to social and geographical values represented in the paintings. Examining several of these paintings offers insight into the richness of the concept of landscape and shows how these ideas are manifested along the George Washington Memorial Parkway.

Figure 7.—Giorgione, *The Tempest*. Museo Nazionale Gallerie dell'Accademia di Venezia, Venice.

Giorgione's *The Tempest* (1506–1508) is among the first European landscape paintings, and it has defied clear interpretation for centuries (Fig. 7). In the picture, a nearly naked woman nurses a child in the foreground, seemingly disregarding or unaware of a dressed man standing on the left looking at her. The figures are quite evidently posed in the foreground and upon closer examination the landscape contains a variety of potent symbols—a pair of broken columns, a small bird on a roof, civic emblems on buildings—that invite speculation about their intended meaning. Various structures and trees are equally composed in the increasing distance where a river, several monumental structures, and a stormy sky focus the perspective in the center of the picture. At the peak of this deep perspective, a flash of lightning animates the foreboding sky.

Cultural geographer Denis Cosgrove uses *The Tempest* to link the idea of landscape to the development of perspectival drawing in the Italian Renaissance (Cosgrove 1998). He points out that the use of perspective in landscape paintings offers an illusion of control over space and time—the lightning has flashed just at the right moment—and all this visual control projects an authority over the landscape. The viewer of the painting occupies the single most important "point of view" of the scene and assumes a privileged position over the landscape. From this vantage, the whole scene recedes deep into the distance, enabling the viewer to assert perspectival control and authority over the whole space of the landscape. All this is masked by the implied reality of the picture even though the image is not actually all that real. Lightning never strikes in the same place, forever.

All of this is rather well trodden terrain in cultural geographic circles and Cosgrove's ideas have spawned additional speculation about the ideology of landscape. While he seems to suggest that viewing land as landscape is somehow a sinister or pernicious act, his interest lay in exposing the assumptions of authority and realism so that other values could be given equal recognition. Not surprisingly, other paintings reveal different insights.

Johannes Vermeer's *View of Delft* (1660-1661) differs from *The Tempest* in telling ways (Fig. 8). Vermeer's painting depicts the City of Delft from across a river where its steeples, towers, and chimneys make an intricate skyline beneath an expansive sky. The red roofs of the town are sheltered by a wall and fortifications protecting the watery entrance into the city via a small canal. Half a dozen figures stand on the foreground bank of the river conversing, it seems, in rather ordinary groupings.

Whereas Giorgione's *The Tempest* is an obviously staged scene, *View of Delft* has a sense of being a found image, more happenstantial than staged. The painting was unusual in its time because it built on a topographical tradition of depicting cities from afar, often viewed across water bodies, and yet it rendered Delft with an intimacy and presence that makes it believably real. The picture has the distance of mapping but the expression of painting, especially in its contrasts of bright sunlight and shadows from overhead clouds (Alpers 1983). All this confounds the boundary between the image and actual terrain, and it is easy to imagine that we are looking at the actual city rather than seeing Vermeer's interpretation of it. The realness seems to invite us in yet it still keeps us at a distance, quietly watching the town from a detached point of view. Vermeer's painting transforms the city into a landscape but the ideology is so well hidden, so naturalized, that we do not realize we are viewing a landscape at all.

Figure 8.—Vermeer, *View of Delft*. Mauritshuis, The Hague.

Figure 9.—Peter Brueghel the Elder, *Hunters in the Snow.* Kunsthistorisches Museum – Museumsverband, Vienna.

Pieter Brueghel's *Hunters in the Snow* (1565) (Fig. 9) is a remarkably different scene (Olwig 1996). A group of hunters is returning home at the end of a cold winter day, apparently a poor hunting day since only one carries a small animal over his back. The men and dogs appear tired as they plod through the snow atop a small but steep hill. Nearby a group of women work around a hot fire, and in the village below, numerous other townsfolk skate on a pair of ponds. Many are playing sports, hockey players and curlers are visible, and others go about their daily work. The roofs of the village houses are all snow covered and blend in with a landscape that recedes far into the distance.

Unlike the previous paintings, this landscape is saturated with people—people going about the tasks and joys of living on a very ordinary day in their community. Peering over the shoulders of the hunters, the perspective might be from another hunter in the party or from a neighbor's house on the hillside. Whereas the figures in *The Tempest* are awkwardly posed in the foreground and in *View of Delft* they give scale and balance to the picture, here they are truly inhabitants of the landscape. This is their home.

According to geographer Kenneth Olwig, this combination of community and territory is fundamental to the origins of the word "Landschaft," the German root of the English word landscape. In the borderlands of Denmark and Germany, "Landschaft" referred to territory where people had a communal form of government reinforced with customary laws and cultural traditions. A "Landschaft" was more akin to current New England townships governed with democratic town meetings than it was to a German county ruled by a count (*Grafschaft* ruled by a *Graf)*. In these northern territories, "Landschaft" referred to the land itself combined with the customs, laws, and cultural identity of the community living on it. Given this intertwining of people, customs, and terrain in the notion of "Landschaft," it is not surprising that Brueghel's painting would depict so many people going about so many different activities.

If *Hunters in the Snow* exemplifies a northern European "Landschaft," Claude Lorrain's *Landscape with Apollo Guarding the Herds of Admetus and Mercury Stealing Them* (1645) typifies Italian landscapes (Fig. 10). The imagery and perspective are more naturalistic and believable than in *The Tempest*, but the setting and composition are remarkably similar. The narrative again unfolds in the foreground with one figure oblivious of the other, and they have little apparent relationship to a distant town across the river. However, whereas the story depicted in *The Tempest* is unclear, in Claude's painting the narrative is evident in the title: Mercury is stealing cattle that Apollo is supposed to be guarding.

The story of Mercury and Apollo is typical for a painting by Claude. As landscape historian Mirka Benes explains, Lorrain painted pastoral landscapes in Rome at a time when agricultural production was shifting from cultivating grain to grazing livestock (Benes 2001). According to Benes, the actual fields

Figure 10.—Claude Lorrain, *Landscape with Apollo Guarding the Herds of Admetus and Mercury Stealing Them*. Galleria Doria Pamphilj, Rome.

around Rome were overgrazed and the shepherds and cattle herders lived in pretty miserable conditions. Claude studied the land closely, drawing the animals grazing and manuring the fields so that he would have vivid understanding of the terrain and grazing practices, but his finished paintings were lush landscapes populated with mythic figures and people in ancient attire. In effect, he depicted the contemporary landscape as the inheritor of ancient traditions.

Claude's *Landscape with Apollo Guarding the Herds of Admetus and Mercury Stealing Them* fits this pattern well. The cows are believably painted, one or two have stopped to graze despite Mercury's efforts to hurry them along the path, and the bridge and defensive structures are presumably like those outside Rome. The story is an ancient myth, however, and by setting it in the 17th century Roman countryside, Claude consecrates the overgrazed lands, rendering them as an idealized landscape. He gives his artistic blessing to the new agricultural practices and the newly wealthy papal families that owned the land.

THE LANDSCAPE OF THE GEORGE WASHINGTON MEMORIAL PARKWAY

How does this selective history of landscape painting help us understand the George Washington Memorial Parkway as a landscape? Is it a sinister or pernicious act, an imposition of authority as Cosgrove's reading of *The Tempest* would suggest? In part. The National Park Service does manage the landscape with the authority to limit the kinds of activities and uses allowable in the park. It is unlikely that fishing shacks will ever be allowed again at Dyke Marsh, nor will other activities like hunting or harvesting firewood that likely occurred on this land in the past. From this perspective, the Parkway landscape can be seen as having supplanted earlier residents' ways of using and inhabiting this land with a more sanitized and controlled set of uses and acceptable behaviors. In this reading, the transformation of land into landscape does seem rather authoritarian.

However, other readings inspired by the other paintings reveal greater complexity to this landscape. Like the Pieter Brueghel's *Hunters in the Snow*, the Parkway landscape is richly inhabited. By design, houses face the parkway across a swath of greensward, integrating the Parkway into the community (Fig. 11). City buses traverse it with bus stops sited so that residents can travel the Parkway to and from Alexandria on public transportation. More obvious is the presence of countless people along its full length: people walking, cycling, jogging, fishing, talking on cell phones, and eating (Fig. 12). Numerous picnic areas, a multi-use path, small parking areas, and several designated parks provide opportunities for many kinds of activities. On a warm summer day, the landscape seems as saturated with people as Brueghel's snowy scene, each acting out recreational customs and asserting their claim to this public landscape.

Like Italian landscapes, the alignment of the parkway and Wilbur Simonson's choreographed sequence of views make a narrative about George Washington's life and legacy along the Potomac River. Landscape architects and engineers aligned the road so motorists would pass by or see various places important in Washington's life and memory: his place of worship; the ruins of his granddaughter's home; Fort Washington, on a site he chose to defend the city; the George Washington National Masonic Memorial, constructed by his former Mason's Lodge; and his beloved home Mount Vernon (Davis 2001, Kelsch 2011). The parkway stitches these fragments of history into a commemorative story of Washington's presence along the river, a cinematic montage where geographical proximity and sequence evoke a kind of connect-the-dots narrative.

Like Claude's painting of *Apollo Stealing Mercury's Cows*, Washington's personal history is framed with classical references. The Washington Monument explicitly references the obelisks of Egypt, also envisioned as captured rays of sunlight. The dome of the Capitol, where he laid the cornerstone, has its own lineage of classically inspired domes tracing their heritage back to the Pantheon in Rome. The Masonic Temple is modeled after the lighthouse in Alexandria, Egypt, one of the Seven Wonders of the Ancient

Figure 11.—Houses, multi-use path, and parkway, 2014. Photo by Paul J. Kelsch, used with permission.

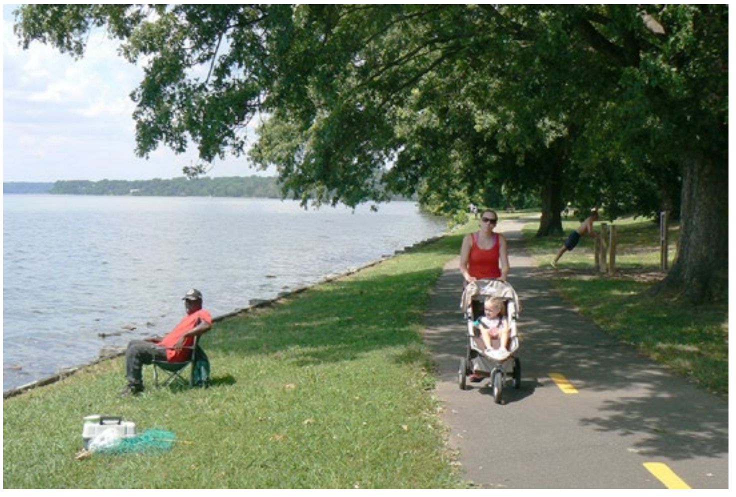

Figure 12.—Fishing, strolling, and exercising on path, 2014. Photo by Paul J. Kelsch, used with permission.

World. Collectively, these classical structures, viewed while driving along the river, consecrate the Potomac, elevating its status from a swampy tidal estuary to our own "Capital River," one worthy of an emerging player on the world stage. In this light, George Washington himself becomes one of those players, his home and his reputed dignity as President becoming part of the larger story of Washington, D.C., as a capital city, rising in importance in the first decades of the 20th century.

None of this is very overt. Despite the evident composition of the Washington Monument view, these various landscape perspectives are not immediately obvious while driving the George Washington Memorial Parkway. Indeed, the parkway landscape seems as happenstantial as Vermeer's *View of Delft*, all of it naturalized to seem inevitable and without design.

"LANDSCAPE" AND STEWARDSHIP

How might this landscape reading of the George Washington Memorial Parkway inform visual resource management? I see three values.

The first is fairly pragmatic and deals with the management of specific views. The northbound view sequence was devastated by the construction of Reagan National Airport. Most views of the monument and Capitol are irretrievably lost today but one important view could be reclaimed, the complement to the initial view of the Washington Monument.

In the original design, the parkway curved out into the shallows of the river on a new causeway at Gravelly Point, just north of the current airport. Driving the causeway, travelers would be surrounded by water and straight ahead, framed by a grove of American elms, was the dome of the U.S. Capitol. This dramatically composed and sequenced view was the culmination of the whole sequence and would have underscored the classical and mythic narrative of George Washington's presence along the river. Today, that site is under the glide slope of the airport, and the FAA maintains strict height limits on the vegetation. As trees grow large, they are cut down, and the vegetation has alternated between blocking the view of the Capitol and being an unfocused vista. Currently, the dome is visible but unnoticed because no vegetation composes the open space into a view (Fig. 13). Given the classical emphasis of the parkway in key places, the loss of this particular

Figure 13.—View of U.S. Capitol at Gravelly Point. Photo by Paul J. Kelsch, used with permission.

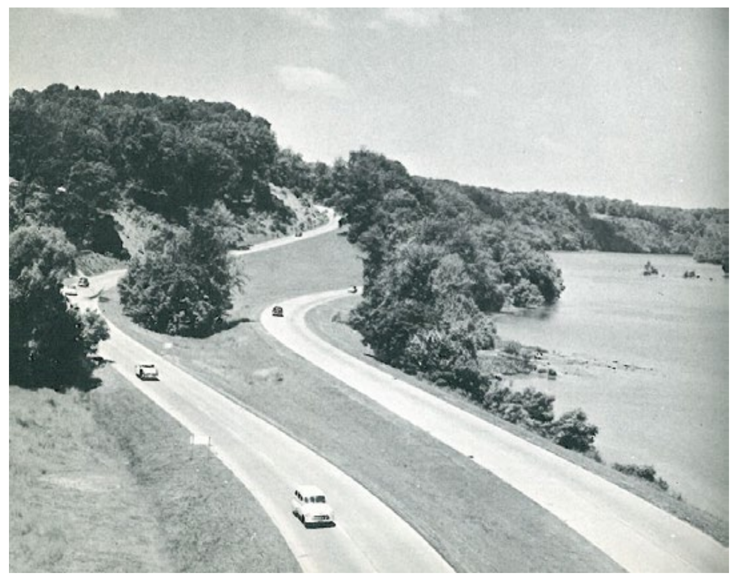

Figure 14.—Image of George Washington Memorial Parkway c. 1954, used in textbooks as example of good road design. U.S. Public Roads Administration, National Archives

view diminishes the landscape in a small but important way. Reframing the view could reinforce this important scene in the commemorative montage of the Parkway.

This history of landscape painting also shines light on qualities that have been overlooked in the southern section of the Parkway. Numerous design decisions contribute to a rich inhabitation of the landscape, saturating it with people. Yet few parkways integrate this well into their communities, including the extension of the George Washington Memorial Parkway to the north. The northern section was literally a textbook example of good highway design (Fig. 14) and it is a striking road to drive today (Stone 1959, Tunnard and Pushkarev 1963). But it has almost none of the public use and integration into the surrounding communities that characterize the southern section. From Cosgrove's perspective, the northern section presents the landscape as a seamless detached view being framed and experienced only through the windshield. The southern section, by contrast, is more like a "Landschaft" and is worthier of recognition because of this difference. In an era of rising concern for social equity, the balance of community and highway in the original design would seem to be a better textbook example today.

Albert Bierstadt's *Yosemite Valley, 1868* (Fig. 15) casts a glow on the idea of landscape that yields a final value to this study of landscape paintings. It depicts a westward view down Yosemite Valley with the setting sun casting El Capitan in silhouette while washing Cathedral Rocks in golden light on the opposite side of the valley. The Merced River winds through the foreground reflecting bright sky and leading us deep into the perspectival space of the painting. As with *View of Delft*, this picture allows us to imagine we have just happened upon the scene, and it seems we could walk right into the grassy foreground. Unlike Vermeer, Bierstadt includes no evidence of people at all. The foreground is only populated with trees and rock outcrops real enough to sit down on and enjoy the view.

With its lack of obvious composition or evident signs of inhabitation, it is easy to imagine Yosemite Valley as a scene of pristine nature, free from human influence. It seems, in other words, not to be a landscape at all. Yet the painting is clearly a landscape, and as historian Simon Schama contends in "Landscape and Memory," the countless acts of photographing and painting the valley, as well as naming the mountains and making pilgrimages to see them, are all part of a transformation from land into landscape (Schama 1995). While some might think this is an act of despoliation, he sees it as a positive act because it indicates the extent to which the landscape has become part of our collective consciousness and cultural memory. Whereas from Cosgrove's perspective, the transformation from land to landscape seemed a somewhat sinister change with its imposition of authority over the land, for Schama it is cause for celebration:

> Even the landscapes that we suppose to be most free of our culture may turn out, on closer inspection, to be its product. And it is the argument of "Landscape and Memory" that this is a cause not for guilt and sorrow but for celebration. Would we rather that Yosemite, for all its overpopulation and overrepresentation, had never been identified, mapped, emparked? The brilliant meadow-floor which suggested to its first eulogists a pristine Eden was in fact the result of regular fire-clearances by its Awahneechee Indian occupants. So while we acknowledge (as we must) that the impact of humanity on the Earth's ecology has not been an unmixed blessing, neither has the long relationship between nature and culture been an unrelieved and predetermined calamity. At the very least, it seems right to acknowledge that it is our shaping perception that makes the difference between raw matter and landscape (Schama 1995, p. 9-10).

Figure 15.—Albert Bierstadt, *Yosemite Valley, 1868*.

Constructing the George Washington Memorial Parkway did indeed transform the banks of the Potomac River into a landscape (Fig. 16). The informal fishing shacks at Dyke Marsh no longer exist and indeed are no longer permitted. The whole landscape has an aura of formality and authority, applied through the agency of the National Park Service and consistent with the authoritative aspects of landscape painting. But the parkway also allows for greater public inhabitation of this landscape and it elevates the 15 miles of river to be part of the national imagery of the Capitol City. In this regard, it does indeed seem worthy of celebration as Schama suggests. Viewing the Parkway as a landscape is not free of ideological baggage but its particular baggage does allow us to take a pretty wonderful drive or ride or walk along the banks of our capital river.

Figure 16.—View of George Washington Memorial Parkway at Dyke Marsh, 1950. Abbey Rowe, National Park Service.

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GETTING IN THE GAME: A NATIONAL PARK SERVICE APPROACH TO VISUAL RESOURCES INVENTORY

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Abstract.—In 2013 the National Park Service launched a visual resources inventory method designed to capture visual experiences accurately and consistently across diverse landscapes. In the inventory process, each view is mapped and described from the viewers' perspective. Views are also evaluated to capture scenic quality and importance to the visitor experience. Because of the scale of many park landscapes and the dynamic nature of visual resource pressures, park staff must be able to conduct inventories in a modular way. Inventory data can be used in spatial analysis to show where views overlap, which portions of the landscape are visible from a given view point, and what is the composite value of all intersecting views. Robust inventory information allows managers to integrate visual resource considerations into park planning and management. This is important when working with partners beyond park boundaries to target critical areas for visual resource protection. The National Park Service visual resources inventory method has proven effective in diverse park landscapes and is gaining traction.

INTRODUCTION

Some of the Nation's most spectacular and historically significant landscapes are entrusted to the National Park Service (NPS). People experience and learn about these places largely by traveling through a park landscape and observing scenes within and beyond park boundaries. In fact, a review of 91 visitor surveys from parks across the country (1988–2011) found that 90 percent of visitors identify scenic views as very or extremely important. Over half of the people surveyed considered scenic views the first or second most important resource to protect (Kulesza et al. 2013). Every unit of the National Park System has visual characteristics that influence how people experience it.

But landscapes around parks are changing. Renewable and conventional energy development, urban growth, and internal park changes are some of the pressures creating visual change. Without thoughtful involvement, these activities threaten to degrade the most valued park scenery, which in some cases, is the very reason for the park's existence.

Therefore, the NPS recently launched a systematic, servicewide approach to managing scenery as a resource (Sullivan and Meyer 2016). This enables parks to actively engage in scenic stewardship and integrated resource management. It also supports the NPS's ability to identify shared values and support strategic growth with stakeholders.

The first step in managing scenery as a resource is learning what's out there. The NPS visual resources inventory (VRI) is a systematic process for documenting and evaluating scenic resources within and beyond park boundaries that is designed to meet park management and protection goals. The VRI was developed specifically to meet the unique needs of National Parks and the NPS. Capturing visual experiences accurately and consistently across diverse landscapes is a key goal. Because most visitors experience parks first through their eyes, their visual experience of a park is often essential to enjoyment and appreciation of park resources.

Comprehensive management of visual resources is a relatively new concept for the NPS as an agency. For some NPS staff, it can be difficult to think about scenery as a "resource." But this concept is key to successfully integrating it as part of park management. As a resource, scenery can be measured, managed, and protected. It is also finite and can be damaged or lost.

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AN NPS APPROACH

The concept of an inventory of the visual landscape, and its subsequent management as a resource, has been in place at the Federal agency level since the 1970s (Bureau of Land Management 1984, 1986; USDA Forest Service 1974, 1995). The Bureau of Land Management (BLM) and the USDA Forest Service (FS) have each developed and implemented visual resources programs to manage the scenic values of the large areas of lands they manage, and both of these programs include an inventory process (Bureau of Land Management 1984, 1986; U.S. Forest Service 1995). The new NPS system includes elements from these well-established visual inventory programs but is customized to meet specific NPS needs. Park managers, landscape architects, and planners, as well as natural and cultural resource specialists, all contributed to the development of the NPS visual inventory methodology.

Visual resources inventory information provides:

- A baseline for monitoring changes over time
- An additional layer of information for evaluating potential visual impacts of projects
- A basis for incorporating visual resources in park management and planning
- Resources for engaging in collaborative scenic conservation

Key Concepts

The following key concepts underlie the approach taken in designing the NPS VRI.

Unit of Inventory

Individual views comprise the basic unit of inventory in the NPS system and each view is mapped and described from a viewer's perspective. As an inventory unit in the NPS VRI, a view consists of the viewpoint (where the viewer is standing) and the viewed landscape (what they are looking at) as defined by left and right bearings. The decision to inventory and assess individual views is based on the way in which viewers experience a scene, and thus directly supports the NPS goal of providing for visitor enjoyment of scenery. This is a major distinction between the NPS VRI and the BLM and USFS systems. In other agency systems, the visual characteristics of relatively large areas on the landscape are evaluated and the boundaries of these areas may not directly correspond to a viewer's experience of the landscape from a fixed viewpoint.

Geographic Scope

Important park views often extend both across and beyond park owned property. For this reason, it can be essential for the NPS to look beyond its boundaries when considering visual resources. People don't "see" management boundaries when they visit parks. It is the NPS's responsibility to document and evaluate the visual resources in a way that reflects the visitor experience. It is also important to note that visual inventory results do not dictate management actions on either NPS or other lands. Instead, inventory results are used to help the NPS understand and communicate visual resource values.

Scenic Quality and View Importance

Park views are not entirely about aesthetic beauty. Some views may be highly prized because of their historic context or interpretive potential rather than (or in addition to) their purely scenic quality. In the NPS VRI system, each view is assessed to capture two distinct and equally weighted values of the view:

1) What is its scenic quality?
2) How important is it to the visitor experience and the park's purpose and goals?

Giving equal value to scenic quality and view importance allows the NPS to assess and understand visual resources in a more complete and holistic way. In other words, in the NPS VRI, nonscenic quality values, which include a number of items relevant to historic and cultural values, count as much as the scenic quality in determining the total value of the view (Sullivan and Meyer 2016).

Works in All Types of Landscapes

Breathtaking natural landscapes, historic battlefields, archaeological sites, urban corridors, and wilderness areas all have visual resource values. These values must be considered in context of their primary landscape character type (e.g., natural, agricultural, urban) rather than compared against a single standard. The NPS VRI system does not value natural scenery more than historic or cultural views which often include development or other human-made features. This philosophy reflects the NPS need to value differing visual expectations appropriately across the wide variety of park landscapes.

Regional Context

Views are evaluated in the context of the NPS unit and surrounding landscape. The system does not compare NPS units to one another even when they have the same landscape character type. For example, a predominantly natural scene at Denali National Park and Preserve would not be rated in comparison to a predominantly natural scene at Cape Cod National Seashore. This is important because it allows for the application of consistent methodology that respects and recognizes regional differences in landscape character.

Approachable

Volunteers and/or park staff from any background can gain the skills to conduct an NPS visual resources inventory with relatively brief training and field practice. A training workshop is the standard model for providing a foundation of visual resource knowledge. Workshops equip teams with the skills needed to continue inventory work in the future. Because of the vast scale of many park landscapes and the dynamic nature of visual resources, the capacity of park staff and volunteers to conduct an inventory without the direct assistance of a visual resource specialist is a necessary part of making this system work for the NPS.

VISUAL RESOURCES INVENTORY STEPS

Conducting a visual resources inventory is a relatively straightforward process. Parks identify the need for an inventory and select viewpoints that address potential challenges and/or resource goals including the establishment of baseline condition information. Inventory teams visit identified viewpoints, spatially define each view, describe them in a systematic way, and rate the scenic quality on defined criteria. Next, a team of local experts document viewpoint and viewed landscape significance before rating the importance of each view for park purpose and visitor experience based on established metrics. Scenic quality and view importance ratings are then combined into an overall scenic inventory value that can be represented on maps and applied to a variety of spatial analyses.

The datasheets, rating guides, and instructions used to support the NPS VRI are available through the Visual Resource Clearinghouse hosted by the BLM Wyoming State Office (http://blmwyomingvisual.anl.gov/vr-inventory/nps/index.cfm).

Inventory Design and Planning

View Selection

Views may be selected to establish a baseline for monitoring visual change over time or to capture the current state of visual resources in an area facing immediate development pressures. Views may be selected to comprehensively assess the quality of the visitor experience or to document the character of a wilderness area. None of these approaches is wrong. Park staff are encouraged to select key views that will help them address their visual resource challenges and goals.

Interdisciplinary Teams

The NPS VRI can be implemented by nonvisual resource experts. It has proven effective to have team members with a variety of backgrounds participate in inventory work. Park staff from natural and cultural resources as well as interpretation, facilities, law enforcement and administration can all provide valuable input to the process, particularly in assessing view importance. Volunteer, partner, and stakeholder participation in the inventory is an excellent way to enhance staff capacity. Inviting these participants also facilitates shared understanding of visual resources and helps build relationships that ultimately strengthen the park's ability to achieve visual resource management goals.

Scenic quality field teams are ideally composed of 4–8 members to ensure balanced discussion and reasonable maneuverability. The scenic quality field work often provides the best opportunity to involve volunteers, partners, and stakeholders. Everyone who has participated in training will be equally qualified to assess the characteristics of what they see. It is strongly recommended that at least one local park staff person participate in each field team since knowledge of local landscapes and park protocol are essential. Additionally, NPS staff participation in the inventory will lend greater credibility to the inventory results.

View importance evaluation teams do not necessarily have to be the same people who participated in scenic quality field work. Group size is less significant but should include staff with different expertise (e.g., cultural resource specialists, interpreters, and natural resource specialists) because it is essential to capture nonscenic values of both the viewpoint and viewed landscape. In-depth local knowledge is critical for well-rounded discussion and efficient completion.

Timing

The NPS VRI captures the scenic quality and importance of views from the viewer's perspective, and it is important to do the landscape description and scenic quality evaluation at a time that reflects the average visitor experience. To the extent possible, the timing of the inventory should avoid fall color, wildflower blooms, and other ephemeral phenomena that could substantially affect scenic quality ratings. Situations such as smoke from a fire or very hazy days should also be avoided. Many parks have visitors year round and in some cases it may be desirable to inventory specific views under "leaf on" and "leaf off" conditions to capture the different viewing experiences.

Scenic Quality

Scenic quality data are collected in the field, on-site at selected viewpoints. By using a standardized approach, the process collects consistent descriptions and defensible ratings of scenic quality. Employing these methods lends credibility to the inventory of views by minimizing individuals' opinions.

Robust scenic quality information can provide:

- A baseline for monitoring changes to scenic quality over time
- Information needed for visual impact assessment of proposed projects
- Support for visual impact mitigation, restoration, or actions to improve existing views

Scenic quality evaluations describe and rate the landscape as it is observed at the time of inventory. When conducting an inventory, it is important not to imagine future conditions or rate based on memories of past conditions. Rather, the inventory data are a snapshot in time reflecting the visual observations on the day they were collected.

At each viewpoint a recorder documents the observation data and completes a structured landscape description while the other team members rate the scenic quality. The recorder then facilitates a consensus discussion among all team members and identifies the final team score and rationale for each rated element of scenic quality.

Observation Data

Information about the view point location, view boundaries, evaluation team, and conditions at the time of assessment are recorded as observation data (Fig. 1).

Landscape Description

Describing landscapes is complex and lacking a systematic method, individuals might approach it in many different ways. This can make it difficult to get consistent information about landscapes. Therefore, the NPS VRI process implements a standard format for describing the physical and aesthetic characteristics of a view. This structured description does not have any direct bearing on the numeric scenic quality rating. Rather, the landscape description is useful for documenting current conditions and may be useful for informing land use planning or project-specific impact assessment and mitigation. Landscape description information is recorded on the view description and scenic quality data sheets as shown in Figures 2 and 3.

Key aspects of the landscape description include:

- **View Type**—The view type is a general descriptive term for the viewing experience of the landscape, based on the spatial relationship of elements within the viewed landscape, and the spatial relationship of the viewer to those elements. The view types in the inventory process are panoramic, enclosed, focal, feature, framed, and canopied.
- **Landscape Character Type**—Landscape character is an overall visual and cultural impression of the landscape, and embodies distinct landscape attributes that exist throughout an area. It is a product of both the natural and human influences on the landscape. The landscape character types in the inventory are natural/natural appearing, pastoral, agricultural, rural, suburban, urban, and industrial.

Observation Data		
NPS Unit:	Date:	Time:
Viewpoint Name:	Recorder:	
Viewed Landscape Name (if needed):		
Evaluators:		

Viewpoint Coordinates:	☐ UTM, Zone: / ☐ Lat./Long.	/

View Geometry Bearings ☐ Magnetic or ☐ True N	Left:	Center:	Right:

Weather: ☐ Sunny/Clear ☐ Mostly Sunny ☐ Partly Cloudy ☐ Mostly Cloudy ☐ Cloudy/Overcast ☐ Cirrus

Observer Position: ☐ Looking down at scene ☐ Looking at eye level ☐ Looking up at scene

Photo Record		
Photographer:	Camera/Lens 1:	Camera/Lens 2:

Camera	Photo Number(s)	Pano	Notes

Figure 1.—Excerpt of the view description and scenic quality data sheet showing the observation data section.

- **Distance Zones**—The delineation of distance zones—foreground, middle ground, and background—for a view is related to the visibility of landscape elements and the degree to which landscape details can be discerned. At shorter distances, the details of the landscape are more visible.
- **Landscape Elements**—The landscape elements are specific features of the view that give it its unique characteristics and contribute to its value as a scenic view. Landscape element types include landform, land cover, land use, and structures. For each of these landscape element types, a list of possible landscape elements is provided in a checklist.
- **Design Elements**—Form, line, color, and texture are design elements used to describe the primary visual attributes of features in the landscape. The inventory process records the most prominent design elements in view to provide a baseline for identifying the important elements that could be affected by changes to the viewed landscape.

Scenic Quality Rating

For each view, individual raters assess the following indicators of scenic quality:

- **Landscape character integrity**: How intact is the landscape character? Is the landscape character impacted by elements that are inconsistent with the landscape character? What are the quality and condition of the elements in view?
- **Vividness**: Does the view have strong focal points? Does the view have bold forms and lines? Are there memorable, striking colors or contrasts?
- **Visual harmony**: Are elements of the view in scale with each other? What is the quality of the spatial relationships? Do the colors in the scene work well together?

Using the established guidelines described below, team members independently assign a numeric score of 1–5 to each of the components that make up the scenic quality indicators identified above. Note that even numbers and half point scores are allowed. The full team then discusses each component and agrees on a team rating.

Landscape Description
View Type: ☐ Panorama ☐ Feature ☐ Framed ☐ Focal ☐ Enclosed ☐ Canopied
Landscape Character Type: ☐ Natural/Natural Appearing ☐ Pastoral ☐ Agriculture ☐ Rural ☐ Suburban ☐ Urban ☐ Industrial
Are seasonal/ephemeral effects (e.g., wildflower displays, snow, haze) important to the scenic quality of the view? ☐**Yes** ☐**No** If yes, please describe:
Notes:
Extent of Distance Zones
Foreground:
Middle ground:
Background:
Landscape Elements

	Distance				**Distance**				**Distance**				**Distance**		
Landform	**F**	**M**	**B**	**Landcover**	**F**	**M**	**B**	**Land Use**	**F**	**M**	**B**	**Structures**	**F**	**M**	**B**
Mountains				Development				Natural Areas				High Rise - Residential			
Hills				Barren				Timber				Low Rise - Residential			
Buttes				Forest - Deciduous				Grazing/ Rangeland				High Rise - Commercial			
Mesas				Forest - Evergreen				Agriculture				Low Rise - Commercial			
Valleys				Forest - Mixed				Mining				Farm Buildings			
Ridge				Shrub/Scrub				Industrial				Misc. Industrial (Factories, etc.)			
Cliffs/Bluffs				Grassland				Office/Retail				Power Plants			
Canyons				Pasture/Hay				Urban Residential				Wind Turbines			
Plains				Cultivated Crops				Suburban Residential				Solar Facilities			
Beaches				Wetland/Bog				Rural Residential				Communication Towers			
Sand Dunes				Ocean				Transportation				Oil/Gas Wells			
Islands				Lake/Pond				Parks/ Recreation				Local Roads			
Headlands				River/Stream				Urban Center				Highways			
Water								Small Town				Transmission/ Substations			
								Energy Generation				Unidentifiable Structures			
								Transmission							

Figure 2.—Excerpt of the view description and scenic quality data sheet showing the first part of the landscape description.

Prominent Design Elements			
FORMS		**LINES**	
Descriptor	**Elements**	**Descriptor**	**Elements**
Rolling		Vertical	
Blocky		Horizontal	
Rugged		Curving	
Angular		Undulating	
Conical		Angular	
Pyramidal		Diagonal	
Rounded		Broken	
Circular		Irregular	
Flat			
COLORS		**TEXTURES**	
Color	**Elements**	**Descriptor**	**Elements**
		Smooth	
		Rough	
		Medium	
		Coarse	
		Fine	
		Patchy	
		Stippled	
		Random	
		Uniform	
		Ordered	
Brief Narrative			

Figure 3.—Excerpt of the view description and scenic quality data sheet showing the second part of the landscape description.

Landscape Character Integrity

When people recognize the landscape character of an area, they expect that views in the area will conform to that character. When the visible elements of the landscape conform to the identified landscape character, are relatively free from elements that do not conform to the expected landscape character, and are in good condition, the result is usually a pleasing view. In the best cases, this type of view can be thought of as the ideal "postcard" view of that type of landscape.

Landscape character integrity for individual views is assessed by evaluating:

- Landscape character elements
- Inconsistent elements
- Quality and condition of elements

The guidelines for rating these components of landscape character integrity are shown in Figure 4.

LANDSCAPE CHARACTER INTEGRITY				
Landscape Character Elements	Identify the degree to which the full range of important desirable landscape character elements, e.g., natural features, land use types, structures, is plainly visible in the view.			
	Few elements are plainly visible and/or many elements are missing. **(1)**	Some elements are present, but some elements are missing. **(3)**	Most or all elements are plainly visible. **(5)**	**RATING**
Rationale:				
Inconsistent Elements	Identify the degree to which inconsistent elements, e.g., agricultural fields in an urban landscape or industrial facilities in a natural landscape, are plainly visible in the view.			
	Many or major inconsistent elements are plainly visible & may be dominant features. **(1)**	Some inconsistent elements are plainly visible. **(3)**	Only a few, minor inconsistent elements are plainly visible. **(5)**	**RATING**
Rationale:				
Quality and Condition of Elements	Assess the quality and condition of all landscape elements, including natural and human-made features. (Do not lower the rating for historic structures, if their condition is appropriate to setting.)			
	Most elements are of poor quality and/or are in poor condition. Natural appearing elements look very unhealthy, seriously damaged, or in poor condition from pollution, or the presence of debris or litter. Built elements appear to be of poor quality, or are in an advanced state of disrepair. **(1)**	Most elements are of fair quality and/or in fair condition. Some natural appearing elements do not look healthy, have some damage visible, or have some pollution, debris, or litter evident. Some built elements may be of lower quality, are of unfinished construction, or not well cared for. **(3)**	Most elements are of high quality and in good condition. Most natural appearing elements look healthy, undamaged, clean, and free of debris. Built elements are of high quality with appropriate materials, designs, and finishes; and appear to be well cared for. **(5)**	**RATING**
Rationale:				
LANDSCAPE CHARACTER INTEGRITY TOTAL RATING				

Figure 4.—Excerpt of the scenic quality individual rating data sheet showing the rating guidance and worksheet that individual evaluators use when rating landscape character integrity.

Vividness

In considering vividness, and later visual harmony, as part of scenic quality, evaluators are looking at the components of the landscape much as an artist would. For vividness, the NPS VRI analyzes the aspects of views that contribute to how visually striking or memorable a view is. This can be thought as measuring the "Wow factor" of the view. Striking views have elements that attract and hold attention, including strong focal points as well as bold forms, lines, colors, or textures. Where views lack elements that strongly attract the eye, and have weak forms, lines, colors, and textures, the view will usually be perceived as unremarkable.

<table>
<tr><td colspan="5">VIVIDNESS</td></tr>
<tr><td rowspan="2">Focal Points</td><td colspan="4">Identify the degree to which focal points attract visual attention.</td></tr>
<tr><td>The view has weak focal points, or does not have any features that attract and hold attention.
(1)</td><td>The view has a moderately strong focal point, or has multiple focal points and attention is focused on each one roughly equally.
(3)</td><td>The view has one very strong focal point that attracts and holds visual attention.
(5)</td><td>RATING</td></tr>
<tr><td colspan="5">Rationale:</td></tr>
<tr><td rowspan="2">Forms & Lines</td><td colspan="4">Identify the degree to which landforms, lines, structures, or water elements add interest to the view.</td></tr>
<tr><td>Landforms, lines, structures, and water elements are weak, poorly defined, or insignificant. These elements add little interest.
(1)</td><td>There are one or more moderately bold and distinct landforms, lines, structures, or water elements that add interest
(3)</td><td>There are very bold and distinct landforms, lines, structures, or water elements that add strong visual interest.
(5)</td><td>RATING</td></tr>
<tr><td colspan="5">Rationale:</td></tr>
<tr><td rowspan="2">Color</td><td colspan="4">Identify the degree to which the view includes bold colors, and prominent textures or moving elements. Texture and movement are secondary considerations for this component.</td></tr>
<tr><td>Colors are generally muted and there are minimal textures or moving elements.
(1)</td><td>There are moderately bold colors, textures and/or prominent moving elements.
(3)</td><td>There are very bold or striking colors, textures, and/or moving elements.
(5)</td><td>RATING</td></tr>
<tr><td colspan="5">Rationale:</td></tr>
<tr><td colspan="5">Are seasonal/ephemeral effects (e.g., wildflower displays, snow, haze) affecting the scenic quality of the view? ☐Yes ☐No
If yes, please describe:</td></tr>
<tr><td colspan="4">VIVIDNESS TOTAL RATING</td><td></td></tr>
</table>

Figure 5.—Excerpt of the scenic quality individual rating data sheet showing the rating guidance and worksheet that individual evaluators use when rating vividness.

Vividness for individual views is assessed by evaluating:

- Focal points
- Forms and lines
- Color vividness

The guidelines for rating each of these components are defined in Figure 5.

Visual Harmony

When landscape elements in the view exhibit a consistent, orderly, or pleasing arrangement of parts and colors, the scene has strong visual harmony. This can be thought of as a measure of the quality of the visual composition, much as one might assess a painting or a photograph. Generally, views that are balanced (but not necessarily symmetrical), ordered, have elements in good size proportion to one another, and colors that seem to "fit together well," have higher scenic quality.

VISUAL HARMONY				
Spatial Relationship	Identify the degree to which the spatial arrangement of landscape elements makes the view seem structured, ordered, and balanced.			
	The arrangement of elements appears random or chaotic, and the view has little evident order, discernable pattern, or balance between elements. **(1)**	The arrangement of elements shows some structure or discernable pattern, but one or more elements seem out of place, making the view appear somewhat disordered or unbalanced. **(3)**	The arrangement of elements appears to have an easily discernable structure, pattern, and organization that make the view seem well ordered and balanced. **(5)**	**RATING**
Rationale:				
Scale Relationship	Identify the degree to which the sizes of landscape elements, relative to each other and to the view as a whole, make the view seem well-proportioned and balanced.			
	One or more elements appear substantially larger or smaller than desirable, and seem significantly out of scale with other elements or the view as a whole. **(1)**	One or more elements appear somewhat larger or smaller than desirable, and seem out of scale with other elements or the view as a whole. **(3)**	The elements are in excellent size proportion to one another and to the view as a whole, making the view seem well-proportioned and balanced. **(5)**	**RATING**
Rationale:				
Color Harmony	Identify the degree to which the view includes a range of compatible colors and pleasing color contrasts where they occur.			
	One or more major colors clash strongly and unpleasantly with the overall color scheme of the landscape, and /or there is a very limited range of colors. **(1)**	One or more major colors is somewhat incompatible with the overall color scheme of the landscape, and /or there is a somewhat limited range of colors. **(3)**	The visual elements of the landscape display a wide range of compatible colors or pleasing color contrasts. **(5)**	**RATING**
Rationale				
VISUAL HARMONY TOTAL RATING				

Figure 6.—Excerpt of the scenic quality individual rating data sheet showing the rating guidance and worksheet that individual evaluators use when rating visual harmony.

Visual harmony for individual views is assessed by evaluating:

- Spatial relationship
- Scale relationship
- Color harmony

The guidelines for rating each of these components are defined in Figure 6.

Team Consensus

For each inventoried view, the team recorder facilitates a consensus discussion among all team members and identifies the final team score and rationale for each rated element of scenic quality. This provides an opportunity for real-time quality assurance and quality control of ratings among individual team members and results in strong adherence to the established

Scenic Quality					
Scenic Quality	Rating	Rationale			
Landscape Character Integrity					
Landscape Character Elements					
Inconsistent Elements					
Quality and Condition of Elements					
Integrity Total					
Vividness					
Focal Points					
Forms/Lines					
Color Vividness					
Vividness Total					
Visual Harmony					
Spatial Relationship					
Scale Relationship					
Color Harmony					
Harmony Total					
TOTAL					
SCENIC QUALITY	☐E (9-15)	☐D (16-23)	☐C (24-30)	☐B (31-38)	☐A (39-45)

Figure 7.—Excerpt of the view description and scenic quality data sheet showing the scenic quality rating section where rationale and team consensus scores for each scenic quality indicator are recorded. Component scores are summed to identify the overall scenic quality rating.

rating guidelines among rating teams. Team ratings are recorded along with a brief rationale on the portion of the view description and scenic quality data sheet shown in Figure 7. Team ratings for the scenic quality indicators are then summed into an overall scenic quality rating which is recorded and identifies the scenic quality category for that view.

View Importance

View importance data are compiled for each inventoried view as an office exercise following the scenic quality assessments. As with the scenic quality portion of the inventory, parks gain consistent descriptions and defensible ratings of view importance by using a standardized approach.

Evaluating and documenting view importance provides:

- A measure of the value of views to visitors and to the NPS in addition to their inherent scenic quality
- A structured and defensible approach to identifying and communicating the nonscenic value of views
- Information useful in prioritizing areas for visual impact mitigation, for viewpoint and viewed landscape protection and restoration, or actions to improve existing views

The view importance assessment focuses on the unseen values of the view – that is, things that make the view important to visitors and to NPS, but are not necessarily apparent in the view itself. While the view importance assessment does record information about certain elements of the view, such as designated or nondesignated scenic or historic/cultural elements in the view, this information requires research or knowledge beyond what is apparent to the casual observer (Sullivan and Meyer 2016). The view importance evaluation can be thought of as roughly analogous to the sensitivity assessment and concern level of the BLM and USFS inventory systems respectively (Bureau of Land Management 1986, USDA Forest Service 1995). The view importance evaluation captures information about the relative number of viewers and view duration, as well as information about the importance of the view to the NPS unit's goals for visitor experience.

Viewpoint and Viewed Landscape Descriptions

The viewpoint and viewed landscape descriptions record information about applicable scenic, historic/cultural, or other special designations. The information that is recorded in this section is not scored, but is used to provide context and supporting material for the rating process. Designated scenic, historic/cultural, or otherwise significant features or locations are recorded for each view as they pertain to the viewpoint and/or viewed landscape. This information is recorded through a series of check boxes with opportunities to record details such as name and resource identification number for the designated/significant components.

View Importance Rating

For each view, the full team evaluates the following indicators of view importance:

- **Viewpoint importance**: How well publicized is the viewpoint as a viewing destination? What level of effort goes into managing the viewer experience at the viewpoint? What level of interpretive services are offered at the viewpoint?
- **Viewed landscape importance**: How well publicized is the viewed landscape? What portion of the view is comprised of designated or significant scenic, historic, scientific, or cultural components? How well does this landscape illustrate park purpose or interpretive themes?
- **Viewer concern**: What is the relative annual visitation for the viewpoint? What is the relative view duration at the viewpoint? To what degree are the activities that viewers are engaged in at the viewpoint tied to the visual experience?

Using the established guidelines described below, evaluation teams assign a numeric score of 1–5 to each of the components that make up the view importance indicators identified above.

Viewpoint Importance

The location from which one experiences a view can contribute to the overall importance of a view. Some viewing locations are well known as destinations for experiencing scenic views. Some viewpoints reflect significant investments in management or infrastructure. Some viewpoints provide a venue for important interpretive services. Viewpoints with all of these characteristics contribute positively to overall view importance ratings.

For each inventoried view, viewpoint importance is assessed by evaluating viewpoint:

- Viewpoint publicity
- Management
- Interpretive services

The guidelines for rating these indicators of viewpoint importance are defined in Figure 8.

Viewed Landscape Importance

Just as the viewpoint characteristics affect the importance of a view, the content of the viewed landscape does as well. Some views are classic and well-publicized examples of geologic phenomena or historic events, or are renowned for their scenic beauty. Some views may contain a significant feature or even be entirely composed of a designated or significant area. Some views perfectly illustrate interpretive themes in a park or perhaps the very purpose for which the park exists. Viewed landscapes with these attributes will contribute positively to the overall view importance rating for a view.

For each inventoried view, viewed landscape importance is assessed by evaluating:

- Viewed landscape publicity
- Designated areas
- Interpretive themes

The guidelines for rating these indicators of viewed landscape importance are defined in Figure 9.

Viewer Concern

The number of viewers that come to experience a view, how long they spend viewing the landscape, and the types of activities in which they are engaged are all proxy evidence for how sensitive these viewers may be to a change in the landscape. For example, it is reasonable to conclude that in highly visited locations where landscape photographers spend hours to capture the perfect lighting, viewers are likely to be concerned about potential changes to the view.

VIEWPOINT IMPORTANCE			
Viewpoint Publicity	Identify the relative extent to which the viewpoint is promoted as a viewing destination in visitor communications (e.g. brochures, park Web sites) or receives external recognition in media (e.g. hiking guides, history pubs, Web sites, movies).		
	Viewpoint receives little or no mention in visitor communications or external media. **(1)**	Viewpoint is noted but not strongly promoted in visitor communications or external media. **(3)**	Viewpoint is well publicized in both visitor communications and external media. **(5)**
Viewpoint Management	For this park, identify the relative extent to which the park has expended time, funds, and effort into planning the viewpoint visitor experience and/or that the viewpoint is managed to enhance or preserve that experience.		
	The visitor experience at the viewpoint is not planned and there is little or no maintenance of grounds or facilities for the viewpoint. **(1)**	Moderate effort has been undertaken to facilitate visitor experience at the viewpoint. This may include addition of some infrastructure, and/or occasional maintenance. For example, occasional trash removal, adding/maintaining portable toilets, mowing/tree trimming, or erosion repair. **(3)**	Extensive effort has been undertaken to facilitate visitor experience at the viewpoint. This may include addition of substantial infrastructure, frequent maintenance, removing intrusive elements to maintain a natural setting, extensive vegetation/trail management, or operation of a backcountry permit system. **(5)**
Viewpoint Interpretive Services	For this park, identify the relative level of interpretive services offered at the viewpoint, and the extent to which they contribute to the visitors' enjoyment of scenic, historic, cultural, scientific, or other park values.		
	No interpretive services are offered. **(1)**	Some interpretive services are offered, such as brochures, park newspapers, interpretive panels, or digital media. **(3)**	Extensive interpretive services are offered, such as talks, major interpretive panels, or kiosks. **(5)**

Figure 8.—Excerpt of the view importance rating guide showing the guidance that view importance assessment teams use when rating viewpoint importance.

Conversely, viewers may be less concerned about potential changes to views that are briefly visible while commuting to work.

Viewer concern for individual views is assessed by evaluating:

- Visitation
- View duration
- Viewer activities

The guidelines for rating these indicators of viewer concern are defined in Figure 10.

Team Consensus

For each inventoried view, team ratings for the view importance indicators are discussed and agreed upon by the full view importance evaluation team. Ratings are recorded along with a brief rationale on the portion of the View Importance Data sheet shown in Figure 11. Indicator ratings are then summed into an overall view importance rating that identifies the view importance category for that view.

VIEWED LANDSCAPE IMPORTANCE			
Viewed Landscape Publicity	For this park, identify the relative extent to which the viewed landscape is publicized for visual qualities (scenic, historic, cultural) in visitor communications or receives external recognition in media.		
	The viewed landscape receives little or no mention in visitor communications or external media. **(1)**	The viewed landscape is noted but not highlighted in visitor communications or external media. **(3)**	The viewed landscape is well publicized in both visitor communications and external media. **(5)**
Designated Areas	Identify the extent to which the viewed landscape includes all, or parts, of specially designated areas, or nationally/regionally significant scenic, historic, cultural, or scientific features or landmarks.		
	There are no known designated areas, significant features, or landmarks within the viewed landscape. **(1)**	The viewed landscape has some designated lands, but they do not constitute most of the view and the view is without plainly visible significant features or landmarks. For instance a small portion of the view is comprised of a wilderness area but no significant landscape features are visible. **(3)**	The viewed landscape consists primarily of designated areas and/or has significant features or landmarks plainly visible. For instance, the view consists largely of a designated wilderness area or cultural landscape. **(5)**
Interpretive Themes	Identify the degree to which features within the viewed landscape illustrate the unit's purpose or interpretive themes.		
	The viewed landscape is clearly incompatible with the unit's purpose or interpretive themes, such as large industrial or residential developments seen from a unit emphasizing natural processes or cultural landscapes. **(1)**	The viewed landscape is partly compatible with the unit's purpose and interpretive themes, but may have some incompatible elements, such as some modern roadways seen from a unit emphasizing natural processes or historic landscapes. Alternatively, the viewed landscape is not relevant to the unit's interpretive themes, but does not detract from the themes. **(3)**	The viewed landscape clearly illustrates the unit's purpose and/or interpretive themes, such as a canyon landscape illustrating erosion and geologic processes. **(5)**

Figure 9.—Excerpt of the view importance rating guide showing the guidance that view importance assessment teams use when rating viewed landscape importance.

<table>
<tr><th colspan="4">VIEWER CONCERN</th></tr>
<tr><td rowspan="2">Visitation</td><td colspan="3">For this park, estimate the relative annual visitation for the viewpoint.</td></tr>
<tr><td>Viewpoint is in the bottom one third of viewpoints with respect to visitor use, i.e., it is relatively lightly visited.
(1)</td><td>Viewpoint is in the middle one third of viewpoints within the unit with respect to visitor use.
(3)</td><td>Viewpoint is in the top one third of viewpoints with respect to visitor use, i.e., it is relatively heavily visited.
(5)</td></tr>
<tr><td rowspan="2">View Duration</td><td colspan="3">For this park, estimate the relative view duration for visitors at the viewpoint.</td></tr>
<tr><td>Viewpoint is within bottom one third of the park viewpoints for view duration, i.e., on average, views are of relatively brief duration.
(1)</td><td>Viewpoint is within middle one third of the viewpoints for view duration.
(3)</td><td>Viewpoint is within top one third of the viewpoints for view duration, i.e., on average, views are of relatively long duration.
(5)</td></tr>
<tr><td rowspan="2">Viewer Activities</td><td colspan="3">Considering the majority of visitors and the activities they engage in at the viewpoint, identify the degree to which most viewers would likely be sensitive to incompatible visual intrusions within these viewed landscape categories:
Natural – Visitors seek natural appearing views, without visible human-made elements.
Historic – Visitors seek to recreate the visual experience of the landscape as seen during a historically significant event or time period.
Human Influenced – Visitors appreciate the existing human-influenced landscape character (e.g., pastoral, agricultural, urban) as a particularly important part of the view.</td></tr>
<tr><td>Most viewers likely have low sensitivity to incompatible visual intrusions. The primary activities of viewers are relatively independent of the visual setting, for example, where most viewers are workers or commuters.
(1)</td><td>Most viewers would likely be moderately sensitive to incompatible visual intrusions. While the visual setting is important, it is not the focus of activities, for example fishing, hiking, or wildlife viewing.
(3)</td><td>Most viewers would likely be highly sensitive to incompatible visual intrusions. The primary activities at the viewpoint are directly tied to the scenery, such as landscape photography, seeking wilderness experiences, or viewing historic landscapes.
(5)</td></tr>
</table>

Figure 10.—Excerpt of the view importance rating guide showing the guidance that view importance assessment teams use when rating viewer concern.

VIEW IMPORTANCE						
Importance Factors	Rating	Rationale				
Viewpoint Importance						
Viewpoint Publicity						
Viewpoint Management						
Viewpoint Interpretive Services						
Viewpoint Total						
Viewed Landscape Importance						
Viewed Landscape Publicity						
Designated Areas						
Interpretive Themes						
Viewed Landscape Total						
Viewer Concern						
Visitation						
View Duration						
Viewer Activities						
Viewer Concern Total						
VIEW IMPORTANCE TOTAL						
VIEW IMPORTANCE RATING		☐**5** (9-15)	☐**4** (16-23)	☐**3** (24-30)	☐**2** (31-38)	☐**1** (39-45)

Figure 11.—Excerpt of the view importance data sheet showing the view importance rating section where rationale and consensus scores for each view importance indicator are recorded. Component scores are summed to identify the overall view importance rating.

PRODUCTS

The NPS VRI provides a mechanism for park staff to use in documenting and analytically assessing visual resources. The maps and data that come out of this process can then become powerful communication tools that inform critical thinking about how the NPS manages internal resources and how the agency approaches neighbors to find shared values and mitigate or avoid visual impacts where possible.

Scenic Inventory Value

The scenic inventory value (SIV) is the combination of the scenic quality rating and view importance rating into a single measure for each inventoried view. The SIV is derived using a matrix (Fig. 12) to identify one of five possible values ranging from very low (VL) to very high (VH). By combining scenic quality and view importance, the SIV provides an easy way to categorize and discuss the overall assessment of each view. It is important to note that the scenic quality and view importance ratings that determine the final SIV are retained for all future analyses.

Scenic Quality	View Importance Rating				
	1	2	3	4	5
A	VH	VH	VH	H	M
B	VH	VH	H	M	L
C	H	H	M	L	L
D	H	M	L	VL	VL
E	M	L	VL	VL	VL

Figure 12.—Scenic inventory value (SIV) matrix. This table identifies the combinations of scenic quality and view importance ratings that indicate overall SIV categories ranging from very low to very high.

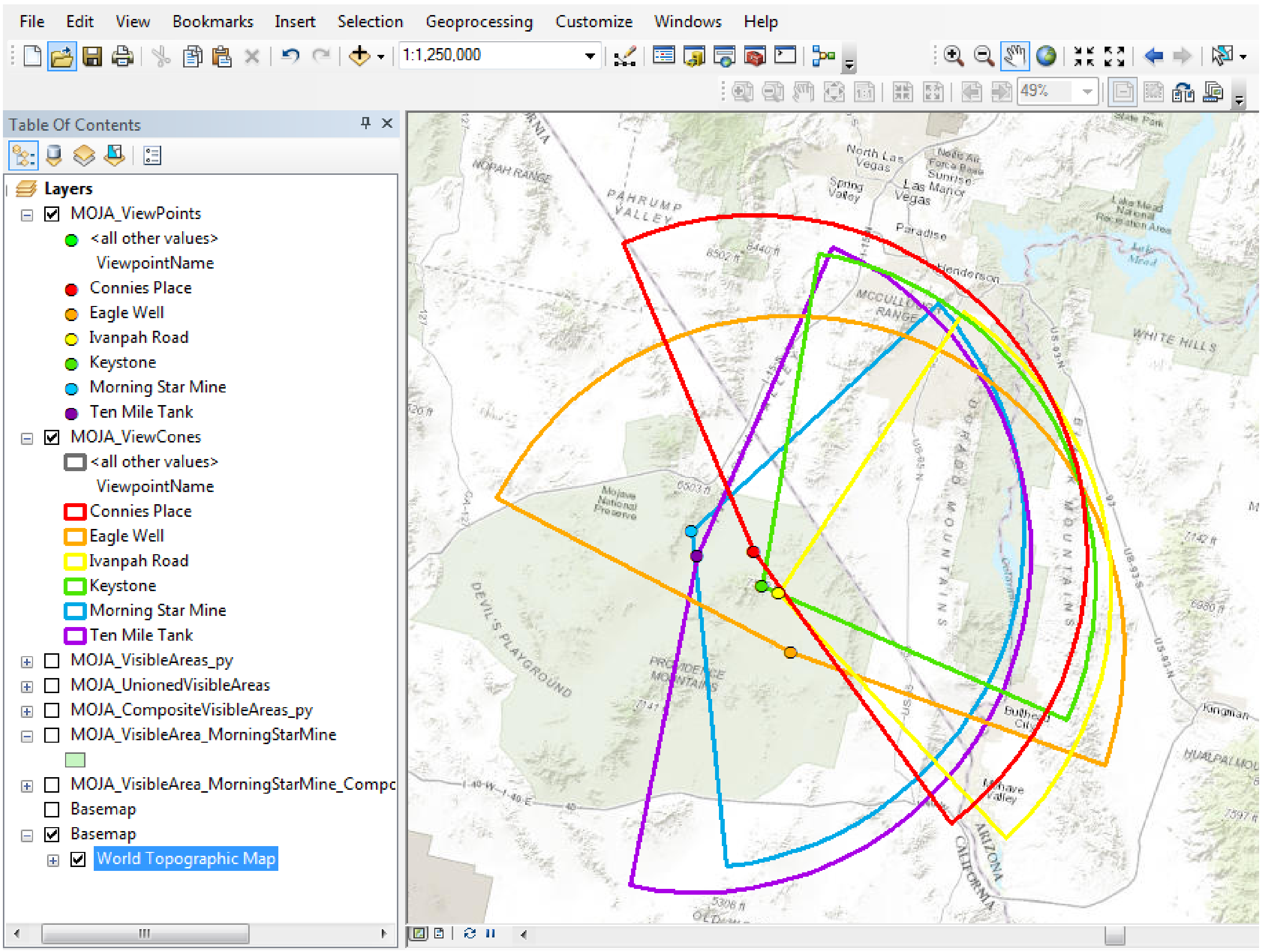

Figure 13.—Viewpoints and view cones. ArcGIS screen shot showing an example of viewpoints and view cones generated using NPS VRI data and spatial analysis tools for Mojave National Preserve, California. For this illustration a view distance of 50 miles was used. Source: National Park Service.

Data

Each view inventoried necessitates the creation of data which include:

- Spatial Data
  - o View Point Locations
  - o View Cones (generated by recorded bearings)
- Photographic Record
  - o A panoramic photo
- Scenic Quality
  - o Description
  - o Rating
- View Importance
  - o Information
  - o Rating

These data are entered into and stored in a geospatially enabled online database. This database serves as the national repository for all NPS visual resource data and is currently only accessible to NPS employees. The database also has reporting capabilities, and several types of standardized reports can be run for individual views or by park unit.

Geospatial Products

An “Enjoy the View” toolkit has been developed that uses NPS VRI data and ArcGIS software (ESRI, Redlands, CA) to automate the creation of several map products on a park by park basis. Viewpoints and view cones (depicting the left and right bearings of each inventoried view as identified in the field in combination with a user defined distance) are created directly from inventory data (Fig. 13). With the addition of a digital elevation model some further analyses are possible (described below).

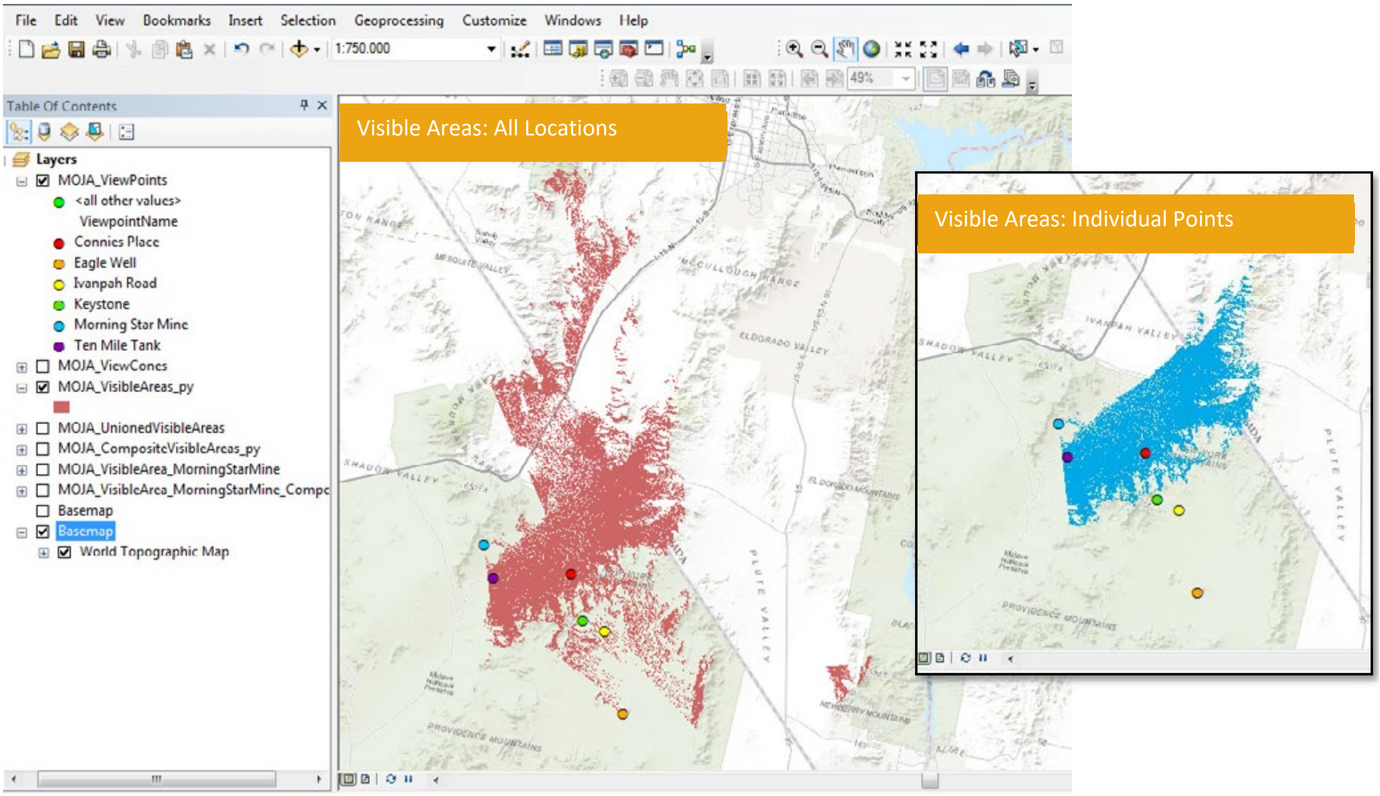

Figure 14.—Visible areas. ArcGIS screen shot showing an example of visible areas from all views and from an individual view inventoried as part of the NPS VRI for Mojave National Preserve, California. Source: National Park Service.

Visible Areas & View Counts

This tool runs a traditional viewshed analysis from each inventoried viewpoint and then clips the results using the view cones. The result is identification of visible areas seen from each of the individual viewpoints and a combined viewshed showing which parts of the landscape are visible from any one of the inventoried views (Fig. 14). In the combined visible areas product, each visible area has "count" information revealing how many views can see that location (Fig. 15). Information about which specific views contribute to the view count is also retained.

Scenic Inventory Composite

This analysis takes the combined viewshed for a park to the next level by developing a composite SIV value for each visible area. To do this, the highest scenic quality rating and highest view importance rating from each contributing view is selected to create a new SIV for the visible area (Fig. 16). The contributing ratings from all views are retained so that this can be used as a summary or data exploration product.

SUMMARY AND CONCLUSION

The NPS is responsible for managing some of the nation's most iconic and treasured visual resources and has developed a VRI method to meet the unique needs of park managers. In the NPS VRI, each view is mapped and described from viewers' perspectives. Views are also evaluated to capture both scenic quality and importance to the visitor experience. This approach allows the NPS to assess and value visual resources in a holistic way.

Inventory data can be used in spatial analysis to quickly show where views overlap, which portions of the landscape are truly visible from a given view point, and what the composite SIV of all intersecting views is. Robust inventory information allows managers to integrate visual resource considerations into park planning and management. This is especially important when working with partners beyond NPS boundaries to affect project proposals and target critical areas for visual resource protection.

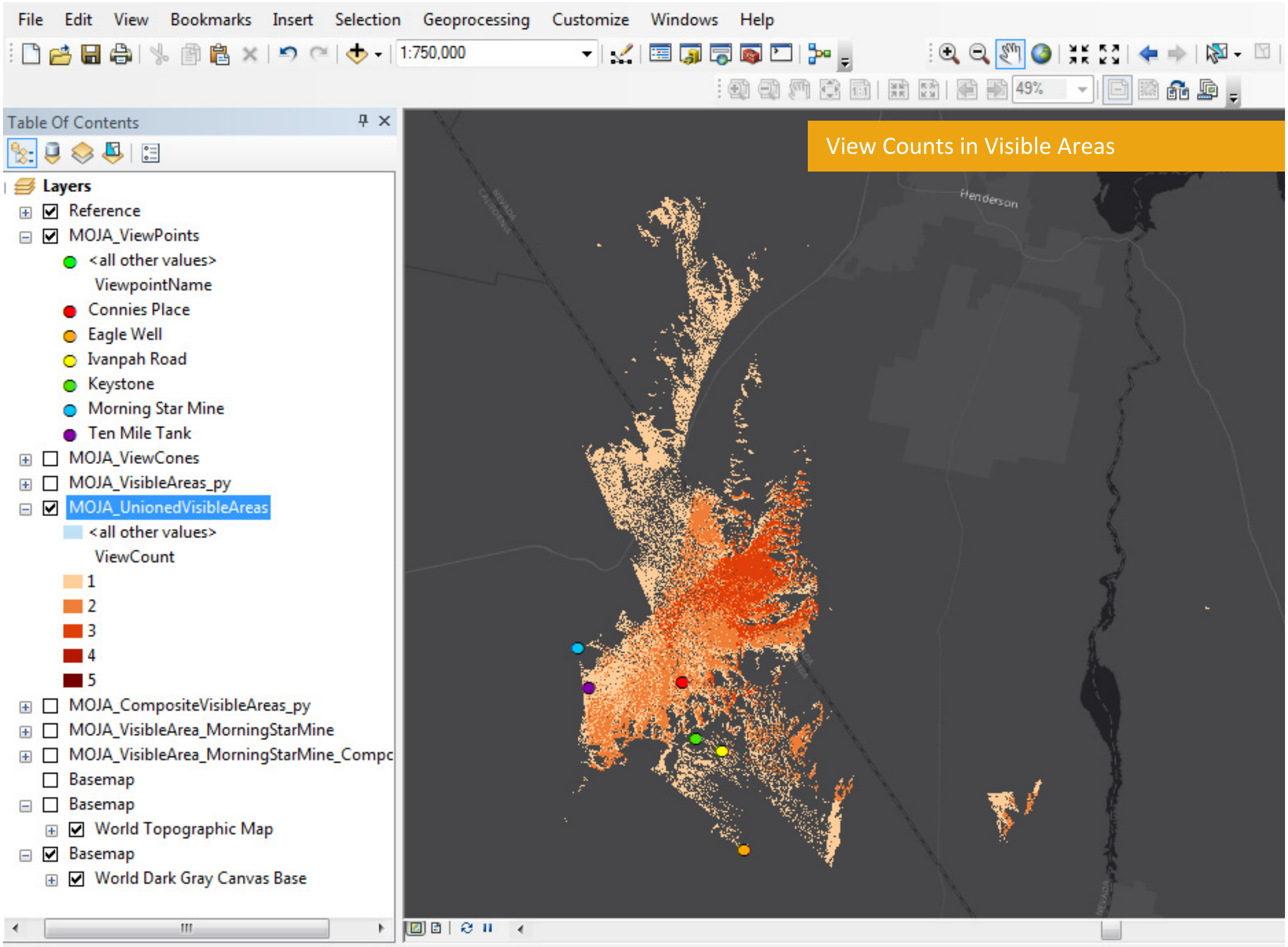

Figure 15.—View counts in visible areas. ArcGIS screen shot showing view count information for areas visible from one or more views inventoried as part of the NPS VRI for Mojave National Preserve, California. In this illustration, areas shown in a darker red color are visible from a greater number of inventoried views. Source: National Park Service.

The NPS VRI has already been implemented in over 30 parks, has proven effective in diverse park landscapes, and is gaining more traction. Experience has shown that park staff from any background can gain the necessary skills to conduct a VRI with relatively brief training and field practice. Also, the VRI has emerged as a modular solution for parks in that it has proven useful for targeted projects that require a limited inventory data set for analysis as well as for establishing more comprehensive baseline condition information. The vast scale of many park landscapes, the dynamic nature of visual resource pressures, and the capacity of park staff to conduct inventories, all lend weight to the value of a system that can be implemented in a modular fashion. Across the service, parks are welcoming a systematic process of VRI that supports the NPS role in preserving and protecting visual resources. This information will inform internal management decisions, communication with neighboring landowners about shared visual resource values, and ultimately may positively affect the continued viability of NPS areas as places of national significance.

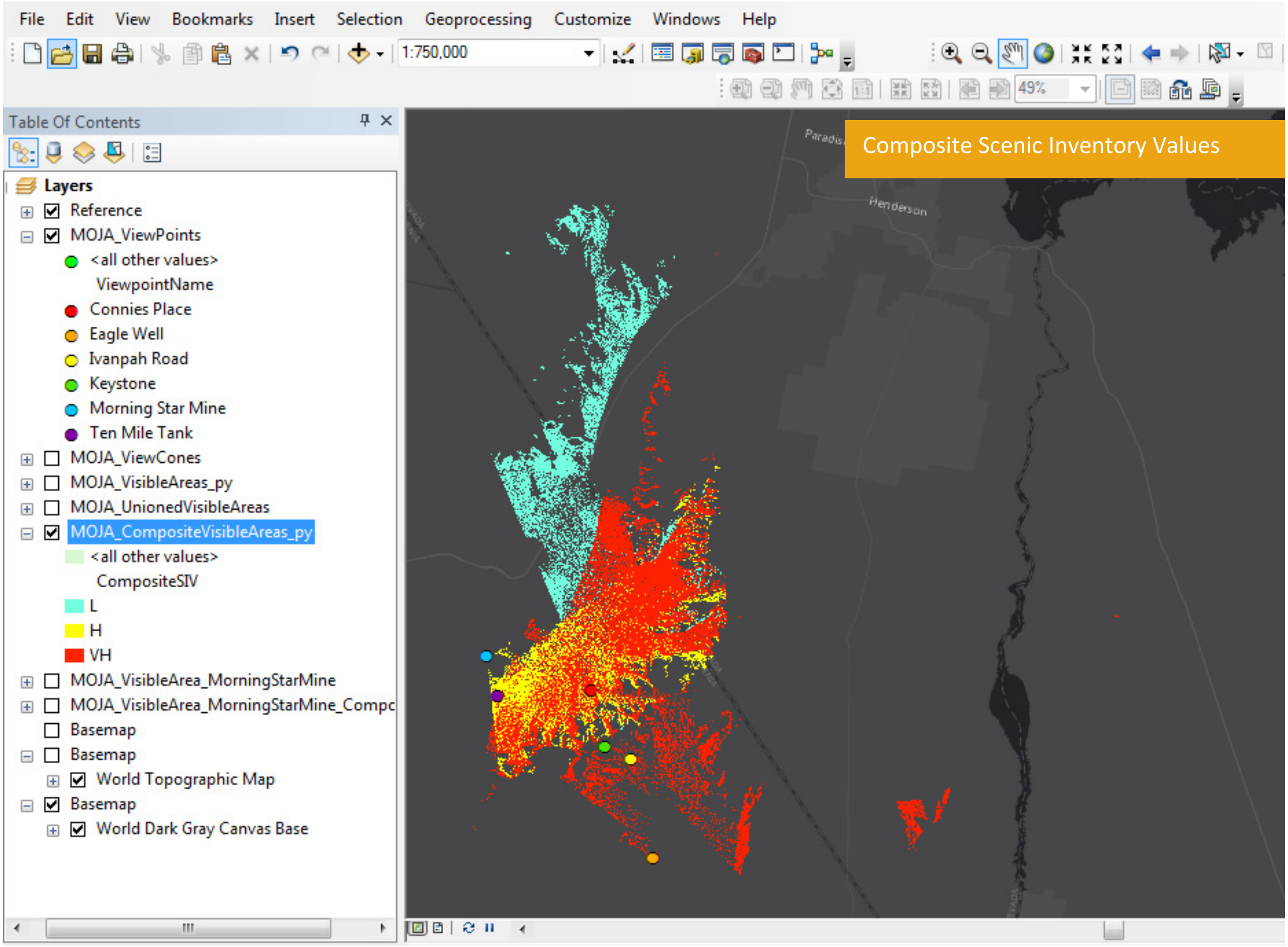

Figure 16.—Scenic inventory composite. ArcGIS screen shot showing composite SIVs for areas visible from one or more views inventoried as part of the NPS VRI for Mojave National Preserve, California. In this illustration, areas shown in blue have a composite SIV of low, areas shown in yellow have a composite SIV of high, and areas shown in red have a composite SIV of very high.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

THE USE OF CROWDSOURCED AND GEOREFERENCED PHOTOGRAPHY TO AID IN VISUAL RESOURCE PLANNING AND CONSERVATION: A PENNSYLVANIA CASE STUDY

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Timothy M. Murtha, Associate Professor, University of Florida
Brian Orland, Rado Family Foundation Professor of Geodesign, University of Georgia

Abstract.—This paper uses a Pennsylvania case study to discuss opportunities for using crowdsourced and georeferenced photography to aid in visual resource conservation and planning. Studies have shown that clustering of georeferenced photos indicates interest in a point of view within the landscape or a particular visual or cultural resource. This clustering can also aid in prioritizing visual resource conservation efforts by indicating preference for certain locations over others. The present research began by examining where in Pennsylvania people were taking photos using Google Earth imagery sourced from the now nonoperational (as of November 2016) Website Panoramio. We analyzed the content and locations of 7,309 photos. To provide some context for conservation, we focus here on photos taken in areas of Pennsylvania with natural gas "fracking" activity. However, this method can also be applied to situations with other forms of landscape impacts related to climate change, population growth, and urban/suburban sprawl.

INTRODUCTION

In their introduction to landscape-scale conservation planning, Trombulak and Baldwin (2010) emphasize that:

> "…[C]onservation planning is a multilayered, systematic process that progresses in an orderly fashion from conservation vision to science, to communication of results and engagement of stakeholders, to design, and finally to implementation" (p. 8); and
>
> "[It is important to select] the proper temporal and spatial scale for the conservation goals chosen, considering both cultural and natural history, responding to present and emerging economic trends, engaging both stakeholders and experts, developing multivariate measures of threats and opportunity, and practicing patience, creativity, and collaboration" (p. 13).

Visual and cultural conservation may also need to be done at scales larger than those typically addressed by cultural landscape studies. At the regional scale, specialist consultants, designers, policy-makers, NGO stakeholders, and scientists, to name a few, may all need to collaborate in order to establish a satisfactory conservation plan (Steinitz 2012, Trombulak and Baldwin 2010). For problems that occur at the regional scale, it is often difficult to find current data that cover the entire affected area.

Visual Resource Assessment

Traditional methods of visual resource assessment in landscape architecture and allied disciplines have long included the use of photographs and video, both analog and digital. In one type of assessment, the investigator provides images for test respondents to analyze and rank, sometimes allowing for projection of preference across the landscape. This top-down approach is usually used with respondents who are removed from the actual landscape experience. In another method, trained landscape architects (typically) apply principles of formal aesthetics to judge the value of landscape settings. Daniel (2001) and Zube (1984) warn against this "expert" approach, indicating that it may not take into consideration all of the public's values and perceptions. Finally, as Riley (1997) suggests, all of these forms of visual analysis tend to be atemporal.

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To address these shortcomings, another approach asks research participants to bring a camera into the field and take photographs either at their whim or in response to a prompt (such as photographing what they consider to be “scenic” or “beautiful”). The photographer gives photos to the investigators for later analysis; the investigator may have asked the subjects to record their reasons for photographing. These approaches, termed “visitor employed photography” or “photovoice,” while addressing weaknesses in other methods, require that the subjects are aware that they are part of a study, which may sway their intentions or influence the subject matter of their photos.

We postulate that crowdsourced data from photographs taken voluntarily in situ remedy both the atemporal and top-down problems in visual analysis.

Big Data, Crowdsourced Photography, and Social Media

The advent of Web 2.0 and the growth of social media platforms have fostered a new environment for the taking and sharing of photos. Social media Websites like Flickr and Panoramio (previously the image hosting site for Google Earth, closed as of November 2016) allow users worldwide to upload and share georeferenced photographs. A New York Times (2011) survey about online sharing via social media (n = 2,500) found that:

- 68 percent of respondents share photos or other information to give people a better sense of who they are and what they care about;
- 73 percent share information because it helps them connect with others who share their interests;
- 84 percent share because it is a way to support causes or issues they care about; and
- 94 percent carefully consider how the information they share will be useful to the recipient.

These findings suggest that most social media posting is meaningful to the user and not haphazardly done.

These new resources also allow investigators to access large reserves of photographic images taken in situ, many with substantial metadata and geographic coordinates. Images are taken without prompt and contributed voluntarily to various image hosting Websites. The photos represent what the individual was observing in the landscape at a particular moment and their decision to share the image suggests a positive valuation of the photo and the view.

Recent studies that have used publicly available online data to understand people’s perceptions of the environment or landscape include Dunkel (2015) and Newsam (2010). Some studies have looked specifically at scenic-ness as their metric (Alivand and Hochmair 2013, Hochmair 2010, Xie and Newsam 2011).

One way to coalesce impact data across a region is to crowdsource it by deliberately requesting that people provide images that fit a particular theme. FrackTracker Alliance and its Website fractracker.org, for example, use crowdsourced photography and videos to document impacts of unconventional shale gas development in the United States and other countries. The volunteered media can be sorted by theme (e.g., air quality concerns, rigs, water impoundments, pipelines, etc.) or by location such as state or country. While the photos are not georeferenced, they do have locational information in their descriptions so at least municipal level location can be determined for impact assessment. It is possible to combine this information with photographic preference data to see where spatial overlaps occur between impacted areas and sites or areas with special significance to the photographers.

Similarly, our work uses photographs posted voluntarily online to address visual and cultural conservation at larger scales. Beyond the kinds of records traditionally collected at the site scale, these big data allow for more efficient visual landscape assessment at the regional scale and a broader representation of stakeholder viewpoints throughout the impacted region. At larger scales, photographs may reveal broad patterns in the landscape including preference for certain land cover types and ease (or lack of) access to visual and cultural resources.

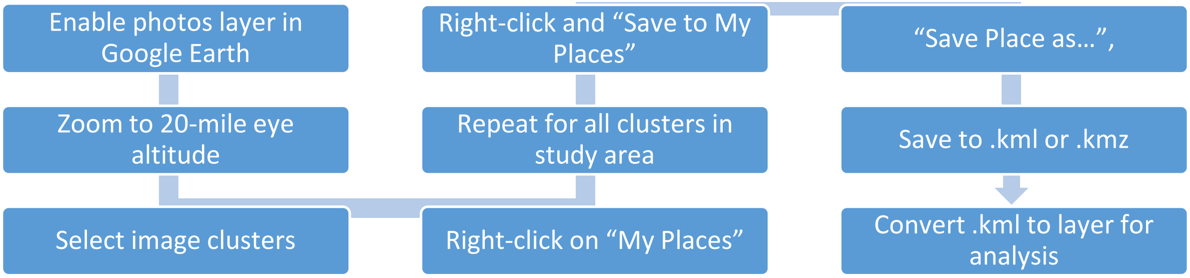


Figure 1.—Data collection process.

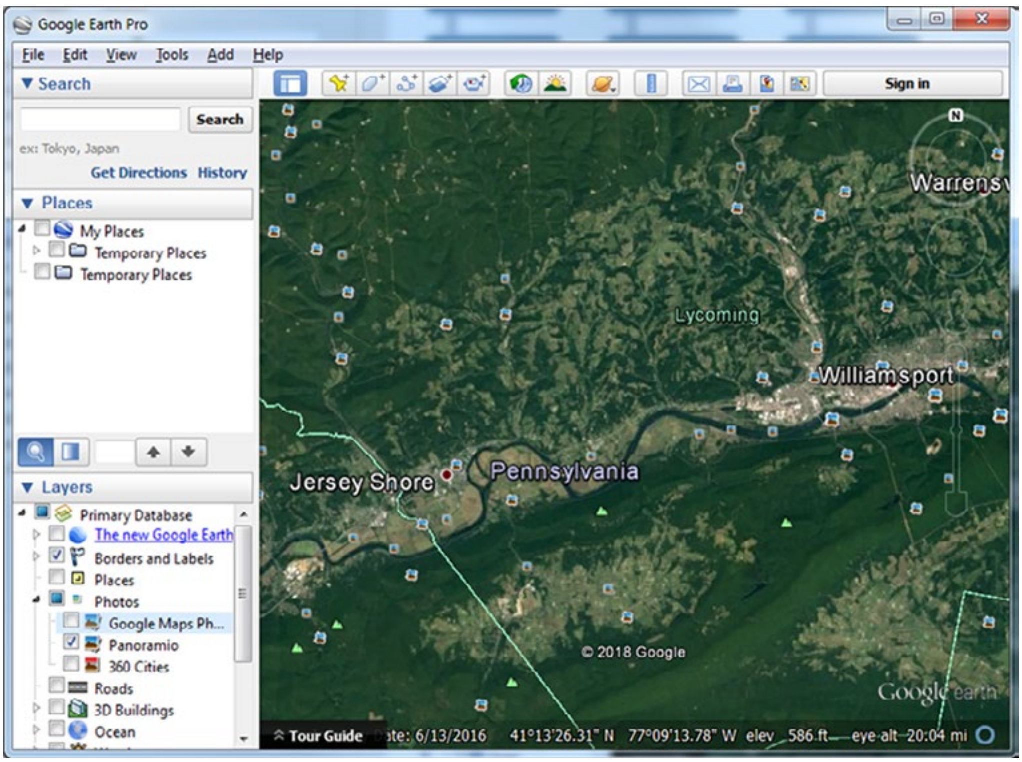


Figure 2.—Computer screen shot using Google Earth with Panoramio photos. Google Earth Pro.

OBJECTIVES OF THIS RESEARCH

The onset of Marcellus Shale natural gas development in the State of Pennsylvania, together with the rapidly widening availability of crowdsourced citizen photography, provided a valuable opportunity to study crowdsourced and georeferenced photography as an aid in visual resource conservation design and planning. Following Trombulak and Baldwin (2010), the goals for this work include: 1) identifying spatially explicit measures of change in the landscape, 2) predicting spatially explicit threats to the landscape, 3) recognizing sites within the region that are important or irreplaceable, and 4) prioritizing areas for conservation action to address pressures and preserve/conserve exceptional sites in the future.

METHODS

The data collection process (Fig. 1) involved gathering photos from Google Earth's Panoramio layer. Panoramio clusters photos differently at different scales so that zooming away from the Earth's surface condenses photos into fewer clusters while zooming in separates them into more clusters with fewer photos.

We collected photos at a 20-mile eye altitude zoom level (Fig. 2). At this distance, only clusters with multiple photos were selected, based on the assumptions that multiple photos indicate interest in a location and that multiple users photographing and uploading in a location demonstrates consensus (Alivand and Hochmair 2013, Dunkel 2015, Hochmair

2010). When saving the cluster, the metadata and embedded title provided by the user were saved from the most popular photo (most viewed or liked/favorited photo) within that cluster. The resulting data points saved from the cluster locations thus represent interest in a place, but not necessarily in the photo itself.

This process was repeated all over Pennsylvania, working county by county, using the right-click "Save to My Places" command within Google Earth. Each county was then exported as a KML file by right-clicking on "My Places," then "Save My Place as …," then "Save to .kml" and named for the county. After all counties were inventoried, we added all of the county KML files back into Google Earth and exported a master KML file for the entire state. The master file contained 7,309 photos (and corresponding location points).

We then applied a 1-km buffer to the point locations to help document and describe the physical context of each photo using 2011 National Land Cover Dataset (NLCD), 30-meter resolution (Homer et al. 2015). Using the Geospatial Modelling Environment (GME) software program, we calculated the representative area of all land cover types for each of the 7,309 1-km buffers. For this task, the GME "isectpolyrst" (intersect polygons with raster) function offers a benefit over traditional spatial joins and similar tools in ArcGIS, which do not include overlapping polygon areas in the calculations. Finally, we calculated percentage of land use/land cover within the 1-km buffers and classified the 7,309 photo location points by the majority land cover type found within their respective buffers.

In addition to evaluating the physical context of the 7,309 photos, we classified and categorized metadata included with the photos to integrate our work more fully with the broader Appalachian Landscape Conservation Cooperative pilot study. The goal was to categorize the images using a classification system based on the key categories in the National Register of Historic Places. We chose the National Register of Historic Places because it is a well-known and long-established program that coordinates public and private efforts to identify and protect America's historic and archaeological resources.

Initial categories included The Arts, Infrastructure, Religion, Economy, Society, Education, Military, Environment, and Transportation. These were amended to add a Scenic category (to catch images whose subject looks out over a mixed landscape in a long-distance view), and Ephemeral (to catch images whose subjects are fleeting, such as weather, seasons, etc.). The Environment category was subdivided into Human Environment and Natural Environment to help understand the nuances between environments and landscapes that are clearly touched by people and those that appear more "natural." Images were classified by their titles, initially using a keyword search, and then manually for those not captured by the keyword search. Untitled images (704) and those whose titles were not intuitively descriptive were visually inspected and classified according to their subject matter.

RESULTS

Using 2010 U.S. Census data, 3,019 images fell within areas classified as urban and the other 4,200 were in non-urban areas. Figure 3 shows the point density for the distribution of the photos, and units of density are points per square meter represented in 500-meter pixels.

Comparison with the NLCD classifications shows that the majority of people took photos in areas with forest land cover; 52.4 percent depicted deciduous forest, 1.8 percent showed mixed forest, and 0.3 percent included evergreen forest for a combined 54.5 percent total forest classification. The next highest category was developed open space, such as parks, at 10.6 percent. All results are shown in Table 1.

Interestingly, even when we separated urban and non-urban areas according to the 2010 Census data, deciduous forest was still the highest ranked land cover type. After deciduous forest, in urban areas, the most photos were taken in developed open space and developed low and medium density areas. In nonurban areas, deciduous forest was followed by hay/pasture areas and cultivated crops.

Figure 4 shows the geographic distribution of all of the photo buffers and their dominant land cover types. Development is represented in reds, pinks, and purples, and these aggregate in the urban areas. The length of the Susquehanna River is clearly displayed in blue.

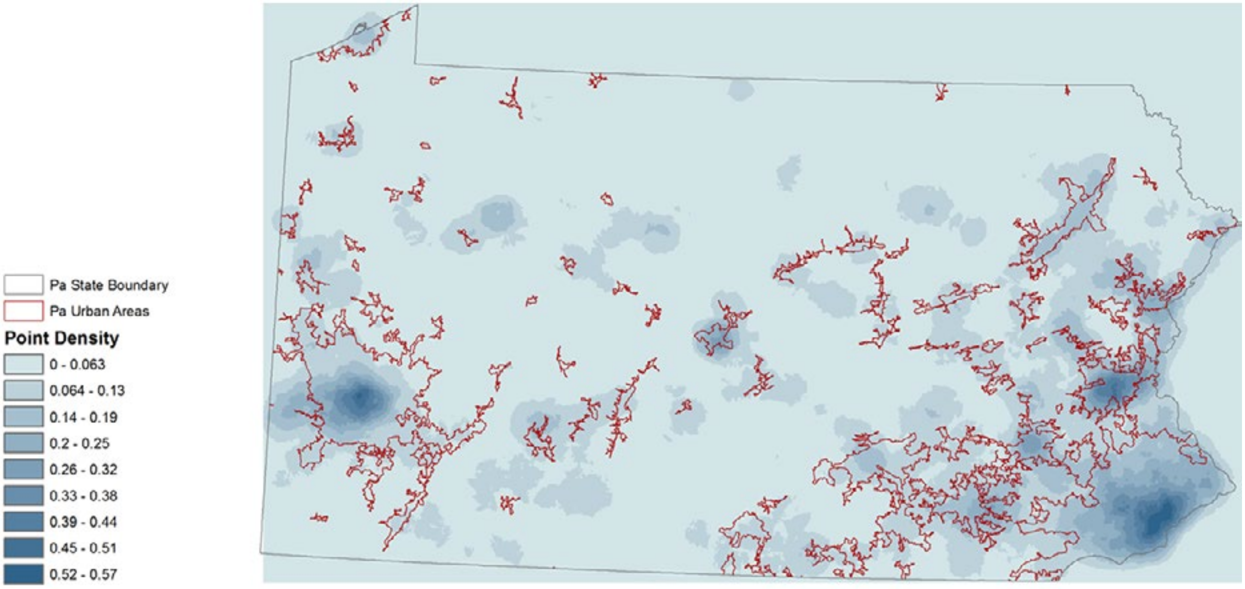


Figure 3.—Point density of photos in Pennsylvania areas and delineation of urban areas.

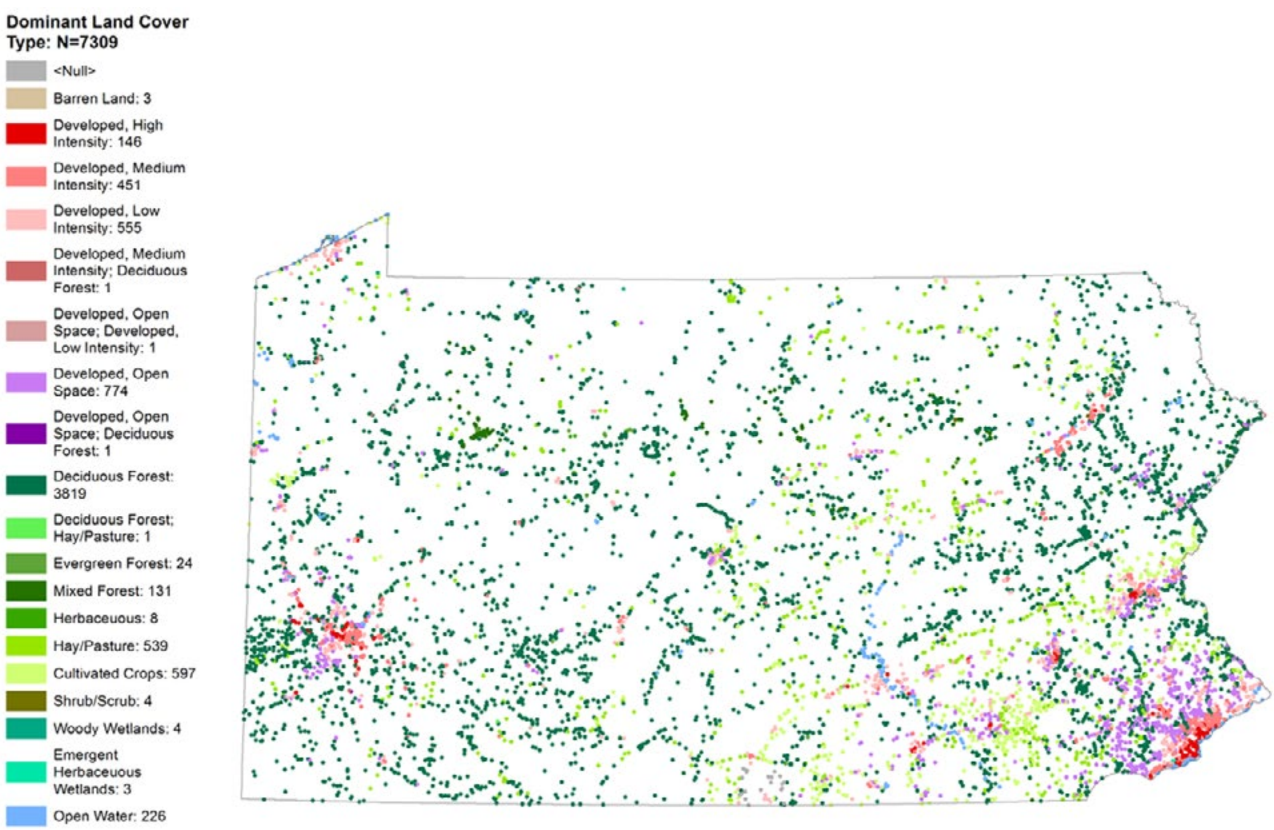


Figure 4.—Distribution of photos and land cover type in Pennsylvania.

Table 1.— Percentage land cover type: urban vs. nonurban (colors [red-through-green] denote 5 most prevalent categories in the combined "all" list and show where these categories fall in the "urban" and "nonurban" sub-areas)

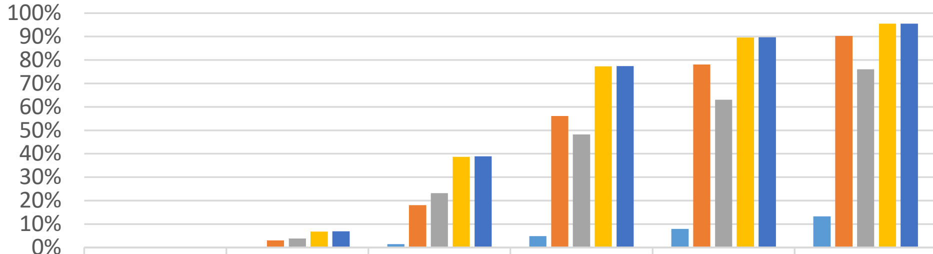
Classification	urban	nonurban	all
Deciduous forest	33.8%	72.9%	52.25%
Developed, open space	19.5%	0.6%	10.6%
Cultivated crops	7.2%	9.2%	8.2%
Developed, low intensity	14.3%	0.1%	7.6%
Hay/pasture	5.3%	9.6%	7.4%
Developed, medium intensity	11.7%	0.0%	6.2%
Open water	3.7%	2.4%	3.1%
Developed, high intensity	3.8%	0.0%	2.0%
Mixed forest	0.2%	3.6%	1.8%
Evergreen forest	0.0%	0.7%	0.3%
Herbaceous	0.0%	0.2%	0.1%
Shrub/scrub	0.1%	0.0%	0.1%
Woody wetlands	0.0%	0.1%	0.1%
Barren land	0.1%	< 0.1%	< 0.1%
Emergent herbaceous wetlands	0.1%	< 0.1%	< 0.1%
Developed, medium intensity; deciduous forest	< 0.1%	< 0.1%	< 0.1%
Developed, open space; deciduous forest	< 0.1%	< 0.1%	< 0.1%
Developed, open space; developed, low intensity	< 0.1%	< 0.1%	< 0.1%

Another interesting pattern that emerged relates to access. Figures 5 and 6 show that 95.5 percent of all photos were taken within 0.5 kilometers of a road. This equates to about four blocks or an 8-minute walk. The textual analysis also yielded useful results. While we expected a high number in the "natural environment" category based on the geographic distribution and land use analyses, we did not expect transportation to be the second largest category. Table 2 shows the category percentages and Table 3 shows the number of photos in each category and subcategory.

DISCUSSION

This research used crowdsourced georeferenced photos in a manner similar to Alivand and Hochmair (2013) and Hochmair (2010), who suggest that a location or artifact is scenic if more than one photo, posted by unique users, is located in a particular place. As an artifact, each photo is a spatial event. Relying on analogies from ecology, we recognize that these events occur in a spatial context. In order to capture or model that context, we buffered each location. With scenic vistas, there are often several vantage points from which a view can be seen, so a distance buffer is required for those images. Similarly, an artifact such as a building can be photographed from multiple sides and locations, again requiring a buffer to associate those images with one another. In this case, we filtered metadata tags (Dunkel 2015) to find relationships between images.

As has been found in much of scenic conservation research and literature, natural or naturally appearing areas and greenery were common in the photos we analyzed. The geospatial analysis showed that deciduous forest was the most photographed land cover type in Pennsylvania, in both urban and nonurban areas. In urban areas, developed open space (parks and similar) were second. In nonurban areas, people photographed and shared hay/pasture and cultivated crops second and third, respectively. Compared with the textual analysis, this makes sense as the natural environment category was the most popular. However, one issue is that small water bodies in forested areas would not be visible at the NLCD 30-meter scale (water was the most popular subcategory in the textual analysis). The next steps for this work would be to combine and cross-validate the geographic and textual analyses.



	0m	1m	10m	100m	.25km	.5km
Unpaved	0.0%	0.2%	1.5%	4.8%	8.0%	13.3%
Local	0.0%	3.0%	18.1%	56.1%	78.0%	90.2%
State	0.0%	3.8%	23.2%	48.2%	63.1%	76.1%
Improved	0.0%	6.8%	38.7%	77.3%	89.6%	95.5%
All	0.0%	6.9%	38.9%	77.4%	89.7%	95.5%

Unpaved Local State Improved All

Figure 5.—Photo locations as a percent and their proximity to roads types.

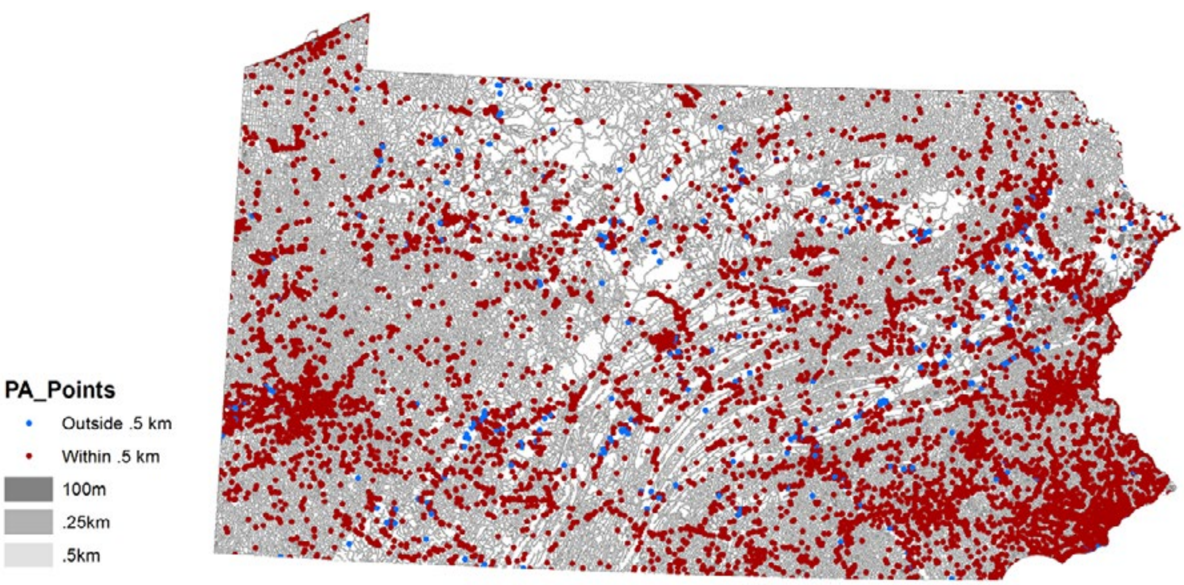


Figure 6.—Photo proximity to roads.

Table 2.—Textual analysis results

Category	percent
Natural environment	18.5%
Transportation	18.3%
Human environment	17.2%
Cultural	14.9%
Economic	8.1%
Religion	6.0%
Infrastructure	5.2%
Ephemeral	3.8%
Scenic	3.6%
Education	2.2%
The arts	1.5%
Military	0.7%

Table 3.—Textual classification index.

Natural environment	count
Water	627
Waterfall	133
Vegetation	116
Forest	103
Animals	89
Geology	79
Mountains	61
Field	38
Nature preserve	35
Valley	16
Wetland	14
Island	13
Disaster	9
Beach	5

Transportation	count
Road	470
Bridge	288
Covered bridge	152
Railroad	150
Tunnel	47
Air	45
Transportation	30
Gas station	28
Train	26
Vehicle	26
Canal	23
Boat	21
Dock	10
Parking lot	7
Port	4
Disaster	1

Infrastructure	count
Sign	113
Energy	100
Firehouse	24
Hospital	23
Telecommunication	21
Post office	17
Courthouse	15
Fire tower	15
Water tower	13
(Storm)water management	9
Town hall	9
Utilities	6
Prison	4
Police	3
Springhouse	3
Senior living	2
Turnpike commission	1
Plaque	1

Cultural	count
House	321
Town/city	319
Recreation	241
Ruins	42
Memorial	28
People	22
Monument	21
Festival	17
Civic center	14
Object	13
Cultural	9
Visitor center	6
Cultural/historical society/center	5
Historic site	5
Historic/cultural district	4
Historical marker	4
Plaque	4
Archaeological site	3
Political	2
Mound	1

Economic	count
Business	201
Restaurant	99
Hotel	81
Industry	66
Store	62
Mill	60
Quarry	12
Bank	5

Religion	count
Place of worship	271
Cemetery	148
Religious symbol	7
Religion	4
Plaque	1

Scenic	count
Vista	262

Education	count
School	72
Education	66
Library	9
Schoolhouse	8
Arboretum	4
Plaque	1

Military	count
Military	38
Memorial	10

Human environment	count
Park	280
Trail	211
Farm	156
Barn	100
Agriculture	83
Countryside	68
Dam	65
Building	41
Reservoir	29
Structure	27
Domestic animals	26
Cabin	25
Yard	25
Object	23
Decay	14
Disaster	14
Fountain	9
Garden	9
Fair grounds	8
Dump	6
Square	6
Lighthouse	5
Wall	5
Human environment	4
Courtyard	2
Construction	1
Greenhouse	1
Interior	1
Plaque	1
Wrong	1

Ephemeral	count
Sunset	81
Snow	53
Autumn	39
Weather	31
Sunrise	23
Clouds	15
Rainbow	13
Winter	9
Moon	5
Spring	4

The arts	count
Art	37
Architecture	27
Museum	18
Theater	15
Statue	11
Arts	2

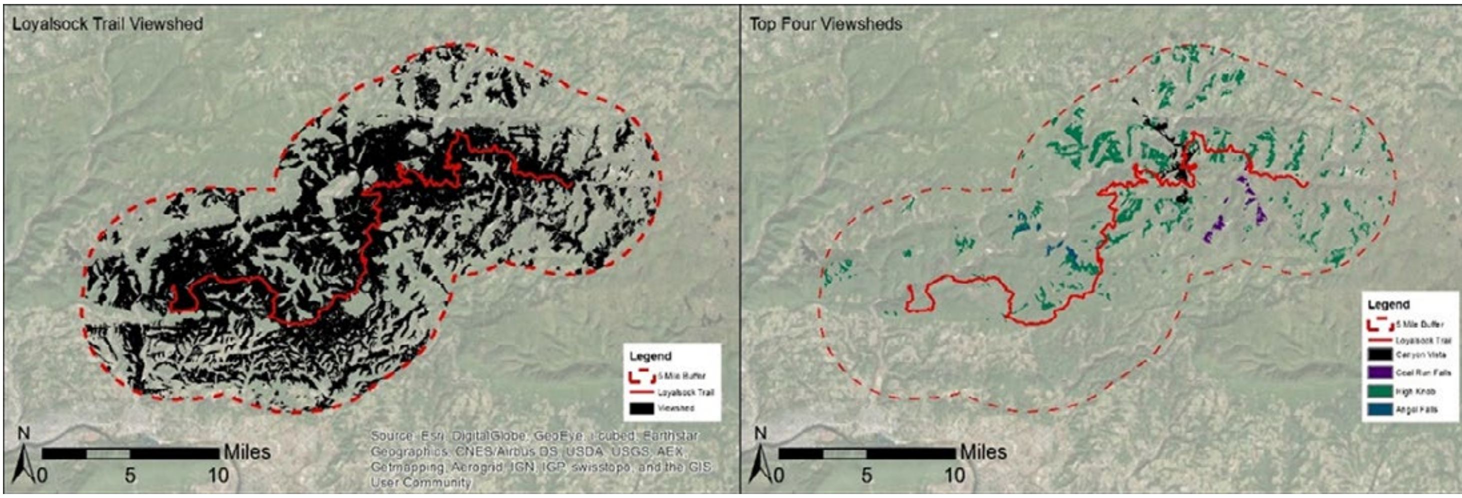


Figure 7.—Loyalsock Trail: entire viewshed and top four sub-viewsheds.

One unexpected finding was the popularity of transportation as a photographic subject in the textual analysis. About 35 percent of transportation-related photos showed roads and many were obviously taken from a vehicle. These included streets and intersections, highways, and images specifically titled as “xxxx Street” (or Road, Boulevard, etc.). Further research is needed to better understand why roads are so important and so frequently photographed. One obvious hypothesis is that roads enable people to visit a location and take a photo; therefore, if people cannot drive to a location, they are unlikely to visit and photograph it.

This has implications for conservation in that if people cannot visit or see something, they will not value it (Whyte 1968). On the other hand, limiting vehicular access to an area may prevent many people from visiting it, which can be good for sensitive landscape areas and habitats.

Examples of Potential Applications

The work described here has several additional potential applications. First, our findings suggest that locations with the most crowdsourced photos (from unique contributors) may be obvious priorities for conservation efforts. An example of this from a related project (Goldberg 2015) looked at the 113,743-acre viewshed of the Loyalsock Trail, a historic 60-mile hiking trail in central Pennsylvania. In the midst of Marcellus Shale development, the Loyalsock Trail spans two counties, eight municipalities, and two conservation regions (the Pennsylvania Wilds and Endless Mountains regions). To focus limited resources along the trail, crowdsourced photos were analyzed and areas with the most photos (from unique contributors) were listed in rank order. This allowed sub-viewsheds along the length of the trail to be dealt with individually and in order of scenic and cultural importance (Fig. 7).

A second potential application is analyzing how areas of Pennsylvania that are visually and culturally important are being impacted by energy development. Figure 8 shows where Marcellus Shale gas well development locations and photo point locations co-occur. This rough analysis quickly draws focus to the northeastern part of the state where densities of both kinds of locations are high. This region is known as the Northern Tier or the Endless Mountains region and is highly valued for its rolling hills, beautiful forests, and bucolic scenes. As seen in the figure, these valued areas and the associated scenery are at risk from shale gas development.

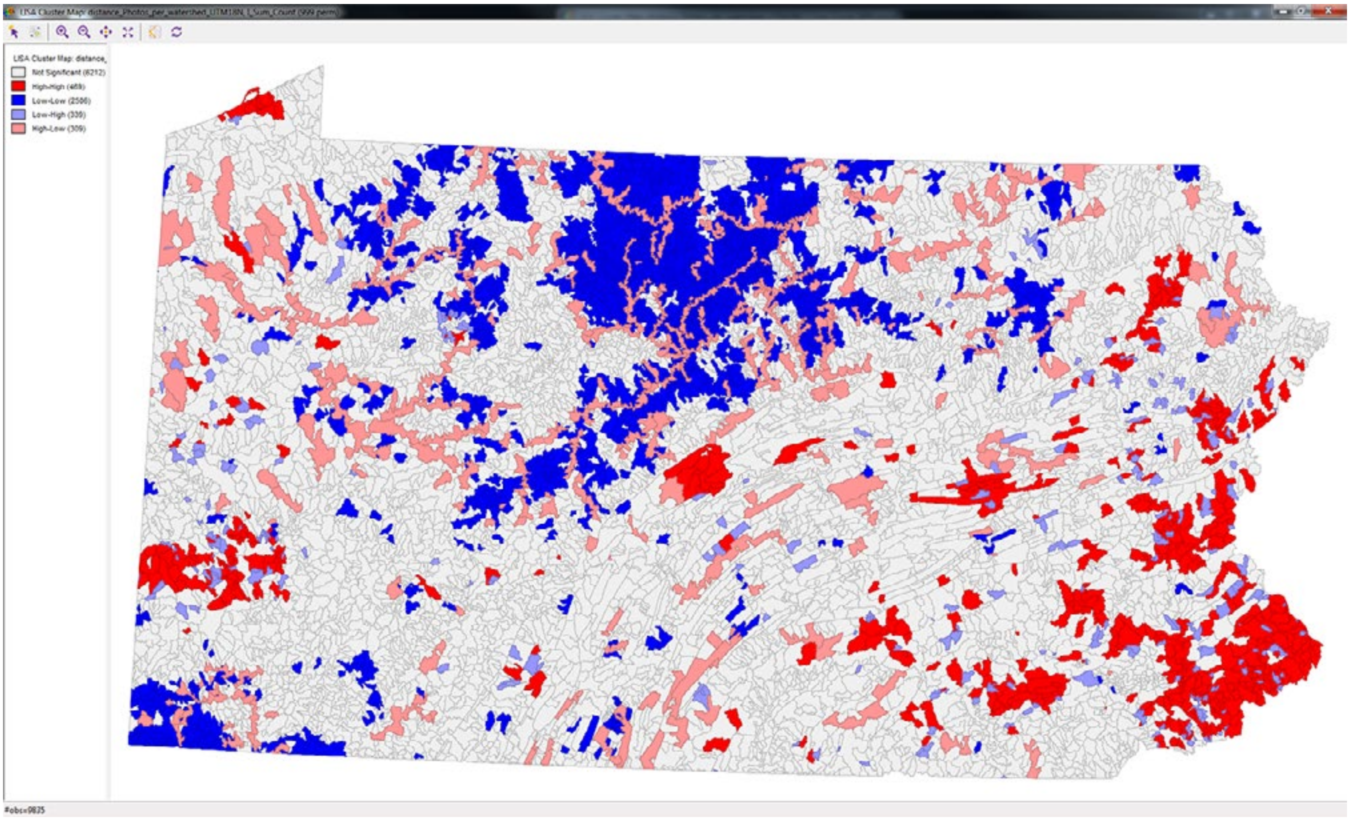


Figure 8.—Marcellus Shale gas well and photo point density overlay.

CONCLUSIONS

This paper examines several forms of crowdsourced data and their utility and versatility in visual resource planning and conservation. As this study shows, crowdsourced photos can reveal where people are visiting and taking photographs in a landscape. The next step of subsequent sharing to social media indicates that the photographers value these locations. Repeat photographs in a particular location suggest consensus among those visiting, seeing, and sharing these visual and cultural landscapes and amenities.

Crowdsourced data does have its faults. It is a convenience sample and may not represent the opinion or views of all stakeholders, particularly those without access to transportation, technology, or social media. The photos themselves may be labeled with incorrect locations, have missing or incomplete metadata, and may depict subjects that are unclear to the researcher without further explanation. However, big data, as the name suggests, are large data sets, inexpensive or free for use in a multitude of analyses.

This work aims to inform a broader pilot study of the Appalachian Landscape Conservation Cooperative Network.

ACKNOWLEDGMENTS

Funding and support for this research were provided by a National Park Service cooperative agreement #135414 P11AC30805, Comparative Landscape Scale Cultural Resource Conservation: Pennsylvania, the Appalachian Landscape Conservation Cooperative, and the Hamer Center for Community Design housed within the College of Arts and Architecture at The Pennsylvania State University. A special thanks to Monica Genuardi for her help in data collection and analysis.

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REAL-TIME LANDSCAPE ASSESSMENT: THE CLAYTOR LAKE VISUAL MANAGEMENT STUDY

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Abstract.—This paper describes the development of a visual management tool that allows landscape architects and planners, government officials, and community members to view the visual characteristics of the landscape in three dimensional (3D) real time from their homes or offices. The tool uses Google Earth, a free and easy-to-learn software that could be used by citizens and public officials. The user can view various landscape overlays, including land cover, visual quality, and visual sensitivity, and assess the extent to which proposed development will fit the scenic characteristics of the existing landscape. This paper describes pilot testing of the tool on the shoreline of Claytor Lake in southwest Virginia. Key viewpoints are identified systematically. While the resolution of Google Earth is not very detailed, the application includes links from each viewpoint to an archive of higher resolution photographs of the shoreline. This archive can be used to record and document incremental change over time. It also contains links to visual design guidelines that can help make proposed development more compatible with the visual character of the landscape in each area. The tool is envisioned as a prototype that can be used by citizens and public officials to make decisions about development around the Lake.

INTRODUCTION

We came to see, but could only listen.

How many of us have worked on visual assessment studies that sit on a shelf in a planner's office collecting dust? Visual inventories and management plans can be rather lifeless compared to actually seeing the landscape. In the past, visual concerns were mostly related to resource extraction on public lands or large infrastructure projects, such as installation of electric power lines. These days we find more and more people concerned about the scenic quality of the landscapes in which they live. This relationship between people and how they live in a landscape is called dwelling and results in a unique "sense of a place" that is very important. The visual characteristics of these places are critical to maintaining this relationship between people and the landscapes they dwell in. What tools can landscape architects use to help people live in and enjoy a place without destroying this special quality?

How many of us have watched the eyes of an engineer or planner glaze over as you try to explain visual characteristics of a landscape of concern to them, such as the visual complexity or sensitivity? But the moment that you produce real images of the landscape, they come to life. They gather around excitedly pointing at the images and have no shortage of opinions about what looks good. What type of tools can landscape architects use to help professionals involved in land development better understand what is important about the visual character of the land and how development might affect its scenic value?

Traditional methods of scenery management rely on single viewpoints for visual assessments. If multiple viewpoints are used, the assessment tool becomes more cumbersome. Williams et al. (2007) noted that even though photographs have been found by researchers to be a valid surrogate to represent actual landscapes, the images are still subject to viewpoint selection and lack of nonvisual information associated with the viewshed (Rohrmann and Bishop 2002). The ability to look at a landscape from multiple viewpoints would be a clear benefit.

STUDY METHODS

Experts use computers, but what about the rest of us?

Study Objectives

The objectives of the study were to develop a digital scenery management tool for Claytor Lake that:

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- Can display in three dimensions the geospatial landscape data that is typically displayed two dimensionally
- Allows the viewer to view three-dimensional (3D) geospatial data from multiple viewpoints
- Uses open source (free) software that is readily available to public officials and the public
- Can attach nonvisual geospatial data to critical viewpoints in the landscape, such as panoramic photographs recording landscape change over specific periods of time, 2D viewshed maps depicting seen-areas from that point, and design guidelines

The tool was envisioned as dynamic and easy to use in an office or home to explore the landscape in 3D and visualize how proposed landscape changes would affect the scenic quality of the landscape (Ghadirian and Bishop 2008). The application or tool should contain panoramic photos and design guidelines for different locations around Claytor Lake. Google Earth was a good choice for the platform because it is a free, readily available, and easy to use software that citizens and public officials could use to make decisions about development occurring around the Lake.

Study Area Selection

Claytor Lake, in Pulaski County, Virginia, was selected to pilot test the new tool because it has a number of characteristics that make it a good candidate:

- The study area is a popular water-oriented recreation and retreat destination in southwest Virginia.
- The scenic experience of the Lake is important to recreationists and local residents (see Fig. 1).
- The impact of development on scenic quality is a particular concern because of the steep shoreline in many places.
- Scenery management in this area will protect the existing scenic beauty and integrity of the Lake and provide future development guidelines for stakeholders.

The Claytor Lake Visual Management Study was completed for American Electric Power Company (AEP), at the request of residents who live around the Lake. The study described in this paper was undertaken by a research team from the Landscape Architecture Program and the Community Design Assistance Center (CDAC) at Virginia Tech for AEP.

A dam on the New River in southwest Virginia creates the Claytor Lake impoundment. The Lake has a surface area of 4,472 acres (1,810 ha) and is approximately 21 miles (34 km) in length. AEP generates electric power with the dam. AEP is required to conduct a periodic public outreach program to maintain its license to generate power on the New River. It was during this outreach program that local residents expressed concern regarding the effect of development on the scenic quality of the Lake (see Fig. 2).

Figure 1.—The shoreline of Claytor Lake is very scenic but also steep and rugged in many places. Photo by P. Miller, used with permission.

Figure 2.—New development is occurring along the shoreline of Claytor Lake. This includes homes, boat houses, docks, erosion control structures, and development on steep slopes. Some local citizens have expressed concern that this development could have an adverse effect on scenic quality if not done with care. Photo by P. Miller, used with permission.

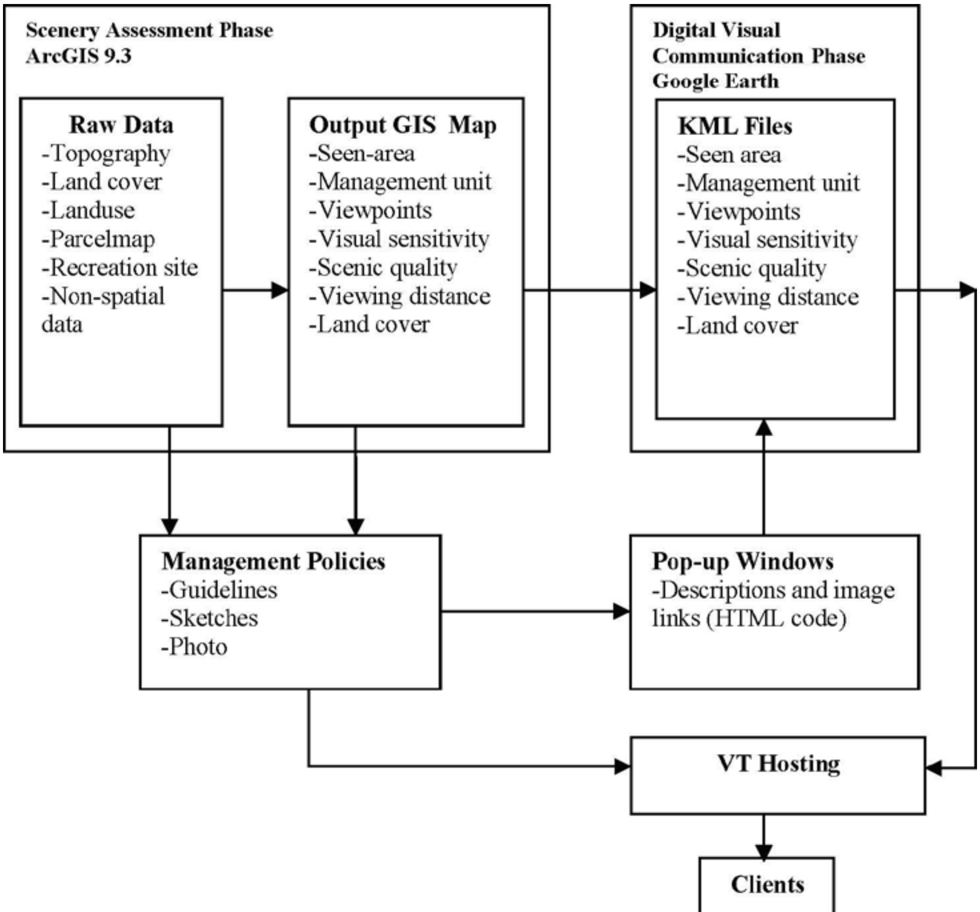


Figure 3.—Flow chart of procedures used in the study. Source: Claytor Lake Research Project, Landscape Architecture Program, Virginia Tech. May 2009.

Study Phases

The initial visual landscape management study was fairly typical and included assessments of visual quality and visual sensitivity of the viewshed around the Lake, as well as other landscape characteristics. The second, more unconventional, part of the study used the new tool to allow people to view the landscape in 3D from an office or someone's home. The users of the tool could control viewing locations and explore viewsheds around the Lake in order to better understand how proposed changes would affect the scenic value of this special place.

The methods used in this study can be divided into four phases: 1) scenery assessment, 2) digital visual communication, 3) management policies, and 4) pop-up windows (Fig. 3.)

The Scenery Assessment phase involved extensive fieldwork and geographic information system (GIS) lab work that any visual study requires. We used GIS data to produce the following maps:

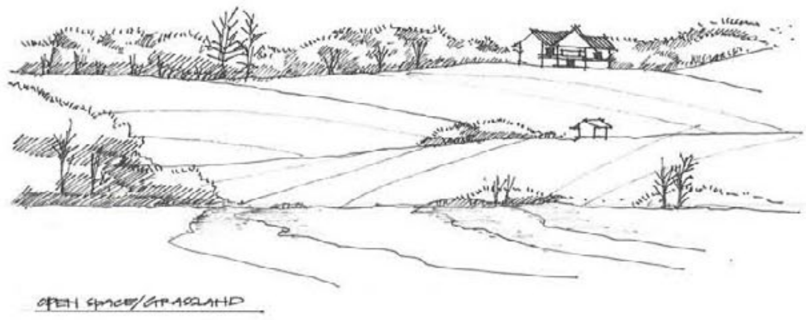
- Critical viewpoints (31 points, ½ mile apart) (Litton 1973)
- Seen areas (viewsheds)
- Distance zones (foreground, middleground, and background)
- Land cover
- Visual units (areas with similar visual characteristics – see Fig. 4) (Lewis and Sheppard 2006)
- Scenic quality
- Visual sensitivity
- Visual management units

Open Space/Grassland Characteristics

This unit is characterized by gently sloping pastoral lands, open spaces, canopied forests and few residential structures. There are no man-made structures near the shoreline. Mixed forests border the pasture. The pastoral qualities are quite picturesque. The area has a high diversity of textures, colors and forms.

Scenic Quality and Visual Sensitivity

The scenic quality in this unit is moderately high, and the visual sensitivity differs based on the location of the unit.



Flat Settlement Characteristics

The flat settlement unit is a landscape with a narrow strip of intensive development next to water, usually with steep wooded slopes directly behind the built structures. The dominant visual element in this unit is settlement on the flat, open space along the shoreline. This unit contains certain man-made structures such as residential development, retaining walls, and boat docks.

Scenic Quality and Visual Sensitivity

The scenic quality in this unit ranges from moderately low to moderate, The visual sensitivity is either moderately low or high because of the location of the unit.

Hilly Settlement Characteristics

This unit in characterized by settlement on upper hill slopes or ridgelines. Distant views are limited by topography and vegetation. Housing, stairs, boat docks and retaining walls are common man-made features in this unit. Retaining walls and stairs on the steep slopes are the main man-made intrusion in this unit that detracts from scenic quality.

Scenic Quality and Visual Sensitivity

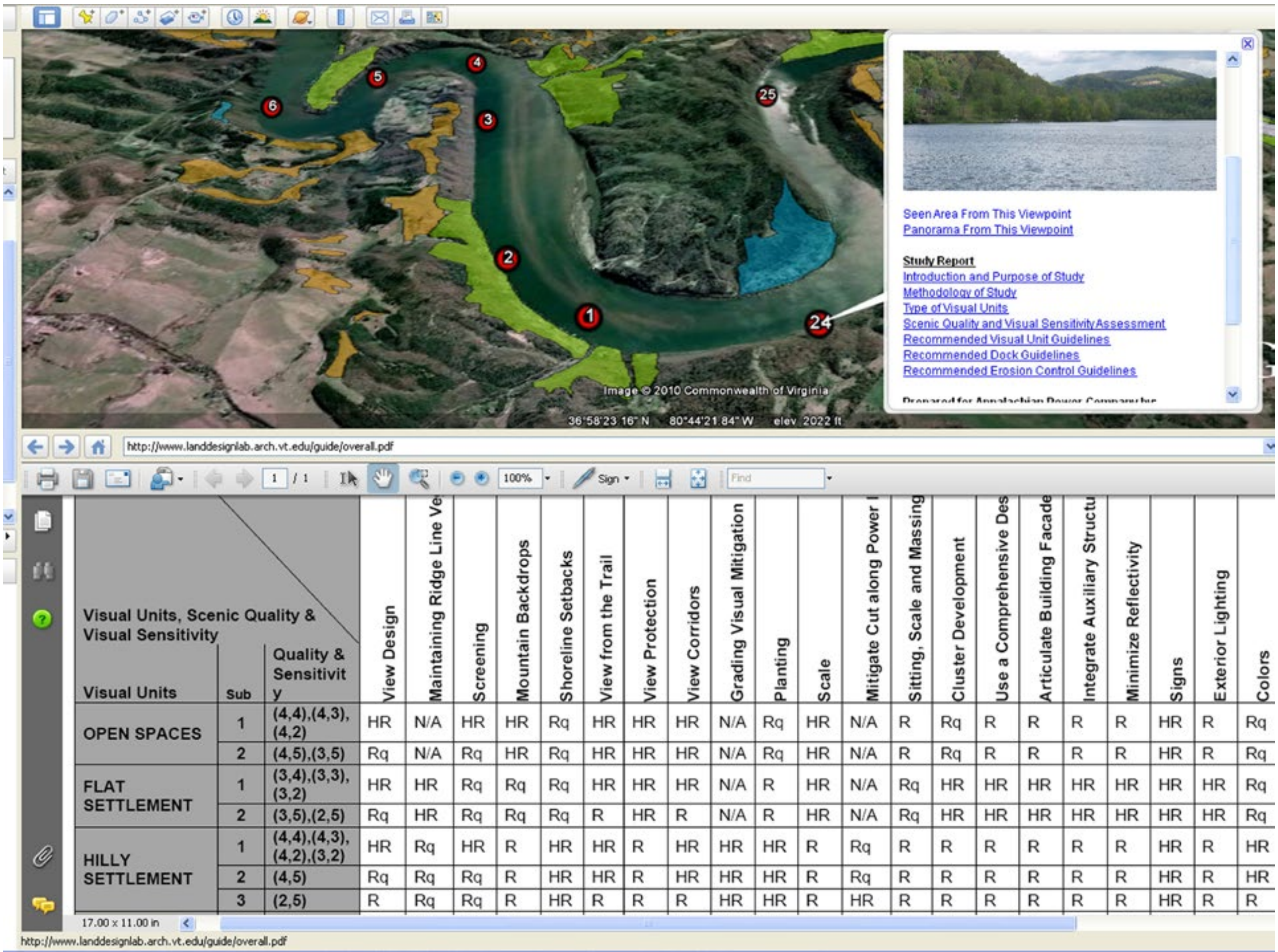
The scenic quality in this unit is either moderately low or moderately high since settlement density changes. The visual sensitivity varies because of the location of the unit.

Figure 4.—Example of selected visual units with descriptions and assessment of scenic quality and visual sensitivity. There were eight visual units in a variety of locations around the Lake. Source: Claytor Lake Research Project, Landscape Architecture Program, Virginia Tech. May 2009.

We collected photographic panoramas and design guidelines for typical proposed development for each visual management unit (see description below). Then, in the Digital Visual Communication phase, we converted the GIS maps from the first phase to KML files for 3D overlays in Google Earth (MacFarlane et al. 2005).

The Management Policies phase of the study involved preparing design guidelines for the visual management units based on traditional procedures using visual sensitivity and scenic quality (Fig. 5) (Tetlow and Sheppard 1979). We used sketches to illustrate guidelines for different types of development including the location of structures relative to the shoreline, the use of vegetation to avoid silhouetting structures, shoreline access on steep sites (see Figs. 6 and 7), shoreline erosion structures, and boat docks.

For the Pop-up Windows phase, we linked development policies, design guidelines, and panoramic photographs to each viewpoint via a pop-



Visual Units, Scenic Quality & Visual Sensitivity — Visual Units	Sub	Quality & Sensitivity	View Design	Maintaining Ridge Line Ve	Screening	Mountain Backdrops	Shoreline Setbacks	View from the Trail	View Protection	View Corridors	Grading Visual Mitigation	Planting	Scale	Mitigate Cut along Power l	Sitting, Scale and Massing	Cluster Development	Use a Comprehensive Des	Articulate Building Facade	Integrate Auxiliary Structu	Minimize Reflectivity	Signs	Exterior Lighting	Colors
OPEN SPACES	1	(4,4),(4,3),(4,2)	HR	N/A	HR	HR	Rq	HR	HR	HR	N/A	Rq	HR	N/A	R	Rq	R	R	R	R	HR	R	Rq
	2	(4,5),(3,5)	Rq	N/A	Rq	HR	Rq	HR	HR	HR	N/A	Rq	HR	N/A	R	Rq	R	R	R	R	HR	R	Rq
FLAT SETTLEMENT	1	(3,4),(3,3),(3,2)	HR	HR	Rq	Rq	Rq	HR	HR	HR	N/A	R	HR	N/A	Rq	HR	HR	HR	HR	HR	HR	HR	Rq
	2	(3,5),(2,5)	Rq	HR	Rq	Rq	Rq	R	HR	R	N/A	R	HR	N/A	Rq	HR	HR	HR	HR	HR	HR	HR	Rq
HILLY SETTLEMENT	1	(4,4),(4,3),(4,2),(3,2)	HR	Rq	HR	R	HR	HR	R	HR	HR	HR	R	Rq	R	R	R	R	R	R	HR	R	HR
	2	(4,5)	Rq	Rq	Rq	R	HR	HR	R	HR	HR	HR	R	Rq	R	R	R	R	R	R	HR	R	HR
	3	(2,5)	R	Rq	Rq	R	HR	R	R	R	HR	HR	R	HR	R	R	R	R	R	R	HR	R	R

Figure 5.—Screen capture depicting visual management units at viewpoint # 24 (upper window) with access to pop-up link to development guidelines (open space, flat settlement, and hilly settlement) for this visual unit of the shoreline. Source: Google Earth, May 2009 and Claytor Lake Research Project, Landscape Architecture Program, Virginia Tech. May 2009

Figure 6.—Switchback access down to a boathouse on a steep shoreline detracts from scenic quality. It will be difficult to maintain and will continue to erode over time. Photo by P. Miller, used with permission.

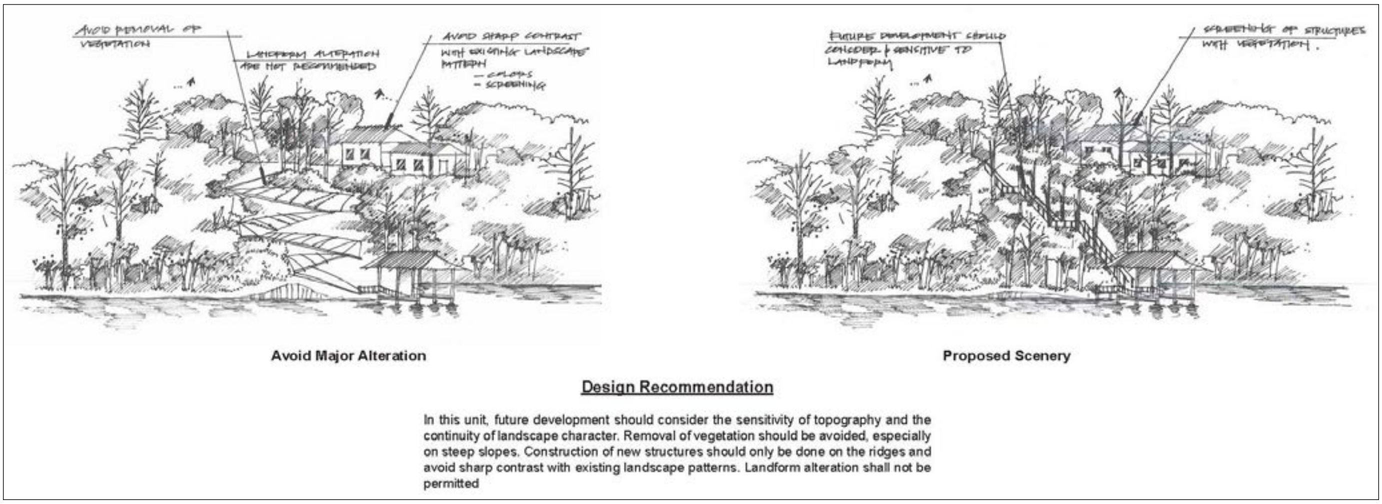


Figure 7.—Example of illustrated design guideline for shoreline access on steep shoreline. Source: Claytor Lake Research Project, Landscape Architecture Program, Virginia Tech. May 2009

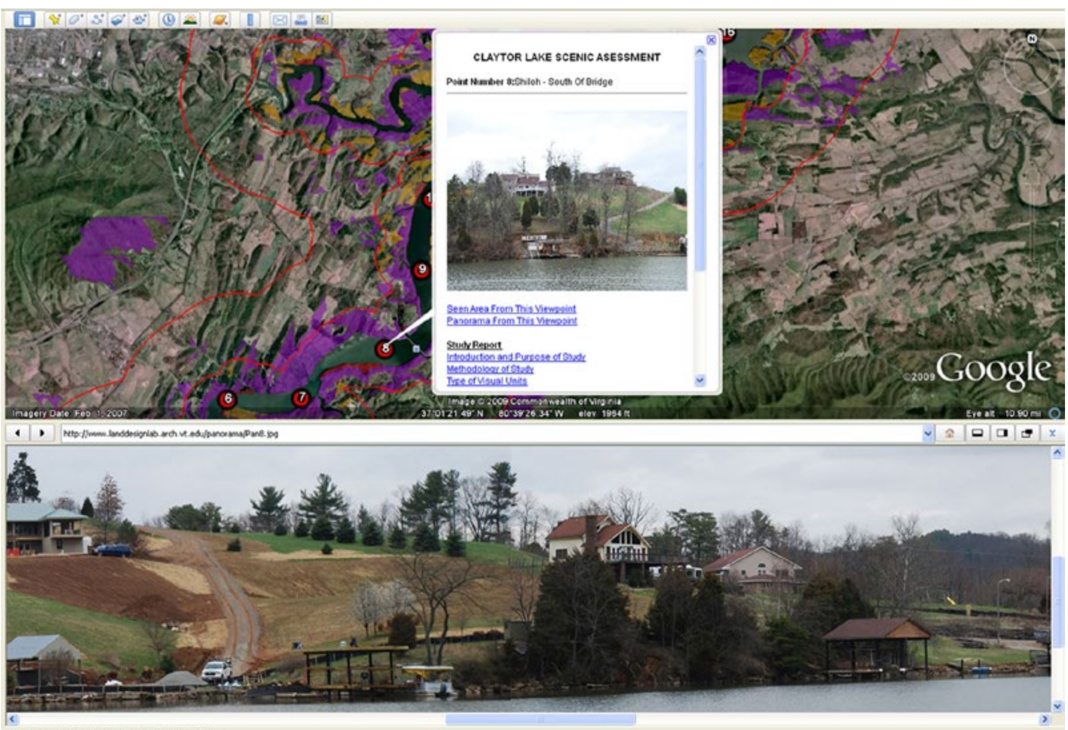


Figure 8.—Screen capture depicting viewing distances zones (red lines) and seen-area (purple shading) in upper window with access to scrollable panoramic photographs from viewpoint #8 (lower window). This can be accessed from a pop-up menu, allowing simultaneous comparison (photo and seen-area) for a specific viewing location. Source: Google Earth and Claytor Lake Research Project, Landscape Architecture Program, Virginia Tech. May 2009.

up window. We took panoramic photographs from each viewpoint, capturing the present condition of the landscape. We envisioned adding photographs in the future to provide a photographic record of change along the shoreline over time. When viewed in Google Earth, the user can easily access the panoramic photos for each viewpoint plus reports on the background of the project, methods, assessment procedures, terminology, contacts, and development guidelines and recommendations (Fig. 8).

The use of "pop-up windows" was very useful for integrating various types of information that allow users to have a deeper understanding of the scenic assessment process (see Fig. 9). The ease of access should make the task of evaluating the visual implications of a

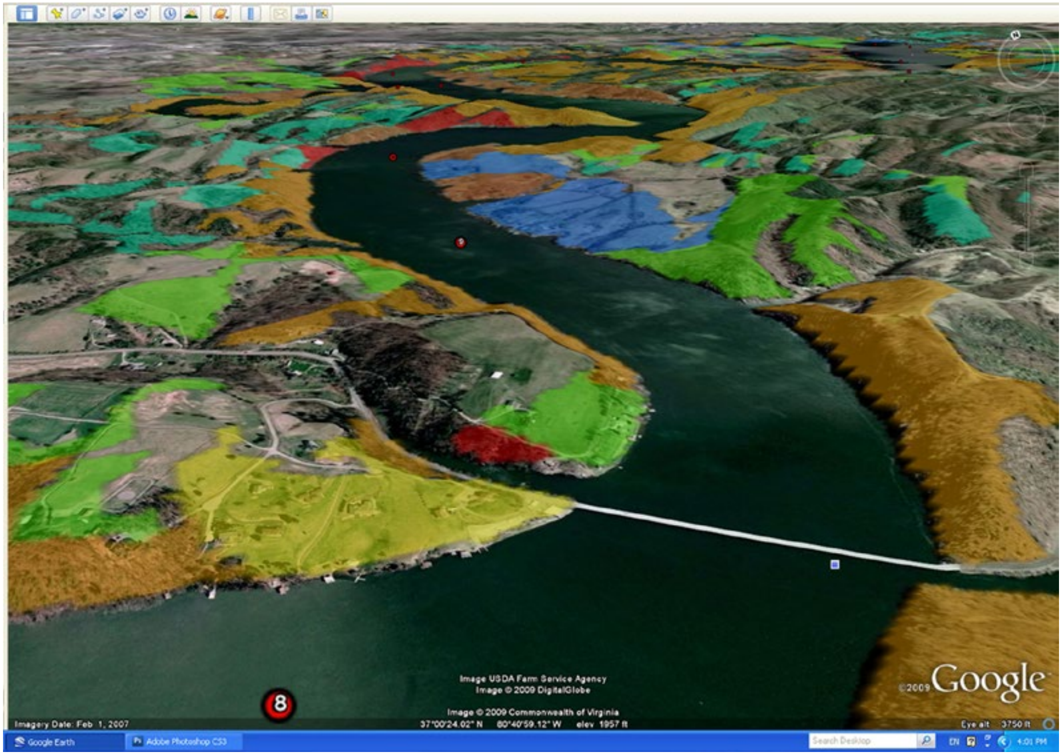


Figure 9.—Users can obtain different views of the landscape by changing viewing distance (zoom) and viewing angles. Source: Google Earth May 2009 and Claytor Lake Research Project, Landscape Architecture Program, Virginia Tech. May 2009

proposed development much more understandable and provide design guidance for specific areas around the Lake (Appleton and Lovett 2003). It should also make the process less frustrating for property owners and government officials (Williams et al. 2007).

CONCLUSIONS

Seeing the future means looking now.

It is clear from this study that a real-time scenery management tool would help guide development and preserve scenic values in landscapes that are important to people. But are we ready for these tools? There are two things that need to happen before these tools can make a real difference in preserving scenic quality: 1) an improvement in the technology, and 2) changes in the regulatory system in most places in the United States. Each of these is discussed in more detail below.

Technology

There are many visualization tools and applications available for managing the scenic value of the landscape. However, many of these are too complicated for citizen stakeholders to use (Appleton et al. 2002). Thus, many of the available applications have been ignored due to poor accessibility and lack of intuitive understanding (Appleton and Lovett 2003).

Google Earth images are arguably not very good due to low resolution but they can still provide valuable spatial information to stakeholders and researchers (see Fig. 9). Also, this technology is improving, and higher resolution images are already available on platforms similar to Google Earth. The advantages of using Google Earth or similar applications include ease of access, dynamic 3D visualizations, and simultaneous access to multiple sources of information. MacFarlane et al. (2005) have suggested that in the future, landscape assessment will not depend on typical hard copy data presentations but will involve mostly hyperlinked data that are interactive through Web browsing techniques.

Another factor is that lower production costs can be expected since investment in human resources to produce printed materials will be reduced by displaying scenic, geospatial information in a digital format. Lower cost will encourage use.

Regulatory System

In many locations, the land development laws and regulations do not include mechanisms for preserving scenic quality. We believe that the lack of regulation is primarily due to the difficulty of understanding visual concepts and principles, both among professionals and citizens. Scenic quality is something that most people know when they see it, but they lack knowledge of the visual concepts and principles necessary to explain why a landscape is scenic. A tool that allows people to view both the landscape and information about how it might be developed would make policy and regulation more understandable.

It would be particularly helpful if proposed developments could be simulated and viewed in the landscape. In fact, The National Capital Region Planning Commission is already doing this. They call it, "EyeSite AR/Augmented Reality." The application combines building information modeling (BIM) and GIS to simulate proposed building in the urban landscape. We believe that regulatory mechanisms will follow once these tools become increasingly available and can aid in understanding the visual implications of landscape change.

Final Thoughts

The combination of these technologies will provide a remarkable opportunity for landscape managers to deliver their ideas effectively to the public and efficiently receive feedback. At the same time, these new technologies and new applications of existing technologies encourage landscape managers and citizens to engage in positive interaction and critique proposals for new development in a way that can preserve scenic value and enhance sense of place. Orland et al. (2001) and Lewis and Sheppard (2006) have also noted that visualizations can be a "common currency of planning" that can encourage participation and understanding among users, providing a basis for managing scenery in a manner consistent with public values.

As we stand at this moment looking into the future and contemplating the opportunities that visual technologies present us, we feel compelled to express a bit of caution. No matter how good the digital representations and the value of the knowledge they can provide us, we should also remember that nothing can ever be as rich as the experience of the landscape. This is why we do this work.

ACKNOWLEDGMENTS

Funding for this research was partly provided by a sponsored program agreement between American Electric Power and CDAC at Virginia Tech. The authors wish to acknowledge the contributions of the Project Team: Song Liu, Visiting Scholar, Tongji University, Shanghai, China; Elizabeth Gilboy, Director, CDAC; Kim Steika, Landscape Architecture Project Coordinator, CDAC; Shamsul Abubakar, graduate student, Architecture & Design Research; Christine Calorusso, graduate student, Environmental Design & Planning; Melissa Philen, graduate student, Environmental Design & Planning; Yining Xu, graduate student, Landscape Architecture; Zheng Chen, graduate student, Architecture & Design Research; and project consultant Seth Peery, Senior GIS Architect, Enterprise GIS Research & Development Administration, Virginia Tech.

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IDENTIFYING VALUED SCENES AND SETTINGS IN AN ORDINARY LANDSCAPE

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Abstract.—The Georgia Scenic Byways program is a "grassroots effort … to identify, preserve, promote, and protect treasured corridors throughout the state" (Georgia Department of Transportation 2013, p. 32). To date, the Georgia Department of Transportation has designated 15 Scenic Byways. This paper presents a model "valued landscape detector," a smartphone application that uses social media and augmented reality mechanisms to engage interested citizens in evaluating the scenic value of highways (or stretches of highways). Citizen data collectors, guided by GIS via their smartphones, are invited to provide *in situ* evaluations and upload photos and geolocation data for the Georgia Scenic Byways designation program. Another goal of the project is to identify currently undesignated stretches of highway that may be candidates for future State designation. Beyond the current application, the method may be useful for identifying a wide array of cultural and natural resources that might otherwise be overlooked.

BACKGROUND

This paper presents a model for scenic highway designation that is citizen driven and grassroots in nature. The goal is to identify landscape resources that are locally valued but may otherwise go unnoticed and unrecognized in regional or statewide management initiatives.

Scenic resources are the backdrop to everyday life and provide a sense of place but it can be challenging to articulate their value(s) and in most cases there is no existing consensus about the need to protect and preserve them. Likewise, cultural resources (like archaeological and historical sites) and ecological resources are not evenly dispersed on the landscape and often go unnoticed. Some known cultural sites are prominent and well recognized while others are less well known and may be deliberately hidden from view, either physically or by withholding spatial data to avoid the removal of artifacts. Ecological resources are also highly dispersed, and protected areas receive varying levels of protection.

Over the last few decades, scholars and Federal land agencies have developed systematic ways of evaluating landscape scenic quality. The approaches have generally fallen into two categories. First, experts, often landscape architects, have developed scoring systems for landscapes based on the extent to which they have formal aesthetic characteristics such as variety in form, line, color, and texture (Bureau of Land Management 1984, Smardon and Karp 1993, USDA Forest Service 1995). Second, social scientists have developed psychophysical approaches that systematically capture research participants' evaluations of typical scenes and use statistical methods to identify the physical characteristics of the landscape that elicit scenic evaluations (Daniel and Boster 1976, Parsons et al. 1998).

Both types of approaches aim to account for public values, but when aesthetic appreciation is not the predominant value of a landscape, the utility of these approaches diminishes substantially. This is especially true in the case of cultural resources since agriculture and other built artifacts are often thought to detract from natural scenic value (Daniel 2001, Gobster et al. 2007, Parsons and Daniel 2002).

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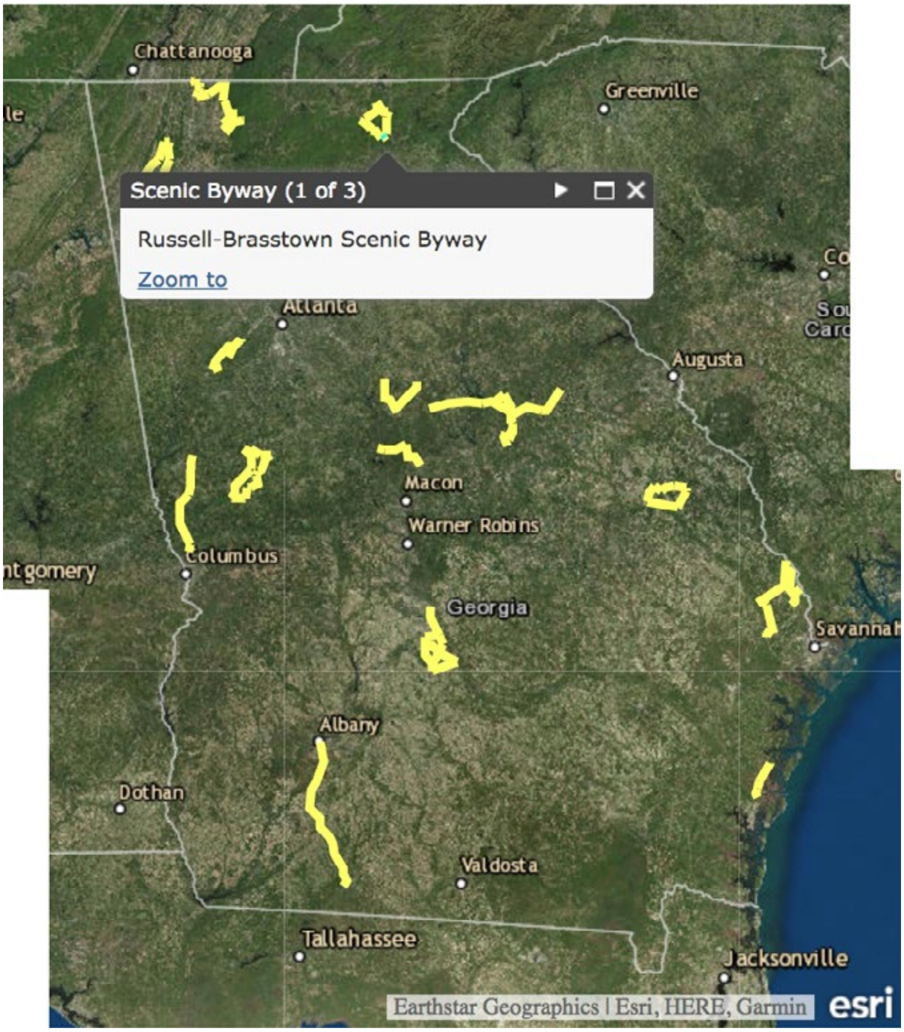


Figure 1.—The 15 designated Georgia Scenic Byways. Scenic Byways are in yellow. Georgia Department of Transportation Scenic Byways map. http://www.dot.ga.gov/DS/Travel/Scenic. Sources: ESRI, HERE, Garmin, NGA, USGA, NPS (accessed February13, 2018).

GEORGIA'S SCENIC BYWAYS PROGRAM

The State of Georgia, USA, is not generally recognized as an iconic destination for the enjoyment of scenic beauty. Nevertheless, for many residents and visitors, the Southern terminus of the Appalachian Trail in the North Georgia highlands and the Golden Isles of the Georgia coast, for example, represent highly valued scenic landscapes (Georgia Department of Economic Development 2017).

Administered by Georgia's Department of Transportation, Georgia's Scenic Byways program is promoted as "a community driven effort [that] preserves these treasures in ways that appeal to Georgians and travelers alike, and ultimately enhances economic development" (Georgia Department of Transportation 2013, p. 32). Figure 1 shows the distribution of officially designated Scenic Byways in Georgia. Anyone can submit an application for a road to receive official scenic byway designation. The application requires comprehensive descriptions of the "intrinsic qualities" of the byway and its surroundings. Yet there is no official description of what comprises a scenic landscape or how its attributes should be identified. In addition, the State of Georgia currently lacks the expertise and resources to identify additional candidates for Scenic Byways designation.

Another major drawback of the program is that features of local significance such as aesthetically appealing landscapes, valued historic vistas, abandoned farms and home sites, or historic burial grounds are likely to be missed. A look at the officially designated Scenic Byways in western Georgia illustrates the point (Fig. 1). The *I-185 Byway* is a major highway corridor surrounded by mixed pine

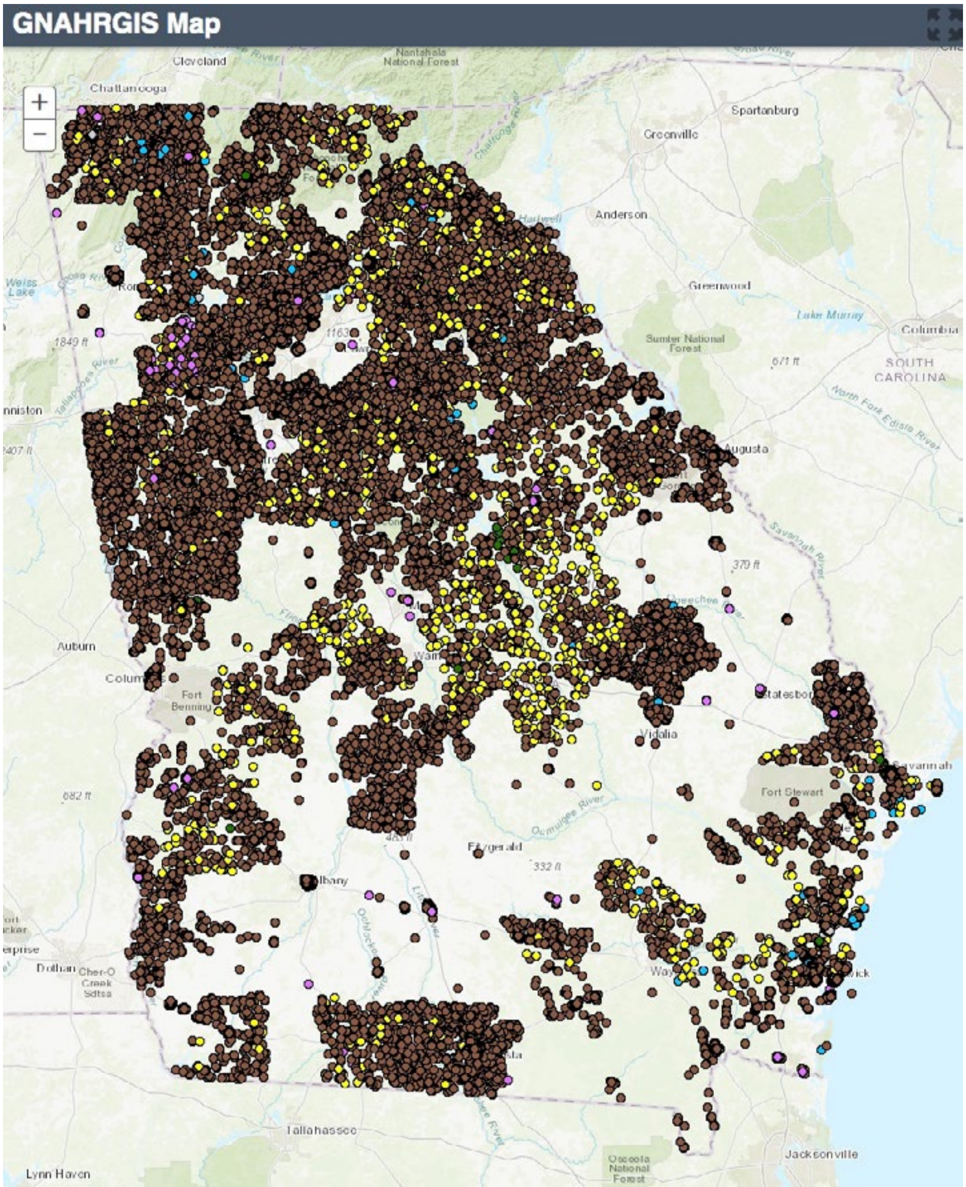


Figure 2—Georgia Archaeological and Historic Resources. Georgia's Natural, Archaeological and Historic Resources (GNAHRGIS) GIS. https://www.gnahrgis.org/gnahrgis/index.do (accessed March 2, 2018).

forest. *Enduring Farmlands* showcases historic rural towns and their pastoral settings. *Ridge and Valley* focuses on the natural attractions of the southern tip of Appalachia and *Altamaha* threads a mix of natural and cultural settings in coastal Georgia (Georgia Department of Transportation 2017). While the eclecticism of these examples is appealing and encompasses a wide range of values, it is clear that other, similar potential Scenic Byways may not yet have been recognized. In addition, there are substantial "gaps" in the northeast, southeast, and southwest corners of the State that do not reflect Georgia's widespread natural and cultural richness.

Once a Scenic Byway does receive official designation, the Georgia Department of Transportation develops a Corridor Management Plan that describes the scenic, natural, historic, cultural, archaeological, and recreational features that deserve protection (see Figs. 2, 3). However, the only legal mechanism for protecting these features is a restriction on billboards in Scenic Byway corridors.

To address the potential loss of scenically, culturally, and ecologically valuable landscapes in Georgia, we need a process that captures grassroots values in a way that can be applied across the entire network of Georgia highways.

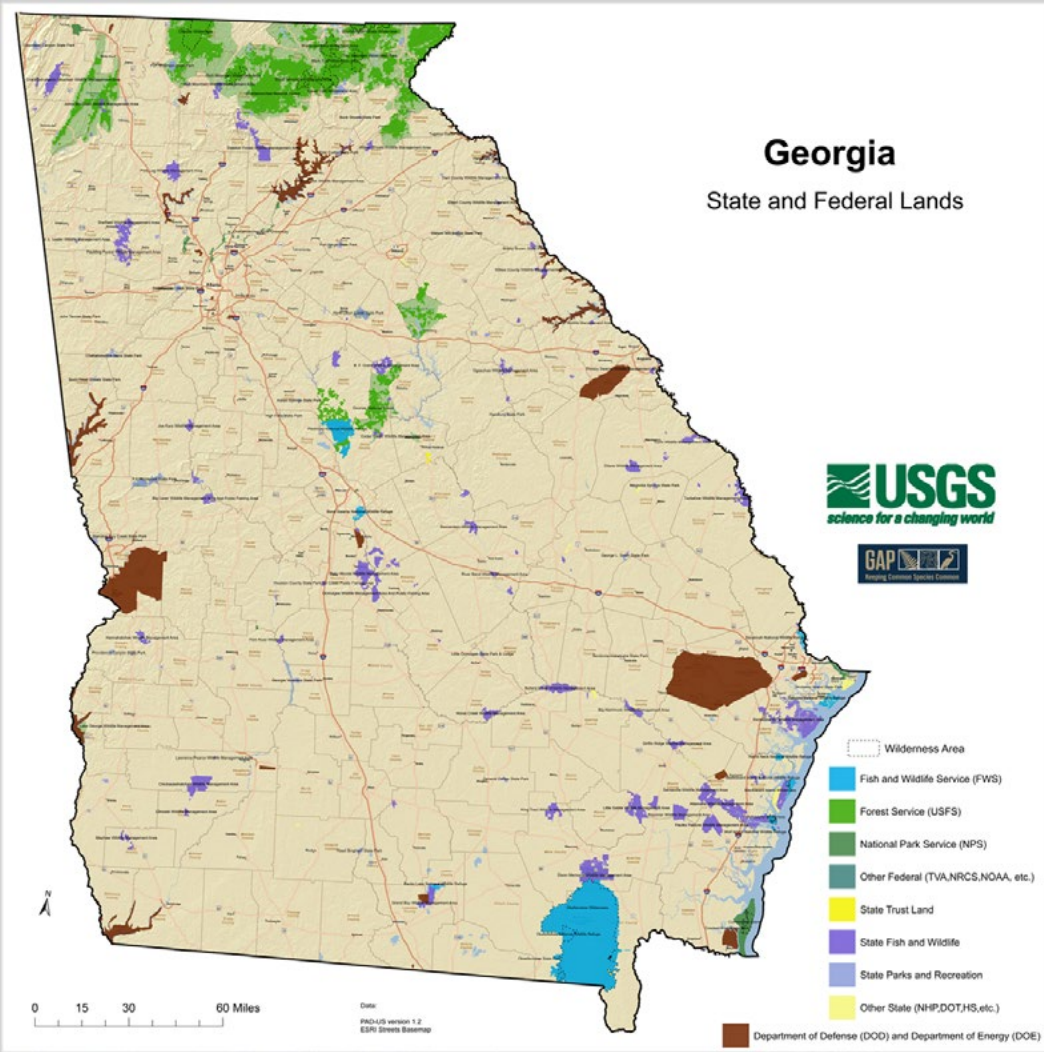


Figure 3.—Georgia protected areas highlighted by agency jurisdiction. USGS National Gap Analysis Project|Protected areas data portal. https://gapanalysis.usgs.gov/padusapps/maps/Georgia.pdf (accessed March 2, 2018).

"GRASSROOTS" VALUES IN SCENIC ASSESSMENT

There are many processes that have been used to identify and officially designate scenic highways and byways in the past (Clay and Smidt 2004, Evans and Wood 1980, Muck 2006, Rottle 2006). However, as noted above, these approaches may have been biased toward the opinions of outside experts and consequently may have undervalued the place-based knowledge of local stakeholders.

Expert planners Dzur and Olson (2004) observe that scientific and professional knowledge alone cannot solve complex design and planning issues. Rather, they encourage scientists and planners to stop thinking of themselves as working *for* the public and instead think of working *with* the public. This approach includes developing placemaking narratives and employing participatory design and action research to capture local knowledge. One challenge of this approach noted by Orland and Murtha (2015) is that local stakeholders may believe that they lack broad knowledge of natural and cultural systems and are not qualified to participate fully in land planning processes. If this can be overcome, authentic and effective participation of a range of stakeholders can lead to deeper engagement with the design process, ownership of the outcomes, and future involvement in ensuring that plans are implemented (Phillipson et al. 2012).

Another inherent tension in "grassroots" processes to identify scenic resources is the possibility that the assessment of resources will not be thorough and systematic. This could lead to a lack of compelling evidence for extensive and effective scenic resource protection and may inhibit identification of some scenic resources. A key to addressing both issues lies in: 1) raising public awareness of locally "treasured" resources, and 2) developing mechanisms by which such places can be found in the landscape and brought to the appropriate forum for discussion and potential recognition.

Capturing People's On-site Records of Valued Places

Visitor Employed Photography and Photovoice are two techniques for capturing people's responses while they are immersed in the study of landscapes. Visitor Employed Photography has been used for more than 40 years to study how people use and connect with particular places during outdoor recreation (e.g., Balomenou and Garrod 2016, Chenoweth 1984, Cherem and Traweek 1977, Hull and Stewart 1995). Participants are asked to photograph places where they encounter peak enjoyment of an environmental experience. Instead of waiting until the experience is over to report on it, the photograph records the immediacy of the situation *in situ*. Chenoweth (1984), for example, used the powerful connection of place and experience to argue in favor of protecting important recreational landscapes along the Lower Wisconsin River.

Photovoice is a related qualitative method where people are asked to take a photograph and then talk about the subject of the photograph and what it means to them (e.g., Balomenou and Garrod 2016, Beilin 2005, Guell and Ogilvie 2015). In this case, the respondent's physical location and narrative provide context such as the motivation for taking the photograph and other evaluative responses.

Both Visitor Employed Photography and Photovoice involve a deliberate intervention—participants are solicited, trained, and motivated to follow a prescribed protocol. Participation is structured and shaped in ways that help investigators identify significant relationships between place and response. However, the deliberateness of the approach and the consent to participate may bias who contributes to the research, what they choose to photograph, and how they report on their experiences to the researchers.

By contrast, social media such as Internet shared photographs, blog posts, and Twitter tweets are potentially rich sources of information about place evaluation that are unaffected by researcher influence. Researchers have pointed to photo sharing services as potential sources of information for identifying, for example, optimum or popular travel routes (Alivand and Hochmair 2013, Dunkel 2015) or valued viewsheds (Berbés-Blázquez 2012, García-Palomares et al. 2015, Goldberg et al. in this proceedings, Salmond et al. 2017). These volunteered data sources, if accompanied by geolocations, could also help identify potential scenic highway corridors.

Crowdsourced Evaluation and Identification of Roadside Scenic Landscapes

There is a growing body of literature calling for greater public engagement in design and planning and in proposing new mechanisms for engagement (Brown and Donovan 2013, Griffon et al. 2011, Phillipson et al. 2012). In developing such tools, the public needs to see its own values represented in emerging plans, be able to engage in the planning process on its own terms, and see its contribution expressed in the way it intended. The use of crowdsourced information, including photographs and personal narratives, offers the opportunity to see one's contribution appear as part of a developing view of the world, not only as an eventual evaluator of plans but also as a participant in establishing evaluation criteria (Alivand and Hochmair 2017, Dunkel 2015, Liu et al. 2016, Martín et al. 2016, Nieuwoudt et al. 2016).

At first glance, photographs taken near a scenic highway (as accessed via Google Earth Pro) appear too eclectic to derive any generalizable insights into what constitutes valued scenery (Fig. 4). In some cases, the existing number of available images may also be too small to derive any generalizations (Fig. 5). However, the variety of photos may signal that the values of a Scenic Byway are more varied than a traditional scenic analysis perspective would suggest. The scenic analysis literature supports this observation with numerous examples of highway related studies where assessments from expert approaches fail to capture factors that are crucial in nonexpert viewer evaluations (Clay and Smidt 2004, Evans and Wood 1980, Hull and Stewart 1995, Rottle 2006).

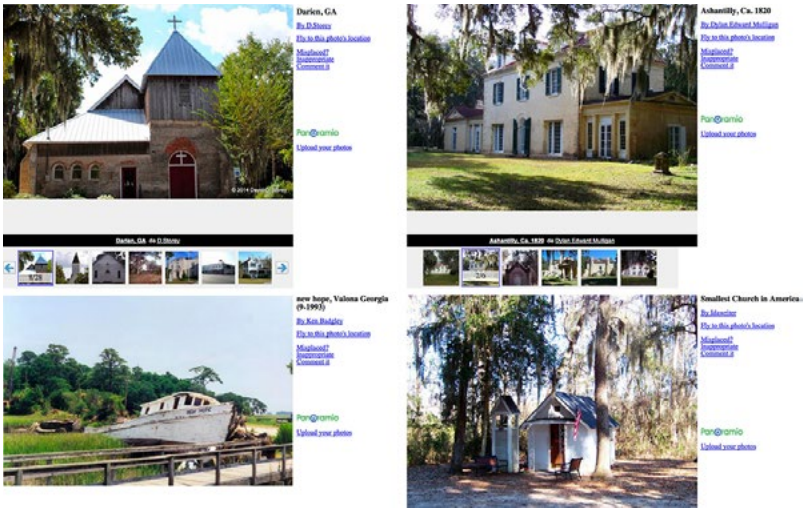


Figure 4.—Photos of locations along the Altamaha Historic Scenic Byway. Google Earth, Google Imagery 2018, TerraMetrics, 2018 (accessed February 13, 2018).

Figure 5.—Google Earth image of Altamaha Historic Scenic Byway. Google Earth, Google Imagery 2018, TerraMetrics, 2018 (accessed February 13, 2018).

In contrast, the Photovoice literature views the eclectic content of scenic photographs as a benefit. Various studies have used photographs to discern a broad range of values in the landscape; for example, sense of place and symbols of well being in rural landscapes (Beilin 2005, Berbés-Blázquez 2012, Guell and Ogilvie 2015, Pastur et al. 2016, Ramírez et al. 2011) and cultural landscapes in urban settings (Liu et al. 2016, Mahmood et al. 2012, Richards and Friess 2015).

In each case, the more explanatory approach of Photovoice (Balomenou and Garrod 2016) addresses what an increasing number of authors are calling cultural ecosystem services. Once the benefits of these services are articulated and understood, land use planners have an incentive to prioritize ecosystem and landscape features that affect them. The research concludes that crowdsourced data can help identify spatial patterns of cultural ecosystem services and their associated landscape settings (Berbés-Blázquez 2012, Matthews 2011, Muck 2006, Nieuwoudt et al. 2016, Pastur et al. 2016).

DEVELOPING A PROTOTYPE "VALUED LANDSCAPE DETECTOR"

The following sections describe a process to identify candidate Scenic Byways in coastal Georgia. The basic idea is that metrics derived from known scenic locations are used to identify potential scenic locations; then, as travelers approach a potential scenic location, they are contacted via a mobile augmented reality (AR) application (app) and prompted to provide *in situ* evaluations of the scenery.

Augmented reality is a subset of virtual reality that overlays images of a projected alternate onto a direct experience of the real world. Rather than replace the viewer's complete world with an immersive computer generated synthetic view, AR uses geolocation and orientation techniques to project parts of the scene based on the location of the viewer (Bishop 2015, Orland 2015). The Pokémon Go craze of 2017 was one example of AR in action (Anthony 2017).

We are developing a tool that prompts users to evaluate their surroundings when they (and their AR device) pass scenic, cultural, or ecological features. The tool delivers narratives and images based on the device's location. Our prototype tool uses the concept of geofences within an AR environment to trigger prompts about cultural/ecological/scenic benefits. A geofence is a virtual threshold located via spatial coordinates that triggers a response in a mobile device. One version of our app delivers visual and audio augmentation to smartphone users who scanned a static map or landscape model in a community location such as city hall or post office (Fig. 6a) (Morrison et al. 2011). A second version delivers imagery and audio narratives to automobile passengers and audio-only cues to drivers, again via their location-enabled smartphones (Figs. 6b, 6c) (Blattner et al. 1989, Vazquez-Alvarez et al. 2012).

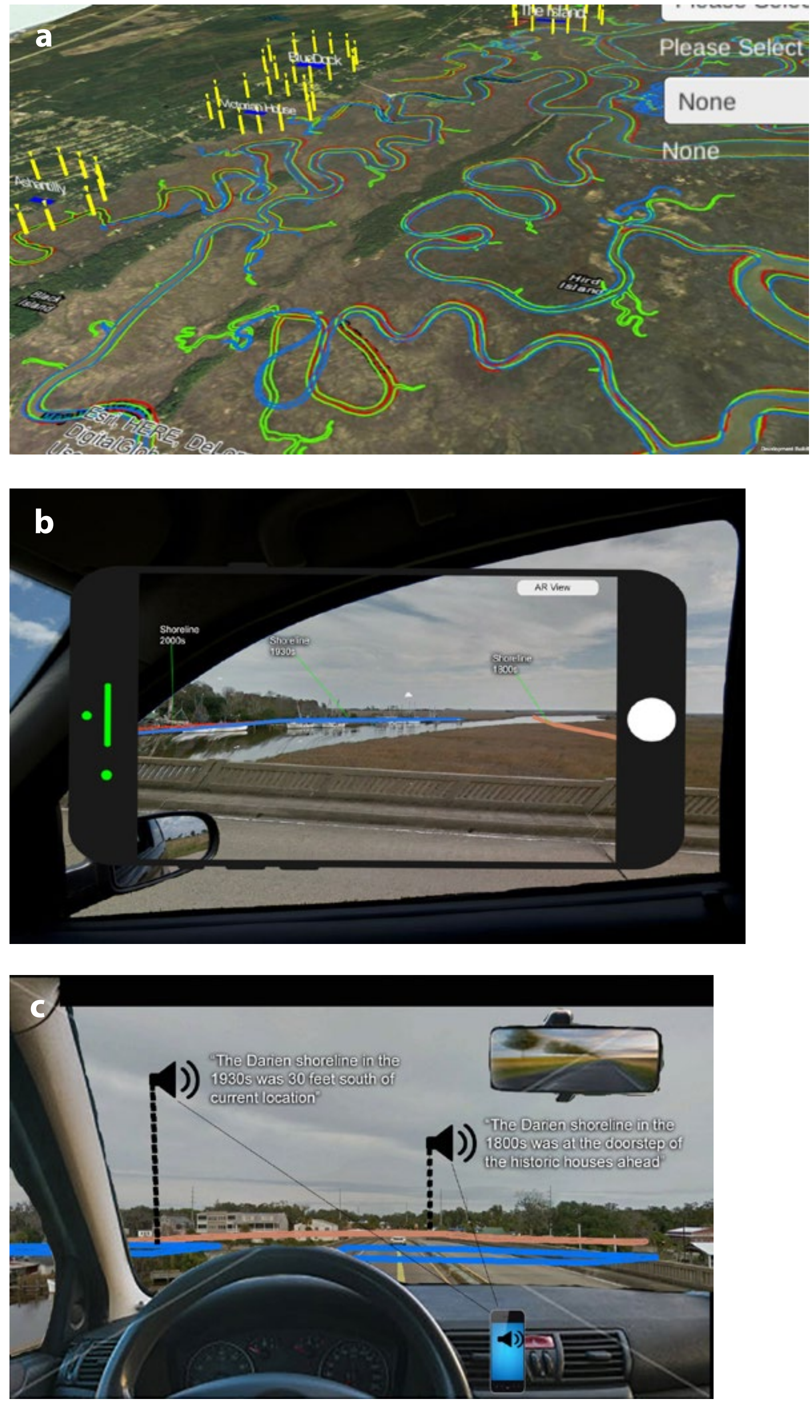


Figure 6.—(a) Map target-based augmented reality; (b) passenger audiovisual augmented reality, and (c) driver audio cue augmented reality. ESRI Basemap. Sources: Earthstar Geographics, CNES/Airbus DS|ESRI, HERE, Garmin.

In the scenic highway version, AR users move along a highway, either viewing a highway map via their smartphone or listening to cues as they drive. The tool delivers visual and/or aural cues preassembled from crowdsourced photos and narratives. The map user or vehicle driver can record their evaluation of the landscape with either a geolocated verbal response or a photograph uploaded to a publicly accessible database of cultural, ecological, and scenic resources. These evaluations may form the basis for an application to the Georgia Department of Transportation for Scenic Byway status.

An Example Based on the Altamaha Historic Scenic Byway

For the app prototype, we used the Altamaha Historic Scenic Byway to test AR features and evaluation tools that could be used in other highway settings for scenic, cultural, or ecological protection.

Sixty-seven miles of U.S. Highway 17 in Georgia, from Richmond Hill to Brunswick, are recognized as a scenic drive (http://www.exploregeorgia.org/). A 7-mile stretch of that highway crossing the Altamaha River from Glynn County to Darien and 8 miles of GA Hwy 99 to Meridian make up the Altamaha Historic Scenic Byway (Fig. 7). Google Earth images from along this route include iconic scenic views of coastal salt marshes, damaged and abandoned boats, community churches including the smallest church in the United States, favorite restaurants, and historic landmarks (Figs. 4, 5).

Creating a Highway Image Log

We assembled an initial image log from crowdsourced images posted to Google Earth. Each of the scenes in Figure 4 contributes to the overall value of the Scenic Byway. Some are discrete locations such as churches and historic sites while others represent typical landscape scenes. For each, our evaluative system must be able to assign a score to distinguish more and less valuable aspects of the landscape.

Creating Geolocated Narratives

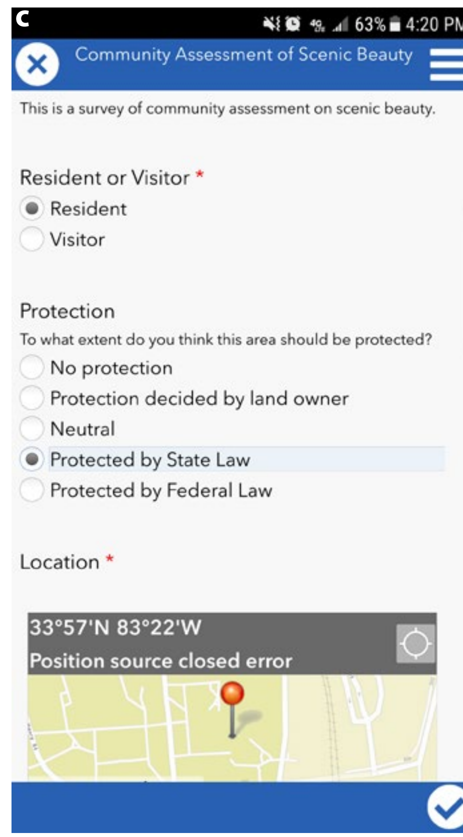
We have found that creating a narrative for cultural/historical/popular destinations—reasons for selecting or identifying it as a place of value—is relatively easy to do based on available descriptions (Fig. 8a, 8b). Creating a narrative may be more difficult when the records associated with scenic landscapes lack an explanation about why the photograph was taken.

For the embedded AR narratives, we used interview and survey responses from a post-Hurricane Matthew study that focused on climate-related migration but also included questions about place attachment and reasons for living on the Georgia coast (Orland and Welch-Devine 2017). We established geofences to trigger images or narratives based on prior crowdsourced knowledge of a cultural/historical/popular feature or by prior GIS-based designation as a scenic, cultural, or ecological "hotspot."

Figure 7.—The Altamaha Historic Scenic Byway (shaded in yellow).Georgia Department of Transportation.

In our prototype visual interface, viewers can select virtual buttons that reveal ancient shorelines of the Altamaha River or NOAA projections of sea level rise in the coastal salt marshes. The app can also respond to GIS indicators to develop a virtual topographical "surface" based on characteristics of known photo locations (Bishop and Hulse 1994, García-Palomares et al. 2015, Martín et al. 2016, Ramírez at el. 2011); the topographic high points of these locations serve as geofences for the evaluation system. A similar process could be used to add nonvisible features, such as locations valued for their known or projected ecological, archaeological, or historical data. There are many possibilities for conveying modeled or projected data.

Figure 8.—(a) Smartphone interface, (b) location-triggered in-car audio, and (c) geolocated feedback. Sources: Earthstar Geographics, CNES/Airbus DS|ESRI, HERE, Garmin.



Evaluating the Passing Landscape

Our evaluation approach is based in the use of locationally aware devices like personal smartphones that deliver a narrative of the drive along the candidate highway. At locations determined by scenic, cultural, or ecological geofences, the user is asked to comment on their surroundings and provide a scenic preference score. Drivers may respond verbally, and their input is recorded and tagged with a geolocation. Passengers may take their own photographs, augmenting the crowdsourced photo resource and providing a more comprehensive evaluation (Fig. 8c). Users may also choose to provide unprompted input at any time, and all responses are tagged with geolocation information. Responses are georeferenced at the time of collection, and users can decide in advance if they want to upload evaluations to a resource database in real time or by later upload.

The evaluations of historical, cultural, and scenic resources that users submit via this crowdsourcing mechanism can be made available to other app users as well. In this way, individuals may contribute their own views and at the same time learn about the preferences and insights of other active users.

CONCLUSION

Locating candidate scenic highway landscapes for protection is not necessarily a straightforward endeavor, particularly when it involves identifying cultural and ecological resources that may be locally important but are not well known to visitors. Consequently, some locations are likely to be under-sampled, and even when a place or feature catches a motorist's eye, there have not been convenient ways to register this information while moving down the highway. The value of tools such as Visitor Employed Photography and Photovoice has been recognized, but their use has been limited to what can be readily seen, heard, or smelled in a specific location.

Here, we propose that such methods can be taken further to capture not just individual experiences of place but also collective experiences reported by multiple individuals. We are able to capture the richness of experience along a scenic highway via crowdsourced photography and narratives and then invite others to consider and respond to those experiences via a smartphone app. We can use the app to convey scientific and historical insights about the landscape.

In the prototype case described here, the goal was to bring attention to scenic landscapes, but the general approach can be applied in numerous other settings where collective grassroots experiences of landscape are essential to protection and preservation efforts. The insights of local people—such as what flooded and how frequently, which family farmed there and how—add authenticity to existing knowledge bases. We hope that the tools described here may lead to a broader understanding and appreciation of landscapes as local people see their own "views" (literal and figurative) represented and honored in larger frameworks of decision making.

ACKNOWLEDGMENTS

Partial support for this project was provided by: U.S. National Park Service cooperative agreement #135414 P11AC30805, "Comparative Landscape Scale Cultural Resource Conservation: West Virginia and Georgia"; U.S. National Science Foundation award 055736-01, "The Wake of Hurricane Matthew: Rethinking Vulnerability, Resilience and Migration"; and Institutional Grant NA10OAR4170084 to the Georgia Sea Grant College Program from the National Sea Grant Office, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

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INTEGRATING VISUAL AND CULTURAL RESOURCE EVALUATION AND IMPACT ASSESSMENT FOR LANDSCAPE CONSERVATION DESIGN AND PLANNING

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Abstract.—While there is increased need for cultural resource conservation and management in North America, there are few assessment approaches that provide robust integration of visual and cultural resources. Our research, focused on the Appalachian Landscape Conservation Cooperative region, used a model to integrate visual and cultural resources for prioritizing landscape-scale conservation. We investigated how "place" can be studied in relation to visual resources given what we know from existing cultural resource databases such as the National Register. The study measured visual quality and viewshed threats to better inform cultural resource planning and management across Pennsylvania. Prominent ridgelines and viewpoints, for example, were designated as integral features of rural and urban aesthetic character. By evaluating potential landscapes for conservation priority, we can bring awareness to important resources for public investment and encourage Federal, private, public, and business stakeholders to engage in scenic and cultural heritage conservation.

INTRODUCTION

The human imprint on the environment is extensive, complex, and often irremediable (Solomon et al. 2009, Vitousek et al. 1997). Anthropogenic activities such as energy development, urbanization, and sprawl can have negative impacts on local landscapes and, through climate change and other effects, are significantly threatening the global environment (Hooke et al. 2012, Marzeion and Levermann 2014). While visual and cultural resource values are often tightly coupled with environmental values, unless they also have some substantial economic benefit such as through tourism, there are few incentives to protect them (Taylor 2011, Throsby 2003). As a result, visual and cultural resources may lack a competitive edge when pitted against economically driven natural resource projects such as material extraction.

Fortunately, visual and cultural resources are becoming recognized for other important values, and there is a growing movement to devise strategies to conserve and protect them in the regional landscape (Tweed and Sutherland 2007). Cultural resources provide information about the past, which can be used to solve modern day issues and inform future decisions. Together, visual and cultural resources define a community's identity and sense of place, which is fundamental to individual and community well-being and can be a powerful gateway for social and environmental connection for residents and visitors alike (Oakes and Price 2008, Stocker 2013, Williams and Stewart 1998). Finally, visual and cultural resources express a coupled natural and human narrative in landscapes and provide a unique perceptive window into preservation design and planning. For these and other reasons, it is clear that visual and cultural resources must be systematically integrated into landscape-scale conservation design and planning.

Cultural Resource Preservation

It is critical to understand the essence of cultural resources, their significance, and ways we can integrate and ultimately preserve them. In this study, we generally classified cultural resources as tangible and intangible consequences of human action. Tangible resources included physical artifacts or expressions of human action with direct and indirect data that

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could be measured, sorted, and/or counted. Intangible resources encompassed the knowledge, skill, and creativity derived from individuals that provide sense of place within the community, including visual resources and scenic quality (Kirshenblatt-Gimblett 2004, UNESCO 2003, Vecco 2010). Together these cultural resources can take many forms including prehistoric and historical sites, structures, bridges, cemeteries, monuments, and landscapes (Knudson 1999, National Preservation Institute 2017).

There are several discourses associated with cultural heritage (Hodder 2010, Kurin 2004, Smith 2004). What is culturally important in one community may be perceived differently in another, and this has led to diverse approaches to cultural resource management based on community participation, conservation planning, and design initiatives. Some regions have attempted to inventory cultural heritage resources and devise programs, such as the historical markers program in Pennsylvania, to enrich cultural understanding of humans in nature (Robinson and Galle 2014). At the same time, many regions are failing to promote cultural resource awareness or prioritize cultural resource management due to budgetary restrictions and/or lack of cultural awareness (Meskell 2013, Timothy 2017). Tourism and community pride are two examples of how cultural heritage preservation can help promote economic stability and growth.

Visual Resource Interpretation

Visual resource assessment came of age with the National Environmental Policy Act (NEPA) in 1969, which in part required that aesthetics be considered along with other environmental values in Federal projects that could significantly impact the landscape (Sheppard 2001). The USDA Forest Service introduced the Visual Management System (VMS) in 1974 to inform management decisions and assess visual quality using human observation, computer generated analysis, theory, and evaluation of change (Bishop and Hull 1991). The Bureau of Land Management introduced its own visual resource management program in 1980, which had a special emphasis on visual impact assessment (VIA) methods that address the visual contrast of project-based activities (Bureau of Land Management 2017). These systems took a largely expert-based approach to evaluating visual resource quality, incorporating perceptual measures of viewer sensitivity and project impact, and setting management objectives for visual resources (Daniel 2001, Feimer et al. 1979, Smardon et al. 1983). However, the main focus of these systems was on natural public lands in the western United States. A broader definition of visual resources would encompass both the built and natural environment, including compositional cues related to water, vegetation, landforms, and infrastructure (Craik and Feimer 1979, Krause 2001).

Many studies distinguish cultural and visual resources as separate entities, but they are not mutually exclusive. Cultural resources are often tangible; there is a physical structure portraying the significance of a culturally noteworthy event, person, or place. Visual resources tend to be intangible because perception and cognition of a certain view are what predominantly arbitrate a resource's significance. Moreover, the tangible informs the intangible.

Research has found that memory and landscape are integrally linked (Kuchler 1993, Spiegel 2004). The physical environment plays a vital role in constructing meaningful experiences and perceptions, and these constructs are not exclusively social (Stedman 2003). We perceive the landscape around us not only by differentiating the physical features from their natural context but also by incorporating aspects of time, condition, and sentiment. The response to a given landscape will consequently be different for different people and at different times based on interpretational variation.

Few studies since the 1980s have evaluated and/or created methodologies to inventory and manage visual resources across the landscape, though there is now a global movement toward a unified vision of the landscape that integrates culture and nature. Our research transforms common ideology, shifting from a once static view of significance to one that recognizes the complex nature of social meaning (Clarke and Johnston 2003). The amalgamation of a scenic inventory with a comprehensive cultural resource inventory can capture the historic and cultural values of the landscape that are essential not only to government agencies like the National Park Service, but also to society in general.

Figure 1.—Extent of the Appalachian Landscape Conservation Cooperative area.

OBJECTIVES

The primary goal of this study was to evaluate prospective visual and cultural landscapes in need of conservation, management, and/or establishment in order to: 1) bring awareness to important resources for public investment, and 2) encourage Federal, private, public, and business sectors to conserve scenic and cultural heritage. Our main objective was to change the traditional disciplinary mindset by applying a broader conception of cultural resource management that includes visual resources. Presently, there is a lack of consistency and structure within the conservation movement and a critically undervalued and unaddressed understanding of visual and cultural resources within environmental design (Maser 1997, Nowak et al. 2006). Traditional conservation strategies fail to address the social component of conservation planning, instead emphasizing reestablishment and preservation in terms of species viability (Wiens 2007). We are attempting to bridge these knowledge gaps and raise awareness about these issues using a spatially explicit resource assessment of visual and cultural resources at a landscape scale.

METHODS

We developed a conceptual framework that provides direction for understanding resource allocation through a multifaceted mapping methodology, and we devised a landscape-scale approach for integrating cultural resource data into conservation design and planning. Direct and indirect measures of cultural resources were overlaid and compared. Through this process, we examined the role of cultural resource distribution within and between subcategories. The framework distinguishes a series of procedural phases to evaluate quantitative and qualitative aspects of cultural and visual resources using Pennsylvania as the contextual extent.

Jointly funded by the National Park Service, The Pennsylvania State University, the National Council on Preservation Education, and the Wildlife Management Institute, this study investigated and applied landscape-scale conservation priority analysis and modeling to the part of Pennsylvania covered by the Appalachian Landscape Conservation Cooperative (AppLCC) (Fig. 1). Pennsylvania was the principal area of interest, but we shaped our conceptual framework to conform to multistate conservation goals and priorities. Within this framework, tangible and intangible models were included, with intangible models predominantly representing visual resources.

Our framework relied heavily on research reported by Paul Leonard and Rob Baldwin at Clemson University (Leonard et al. 2015). We adapted their principles and techniques for assessing biodiversity and landscape-scale conservation planning to inform the process by which we evaluated cultural and visual resources. To develop our conceptual framework, we used comparative studies and existing project documentation on landscape and conservation planning. A primary source of reference was Jones and Amidon (2007), who created a GIS-based software tool called ILARIS, to identify aesthetic resources for setting landscape preservation priorities for the Puget Sound region of Washington State. We also used similar approaches from other studies and relied on time tested research methods developed by Ian McHarg (1969) and discussed more recently by Steinitz (2012) as geodesign.

Conceptual Framework Derivation

The Clemson University team completed a preliminary review of cultural resource valuation, which examined the significance of various terms that stakeholders found to be valuable in understanding sense of place (Brown and Weber 2012, Lowery and Morse 2013, Raymond et al. 2010). Using terms from a Public Participatory Geographic Information Systems (PPGIS) study (Brown 2012), we created a brainstorm matrix to represent the significance of landscape resources related to social, economic, and environmental aspects of life. These values included aesthetic, recreation-related, economic, wilderness, biological, heritage, future, learning, intrinsic, therapeutic, spiritual, life sustaining, social, marine, and many others. We categorized and defined similar terms and developed a conceptual framework that combined these terms into regionally appropriate qualitative and quantitative themes.

We examined current National Register, historical marker, and statewide cultural resource datasets from Pennsylvania. We used information on culturally significant places and people to identify potential gaps across the landscape and within classification categories of approved sites. Our approach compared the spatial distributions of different resources to determine which combinations of data could be used in landscape-scale conservation design and planning. Using the ModelBuilder application in ArcGIS, we devised a cultural resource conceptual framework to highlight potential variables and produce a comprehensive spatial distribution map of high-quality resource areas.

Our theoretical framework applied a series of overlay analyses to explore spatial patterns of resources using direct and indirect sources of data. We assembled the overall model around “tangible” and “intangible” resources as shown in Figure 2. We subsequently broke these resources into 11 discrete submodels or themes that we inventoried and parameterized using available geospatial data. We developed a four-step system: 1) establish potential significance of resource variables by assessing available data layers; 2) determine each data layer’s level of influence; 3) use weighted data layers to create a series of “scenarios” or comprehensive models of tangible and intangible resources; and 4) develop a cultural resource inventory by combining theme data for an eventual design priority and/or threat determination exercise.

The seven tangible themes (recreation, cultural heritage, agriculture, economics, education, water, and wilderness) provided a comprehensive inventory of potential cultural resources; this is uncommon in cultural resource inventories that usually focus on resources in one or several categories. Instead of identifying features based on their unique qualities, our approach allowed for and even anticipated redundancy. We also defined four intangible themes: aesthetics, visual, sense of place, and intrinsic cultural heritage. Although there are fewer themes representing visual resources, the weight each theme brings to the overall inventory will vary as we develop final design recommendations and conservation planning guidelines.

Cultural and Visual Resource Data Attainment

In this study, we assessed numerous variables using a selection and exclusion approach. Many of the geospatial data layers were from government and nongovernmental organization sites such as the Pennsylvania Spatial Data Access (PASDA) clearinghouse, Pennsylvania Fish & Boat Commission,

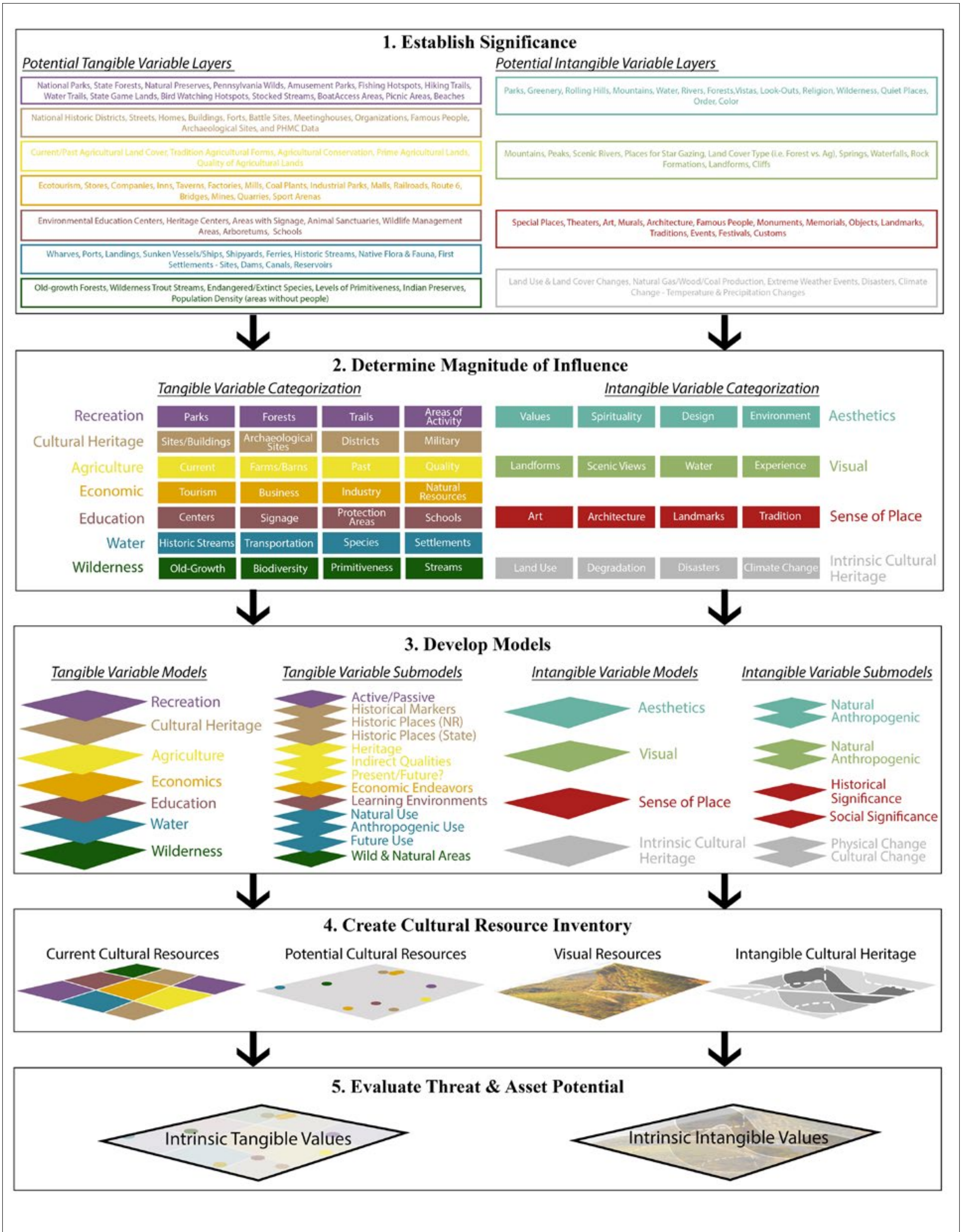

Figure 2.—Cultural and visual resources conceptual framework.

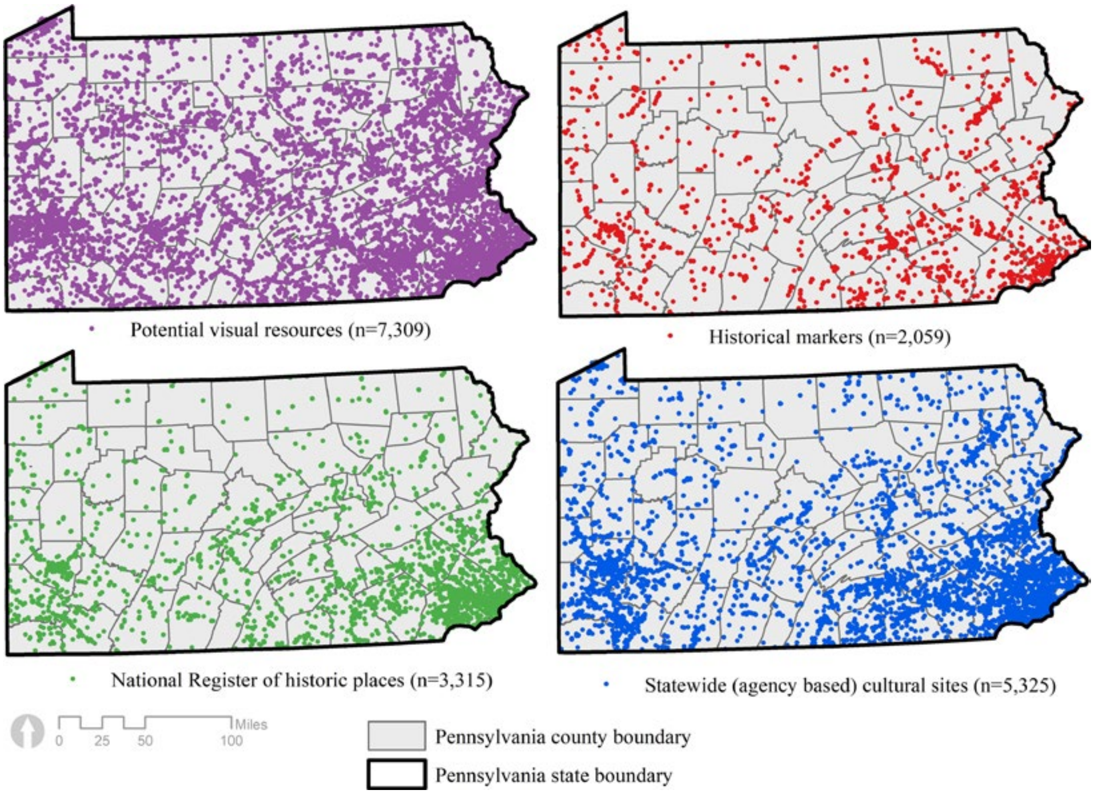

Figure 3.—Clockwise from top left: Map of locations for georeferenced photos (visual resources), historical markers, statewide agency-based cultural resources, and National Register of Historic Places.

Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Historic Museum Commission, and ESRI online. Using overlay methodology within ArcMap, we reconfigured data layers at the small watershed scale (using 14-digit HUC boundaries). We used the natural system as the basic structure of analysis as it proved to be the most suitable for representing results (Bowen and Haynes 2000, Taquino et al. 2002); economic and political boundaries skewed results for variables connected to demographic dynamics.

Cultural resource data for certain themes were easier to obtain than others. For individuals attempting to replicate our process, it may be beneficial to start with recreation themes because data layers relating to recreation, such as National Forests, State Parks, and fishing areas, are open access and available online.

One major challenge we faced in constructing the seven tangible themes was that certain variables overlapped. Variables with high overlap potential were associated with qualitative assessments or experimental datasets where individual opinions mattered. Layers with lower overlapping potential had predefined geospatial data such as State and National Parks. Some data were also more reliable than others, so overlap (especially with qualitative variables) helped highlight underrepresented areas and helped us evaluate the quality of different data sets. We used a weighted variable value system during submodel production to deemphasize variables that were used multiple times in different models (e.g., variables related to fishing that were included in both recreation and water themes).

Visual resource data were more difficult to obtain than data for the seven cultural resource themes, and we therefore had to do significant data mining and data manipulation. For instance, we categorized georeferenced photos from Google Earth (using Panoramio) based on image title using our classification system that mimicked key categories in the National Register (refer to Fig. 3). We used variables including air quality, signage, vegetation, remoteness, naturalness, and visibility to selectively demarcate our visual resource inventory. We used viewsheds to tap into visibility prerequisites; we applied digital elevation models to help determine

Table 1.—Percentage of statewide cultural sites, historical markers, and National Register of Historic Places with a given proximity to a landscape feature

Location description	Statewide cultural sites	Historical markers	Historic places
City center (1 km)	6.6	8.2	8.2
City center (5 km)	27.0	31.3	29.1
City center (10 km)	41.1	51.1	52.2
Streams (100 m)	26.6	20.5	27.3
State game lands	0.2	0.5	0.1
Preserves	0.0	0.1	0.0
State park	0.3	0.7	1.4
State forest	0.3	0.2	0.2
Wild and natural areas	0.0	0.1	0.1
Pennsylvania wilds	6.3	3.1	1.9

viewsheds (Steinitz 1990). There were opportunities to find additional visual data in georeferenced photos online, though we found this to be too time consuming (see Goldberg et al., this proceedings).

In all, we gathered sufficient cultural and visual resource data to develop a comprehensive list of areas of Pennsylvania with high-quality resources. We integrated all of the variables into themes and identified culturally significant hotspots to guide strategic conservation and landscape planning.

RESULTS

Cultural Resources

Even though we used the natural hydrologic unit boundaries for our analysis, population distribution significantly influenced the distribution of cultural resources, which were largely clustered in urban areas. Approximately 48 percent of statewide cultural resources were located within 10 kilometers of a major city center. This distribution was especially skewed in cultural resource themes that emphasized social and/or economic activity such as education, economics, cultural heritage, and agriculture. Importantly, but perhaps not surprisingly, the three publicly available statewide cultural resource inventories we used in our initial analysis largely lacked cultural resources in rural areas. However, the recreation, wilderness, and water themes filled some of these gaps.

Water influences the distribution of statewide cultural resources according to the Pennsylvania Historic Museum Commission's inventory. Roughly 25 percent of all statewide cultural resource sites are within 100 meters of a stream while fewer than 1 percent are in a national, state, or local natural area (i.e., State Parks, National Forests, and wild and natural areas) (see Table 1).

Visual Resources

From a visual resource perspective, topography and vegetation played a major role in determining areas of high visual quality. Almost all photos associated with nature (such as those referring to a sunset or overlook) were viewed as positive, and many of the negative responses, such as references to a "decaying" landscape, were nostalgic. More than 50 percent of the georeferenced photos depicted a deciduous forest, followed by developed areas (open space, low, medium, and high, 26 percent of the photo inventory) and agricultural lands and/or pasture (15 percent of the photo inventory). With regard to elevation, roughly 22 percent of the photos were taken within 100 meters of a ridgeline. High visual quality regions were usually within wilderness areas or areas with minimal anthropogenic activity. These areas have formal aesthetic characteristics of landscapes (e.g., form, color, texture) and provide a memorable visual experience. The results support other VRM studies that highlight landscape features like prominent ridgelines, knolls, and viewpoints that are integral to rural and urban aesthetic character.

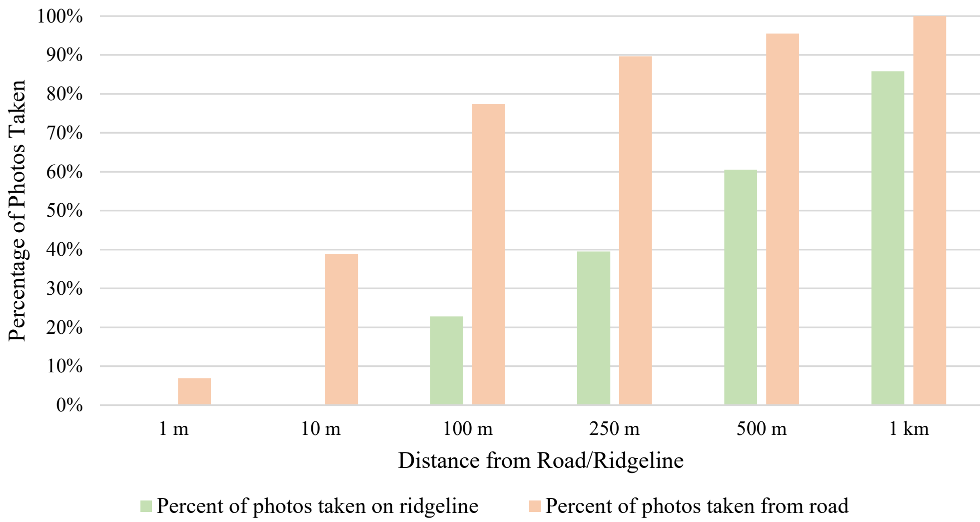

Figure 4.—Percentage of photos taken from roads and ridgelines.

Approximately 77 percent of the georeferenced visual resource locations followed roads since many photos were taken from inside cars or in developed areas (Fig. 4). We also examined viewshed composition to try to understand why people selected popular photo locations. In general, a viewshed in a rural area was larger than a viewshed in an urban area since there were fewer barriers, such as roads or bridges, to distract from the overall view. Viewsheds also changed based on the most desirable view for a given zoning parameter. For example, in commercial areas the emphasis may have been on capitalizing on the visibility of roads to attract consumers (large viewshed) while in residential areas the emphasis may have been on tranquility without noise pollution from roads (small viewshed).

Overall, our conceptual framework helped us analyze visual resource distribution and allocation, determine which views were significant, and understand how management of significant views could help promote conservation (Fig. 5).

Figure 5.—Examples of cultural and visual resources: (a) Fort Bedford, historical marker; (b) Old St. Luke's Church National Register of Historic Places, historical marker; (c) Philadelphia National Cemetery, National Register of Historic Places; (d) Pittsburgh and Lake Erie Railroad passenger station, state agency-based cultural site; (e) Little Falls Trail in Allegheny Forest, visual resource; and (f) Little Buffalo State Park - visual resource. Image Sources: (a) J. Klotz via Wikimedia Commons; (b) Cbaile19. 2014. Via Wikimedia Commons; (c) Department of Veterans Affairs; (d) Nyttend. 2009. "Pittsburgh and Lake Erie Railroad Complex." https://www.american-rails.com/pittsburgh-and-lake-erie-railroad.html; (e) Six local via Wikimedia Commons; (f) Smallbones via Wikimedia Commons.

Table 2.—Potential allocation of resources based on landscape position

Landscape position	Resource allocation
Urban	Cultural resource dominant
Suburban/exurban	Cultural/visual resource mix
Rural	Visual resource dominant

DISCUSSION

This work provides a first attempt to assess how studies of 'place' can be combined with information about significant visual and cultural resources. In collaboration with Appalachian LCC, our study is merging disparate data sets to inform landscape conservation design and planning. In the process, perhaps a more comprehensive model of place is emerging. Clearly, there are biases in both types of datasets but when they are combined a more complex and sophisticated perspective of tangible and intangible resources emerges. This perspective can inform design and planning decisions just as natural resource models already do.

The methods described here can help identify highly significant places where visual and cultural resources co-occur, as well as where threats to those resources could occur. At the same time, identifying places with degraded resources and/or lack of resources facilitates strategic planning and suggests where to focus on improving visual quality and cultural heritage resources. Signage is an important first step in landscape conservation and planning since identification signals that the resource is there and that an agency is aware of its importance. The second step is to preserve and protect resources that contribute positively to a place's scenic, cultural, and historic character.

Since cultural resources are predominately located within urban areas, we can capitalize on existing cultural heritage resources by creating a network of cultural corridors that link urban and rural resources. A cultural corridor can strengthen connections across the landscape, bring awareness and educational value to a region, and, most importantly, enhance social and economic dynamics by highlighting cultural resource sites within highly valued visual resource areas.

Since less than 1 percent of the existing and documented cultural resources are in natural areas, identifying high quality visual resource areas provides a means to bridge this gap. There is also a significant need to expand cultural resource inventories in broader geographic contexts. Federal and state databases focus on prehistoric and historic cultural resources within and adjacent to urban centers and transportation networks. Comparatively little attention is paid to visual resource management, other than in areas already protected by, for example, the National Park Service. The results from this study provide a means to unify and expand visual and cultural resources (see Table 2). This in turn can help us begin to address the limitations of current conservation protocols and enhance local and regional sense of place.

CONCLUSION

Our work establishes a comprehensive way of integrating cultural resources with visual resources to inform conservation and landscape planning priorities. There are still many challenges to address, particularly when working with qualitative datasets, but as data mining becomes more efficient and reliable, resource inventories will become more inclusive. Also, with higher resolution data, cultural and visual hotspots can be strategically integrated into local planning and design initiatives. Combining visual and cultural resource inventories is becoming ever more crucial for communicating regional heritage. Without proper planning for and management of cultural resources, significant knowledge of the past may be erased forever.

ACKNOWLEDGMENTS

Funding and support for this research were provided by: U.S. National Park Service cooperative agreement #135414 P11AC30805 titled Comparative Landscape Scale Cultural Resource Conservation: Pennsylvania; the Appalachian Landscape Conservation Cooperative; the Wildlife Management Institute; and the Hamer Center for Community Design housed within the College of Arts and Architecture at The Pennsylvania State University.

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COMMUNITY FORESTRY PRACTICE AND VISIBLE STEWARDSHIP: A CASE STUDY EVALUATION IN BRITISH COLUMBIA

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Abstract.—This study examines how visual resource management functions in three community forests in British Columbia. We interpret the findings through the lens of visible stewardship theory that encourages care for forest landscape values and making visible the evidence of management activities. We conducted visual quality effectiveness evaluations on each of the forests to assess achievement of Visual Quality Objectives determined by the Ministry of Forests, Lands, Natural Resource Operations & Rural Development. In addition, we interviewed forest staff and community members to collect data on their aesthetic values and insights. Findings reveal that the community forests are managing scenic quality well and that the dominant aesthetic values identified by community members are reflected in the practices of forest managers. These values and practices appear reasonably consistent with the principles of visible stewardship, demonstrating care of the forest resource, safeguarding ecological values, and helping ensure the compatibility of management objectives with local aesthetic and cultural perceptions.

INTRODUCTION

Community forests are a type of forest management tenure that attempts to incorporate various local values and priorities, in part through community-based governance and management systems (Charnley and Poe 2007). As such, community forests offer a valuable context for assessing how visual resource management can help meet local aesthetic values. While there is a long history of visual resource management on Federal lands in the United States (USDA Forest Service 1995) and some State and provincial public lands in North America, few studies have focused on the relationship between community forestry and visual resource management. The strong role of community values and emphasis on local stewardship in managing community forests may influence how visual management is carried out, how effective it is, and how it relates to prevailing theories and principles in protecting visual quality across the landscape.

This study examines how visual resource management performs in three community forests in British Columbia and interprets the findings in relation to the theory of visible stewardship, which advocates for making sustainable management more visible to the public (Sheppard 2001).

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COMMUNITY FOREST TENURE IN BRITISH COLUMBIA

Community forest tenure in British Columbia has evolved over time in response to changing public values and environmental conditions (Pearse 1992). In 1998, the New Democratic Party announced a pilot project called the Community Forest Agreement Program. The program devolved a portion of the Crown timber supply area to small, locally based forest tenures and allowed communities to harvest timber and nontimber forest products (NTFPs) on public lands. In return, a portion of the sales is paid back to the Crown through stumpage.

The overall goals of community forest agreements are to diversify management of Crown forested land, give communities an opportunity to acquire small forest licenses, and manage for a variety of local values, thereby providing for a range of social, environmental, and economic benefits (Teitelbaum et al. 2003). These benefits include creating jobs, fostering sustainability, and gaining public acceptance. Community forestry contrasts with more typical tenures on provincial timber supply areas in British Columbia that have largely been administered to maximize sustained timber yield. This management regime emphasizes high levels (>50 percent) of basal area removal and economic gains over other landscape objectives (Pearse 1992). Land managers under these tenures

Table 1.—Sample community forests

	Revelstoke Community Forest Corporation	McBride Community Forest Corporation	Creston Valley Corporation
Location	Columbia Forest District	Headwaters Forest District	Kootenay Forest District
Size (ha)	119,748	60,000	17,639
Organizational type	Private corporation (Privately owned Tree Farm License)	Private corporation (municipally owned)	Private corporation (not-for-profit status)
Land ownership	Provincial Crown	Provincial Crown	Provincial Crown
Annual allowable cut (m^3/yr)	100,000	50,000	15,000

may operate under remote government control rather than being embedded in and influenced by local communities.

The amendments made to British Columbia's Forest Act in 1996 established the first statutory framework for community forests, defining them as any forestry operation managed by a community group, First Nation, or local government in the interest of the community (Charnley and Poe 2007, Statutes of British Columbia 1996). Initial community tenures were issued under the Community Forest Pilot Program with subsequent tenures awarded through community forest agreements in the form of 25-year renewable leases (British Columbia Community Forest Association 2013).

A team research project on community forests in the interior rainforest of British Columbia provided an opportunity to assess the visual resource performance of three community forests. Creston, Revelstoke, and McBride were selected based on geographical, socioecological, and regulatory considerations (Table 1).

Each community forest is located in a distinct forest district that is subject to independent decision making (Fig 1). All of the sample forests are in rural settings, avoiding the need for comparisons with semi-rural or urban landscapes values (Zube et al. 1974). The allowable annual cuts (AAC) of each community forest collectively represent small (Creston), medium (McBride), and large (Revelstoke) timber harvesting volumes. This allowed aesthetic values and management practices to be evaluated across a spectrum of operational contexts. Both Creston and McBride are subject to provincial visual quality objectives (VQOs), as they occur within areas classified as visually sensitive by the province. In contrast, Revelstoke practices strictly voluntary aesthetic management as it is not located within a designated area of visual sensitivity.

Hypothesis and Research Questions

On most public forest lands in the United States and British Columbia, a structured system of visual resource management is available or mandated to address aesthetic values through specified objectives for acceptable levels of visual contrast in different areas (Ministry of Forests 2001, USDA Forest Service 1995). Mapped inventories of landscape conditions and important viewing areas guide appropriate management/design solutions to meet these objectives. In addition, conventional aesthetic design principles, such as emulating natural patterns and reducing visibility or visual contrasts of forest management activities, are used in the most visible areas (Litton 1968).

Some researchers have argued that the concept of landscape aesthetics needs to be broadened to address appreciation of ecological values (Gobster 1999, Kimmins 2001) and socio-cultural preferences for landscape attributes, such as orderliness or landscape care (Nassauer 1995). Drawing on these ideas, Sheppard (2001) proposed a perceptual theory of visible stewardship, which suggests that managers should pay more attention to making visible the evidence of sustainability and their care or stewardship in managing forest resources and fostering public acceptance. This theory emphasizes the importance of visible indicators, which demonstrate active care of a landscape, representing nonvisible and sustainable ecological conditions to the viewer (Kaplan et al. 1998) and reflecting socio-cultural values and benefits. In

Figure 1.—Map of sample community forest locations. © Google Earth.

some cases, this may mean making forestry practices and treatments more visible in the commonly seen landscape, rather than trying to hide or locate them in wilder and more remote settings. However, it may also require more thoughtful design to demonstrate ecologically and socially sensitive management practices.

In this paper, we hypothesize that there is a natural fit between community forests and management approaches such as visible stewardship that demonstrate sustainable forest values in plain sight of residents, often within the viewshed of the community itself. Specifically, we argue that by making visible the management regime's presence and care for the forest, sustainable forest objectives will also help meet the multiple values of community residents. The central research questions of this paper further explore whether:

- Management of community forests in these case studies meets or exceeds standard visual quality objectives (in terms of visual impacts/contrasts on the ground) and achieves public acceptance.
- There is evidence that community forest practices are aligned with the principles of visible stewardship.

It should be noted that this study does not attempt an explicit comparison with nearby traditionally managed forest landscapes but instead relies on past findings in the British Columbia literature as context for community forest performance.

METHODS

We used two parallel methods of evaluation to assess the three community forests. The first was a quantitative approach that included benchmarking aesthetic standards using an established British Columbia Visual Quality Effectiveness Evaluation method. The second was a qualitative approach, which used interviews and participant observation to explore goals, values, social processes, and perceived outcomes of community forest management. The second approach was conducted by a research team of four graduate students and a professor who spent 10 weeks visiting five community forests in 2009, supplemented by a second professor for a week. The initial sample group of five community forests was reduced to three, as two of the sample forests were not actively practicing visual resource management at the time of the study.

Quantitative Analysis

The lead author conducted the visual quality effectiveness evaluations for the Creston, Revelstoke, and McBride community forests, using the provincial standard assessment method. This included selecting, photographing, and measuring disturbances on key landforms. No official provincial assessments had previously been conducted on any of these tenures. The intent was to determine if operations at the sample community forests were meeting the visual goals and objectives established by the province under the Forest and Range Practices Act and Government Action Regulation (GAR) (Province of British Columbia 2005).

The quantitative analysis included the following procedures:

- We selected viewpoints using VQO Maps (where available), management plans, and site plans for each community forest (Ministry of Forests 2004). We selected cutblocks (designated harvest areas) that had been harvested within the past 3 years and were approximately 1.8 km from identified viewpoints. These areas provided consistent middleground locations for optimal cutblock viewing in scenic areas. We validated all selected viewpoints during field visits.
- We used visual inventory techniques outlined in the Forest and Range Evaluation Program (FREP) Protocols for visual quality management for each effectiveness evaluation (Marc 2008). During field evaluations, we recorded GPS coordinates and viewing direction along with all visual design elements. We also took photographs of landforms and alterations at a standard 55 mm focal length as well as 35 mm and 10 mm wide-angle views to capture additional harvest area details. Following the field evaluation, photographs were stitched together to create panoramas and key landforms (visual landscape units) were delineated.
- We measured forest openings and landform areas in perspective view in the panoramas using Adobe Pro 9 software and determined percent alteration by dividing individual disturbance areas by the total landform area. Percent alteration is the proportion of the landscape surface affected by cutblocks, as seen in perspective view (Marc 2008).
- Following in-field data collection, we completed a FREP Visual Quality Effectiveness Evaluation Form (Appendix 1). We used percent alteration along with the effectiveness of any visual design elements such as boundary treatments, lines of force, cutblock size and shape to provide an overall "visual quality class" rating.[2] We then compared visual quality class with the provincially assigned VQO (established in the context of the relative viewer sensitivity, scenic importance, etc.) in order to determine an effectiveness rating of "not met," "borderline met," "met," and "well met." Finally, we compared these assigned effectiveness values with established VQOs following guidelines set out by the Ministry of Forests and Range.

In the case of Revelstoke Community Forest Corporation where no provincially established visual quality values exist, management goals prioritize extractive resource development. However, the Revelstoke Community Forest Corporation timber supply area is also valued for a number of nontimber resources including aesthetics and recreation opportunities. To assess success in implementing visual management practices, the lead author evaluated three cutblocks in view of a popular ski lodge identified in the Revelstoke Community Forest Corporation's Management Plan as being visually sensitive (Revelstoke Community Forest Corporation 2010).

In order to conduct an effectiveness evaluation, we assigned the areas containing the three selected cutblocks a VQO of "partial retention." This rating is consistent with the legal definition for this visual quality class, which most closely aligns with the visual resource management objectives for lodges, commercial cabins, and camps outlined in the management plan. Partial retention is defined as a "human caused alteration that is evident but subordinate and therefore not dominant on the land form" (Resources Inventory Committee 1999). As with the effectiveness evaluations conducted for other community forests, we assessed all three cutblocks in accordance with provincial guidelines.

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[2] VQO classes most commonly fell within one of the following levels of compatibility or contrast/dominance in relation to natural landscape patterns: Retention, Partial Retention, and Modification. In the BC system, these VQO classes are associated with typical thresholds of percent alteration, as well as other factors.

Qualitative Analysis

We conducted a qualitative assessment of the aesthetic values of approximately 50 community members from all three sample community forests. We used interviews and participant observations to obtain deeper insights into the goals of community forest management, as well as social, cultural, and perceptual constraints and any regulatory standards followed. We used nonrandom sampling methods and rapid rural appraisal to gather information on community members' visual landscape values (Teitelbaum et al. 2003). We selected interview respondents to represent the diversity in the community and included community forest managers, forestry experts, and interested community members. Data collection methods were consistent across all sample groups.

To examine community members' aesthetic values, the research team used qualitative, semi-structured interviews with individual participants, focus groups, and field visits. During interviews and focus groups, the interviewer directed the conversation around topics relevant to the research issues without over-prescribing the discussion. Our interviews focused on the interests of the five principal researchers, including economics, water quality, ecology, comanagement, and aesthetic management of community forests.

When conducting data analysis for this project, we employed blended techniques from a grounded theory approach and more general qualitative research approaches. Grounded theory is well suited for this type of study as it is reflexive and facilitates collecting the subjective details of aesthetic landscape preferences. We collected data without applying any predetermined hypotheses or leading the participants, and we developed explanatory theories following the analysis. This method allowed for responsive theory exploration informed by a comparison of variables from the research literature on interpreting landscape aesthetics.

We established provisional categories or themes from interview data then cross-referenced the provisional categories with externally developed categories from a review of the aesthetics literature. We continually validated the categories from this analysis against each other as new categories emerged in subsequent analyses, as discussed in the findings section. Corbin and Strauss (1998) note the importance of validation in identifying contextually specific categories in this process. The interview questions targeted cultural issues, aesthetic landscape preferences, aesthetic management goals, and the forestry activities used to achieve them. We asked participants to answer questions as openly as possible but emphasized that they were not obliged to answer. We did not mention or explain visible stewardship theory or principles or other theories to participants.

RESULTS

Quantitative Results

The following sections briefly summarize results from the visual analyses for each of the three community forests, which addressed harvesting design practices, number of cutblocks, VQOs, and standards (see Smith 2015 for further details).

The results of the effectiveness evaluation suggest that all three community forests are successfully implementing visual management practices at all of the sample locations and achieving ratings of "borderline met" to "well met" across sample blocks. Forest staff demonstrated a high degree of concern for visual quality and knowledge of alternative harvesting practices such as edge treatments and use of partial cutting (tree retention) that adhere to visual lines of force and borrow from the natural character of the landform. Creston Valley interviewees identified external factors such as pest infestations and existing disturbances on the landscape as occasional challenges (Fig. 2).

At Revelstoke, a number of large anthropogenic disturbances significantly increased the overall level of disturbance but the forest's final visual condition was still "partial retention" and the effectiveness evaluation rating was "well met" or "borderline met" for the three cutblocks (Fig. 3). In addition, the Revelstoke Community Forest Corporation Stewardship Plan is certified by the Sustainable Forestry Initiative (SFI) and approved by the Ministry of Forests. An SFI audit, which included a review of stakeholder communications, found Revelstoke met SFI Objective #5, Management of Visual Quality and Recreational Benefits. The audit also noted that the community forest had undertaken voluntary aesthetic management practices in a number of visually sensitive recreational areas (SAI Global 2012).

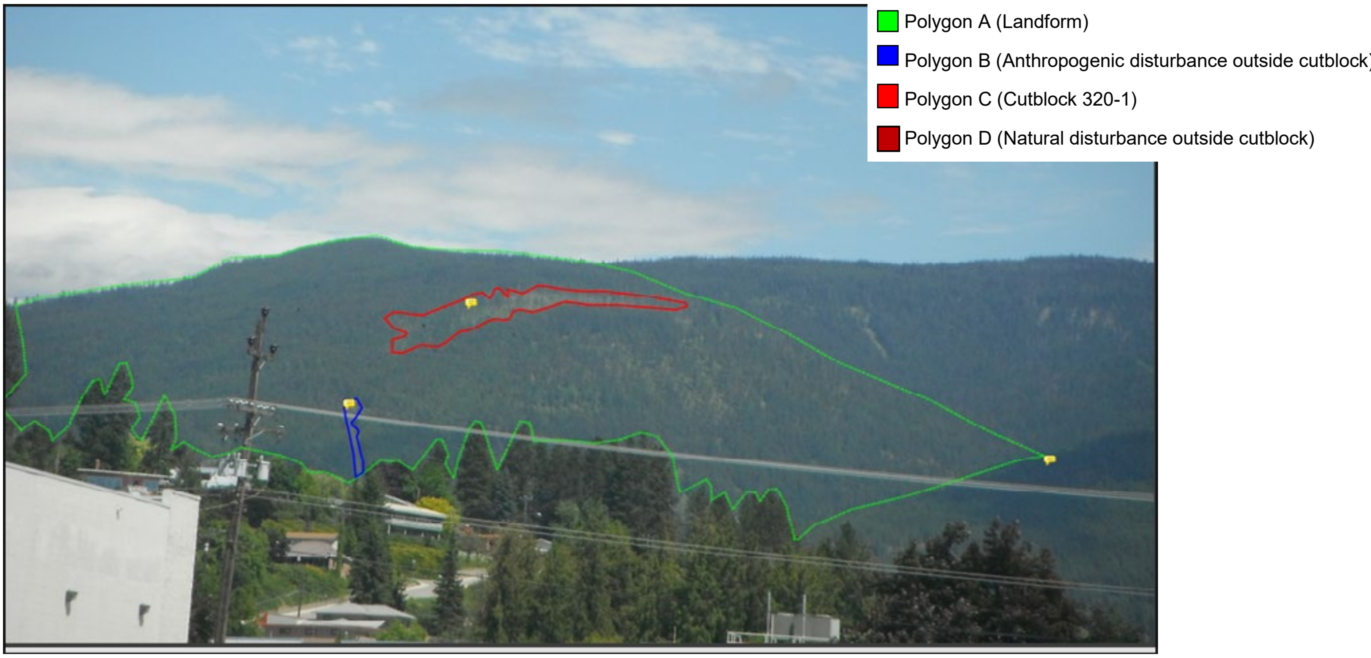

Figure 2.—Creston Community Forest Corporation cutblock K3D 004-2. Photo and enhancements by A. Smith, used with permission.

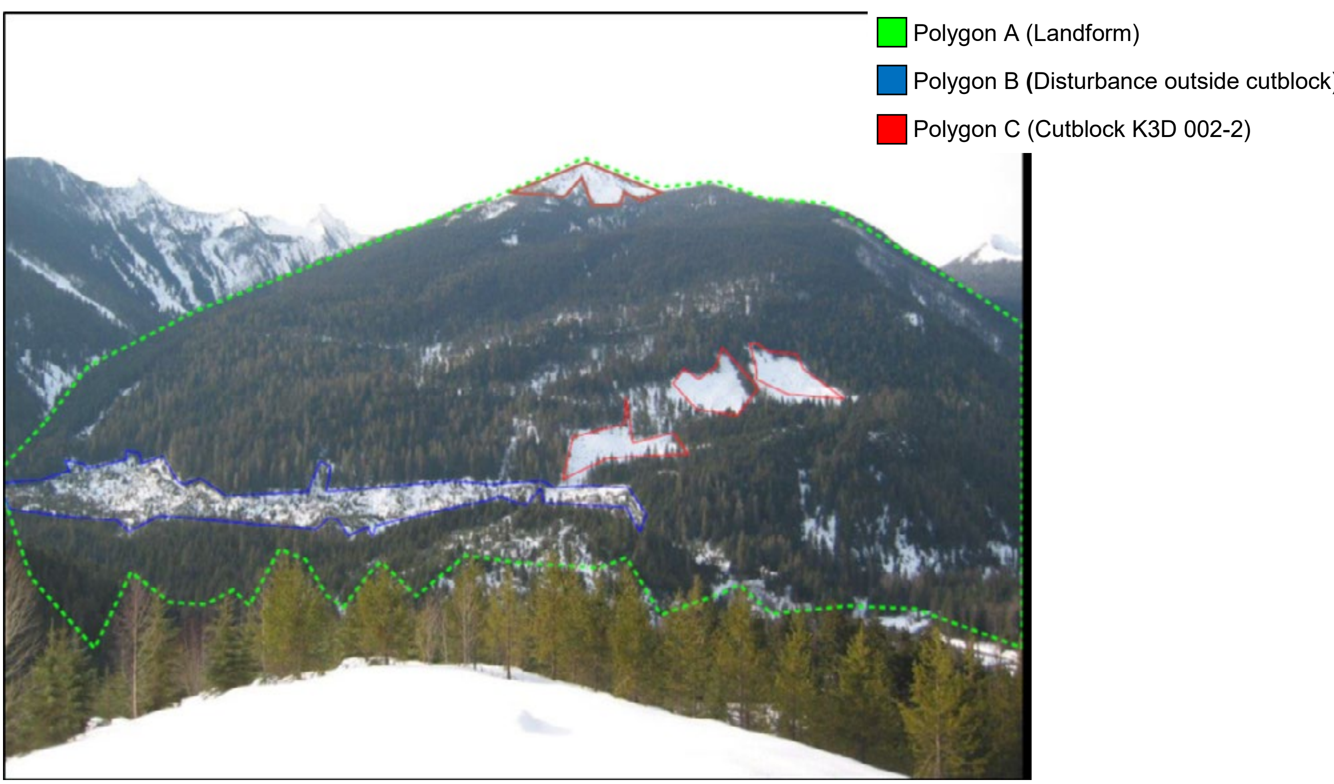

Figure 3.—Revelstoke Community Forest Corporation cutblock 320-1. Photo and enhancements by A. Smith, used with permission.

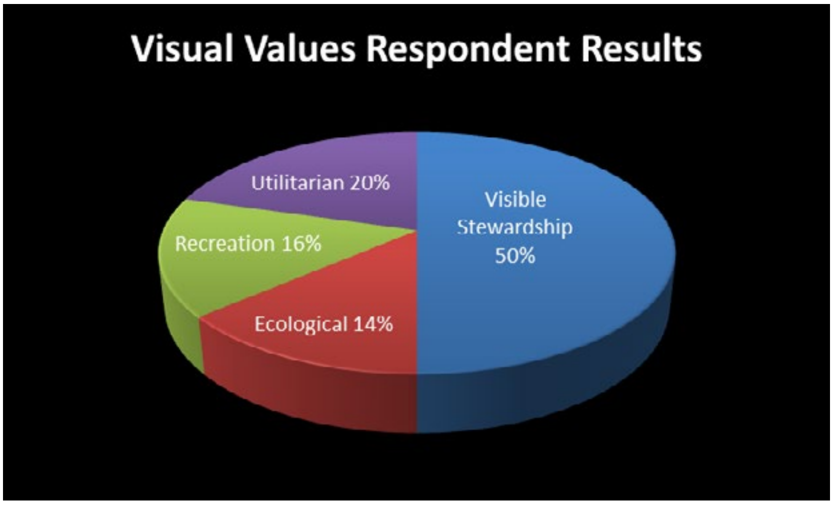

Figure 4.—Visual values of research participants by category.

Qualitative Results

This section summarizes the response patterns and opinions of community members. We did not seek opinions on the specific blocks assessed in the quantitative analysis. Most respondents worked in forestry or were persons knowledgeable of the community forest. When discussing aesthetic landscape preferences and visual sensitivity to disturbance in rural forested areas, interview responses tended to be perceptually based. As Daniel (2001, p. 268) states, perceptual interpretations of landscape aesthetics "treat biophysical features of the landscape as stimuli that evoke aesthetically relevant psychological responses through relatively direct sensory-perceptual processes and/or through intervening cognitive constructs."

The interview findings suggest that ecological, cultural, and personal factors influence the perceived landscape values relevant to community forest management within the sample communities. For example, preferences for different levels of tree removal (basal area) were often related to the participant's use of the landscape and socioeconomic background. We coded aesthetic values expressed by participants and classified them into five unique categories:

- Noninstrumental (existence value)
- Visible stewardship
- Recreational
- Utilitarian
- Ecological

These categories reflected groupings of responses, not necessarily individuals. Some participants emphasized one particular category of responses while others expressed support for a variety of values. With the exception of noninstrumental aesthetic appreciation, all aesthetic values were related in varying degrees to visual informational triggers communicated by the landscape to the viewer. Overall, participants were satisfied with visual quality in the community forests, with most preferring to see elements of visible stewardship across the land base (Fig. 4). Among the expert participants, common ideas centered around stewardship of the visual resource and timber utilization, as in this example: "Most community members are not capable of reading the landscape. As experts in the forest industry, we are best able to strike a type of eco-aesthetic appreciation that both demonstrate productivity and ecologically responsible harvesting practices" (Interview R-2R).

Many interviewees expressed a desire to demonstrate their technical ability to log while maintaining aesthetic resources (Interviews R-20C, R-15C, R-16C). One respondent noted, "The fun and the challenge and the real education takes place in – in designing a landscape and landscape level objectives and then implementing them, you know… and it's possible to do it for visuals, for sure" (Interview R-15C).

Revelstoke Community Forest Corporation staff noted that tourists and new residents were often sensitive to even small levels of disturbance on the landscape. They desired landscapes that were conducive to recreation, had little evidence of anthropogenic modification, and maximized wilderness values (Interview R-2R).

DISCUSSION

Visual Resource Management by Sample Community Forests

The first research question asked if community forest management is meeting or even exceeding standard visual quality objectives (in terms of visual impacts/contrasts on the ground) and achieving public acceptance.

The effectiveness evaluations suggested that all three sample forests were attempting to implement the basic principles of landscape design in their harvesting practices. Some of the common methods for managing visual resources included placing cutblocks lower on the landform, reducing the overall size of the cutblock and percent basal area removed, incorporating edge treatments, and removing slash piles. All of the evaluated cutblocks either complied with or partially complied with established VQOs under the Forest and Range Practices Act for visually sensitive blocks within the timber supply area. Instances of partial compliance were primarily the result of pine beetle uplifts and the presence of previously existing disturbances on the landform.

A comparison against visual quality effectiveness evaluation audits on provincial tenures indicated that community forests were meeting and, in some cases, exceeding the provincial management practices. Sample community forests achieved a "borderline met" rating 36 percent of the time, a "met" rating 18 percent of the time, and a "well met" rating 46 percent of the time. There were no ratings of "not met" within our sample compared to the provincial "not met" average of 20 percent (Ministry of Forests and Range 2009).

There is no obvious evidence of conflicts between the perceptions of community members' aesthetic preferences and the Visual Quality Effectiveness Evaluation findings. Interview results suggest that the majority of community members were generally satisfied with visual quality in the community forests, though some stakeholders expressed a desire for less disturbed landscapes reflecting stronger ecological or productivity values. Correspondence with forest managers and a review of meeting minutes found overall community satisfaction with visual resource management in community forests and few public complaints. Interviewees often mentioned that managing for visual quality was an important part of providing desirable tourism opportunities. This is supported by Revelstoke Community Forest Corporation's proactive visual resource management practices around Adamant's Lodge (see Fig. 3), and McBride's management of viewing opportunities from McBride Peak. In all three sample forests, it was consistently clear that staff knowledge of visual resource management was important.

Public Acceptance of Visual Resources

All of the community forests in this study were established, in part, to give residents greater control over local forest resources. The forests provide a number of monetary and nonmonetary benefits to communities including timber revenues, nontimber forest product revenues, water supply, aesthetic resources, recreation opportunities, wildlife habitat, and open spaces (Community Forest Collaborative 2007). The forests managers already incorporate principles of landscape design into their harvesting regimes in visually sensitive areas. Concern about the local communities and local values is also evident in participatory institutional structures, public engagement strategies, and implementation of alternative harvesting practices.

In all of the forests, community-based boards of directors allow local residents to express aesthetic landscape preferences directly to decisionmakers. As a result, community forest staff are aware of visually sensitive areas in the timber supply sections of the forests. Staff on each of the forests acknowledged the importance of allowing public input to guide forest management activities including visual resource management.

Forest staff reported relying primarily on Websites, newsletters, and regularly scheduled meetings to engage the general public. In addition, forest managers indicated that they felt social pressure from members of the community to maintain the integrity of visually sensitive areas. Despite the above engagement strategies, forest staff reported relatively low levels of direct public engagement in operational decisions. However, members of the public did typically help in setting high-level policy direction, which influenced operations management.

Relevance of Results to Visible Stewardship Theory

The second research question addresses whether there is evidence that community forest practices are aligned with visible stewardship principles.

Many respondents at each of the community forests expressed a preference for landscapes with some obvious signs of care for the land, which is consistent with the theory of visible stewardship. For example, staff at McBride Community Forest Corporation stated, "We are highly visible; everyone is very much in tune with the forest around them and they demand a high level of stewardship" (Interview R-29M, R-9M). A respondent at Revelstoke expressed a similar view: "Aesthetic management should not and does not have to come at the expense of ecologically responsible forest practices" (Interview R-2R).

There was consensus among interviewees that anthropogenic modification should communicate attachment to the land base and evidence of deliberate and ongoing maintenance. During interviews, many respondents mentioned brush removal, variable retention, partial cutting, irregular cutblock design, stream and watershed maintenance, lack of soil disturbance, removal of coarse woody debris, pest management, and management of fire interface zones as visible indicators of sustainable forest management. There was also a general preference for landscapes with higher levels of canopy retention but not necessarily avoidance of visual contrasts. Some respondents spoke of the potential benefit of signage and opportunities to educate the public about forest management practices, specifically when controlling for pest infestations like mountain pine beetle. None of the interviewees expressed explicit knowledge of visible stewardship theory and interviewers did not raise the subject.

In combination, these preferences reflect a general desire to see demonstrable evidence of a healthy, well-cared-for landscape. Therefore, practice under the community forest regime generally seems consistent with visible stewardship theory. Interestingly, visible stewardship concepts appear to be reflected in both non-expert and expert-based landscape values. The combination of observed public acceptance and visibly modified landscapes supports the argument for visible or transparent stewardship, rather than a primarily natural forest appearance, as an appropriate goal.

Moderate, ecologically sound levels of disturbance in visually sensitive areas of the forests fulfill the visible stewardship principle of sustained visibility of forest operations and management (Sheppard 2001). In community forests at least, it may be better to see forestry practices in a working landscape than not to see them as in a wilderness area.

There are analogous findings in the literature with regard to historic, suburban, and rural landscapes that exhibit "cues for care" (Nassauer 1997). Benson (2008) identifies similar aesthetic values in farmers surveyed across the British countryside who regard "tidiness" as an indicator of good farming practices. Visible stewardship as an aesthetic value is a relatively recent trend in appreciation and management of wildland or naturalistic forest landscapes. This preference appears to demonstrate that aspects of the cultural paradigm, personal paradigm, and biological paradigm are acting together (Bourassa 1990). It suggests that humans are influenced not only by innate preferences for nature and aesthetic principles of landscape design and architecture (such as form, line, color and contrast), but also by socio-cultural influences such as individual upbringing, social norms, professional background, and the ethics of good management.

Our findings suggest the need for further research to test these theories in other contexts. Key questions to be addressed include tradeoffs for community forest managers and their stakeholder committees between addressing "soft" social values including aesthetics, and dealing with "hard" economic pressures such as finding funding for skilled staff and creating economies of scale for large industrial forestry tenures.

Challenges and Recommendations

There is a variety of expectations for community forests and forest managers who are supposed to engage in commercially viable, ecologically sustainable, and aesthetically pleasing forestry activities. Some of the challenges noted by community forest managers include the following:

- Operational: terrain, ecological health, size of timber supply area, equipment used
- Communication: ensuring operations staff are knowledgeable of design objectives

- Regulatory: insufficient monitoring, compliance, and enforcement mechanisms under the Forest and Range Practices Act
- Financial: increased costs associated with selective harvesting models and reduced yield

The operational challenges posed by landscape terrain are not easily remedied. In some cases, it may be possible and advisable to increase the size of community forest tenures in order to take advantage of forest lands with inoperable areas and harvesting constraints (as identified in management plans). In "borderline met" areas, more detailed site planning of visually sensitive landscape units could help meet VQOs. In areas that intersect visually sensitive landscape units, submitting site plans and predictive visualizations *before* harvesting could help forest managers and regulators better determine visual impacts associated with a proposed cutblock, as well as any cumulative impacts from existing disturbances and any mitigation measures that may be required.

Some harvesting methods identified in interviews and in the literature may be appropriate for wider use within visually sensitive areas of community forests, including partial cutting and ensuring that boundary treatments are used. In addition, Sheppard et al. (2004) note that the use of radial-strip cutting can reduce the visual impacts of harvesting in steep front-country areas. This method uses feathered edges, buffer strips, and uphill or downhill cable-yarding along multiple narrow strips from each landing with the goal of minimizing visibly disturbed ground from any given viewpoint.

Community forest staff indicated that effective communication between operations staff and contract loggers is critical to achieving VQOs on the landscape. In some cases, this may involve marking specific leave trees in order to maintain sufficient basal area and retain specific trees or clusters of trees. In addition to improving direct communications, foresters should understand both provincial principles of landscape design (theory) and the details of site plans for proposed cutblocks (practical application). We recommend requiring that foresters and logging crews complete training in conducting visual landscape inventories and know the guidelines in the "Visual Landscape Design Training Manual" (Ministry of Forests 1994) and the Web-based "Interactive Visual Landscape Design Training Package" (https://www.for.gov.bc.ca/hfp/training/00018/index-old.htm.htm).

Our literature review and numerous responses during interviews suggest that mandatory submission of visual simulation packages (previously required under the Forest and Range Practices Code) should be reinstated under the Forest and Range Practices Act. This would require regulatory changes at the province level. As Sheppard (2001, 2006) notes, visual simulations can be powerful illustrations of the visual impacts of proposed disturbances. However, creation and use of landscape visualizations should follow visual impact assessment procedures identified in the "Visual Impact Assessment Guidebook" (Ministry of Forests 2001). Visualizations may also help engage and inform boards of directors and the general public on important design and siting issues for harvesting activities.

Interview responses from Creston Valley Community Forest Corporation indicated that financial challenges associated with alternative logging practices may be minimized by reducing layout costs. This may be accomplished by conducting desktop analyses of existing conditions and layout options prior to initiating fieldwork, thereby reducing the amount of time in the field.

Finally, we recommend establishing a self-administered monitoring program for visually sensitive areas within timber supply areas. The use of FREP Effectiveness Evaluation Forms (Appendix 1) would provide a means to evaluate and document the visual impacts of forest harvesting activities more objectively and would help forest managers plan future cutblocks on the same landform or within the same viewshed. These evaluations would assess the existing visual condition of cutblocks within 3 years of harvesting and determine if existing conditions comply with provincial VQOs.

CONCLUSIONS

In summarizing the main conclusions and implications of this study for visual management of community forests, we must acknowledge several study limitations. These include the small number of sample sites in each community forest, the lack of specific controlled comparisons with noncommunity forests, variation in the mix of research participants in the three community forests, and the lack of a wider public perception survey to confirm the representativeness of participants' perceptions. It is possible, for instance, that the community forest managers interviewed were positively biased toward the outcomes of their efforts, although the independent quantitative assessment of visual quality achievement tends to support their assertions. There is also the possibility of bias among the research team in differentially looking for evidence in the qualitative analysis to support the theory of visible stewardship, although the number of respondent references to these principles (without any formal knowledge of the theory itself) supports their validity as key variables in community forest management. Independent replication of such findings by other researchers is strongly encouraged.

Despite operational and nonoperational challenges within the community forests and some differences in aesthetic preferences among community members, community forests appear to be successfully managing visually sensitive areas of timber supply zones. Most cutblocks achieved and in some cases exceeded applicable VQOs, and there were few public complaints related to visual quality. These findings represent a significant achievement for relatively small forest tenures with many competing objectives and suggest that community forest managers are responsive to both provincial level visual resource management requirements and local aesthetic concerns. The British Columbia system of effectiveness evaluation provides a useful method for monitoring visual management performance.

The study also found evidence of a general desire among community members to see—and among community forest managers to provide—visible indicators of a healthy, well-cared-for landscape. This suggests that the practice of visible stewardship can contribute to effectively meeting public expectations in a visibly active and dynamic working landscape. The community forest model may be more widely applied by communities seeking to manage the visual impacts of harvesting, among other resource objectives, with methods that could be adopted for larger scale forest operations.

ACKNOWLEDGMENTS

This research was supported by grant #639682 to Evelyn Pinkerton by the Social Sciences and Humanities Research Council of Canada.

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APPENDIX 1

Visual Quality Effectiveness Evaluation form used for the British Columbia Forest and Range Evaluation Program (Marc 2008)

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2.1.2 Site Information (Office)

Forest District ____________________ Sample Code ____________________
Licensee ____________________ Date of Field Evaluation MM/DD/YYYY
Licence No. __________ CP No. __________ Block ____________________
General Location ____________________ Results Opening ID ____________________

2.1.3 VLI Information (Office)

Date of Update MM/DD/YYYY VAC __________ Established VQO __________
Polygon No. __________ VSC __________ Date of Establishment MM/DD/YYYY
EVC __________ Recommended VQC __________ Source Document __________

2.2.1 Viewpoint (Field)

Viewpoint No. __________ GPS Latitude __________ Viewing Direction __________
GPS Longitude __________ Elevation (m) __________ Viewing Distance __________

2.2.2 Photography (Field)

Roll No. ______ ID Nos. ______ Viewpoint Importance (low) 1 2 3 4 5 (high) Field of View Width(degrees) ______
Digital Photo ID Nos ______ Viewpoint Description __________ Field of View Height(degrees) ______

2.2.3 Assess Basic VQC (Field)

Alterations meet with Basic VQC definition? Circle where in the range for that VQC. Notes:
Basic VQC P R PR M MM |—|—|——|——|———|———|———|———|———>

2.2.4 Design Obervations (Field)

Design Elements	G (-1)	M (0)	P (+1)
Response to visual force lines	______	______	______
Borrows from natural character	______	______	______
Edge treatments incorporated	______	______	______
Distance from the viewpoint	______	______	______
Position on the landform	______	______	______
Total Design	______	______	______

2.3.2 Assess Initial VQC (Office)

a) % of landform altered by recent openings ______
b) % of landform with site disturbance outside openings ______
c) % non veg contribution of old openings ______
X = (a+b+c) = ______ % alteration **Initial VQC** ______

2.3.3 Assess Adjusted VQC (Office)

d) Impact of roads, side cast, etc. (within openings) ______
☐ None ☐ Subordinate ☐ Significant ☐ Dominant Adj. Factor

e) Tree retention
☐ Good ☐ Moderate ☐ Poor Adj. Factor ______

f) Design (enter total from 2.2.4 above) Adj. Factor ______

Total adjustment Y = (d+e+f) Adj. Total ______

Calculate adjusted % alteration X*(1 + 0.14*Y) = ______

Adjusted VQC P R PR M MM |—|—|——|——|———|———|———|———|———>
Adjusted % alt 0 1.5 4 7 12 18 24 30 ++>

Evaluated by ____________________
Signature ____________________

2.3.4 Partial Cut Alterations

Partial cutting
% removed __________

Average tree height (m) ____

Clearcut equivalent ____% alteration as read from Table 4.
Record this value on line 2.3.2 a.

2.3.6 Determining EE Rating for the Landform by Comparing Basic VQC with Adjusted VQC (Office)

1 ☐ **Clearly not met** (Neither method indicates VQO achievement, both are far from class boundary)
2 ☐ **Not met** (Neither method indicates VQO achievement, but both are close to class boundary)
3 ☐ **Borderline** (One method indicates VQO achievement, one does not)
4 ☐ **Met** (Both methods indicate VQO achievement, but one or both are close to the high end "maximum % alteration limit.")
5 ☐ **Well met** (Both methods indicate VQO achievement and are on the lower % alteration limit or mid-range for the class)

2.3.7 Allowance for Over-ride

Over-ride EE __________
Rationale for over-ride ____________________

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2.2.2 Viewpoint Importance

(1) glimpse view, less than 10 seconds
(2) sustained side view
(3) sustained focal view, travelling toward the alteration for more than one minute
(4) viewpoint is at a rest stop, campsite, or other static short-term view location
(5) viewpoint is the location of a community, commercial tourist-related enterprise, or other static long-term view location

2.2.3 Table 1 – Definitions of Visual Quality Classes

Visual Quality (Class Symbol)	Basic Definition
Preservation (P)	"preservation" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration (a) is very small in scale, and (b) is designed to be indistinguishable from the pre-harvest landscape.
Retention (R)	"retention" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration (a) is difficult to see, (b) is small in scale, and (c) has a design that mimics natural occurences.
Partial Retention (PR)	"partial retention" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that, when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration (a) is easy to see, (b) is small to moderate in scale, and (c) has a design that appears natural and is not angular or geometric.
Modification (M)	"modification" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that, when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration is very easy to see and is either (a) large in scale with a design that is natural in its appearance, or (b) small to moderate in scale but with a design that has some angular characteristics.
Maximum Modification (MM)	"maximum modification" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that, when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration is extremely easy to see and one or both of the following apply (a) the alteration is very large in scale, or (b) the alteration is angular and geometric.

2.2.4 Table 2 – Design Observations (Field)

Design Elements	Good (-1)	Moderate (0)	Poor (+1)
1. Response to Major Lines of Force	Strong	Force Lines Not Apparent	Weak or No Response
2. Borrowing from Natural Character	Fully	Partially	Isolated or Not at All
3. Incorporating Edge Treatment	Feathering and Irregular Boundaries Present	Either Feathering or Irregular Boundaries Present	Neither Aspect Present
4. Distance between Alteration and Viewpoint	> 8 km	> 1 and < 8 km	< 1 km
5. Position of Opening on the Landform	Lower Down & To One Side	Small Opening near Center	High on the Landscape or Large near Center

2.3.2 Table 3 – Percent Alteration Ranges for Visual Quality Classes

Visual Quality Class	Alteration percent of landform in perspective view
P – Preservation	0
R – Retention	0 – 1.5
PR – Partial Retention	1.6 – 7.0
M – Modification	7.1 – 18.0
MM – Maximum Modification	18.1 – 30.0

2.3.4 Table 4 – Visual Equivalent to Clearcut Percent Alteration Factors for Partial Cut Alterations

Volume removed (%)	Mean height (m) of residual trees: 5	10	15	20	25	30	35	40	45	50
10	0.1	0.2	0.4	0.6	0.7	0.8	1.0	1.2	1.8	2.2
20	0.3	0.4	0.7	1.0	1.2	1.4	1.8	2.2	3.3	4.4
30	0.7	0.9	1.2	1.4	2.0	2.4	3.3	4.2	5.0	6.5
40	1.2	1.4	2.0	2.4	3.4	4.3	5.2	6.1	6.7	7.8
50	1.8	2.3	3.4	4.3	5.2	6.2	6.8	7.7	8.4	9.0
60	3.5	4.3	5.0	6.2	6.7	7.7	8.4	9.2	10.0	11.5
70	4.9	5.5	6.5	7.7	8.4	9.2	10.0	11.4	12.7	14.0
80	6.0	6.6	8.3	9.2	10.0	11.0	12.0	13.2	14.4	15.5
90	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0

Retention   Partial Retention   Modification

2.3.3 Adjustment Factors

c) Roads: 0 = None
1 = Subordinate
2 = Significant
3 = Dominant

d) Tree Retention: -2 = Good > 22%
-1 = Moderate 15 - 22%
0 = Poor < 15%

e) Design: Record Total from 2.2.4

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CASCADE HEAD SCENERY AND CHANGE: CASCADE HEAD LAW AND OUR EVOLVING UNDERSTANDING OF SCENERY AND LANDSCAPE

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Abstract.—The 9,670-acre Cascade Head Scenic-Research Area (Cascade Head) is a picturesque place of headlands, forested hills, meadows, and estuary on the north-central coast of Oregon. Its dramatic features and changing atmosphere have had a strong appeal for people for centuries. Established in 1974 primarily to ensure protection of its scenic values, its official designation as a Scenic-Research Area came a full decade ahead of the first site in the Congressional system of National Scenic Areas. The Cascade Head Act identifies key qualities and uses of distinct landscape subareas within its boundaries, which form the basis of protection for the Area. This paper highlights Cascade Head's contribution to the evolution of our understanding of scenery as a resource and the new focus it brings for scenery management.

CASCADE HEAD

Cascade Head is a 9,670-acre area of headlands and estuary, edged with hills of forest and meadow on the north-central coast of Oregon. The Salmon River flows from the east into the estuary and the main access road follows the estuary edge west with views of the wide salt marsh, changing water, coastal mists. The Cascade Head landscape is made up of a sequence of spaces following the Salmon River. The large east-west salt marsh is like a huge hall that extends to the mouth of the estuary—a stage-like area facing the Pacific with high headland prospect points to the north and south. The lower slopes have rural houses and some remaining farms, including century-old farms. Off shore, volcanic forms are bird island refuges. Herds of elk travel through the area. Up and down the coast there are other estuaries and rivers, volcanic headlands, and valley spaces leading inland. Cascade Head has dramatic, unique, known, and looked-for Pacific coastal landscape formations (State of Oregon 1973, Roy Mann Associates 1975) (Figs. 1-4).

DESIGNATION AND LAW

Cascade Head's slopes, headlands, and Salmon River estuary were designated as the Cascade Head Scenic-Research Area in 1974. It was one of the few remaining largely undeveloped estuaries on the Oregon Coast.

According to the Cascade Head Scenic-Research Area Act of 1974 (Public Law 93-535), the Area was established "to provide present and future generations with the use and enjoyment of … the areas, to insure the protection and encourage the study of significant areas … and to promote a more sensitive relationship between man and his adjacent environment." The Act, which established the area, is a law that was of a time of the "environment"—a word newly used—and a general recognition and emphasis given to people and environment, people's responsibility and tie to their natural and cultural environment, considering actions' effect on their surroundings, environmental design, design arts, and of the international importance of environmental impacts and responsibilities. Both laws were widely supported, and specifically include people, the practice of design, and the protection of aesthetics and cultural values of our surroundings—our landscapes. NEPA proclaimed that everyone has responsibility for the environment; the Cascade Head law promoted "a sensitive relationship between man and his adjacent environment" and emphasizes a role for people appreciating this place.

Before Cascade Head there were no National Scenic Areas. There were areas designated as scenic within National Forests and labeled scenic along highways. In 1968, there were newly established National Scenic Rivers, National Scenic Trails, and National Scenic Parkways designations. Cascade Head was established during a year-long period (1973-1974) when there were many national scenic river designations and an attempt to establish a scenic area as part of area

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Figure 1.—View of Cascade headland across marsh. Photo by Jessica C. Dole, USDA Forest Service.

Figure 2.—Cascade Head and the Pacific, viewing north. Photo by Oregon ShoreZone, CC-BY-SA; from Oregon Coastal Management Program, used with permission

Figure 3.—Cascade Head landscape viewing north, oblique aerial view. Photo by Oregon ShoreZone, CC-BY-SA; from Oregon Coastal Management Program, used with permission.

Figure 4.—Landscape components of Cascade Head: beach, sand spit, river estuary, forested slope, ridgeline, headland, coastline, lava flow, "bird island" refuges, meadow/pasture and farm. These are repeated along the Pacific coast. Photo by Oregon ShoreZone, CC-BY-SA; from Oregon Coastal Management Program, used with permission.

with a proposed Wilderness Area in California. A review of these initiatives reveals that Cascade Head Scenic-Research Area appears to be the first nationally designated area for scenery. The first National Scenic Area came to be about 10 years later.

Cascade Head was recognized in 1976 as a UNESCO Biosphere Reserve, a landscape that has significance on a worldwide scale.

CASCADE HEAD LAW AND LANDSCAPE ASSESSMENT

The Siuslaw National Forest has the responsibility of managing the Cascade Head Area, coordinating with the State of Oregon, counties, the Confederations of Tribes, other Federal Agencies, the Nature Conservancy, and private landowners (USDA Forest Service 1990).

The Cascade Head law aims to retain the landscape and restore the estuary, in particular. There is emphasis in the law on avoiding a “substantial change” to the manner or intensity of use of the Area since the time of the Act. Assessment of potential impacts to scenery is part of measuring whether a proposal would create a substantial change and includes criteria that when met can help a proposal to fit with the setting.

The law has several ways of emphasizing specific scenery in the assessment process. Landscape assessment of projects proposed at Cascade Head is to be assessed related to fitting with the specific setting, the site, and the Cascade Head setting overall.

Subareas of Cascade Head Landscape

The Cascade Head Act defines “subareas” of distinct characteristics within Cascade Head and sets scenic character goals—though they are not called that—for them.

Existing subareas (see Figs. 5-9) of Cascade Head have a combination of natural and cultural features such as rural houses, farms and forests. There are also low-key recreation use areas associated with distinct natural features like estuary, meadow, forest, headland, and coastline. These subareas form the basis of the effort to protect the character and the landscape of Cascade Head. The Act defined the qualities that describe these natural/cultural areas within Cascade Head and what is integral to them to retain.

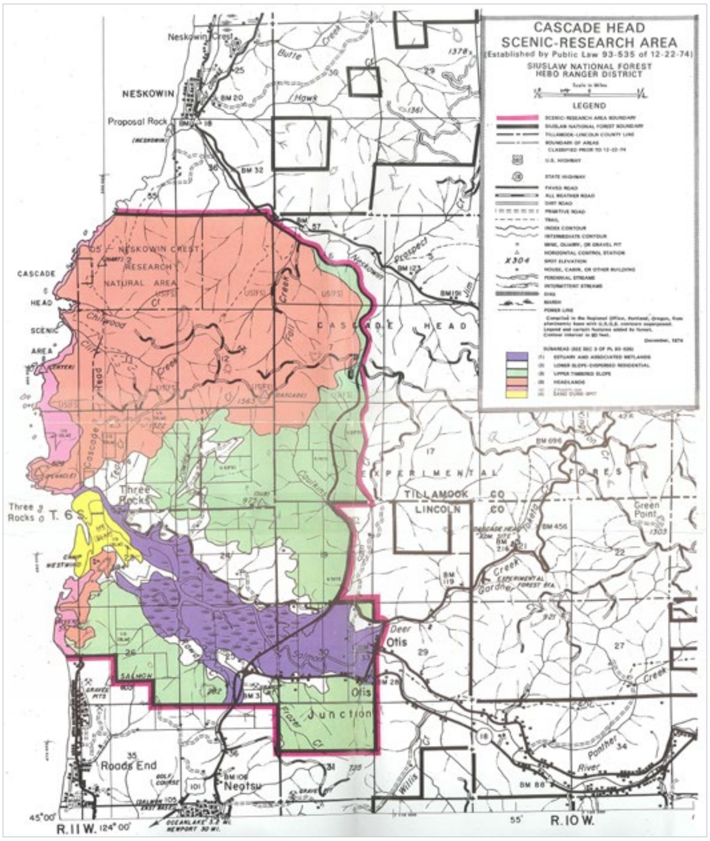

Figure 5.—The Cascade Head Scenic-Research Area subarea map December, 1974. USDA Forest Service https://www.fs.usda.gov/detail/siuslaw/landmanagement/planning/?cid=fsbdev7_007215

Environmental Design Criteria

There are also “environmental design criteria” set out in the final guidelines by the Secretary of the Department of Agriculture (Federal Register 1975), which include requiring a proposal to fit with the color, line, form of the site, and setting without impacting the estuary.

A project must relate to the landscape characteristics of its specific site. The landscape architect assesses the site to determine how it relates to and how to fit with—and minimally impact—its landscape subarea and the wider landscape of Cascade Head.

Each site is assessed based on its own conditions. Environmental design criteria are a way to evaluate whether a proposal will fit with the landscape of the subarea. These criteria also help a project meet standards of retention so that sites will visually appear to be part of the Cascade Head landscape rather than creating noticeable changes to the scenery and natural conditions.

Figure 6.—The south headland subarea and sand spit subarea. Photo by Nancy Craft, USDA Forest Service.

Figure 7.—The sand spit subarea, with the northern Cascade Head headlands subarea to the north. The Pacific Ocean is in view across the mouth of the Salmon River estuary within Cascade Head Scenic-Research Area. Photo by Jessica C. Dole, USDA Forest Service.

Figure 8.—The estuary subarea southeast view at Knight's Park. Photo by Jessica C. Dole, USDA Forest Service.

Figure 9.—Lower slope dispersed residential subarea in view across the estuary. Photo by Jessica C. Dole, USDA Forest Service.

The environmental design criteria consider aesthetics in an integrated, environmental sense. At Cascade Head, there is the line of tree edge, meadow, pasture boundary, headland, estuary edge, color of tree trunk, texture of spruce and alder forest, and the unknowable gray to green to blue color of water.

Fitting with the characteristics of subarea, some aesthetic considerations are:

- Vegetation line–Whole coastal landscape vegetation line, line of meadow edge, forest edge, line of character area
- Form–The horizontal form of the ridgeline and headlands
- Color–Bark, earth color
- Siting in relation to vegetation patterns and forms and topography
- Environmental aesthetics, such as possible soil effects on estuary

Cascade Head Scenic-Research Area's landscape assessment involves landscape and design understanding—the use of the design arts and aesthetic-environmental stewardship choices to support a landscape. Aesthetic judgment is involved when using Cascade Head's evaluation criteria. The aesthetic assessment process involves people as viewers, as their structures and use are part of Cascade Head landscape subareas. Aesthetic assessment involves people as project proponents—participants in the process of project review and adjustment to meet environmental design criteria.

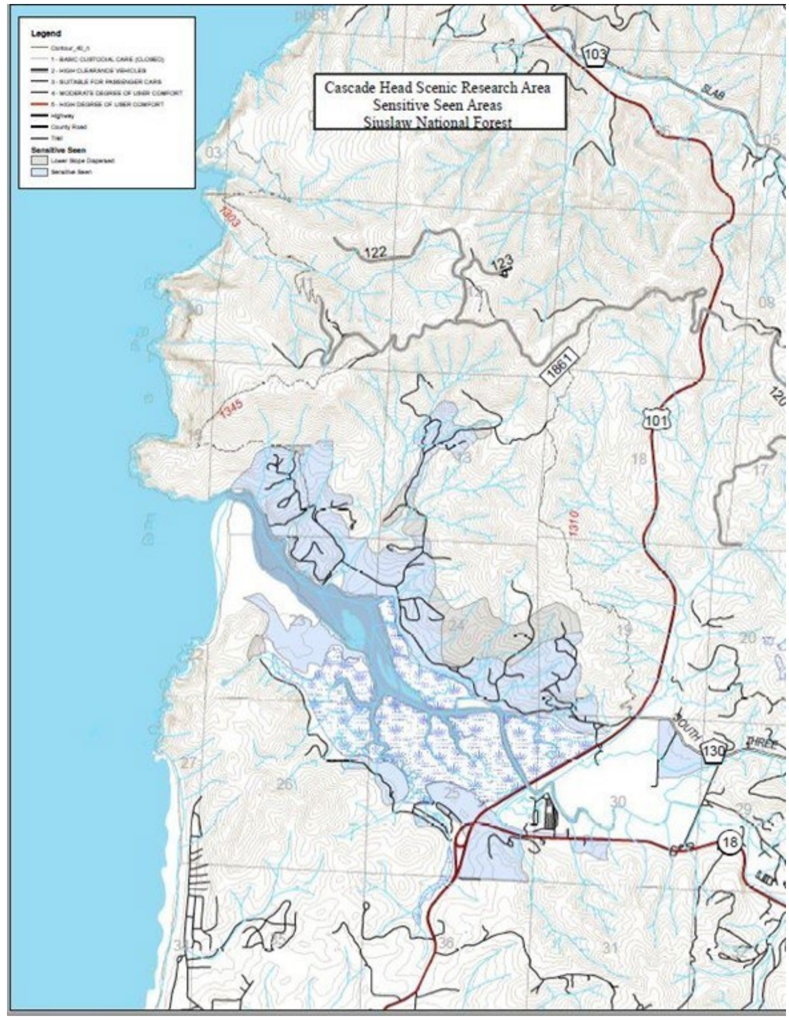

Figure 10.—Showing the viewed area in retention as it relates to the lower dispersed residential subarea and estuary edge, "Sensitive Seen Area." Map by Laura Hoffman, USDA Forest Service.

Retention

Finally, a proposal must meet the visual quality objective, most often of "retention," where changes do not deviate noticeably from the characteristic subarea (USDA Forest Service 1974, 1995). Figure 10 shows the "sensitive" seen area of the lower dispersed residential subarea, a retention area.

Retention tends to be thought of in two dimensions, by distance zones delineating ridgelines. It represents a landscape area in view bordered by ridgelines, part of the description of three-dimensional landscapes.

Site visits show the particular spaces and prospects of a large landscape, and the details of the setting. During project proposal review, site analysis to understand the landscape and a site—on site—is needed for scenery review.

In this way, the components of the landscape at different scales—site-specific, characteristic, and the larger landscape setting—are evaluated in the Cascade Head assessment process.

CASCADE HEAD LAW AND LANDSCAPE CHANGE

The basis of Cascade Head assessment is evaluating whether a proposed change would create a substantial change to the scenery in a subarea. How it will fit with the pattern in the landscape of the subareas? In evaluating potential effects of a proposed project, it is valuable to think, "What will the landscape at this site be? What will the Cascade Head landscape be?"

The 1977 Cascade Head Scenic-Research Area Management Plan (USDA Forest Service 1977) recognizes that vegetation will change. Development is set at the level of the 1974 inventory of use and existing building, and number of buildable sites at the time of the Act. The Plan took this as a standard point of time for level of development with the possibility of built change, with flexibility. Assessment for scenery impact and relationship to setting is to be done at each proposed site. The line of houses, outbuildings, and barns has a standard of relating to the forest edge set by the characteristic subarea, and has form, color, scale, texture and estuary impact, and vegetation and soil impacts set by environmental design criteria.

A landscape has, of course, constant change and various patterns and instances of change. At Cascade Head, there are vegetation changes between areas of marsh, meadow, pasture, alder, and spruce forest. There are changes in tide, sea level, the flooded and not flooded marsh of the estuary, and changes in the free flow of creeks, partly caused by past diking and highway construction. As all along the Pacific coast, there are areas in the tsunami zone. There is evidence of the 1700 tsunami at Cascade Head and of a king or surge tide—a single higher tide that happens sometimes on the coast, this time apparently about 10 feet above usual high water. Edges of the estuary change. Animals' movements, number, and concentration have seasonal changes. Three elk herds are seen up north on the lower slopes of the headlands, to the east and the south. They have been seen crossing the estuary from different directions, to pass each other and play in the water. There are butterflies on the high meadows, where photographers and artists and botanists go.

People's movements, concentrations, dispersal, and sensibilities have patterns and change. There have been changes of ownership of land, with some private land becoming public land, and changes to roads, highways, bridges, and adjacent land. With the constant flux of tide, the atmosphere changes through the day and year, with coastal zone atmospherics—fog, cloud, wind—a visible part of the landscape. This is an east-west landscape, and the long light changes through the day.

Ownership of the estuary and some estuary edge land has changed since the Act's passage, with more land in public ownership and in restored condition. In some areas, the density of development has increased. These changes were anticipated in the Management Plan. There has also been a large area of adjacent land that seemed likely to be densely built now; instead, it has become local open space. Some farm pasture has been lost, and some pasture and meadow was expected to be lost as dikes are removed and marsh area is restored.

The views within Cascade Head are largely the same or more natural appearing than 40-some years ago when the Area was established.

As with any landscape, Cascade Head has layers of associations and meanings and their aesthetic qualities. For thousands of years, people from local Tribes have been attached to this place. About 300 years ago, Spanish explorers traveled the coastline; about 300 years ago, there was a tsunami that cut through a sand bank visible today. Farmers settled on the edges of the estuary about 150 years ago. A number of creeks and roads within Cascade Head have the names of farmers. There are some farms, barns, actively used and remnant fence, and dikes. A large 100+ year-old dairy barn and hillside pasture are in picturesque view from the scenic highway. Some farms are gone now.

Spectacular landscapes, as Cascade Head, have the typical or representative landscapes within them that are important and meaningful. These common, representative, typical landscapes relate to people's lives in a landscape and our essential ties to a landscape and place, showing time and giving meaning in landscape (see Figs. 11 through 14).

At Cascade Head, cultural features of the landscape such as feature names, early use and associated landscape forms, historic barns and adjacent pasture, and people's ties to this place (particularly local Tribes) need greater recognition and inclusion as part of the landscape in practice and as the Management Plan is updated.

Figure 11.—View from Highway 101, National Scenic Byway; note white barn dating from 1910 and pasture. Photo by Jessica C. Dole, USDA Forest Service.

Figure 13.—View from an old farm road, toward Cascade Head. Photo by Jessica C. Dole, USDA Forest Service.

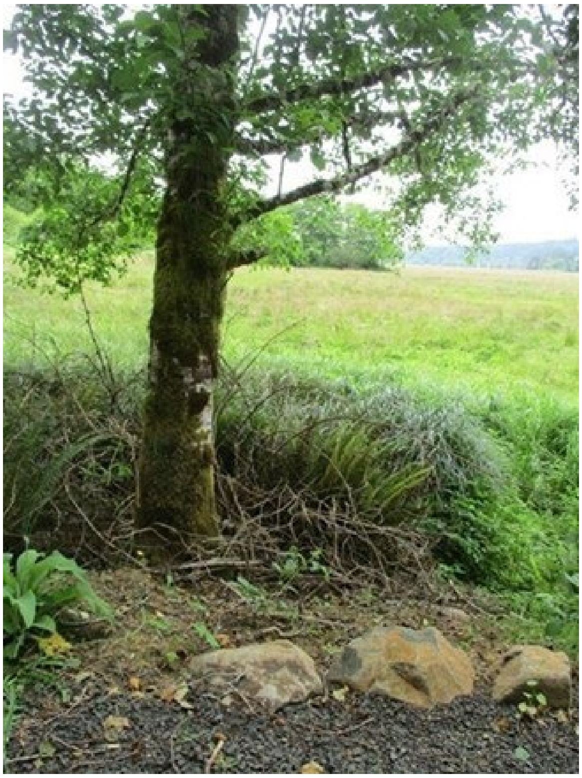

Figure 12.—View from an old farm road, now a trail, at Cascade Head. Photo by Jessica C. Dole, USDA Forest Service.

Figure 14.—Bird island refuges, a representative landscape feature of Cascade Head as part of the Oregon Pacific coast. Siuslaw National Forest photographic archive.

CASCADE HEAD LAW AND OTHER LANDSCAPES

The idea that people are associated with a landscape, that landscape decisions are site based and multi-scaled, and that aesthetics are environmental can be found in Cascade Head law. These ideas merit more thought in further landscape assessment there and for other landscapes, particularly consideration of the people that are part of a landscape.

The subareas defined in the Cascade Head Act have a distinct appearance and specific qualities that the Act sets out as the appearance to retain in the management of Cascade Head. This idea can be further developed for any large landscape, for a landscape at any scale, including spatial, experiential, natural, and cultural qualities, and defining distinct landscape "character areas" (Figs. 15-17). Design criteria can be developed to retain the characteristic appearance and qualities of distinct landscape character areas.

We can broaden our aesthetic-environmental understanding of scenery assessment for changing landscape. There are characteristic patterns and variation from them ("variety" is not a meaningful goal for landscape). Thinking about the flux at water's edge, for example, we can look at the consistencies of pattern, with points and times of variation, following the line of the water's edge through the landscape, then how and why it varies. We can assess and respond to site and setting pattern and have variation from that pattern in landscape.

Every day, typical landscapes have essential value, as seen even within such a distinctive landscape as Cascade Head. The rating of landscapes in the national scenery assessment processes can give attention to the fundamental cultural values and subsistence value of those landscapes designated in scenery mapping as "common" or "minimal" (USDA Forest Service 1995). These typical or representative landscapes have profound beauty of their own, that people recognize. The national landscape assessment systems have evolved in response to landscape needs, originally a response to protect natural landscape quality, and there has been great effort to include the cultural and a broader view of aesthetics in landscape assessment. They have given attention to the

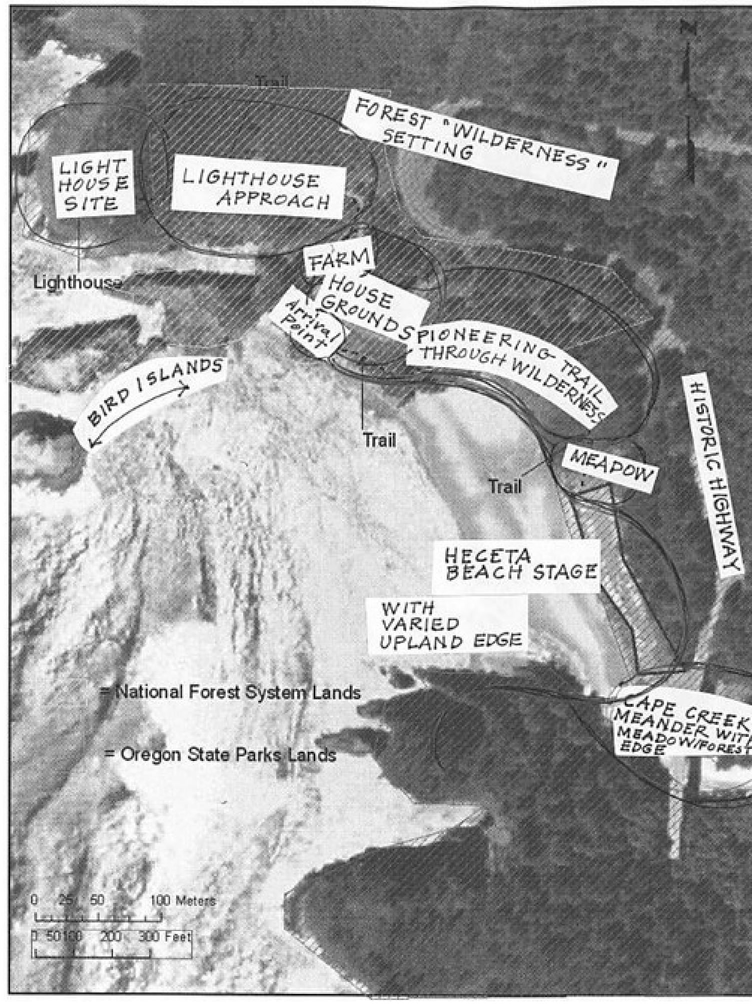

Figure 15.—Landscape character areas. The meadow character area is near the center right of the map. Illustration on aerial photo by Jessica C. Dole, USDA Forest Service.

Figure 16.—The meadow character area, which is a viewing point. Photo by Jessica C. Dole, USDA Forest Service.

Figure 17.—The Heceta Beach character area, with distinctive, Pacific coast landscape features, including volcanic formations, bird islands, and headlands. Photo by Jessica C. Dole, USDA Forest Service.

representative built features—over time—of common landscapes as having aesthetic meaning and value. Let's recognize the common landscapes themselves now and attribute to them their real value to people as part of our national landscapes.

CONCLUSION

The Cascade Head Act was one of the first pieces of Federal legislation that gave scenery specific standing in the law. Cascade Head Area is part of advancing ideas about landscape, where the aesthetic is considered as part of environmental considerations, as part of protecting it as a distinct landscape.

Cascade Head Scenic-Research Area law recognized people as part of the environment and provides for people a chance to study, appreciate, value, and fit in with this special place as it is an environment. It set provisions to protect landscape character, though that word is not used, that included people. The value of the area centers on people's experience of it. Cascade Head evolved the sense of scenery management to be people and experience of a landscape. In managing scenery, we can now look at landscapes on an experiential and essential level, as people experience landscape—forms, spaces, change, and meanings—retaining areas within landscapes that combine the natural and cultural features.

Cascade Head contributes to the evolution of scenery understanding and management. The Cascade Head Act, with the subareas and environmental design criteria, protect the landscape areas with their distinctive features and scenery of Cascade Head in a manner that is inherently site specific. It considers landscape, and people in the landscape, aesthetically—an environment. It has worked well to manage the Area and is an important step in evolving a deeper understanding of scenery and landscape.

ACKNOWLEDGMENTS

Thanks to Brad Cownover for the idea of focusing on Cascade Head, and to Paul Gobster and Richard Smardon for their help. I am grateful for Slim Erickson for helping me and others learn about landscape, its art, and its beauty; and for taking the time to look.

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PROTECTING NIGHT SKIES AND NATURALLY DARK CONDITIONS IN NATIONAL PARKS

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Abstract.—The field of visual resource stewardship has historically focused on assessments of visual quality and impacts to daytime scenery. In recent years, increasing numbers of visitors have been traveling to National Parks to participate in nighttime recreation and astronomy-based park programming. In many parks, nighttime programs have become some of the most popular ranger-led activities and visitors have come to expect superlative nighttime views of starry skies and park landscapes just as they do during the day. However, development of frameworks, methods, and protocols for assessing nighttime visual resources have yet to emerge from the field. This paper discusses the importance of night skies and naturally dark environments and presents an approach developed by the National Park Service (NPS) to measure night sky quality and the photic environment in parks. The approach adopted by NPS can serve as a starting point for developing methods for effective visual resource stewardship at night.

INTRODUCTION

Throughout the development of the field of visual resource stewardship, scant attention has been paid to the protection of visual resources after the sun has set. For example, early policy and guidance on visual resource management from the Bureau of Land Management and the USDA Forest Service (Bureau of Land Management 1980, USDA Forest Service 1995) are silent on views of the night sky and the effects of light on nighttime viewsheds. However, public awareness and appreciation of dark night skies has increased dramatically as illustrated by the number of articles in the popular press and recent studies of national park visitors (Galbraithoc 2012, Kulesza et al. 2013, Manning et al. 2015). As a result, visual resource professionals are recognizing the need to assess visual quality during the night and have begun to incorporate nighttime views into their analyses.

The timing of this trend is fortunate as the technology and practices of the lighting industry and our understanding of the effects of light in naturally dark environments have expanded significantly in recent years. The confluence of increased interest in night skies and nighttime recreation, a better understanding of the effects of light on park visitors and resources, and advancements in lighting technology has created an important opportunity to develop cost-effective methods for preserving night skies and mitigating of the effects of stray light on naturally dark environments.

This paper is organized as follows. Section one briefly introduces several concepts related to light that are important for protecting national park resources and values. Section two examines the reasons for protecting naturally dark environments and night skies. It discusses the importance of minimizing stray light and protecting naturally dark environments in terms of the aesthetic experience of visitors, ecological needs, cultural resources, and wilderness. Section three describes methods used by the National Park Service (NPS) to measure and predict the presence of light in the environment, and section four introduces the six principles of sustainable outdoor lighting that NPS uses to protect night skies and the resources and values that depend on natural cycles of light.

NATIONAL PARK SERVICE POLICIES

The overarching mission and mandate of the NPS is provided in the Organic Act that established the agency (National Park Service Organic Act 1916). The Organic Act states that NPS will conserve natural and cultural resources and values under its protection while also providing for the enjoyment of those

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resources and values. In addition, the Act requires NPS to manage resources in a way that will leave them unimpaired for future generations. Subsequent legislation and NPS policy states that when there is a conflict between conserving resources and values and providing for their enjoyment, conservation is to be predominant (National Park Service 2006).

The NPS has a policy for lightscape management, which states that NPS will preserve, to the greatest extent possible, the natural lightscapes of parks and minimize light that emanates from park facilities to prevent the loss of dark conditions and natural night skies (National Park Service 2006). NPS also recognizes that light affecting the photic environment of parks often originates outside of park boundaries, and therefore directs park superintendents to seek the cooperation of park visitors, neighbors, and local government agencies to prevent or minimize the intrusion of artificial light into park environments and ecosystems.

The management policy on light restricts the use of artificial lighting in parks to those areas where security, basic human safety, and specific cultural resource requirements must be met (National Park Service 2006). Management policies also require NPS to use minimal-impact lighting techniques and to shield lighting where necessary to prevent the disruption of the night sky, physiological responses, and similar natural processes. The policy also recognizes that there are some areas and situations where light should not be introduced into the environment. It states that the NPS will not use artificial lighting in areas such as sea turtle nesting locations where the presence of the artificial lighting will disrupt park resources and values.

Safety and security are often cited as reasons for park lighting. Therefore, it is important to address NPS policy related to public safety. NPS Director's Order 50C is the primary policy document on public risk management. It states, "Within the context of the Organic Act, visitor risk management does not mean eliminating all dangers, nor can the NPS guarantee visitor safety or be responsible for acts and decisions made by visitors that may result in their injury or illness" (National Park Service 2010, p. 1). It also states that park superintendents will seek to identify risks within their jurisdiction and to mitigate these risks without compromising the integrity of the environments they are charged to protect. Specifically, it states that lighting and other safety measures might be appropriate in some settings while not in backcountry campsites, trails, and similar pristine settings, or even in some urban locations.

These and other existing policies require NPS to protect night skies and dark environments and provide direction on how superintendents and park managers can consider tradeoffs between protecting the lightscape and providing for basic human safety (National Park Service 2010). To assist park managers in making lighting decisions, NPS relies on existing guidance and best practices from the fields of lighting design and night sky preservation. Emerging science suggests that more mission-driven best practices would better serve NPS units.

Fundamentals of Light

The electromagnetic wave theory developed by James Maxwell in the late 1800s is a fundamental theory that demonstrates the relationship between electricity, magnetism, and light and shows that these effects are different manifestations of the same phenomenon. Maxwell described visible light as oscillating electric and magnetic fields, perpendicular to each other, that travel away from the source (Chaichian et al. 2014). According to the theory, light is just a small portion of a larger electromagnetic spectrum that ranges in energy level from gamma rays to radio waves. Light is the portion of that spectrum that stimulates nerve receptors in our eyes and allows us to sense our environment.

Correlated Color Temperature

Color correlated temperature (CCT) is an important characteristic that affects the color of light emitted from a fixture. This color (or spectrum) influences how light affects the environment and plays an important role in mitigating ecological impacts of stray light. CCT describes the relationship between the color of light and temperature. Stars vary in color. Some appear blue, some red, others yellow, and that difference is based on the star's surface temperature. When astronomers look at a star in the night sky, they can predict its surface temperature based on the peak wavelength of the star's spectrum. Because of this relationship, the spectra—or color—of a light bulb is typically expressed in degrees Kelvin (DiLouie 1994).

Light Propagation

Understanding how the intensity of light changes as a function of distance is critical for designing effective lighting solutions and mitigating adverse effects of light in a viewshed. The intensity of light diminishes based on the inverse square law (Schreuder 2008). When you double the distance between a light and a receptor, the light is 25 percent as bright. When you move closer by half you increase the brightness by a factor of 4. If you triple the distance, the light is 1/9, or 11 percent, of its original intensity. Because of the inverse square law, when you first begin moving away from a light source, the intensity diminishes rapidly. As you continue moving farther away, the intensity decreases at a slower rate.

Skyglow and Glare

There are two main types of light pollution that can affect natural and cultural resources in national parks: sky glow and glare. Sky glow is light scattered and reflected off of air molecules and atmospheric aerosols. The observer sees anthropogenic light originating on the ground as luminance in the sky. Sky glow diminishes the aesthetics of the night sky and illuminates the observer and the landscape unnaturally (Royal Commission on Environmental Pollution 2009).

Glare is stray light that strikes your eye directly from a source. Glare degrades the visual scene in two ways. First it obscures visual information and second it can degrade scotopic or dark-adapted vision. Our eyes automatically adjust to the brightest source of light in a scene, so when you see a source of glare such as an unshielded lighting fixture, the area surrounding the light becomes difficult to see. Visual information in the vicinity of the light source is lost. Glare caused by improper lighting also creates shadows that can obscure information. As a result, increasing safety and security is not solely related to how much light you have on a scene; it is also a function of how effectively the light provides information about your surroundings (Steinbach et al. 2015). Light allows us to extract information from the environment, and improper lighting often hinders its effectiveness. That is why adding more light to a scene does not always increase safety and security (Richman 2009, Sherman et al. 1997).

Glare also degrades dark-adapted vision. Human vision maintains sensitivity over an impressively large range of ambient light levels. Even though humans maintain visual sensitivity in dark areas, it can take several hours to fully adjust to low light conditions. However, dark adaptation can be lost in just a few seconds of exposure to bright light (American Optometric Association 2006).

Illuminance and Luminance

Illuminance and luminance are two additional concepts that are important for understanding how light interacts with landscapes. Illuminance is a measure of luminous flux on a surface of a given area, or luminous flux density. It is what matters most when the human eye is trying to examine objects by reflected light. Illuminance, measured in lux, is a very useful measure for quantifying anthropogenic light in the natural environment. Illuminance from the sky or a light source overhead is often measured with a detector in a horizontal plane and is known as horizontal illuminance. Horizontal illuminance is an effective measure of sky brightness near the zenith or illuminance from a pole mounted outdoor light. Illuminance from a light source at a distance on the horizon may be measured with the detector in a vertical plane. This measure is called vertical illuminance. Vertical illuminance is an excellent measure of light trespass or glare from light fixtures in a viewshed (Schreuder 2008).

Luminance is a measure of luminous intensity per unit area (candela/m^2). In contrast to illuminance, which measures the intensity of light from a source, luminance measures the intensity of light reflected from a surface. It is sometimes called "perceived brightness" or "surface brightness." Changing the characteristics of a surface such as texture, color, or reflectivity can increase or decrease its luminance (Schreuder 2008).

Both luminance and illuminance are important factors for understanding and measuring light pollution. Sky glow is light reflecting off of aerosols and particulates in the atmosphere and is typically measured using luminance values. Glare on the other hand is the direct output from a source striking the eye and is best measured using illuminance.

IMPORTANCE OF NIGHT SKIES AND NATURALLY DARK ENVIRONMENTS

Aesthetics

As indicated by satellite data, outdoor light levels are rising dramatically, and the visual quality of the night sky is diminishing rapidly in many areas. As the public loses the view of stars and the Milky Way in their backyards, they are increasingly seeking it out in parks and protected lands. In many national parks, nighttime programs such as astronomy and moonlight hikes are among the most popular ranger-led activities. A visitor survey at two Utah parks revealed that 99 percent of visitors prefer to stargaze in a national park over other locations. Ninety percent believed that there should be places that protect dark skies, 80 percent thought that the surrounding communities should help support such protection, and over 80 percent indicated that the quality of night skies was an important or very important part of their visit (Mace and McDaniel 2013). Manning et al. (2015) found that 90 percent of visitors feel that night sky viewing is important and the National Park Service should protect opportunities for visitors to see the night sky. Likewise, Kulesza et al. (2013) found that dark night skies were important to 81 percent of visitors and that the ratings increased over the 24-year period of the study (1988 to 2011).

Astrotourism and Economic Value

Protecting night skies and increasing opportunities for astronomy-based recreation can have a positive impact on local economies surrounding national parks. Attending a nighttime program often turns a drive-thru park visit into additional dinner, breakfast, and lodging revenue for the local economy. The growing public appreciation for these activities has spawned a new component of tourism industry called astrotourism. According to Fayos-Solá et al. (2014, p. 663), "Astrotourism is an activity of travelers wishing to use well-kept nightscapes for astronomy-related leisure and knowledge. This practice has increased in popularity during the past few years, adding value to offbeat tourism destinations offering high-quality night skies and astronomical or archaeoastronomical heritage."

However, measuring the economic value of naturally dark environments poses some significant challenges. Some scholars have suggested that conventional economic approaches used in natural resource valuation are inadequate to capture the scope and complexity of such an expansive resource (Gallaway 2014). According to Willis (2014, p. 250), "The main challenge in the economic appraisal of improved night sky visibility is estimating this public good value of the night sky, and also the other economic externalities (fear about personal safety, accidents, injuries and crime) due to any reduction in street lighting."

In an unpublished manuscript, Mitchell and Gallaway (n.d.) presented an analysis of the potential economic value of night skies above the Colorado Plateau. The authors conclude that over the next 10 years, visitors trying to see a dark sky at night will spend nearly $2.5 billion visiting NPS parks in the area. This additional spending generates $1.68 billion in revenues for local and State economies and creates an additional 52,257 jobs that increase wages in the states by over $1 billion.

Human Health

Since the beginning of life on this planet, there has always been a 28- or 29-day lunar cycle and a 24-hour daily cycle. This natural pattern is ingrained in the DNA of most creatures on Earth. Throughout this time the environment has changed in countless ways. Continents have formed and eroded, sea level has risen and fallen, even the chemistry of our atmosphere has changed. But we have always had the same light-dark cycle—until the last hundred years.

Exposure to light can have direct and indirect physiological effects. In addition to rods and cones, our retinas contain a type of cell called intrinsically photosensitive retinal ganglion cells. These cells play a major role in synchronizing circadian rhythms to the 24-hour light/dark cycle. Stimulation of these cells influences our circadian rhythm primarily by suppressing the production of melatonin, which in turn influences sleep, cognitive performance, mood, memory, and other physiological functions (Cao and Barrionuevo 2015, Pickard and Sollars 2012).

While light of any kind can suppress the secretion of melatonin, recent studies have suggested that blue light has a greater effect on physiological processes than other portions of the spectrum. One study found that blue light suppressed melatonin for about twice as long as green light and shifted circadian rhythms by twice as much (3 hours vs. 1.5 hours) (Harvard University 2017).

Cultural

For thousands of years, views of the night sky have influenced the course of human activity and development. Most people can recall in their own lives an inspirational moment under the stars when the visual perspective of looking outward beyond our planet provided an emotional perspective for our lives. Such perspective has been a wellspring of inspiration for writers, scientists and philosophers (Moore et al. 2009). Musicians from Gustav Holst (*The Planets*) to Joseph Haydn (*The Creation*) have been influenced by the night, and starry skies have inspired artists throughout millennia from the creators of pre-Columbian rock art to Vincent Van Gogh, Edvard Munch, and Georgia O'Keeffe (International Dark-sky Association 2016). Even today, the public seeks views of starry skies in national parks for their scenic and inspirational value. The recent explosion in popularity of astrophotography is evidence of that enthusiasm.

Sites such as the pyramids in Egypt, Angkor Wat, Chichen Itza, and the pueblos of Chaco Canyon are standing testament to our ancestors' relationship with the stars. Humans have looked to the night sky to navigate great distances and measure time, studied the motions of the stars, recorded astronomical events in rock art, aligned our buildings to celestial objects, developed calendars, and made decisions on when to plant crops based on the position of the stars and moon (Ceci 1978, Penprase 2017, Ruggles 2015, Spence 2000).

Big Horn Medicine Wheel located in northern Wyoming provides an example of the cultural importance of the night sky to Native Americans. The "wheel" is a pattern on the surface of the ground, made up of an imperfect circle of stones, about 25 meters in diameter. It includes a central cairn about 4 meters in diameter. Twenty-eight spokes radiate from this inner cairn and connect to the rim. The medicine wheel marks both the rising and setting sun on the summer solstice as well as the rising of the bright stars Aldebaran, Rigel, and Sirius (Eddy 1974). In these and myriad other ways, the night sky connects us with our ancestral past.

Ecological

The ecological consequences of stray light in parks are primarily a function of changes to the natural regimes of light and dark in which all species have evolved. The disruption of natural patterns of light and dark produces a range of adverse effects for wildlife (Longcore and Rich 2006). Recent studies have suggested that in addition to food, shelter, water, space, and other key environmental resources, many species also require darkness. Longcore and Rich's (2017) review of the literature illustrates effects from light on numerous ecological processes including orientation, reproduction, communication, competition, and predation.

Examples of research demonstrating adverse ecological effects are commonplace in the literature and the number of articles is increasing at a rapid pace. The relationship between light and wildlife behavior was a topic of concern as far back as 1918 when Squires and Hansen (1918) documented the destruction of birds near lighthouses. The effects of artificial light on birds continue to be relatively well studied in comparison to other taxa. Birds are susceptible to light pollution as many species are known to migrate using celestial navigation (Mouritsen and Larsen 2001). It is hypothesized that on nights with fog or low cloud ceilings when other visual cues are obscured, migrating birds attempt to use artificial light sources to assist in navigation (Gauthreaux and Belser 2006). Attracted to these light sources, they often have difficulty escaping from the illuminated areas and may die from collision or exhaustion. Becoming trapped by a light source may also lead to additional consequences such as reduced energy stores or delayed arrival at wintering or breeding areas (Seress and Liker 2015). In addition, males of several bird species often start their dawn choruses earlier in the day in places with more pronounced light pollution compared to birds in darker territories (Kempenaers et al. 2010, Miller 2006).

One of the best-known examples of ecological disruption caused by artificial light is the fate of hatchling sea turtles as they emerge from nests on sandy beaches. Under normal circumstances, hatchlings move away from dark inland areas and move quickly toward the relatively bright surf. In many developed areas, light sources from roads and towns disrupt this natural condition and turtle hatchlings move inland toward bright areas instead of out to sea. This disorientation often results in increased predation and higher overall mortality for the hatchlings (Longcore and Rich 2006, Salmon et al. 1995).

Although our understanding of the effects of light on wildlife have increased in recent decades, there are still many unknowns. For example, we know that insects are attracted to light sources. Lights, especially those near natural areas, can attract insects within a large radius (Souza de Medeiros et al. 2017, Wakefield et al. 2018). Unfortunately, the ecological effects of these light traps on insect populations and distributions are still largely unknown.

Wilderness

Wilderness is a unique, vital, and irreplaceable source for a wide range of ecological, cultural, social, economic, ethical, and other values (Cordell et al. 2005). The Wilderness Act of 1964 directs agencies administering any area designated as wilderness to preserve the wilderness character of the area (Pub. L. 88–577). Based on the interagency publication "Keeping It Wild" (Landres 2008), NPS has adopted five qualities of wilderness character: natural; untrammeled; solitude or a primitive and unconfined type of recreation; undeveloped; and other features of value (National Park Service 2014). Protection of night skies and naturally dark conditions is related to all of the wilderness qualities.

Natural

This component of wilderness character holds that ecological systems should be substantially free from the effects of modern civilization. Views of the night sky and natural cycles of light and dark are critical components of the "natural" quality of wilderness character. Stray light negatively impacts natural cycles of light and dark, affects wildlife physiology and behavior, and disrupts important ecological processes. Sky glow and glare within a wilderness viewscape diminish naturalness by creating scenic elements that are caused by modern development.

Untrammeled

Wilderness is untrammeled when it is essentially unhindered and free from intentional human actions or manipulation. This quality is influenced by any activity or action that intentionally controls or manipulates the components or processes of ecological systems inside wilderness. Adding light to the environment is often a way to manipulate the physical characteristics of an area and can reduce the untrammeled quality of wilderness character. Natural night skies are an effective indicator of an untrammeled landscape.

Undeveloped

Undeveloped wilderness retains its primeval character and influence and is essentially without permanent improvement or modern human occupation. This quality is preserved by the absence of structures and installations, and by refraining from other uses prohibited by Section 4(c) of the Wilderness Act, which include the presence of habitations and the use of motor vehicles, motorized equipment, or mechanical transport. Undeveloped wilderness should be without the lighting often associated with these uses.

Solitude or a Primitive and Unconfined Type of Recreation

Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation. This quality is related to opportunities for visitors to experience wilderness character and is preserved or improved by actions that reduce signs of modern civilization inside wilderness. The night sky contributes significantly to opportunities for visitors to experience solitude or a primitive and unconfined type of recreation. Skyglow, glare, and other forms of light trespass are constant reminders of modern civilization and diminish the sense of solitude that many wilderness users seek.

Other Features of Value

Section 2(c) of the Wilderness Act states that wilderness also preserves other tangible features that are of scientific, educational, scenic, or historical value. According to the NPS Wilderness Stewardship Plan Handbook, this quality captures important elements of wilderness that may not be covered in the other four qualities, such as cultural or paleontological resources (National Park Service 2014).

Dark environments are very fragile, and even small amounts of stray light in wilderness have the potential to overwhelm the natural features of the night sky and interrupt natural cycles of light and dark. Light is one of the most common human intrusions that a wilderness user is likely to encounter and can easily decrease their sense of solitude, naturalness, and other components of wilderness character.

MEASURING LIGHT IN PARK ENVIRONMENTS

Natural resource monitoring is a major component of park stewardship. The overall purpose for measuring and monitoring natural resource conditions such as night sky quality and light trespass is to determine the status and trends in the condition of these important resources and values. Monitoring results can be used to determine the effectiveness of management decisions, provide early warning of impending threats, and provide a basis for understanding and identifying meaningful changes in natural resource conditions (National Park Service 2018). Scientists and engineers at the Natural Sounds and Night Skies Division have worked with universities, nongovernmental organizations, and other public and private partners to push the boundaries in developing technology, methodologies, and protocols for measuring the photic environment in National Parks.

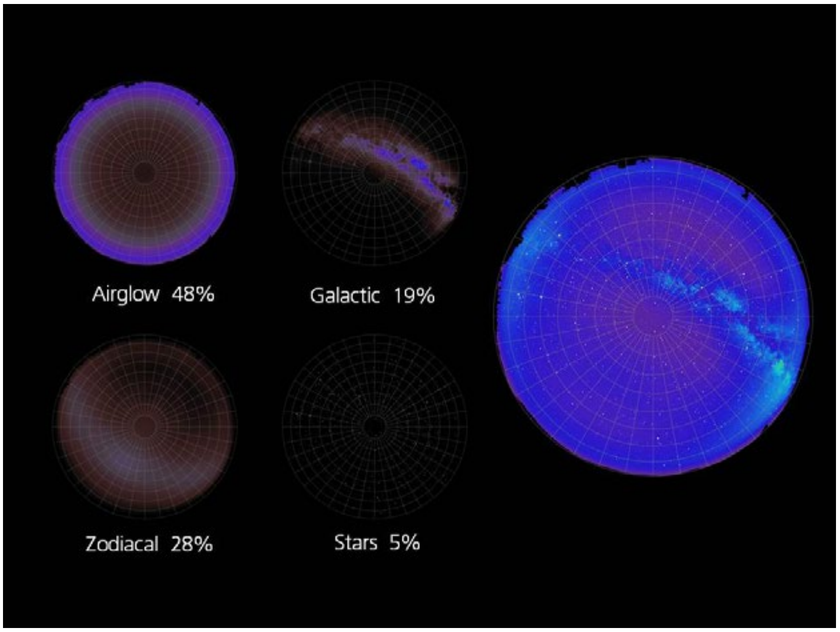

Figure 1.—The main components of the night sky and the average percentage of light that each contributes to natural conditions (Duriscoe 2013). These components are combined into a model of the natural night sky that can be used as a benchmark for comparing existing light conditions. Images from National Park Service.

Natural Sources of Light

In order to assess the levels and effects of anthropogenic light, park managers need to be able to compare existing light levels to a natural reference condition. This natural condition is obtained by modeling the natural light in the moonless night sky devoid of any anthropogenic sources. Natural sources of light in the night sky include starlight, galactic light, zodiacal light, and airglow.

The total amount of light originating from stars represents a small portion of the natural light in the night sky. Venus, the brightest natural object other than the moon, has an illumination level of 0.14 lux. By comparison, the illumination level of the full moon is 250 mlux (Roach and Gordon 1973). Most stars are significantly dimmer than Venus and, when aggregated across the night sky, the light level from stars is relatively low. Compared to other sources of natural light, starlight contributes only about 5 percent of the total natural light in the night sky. Galactic light is the accumulated light from the dense band of stars that make up the Milky Way. Because the stars in this region are so dense, they are measured as a single source. Galactic light represents about 19 percent of the natural light in a cloudless, moonless night sky.

Zodiacal light, sometimes called “false dawn,” is sunlight reflected off of dust particles in the planetary plane of our solar system between Mars and Mercury. Near twilight zodiacal light forms a wedge-shaped band of light at the horizon in the direction of the sun and can be surprisingly bright under dark clear skies. Zodiacal light represents 28 percent of the natural light in the night sky. Airglow is light that emanates from the ionization of gases in the upper atmosphere. It can be seen as a subtle “shell” of light around the Earth. Air glow is the source of approximately 48 percent of the natural light in the night sky. Duriscoe (2013) combines these sources into a model of the natural night sky. Figure 1 illustrates each of the sources of light in the natural night sky and the composite model used by NPS. This model of the natural night sky is used as a benchmark by which the condition of any night sky can be assessed.

Anthropogenic Sources of Light

As mentioned above, the two main sources of light trespass are glare and sky glow. Glare can easily be measured using a standard illuminance meter. In addition to lux levels, some models also provide information related to the light’s spectrum. To measure sky glow, a sky quality meter can be used. Originally designed as an affordable meter for measuring sky brightness for astronomers, sky quality meters measure the brightness of the night sky in magnitudes per square arcsecond. These instruments can be used in the field by visual resource professionals to quickly assess and quantify night sky quality and sources of glare within a viewshed. NPS is also developing technology, methodologies, and protocols for using digital single lens reflex (DSLR) cameras to measure light levels in the field. DSLRs are portable, convenient, and readily available and after effective calibration can be used to precisely measure light levels. DSLRs also provide an excellent qualitative record of the night sky and nighttime visual resource conditions.

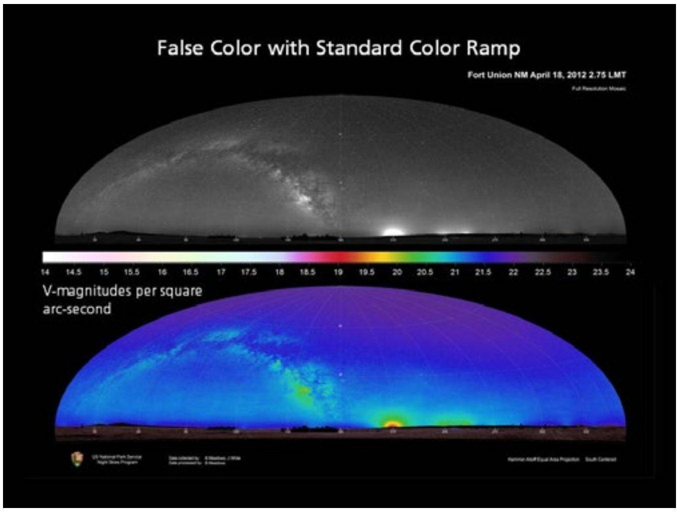

Figure 2.—All-sky brightness levels in natural and false color. Image from National Park Service.

Currently, NPS uses a charged coupled device (CCD) camera to assess night sky quality in National Parks. CCDs allow NPS to create a mosaic of 45 images that can capture the entire night sky with an astonishing level of detail (Duriscoe et al. 2007). As illustrated in Figure 2, the data can be presented in natural and false color graphics to better demonstrate variations in light levels. To illustrate the portion of light levels from anthropogenic sources, natural sources from the natural night sky model are subtracted from the all sky images. The resulting images demonstrate the portion of the light originating solely from anthropogenic sources. The anthropogenic data are then compared to our natural sky benchmark to calculate the anthropogenic light ratio (ALR).

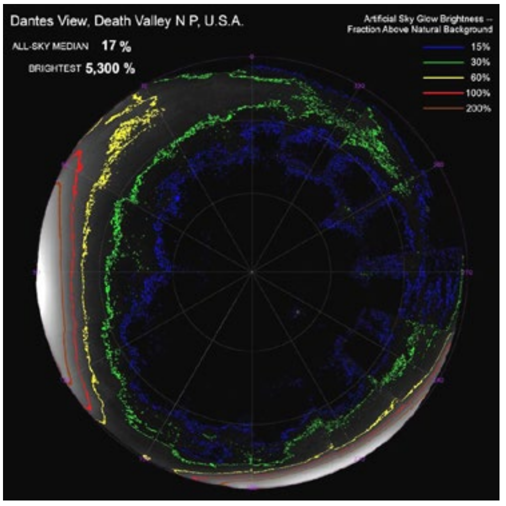

Figure 3.—Anthropogenic light ratio of the night sky measured in Death Valley National Park. Image from National Park Service.

Figure 3 illustrates contours depicting various ALR levels of the night sky measured in Death Valley National Park. In this view, the zenith of the sky directly overhead is at the center of the circle. The brightest areas within the brown contours are 200 percent brighter than natural conditions. The yellow contours represent areas that are 60 percent greater than natural, and areas within the blue contours are 15 percent brighter than natural conditions. The median level for the entire sky is 17 percent above natural.

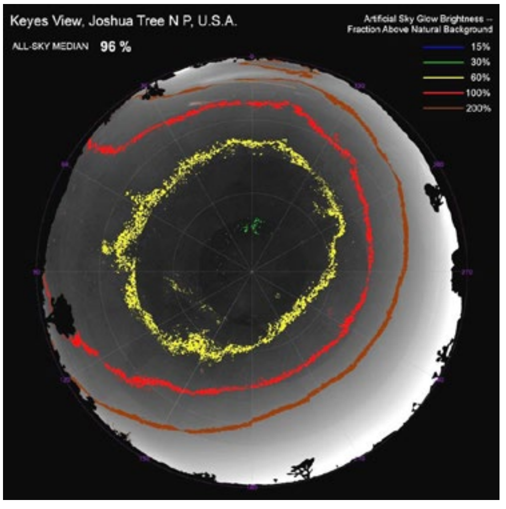

Figure 4.—Anthropogenic light ratio of the night sky measured in Joshua Tree National Park. Image from National Park Service.

Figure 4 shows ALR levels from Keye's view in Joshua Tree National Park, a popular lookout with sweeping views that include the Coachella Valley and Palm Springs. As a result, the all sky median ALR is 96 percent above natural and the brightest area is almost 7,000 percent above natural conditions.

PRINCIPLES OF SUSTAINABLE OUTDOOR LIGHTING

Mitigation of potential effects is a cornerstone of the visual impact assessment process (Bureau of Land Management, n.d.; Landscape Institute and the Institute of Environmental Management and Assessment 2013). In an effort to reduce the effects of lighting on national park resources and values, NPS has built upon existing recommendations and best practices (Dick 2016, Illuminating Engineering Society 2014, International Dark-sky Association 2018) to develop the following six principles of sustainable outdoor lighting. In designing, selecting, and operating outdoor lighting, the combination of these six principles will lead to lighting systems that simultaneously and effectively address social, economic, and environmental concerns of lighting. When designing, installing, maintaining, and replacing lighting fixtures and systems in national park units, park managers are encouraged to implement these principles to protect, preserve, and restore the photic environment and other park resources and values.

Light Only If You Need It

The first principle involves an assessment of whether a light is necessary and warranted. While outdoor lights are often installed with the express purpose of increasing illumination, the real need is often improving visibility. There is a number of ways to improve visibility that do not require illumination such as painting curbs, steps, and crosswalks with light colored or retro-reflective paint, using lighter colored pavement, trimming vegetation that obscures lights or sight-lines, and installing glow-in-the-dark markers.

If there is a particular risk that needs mitigating, such as tripping on a pathway or potential vandalism of valuable resources, there may be solutions available other than installing lighting. Smoothing paved surfaces, reworking stairways, or installing alarm systems can be more effective and cost less than outdoor lighting. Whenever possible, the underlying risk or hazard should be directly addressed as opposed to adding light in order to mitigate risk.

Light Only When You Need It

The central precept of this principle is to turn off or dim lighting when it is not needed. Outdoor lighting should have controls that limit the use of lights when sufficient daylight is available. Timers should be used in appropriate areas to turn off or dim lights when the area is not in use (International Dark-Sky Association and Illuminating Engineering Society 2011). This can be accomplished through the use of motion sensors, timers, dimmers, and other control technologies that reduce the overall time and intensity of illumination. New LED technologies also allow precise control of the direction and spectral composition of light (Pandharipande and Newsham 2018; U.S. Department of Energy, n.d.). In addition to reducing stray light, effectively managing the time that lights are lit, as well as the intensity and spectra emitted, results in the added benefits of prolonged lamp life, lower maintenance costs, reduced energy consumption, and decreased carbon emissions (California Lighting Technology Center 2014, Pandharipande and Newsham 2018, Pust et al. 2015).

Use the Appropriate Spectrum for the Task

All lights emit a characteristic color, also known as correlated color temperature (CCT), that is expressed in degrees Kelvin. Warm tones appear yellow, amber, and red while cool tones appear white and often have a bluish tint. Paradoxically, warmer tones have a lower CCT and cooler color tones have higher CCTs (see Fig. 5). Light with higher CCTs contain a greater proportion of energy in the blue portion of

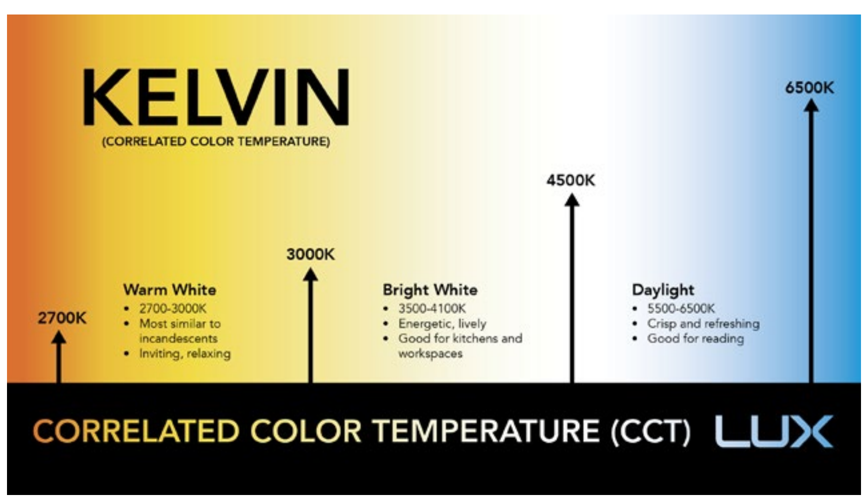

Figure 5.—Correlated color temperature. Image from Sedat ONAT, via Flickr Creative Commons.

their spectrum, which has a disproportionately high impact on dark adaptation, circadian rhythm, and other physiological processes in humans and wildlife (Holzman 2010, Tosini et al. 2016). Also, due to increased atmospheric scattering of short wavelengths, blue-rich light sources produce more skyglow in the vicinity of light sources than an equivalent intensity of yellow-rich lighting (Falchi et al. 2011, Gaston et al. 2012). Considering this greater impact, blue-rich white light with high CCTs should be used only when and where necessary. Otherwise, lamps with a warmer tone (e.g., those that are yellowish, amber, or red) should be used to minimize human and environmental effects.

LEDs generally produce light with high levels of radiant energy in the blue wavelengths. As a result, phosphors are added to the diodes to shift the blue light emitted by most LEDs into a broad spectrum of white light (McKenna 2015). In the past, phosphors had the unfortunate effect of decreasing the overall energy efficiency of the lights. That is why early LED lighting was often perceived as harsh and blue; the lights included less phosphor resulting in higher CCTs in order to maximize energy efficiency. Newer technologies have reduced that effect and the reduction in energy efficiency due to phosphors is negligible (Liu et al. 2015). Recently, the American Medical Association (AMA) released lighting guidance that encourages the use of 3,000K or lower lighting for outdoor installations (American Medical Association 2016). In response to the AMA report, many cities and towns that initially installed 4,000K to 5,000K LEDs are replacing them with 3,000K bulbs (Fundira 2017, Middlebrook 2016).

Light Only Where Needed

The objective of this principle is to limit the footprint of illumination to the area where it is needed. Lighting fixtures should be shielded such that no light is cast upward or horizontally. With proper shielding and advances in controlling the directionality of LEDs, light can be precisely aimed at the area intended to be illuminated, reducing offsite impacts, and preventing light trespass. A fully shielded or full cutoff fixture produces substantially less sky glow and glare compared to an unshielded fixture. As a result, numerous organizations including the U.S. Green Building Council (2018), Royal Astronomical Society of Canada (Dick 2016), and International Dark-sky Association and Illuminating Engineering Society (2011) recommend full cutoff or 0 percent uplight fixtures for outdoor lighting. Similarly, NPS policy also states that parks should shield lighting where necessary to prevent the disruption of the night sky and other park resources (National Park Service 2006).

Minimize the Amount of Light Used

Parks should use the minimum amount of light necessary to meet a task. Most visual tasks in parks such as way-finding, orientation, or detecting whether a person is present, require fairly low illumination levels (International Dark-sky Association and Illuminating Engineering Society 2011, U.S. Green Building Council 2018). Similarly, research shows that simply increasing or maintaining high lighting levels does not promote or enhance safety or security (Richman 2009, Sherman et al. 1997, Steinbach et al. 2015). In order to minimize lighting needs, additional measures should be considered to improve visibility that do not require illumination such as painting curbs, steps, and other features to increase contrast, and using lighter colored pavement. To ensure that minimum lighting levels are used, parks should perform task-based assessments of lighting needs.

Choose Energy Efficient Lamps and Fixtures

When assessing lighting requirements, the most energy efficient lamp and fixture that meets the lighting need should be selected. Energy efficiency is mandated by Executive Orders 13423 and 13693 and is critical in reducing carbon emissions and energy consumption. Lighting constitutes a significant portion of total energy use in national parks and careful selection of lamps and fixtures can help make considerable gains in energy efficiency and cost savings (U.S. Department of Energy 2014). In addition to choosing efficient lamps and fixtures, following the other principles of sustainable outdoor lighting such as implementing controls and minimizing lighting levels will also reduce energy consumption and costs.

CONCLUSIONS

For decades, land managers have understood the importance of protecting daytime viewsheds and the field of visual resource stewardship has created an extensive toolbox of theory, methods, and protocols to support that effort. In recent years, managers have begun to recognize that appreciation of scenic beauty does not end when the sun sets. The aesthetic of the night sky and landscape lit by the stars and moon is as varied, inspirational, and compelling as that of the day. Research suggests that interest and enthusiasm for astronomy, stargazing, and nighttime recreation is increasing as visitors flock to national parks to take part in these activities. As a result of these trends, visual resource professionals need to recognize naturally dark environments and night skies as important elements of visual resource management and incorporate views of the night sky and the nocturnal landscape in visual resource assessment process.

At night, viewsheds expand to include the moon, stars, and landscapes illuminated by these celestial features, and these visual elements are important components of the scenic experience of national park visitors. Stray light in the form of skyglow and glare affects the visual quality of these resources as well as other park resources and values. It impacts wildlife behavior and disrupts visual acuity, circadian rhythms, and other important ecological processes. Methods for precisely measuring photic conditions are available and the NPS has been measuring light levels in national parks for years. Measurement protocols and procedures for assessing potential effects from light on natural and cultural resources continue to improve and lighting technologies that can minimize the impacts of light on visitors and the environment are advancing rapidly. This confluence of increasing public awareness of the resource, improvements in measurement protocols and mitigation strategies, and continuing development of lighting practices and technologies have created an important moment in the field of visual resource stewardship. It is time to extend the realm of visual resources from the light of day into the relative darkness of night.

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COMPARISON OF VISUAL IMPACT ANALYSIS UNDER THE NATIONAL ENVIRONMENTAL POLICY ACT AND SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT

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Abstract.—Section 106 of the National Historic Places Act requires Federal agencies to consider the impacts, including visual impacts, of their undertakings on the ability of certain historic properties to convey their historic significance. Visual impacts of Federal agency undertakings must also be considered under the National Environmental Policy Act of 1969 (NEPA) for their potential to affect historic properties, scenic resources present in the landscape, and the scenic experiences of people who view the landscape. This paper discusses important differences between visual impact analysis (VIA) under Section 106 and under NEPA. In essence, VIA under Section 106 looks at impacts on places, while a NEPA VIA includes impacts on the people at those places and on the larger landscape. Where there are potential visual impacts on both scenic values and historic properties, both NEPA and Section 106 VIAs must be conducted.

INTRODUCTION

In considering the effects of proposed projects or activities on society and the environment, assessment of visual impacts is important to several types of resources. Obviously, visual impacts affect purely scenic resources and people's scenic experiences of the landscape. However, projects or activities may affect other resources and experiences that have an important visual component or aspect such as wild and scenic rivers, wilderness, or historic sites and trails.

Even though the quality and condition of these different resources are vulnerable to visual impacts, the unique characteristics of each resource call for somewhat different approaches to visual impact assessment (VIA). In practice, varying VIA approaches are used for different reasons that sometimes go beyond fundamental distinctions in the nature and role of the visual experience. Different laws, regulations, and/or policies of the various agencies responsible for managing these resources may dictate VIA practices for different resources (though this is seldom stated explicitly).

When conducting VIAs, there may be confusion about the resources that must be evaluated and the appropriate method for assessing impacts on a given resource. When stakeholders focus on a particular resource or when impact assessment professionals are accustomed to using a familiar methodology, the result may be a tendency to see the impacts and assessment approach through the "lens" of the resource they are accustomed to dealing with. This can result in overlooking important impacts and/or using inappropriate methods to conduct the assessment.

Section 106 of the National Historic Preservation Act requires Federal agencies to consider the impacts, including visual impacts, of their undertakings on the ability of certain historic properties to convey their historic significance. Under the National Environmental Policy Act of 1969 (NEPA), Federal agencies must consider visual impacts of proposed projects, including potential effects on historic properties, scenic resources, and the scenic experiences of people who view the landscape. This paper discusses important differences between visual impact assessments (VIA) under Section 106 and under NEPA.

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Visual Impact Assessment Under NEPA

A stated purpose of the National Environmental Policy Act of 1969, as amended, more commonly known as NEPA, is to "assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings" (National Environmental Policy Act 1994). NEPA requires Federal agencies to assess the environmental effects of their proposed actions prior to making decisions on permit applications, the adoption of Federal land management actions, and construction of highways and other publicly owned facilities (U.S. Environmental Protection Agency 2017).

NEPA does not explicitly require VIAs to be conducted, and, indeed, some environmental impact statements (EISs) do not include VIA if the Federal agency determines that there is no likelihood of significant visual impacts. However, if the agency determines that there is potential for significant environmental impacts, including visual impacts that cannot be mitigated such that they are no longer significant, the impacts must be assessed in an environmental impact statement (EIS) (National Preservation Institute 2017). In fact, visual impacts are routinely analyzed in EISs, particularly for large-scale energy generation and transport facilities, including electric transmission (see, for example, National Park Service 2012; Bureau of Land Management 2012, 2013a, 2016; Bureau of Land Management and Western Area Power Administration 2015; U.S. Department of Energy 2017).

NEPA does not, however, dictate *how* to conduct environmental analyses for particular resources. Instead, the Council on Environmental Quality (CEQ) oversees NEPA implementation, ensures that Federal agencies meet their obligations under NEPA, oversees Federal agency implementation of the environmental impact assessment process, and issues regulations and other guidance to Federal agencies regarding NEPA compliance (U.S. Environmental Protection Agency 2017). However, CEQ guidance for impact analysis is general in nature, and Federal agencies determine their own procedures for NEPA compliance. The agencies therefore have considerable leeway in how they conduct EISs, including how they analyze specific resource impacts.

Some Federal agencies have issued their own guidance for conducting EISs that may include fairly specific instructions for VIAs. For example, the Bureau of Land Management (BLM) policy is that the agency's visual contrast rating process is used to assess visual impacts (Bureau of Land Management 1986). The visual contrast rating process assesses a proposed project's effects on views from key observation points (KOPs) deemed to be locations from which people are likely to view the landscape. BLM NEPA directives also require assessing effects on the resource itself although visual resources are not called out specifically in the directive.[2]

The U.S. Federal Highway Administration (FHWA) and the U.S. Army Corps of Engineers (USACE) have specific procedures for conducting VIAs, but these guidelines are not mandatory and their use in practice is variable (Federal Highway Administration 2015, Smardon et al. 1988). Other Federal agencies, such as the National Park Service (NPS), Bureau of Ocean Energy Management (BOEM), and the USDA Forest Service (FS), do not have specific procedures for conducting VIAs, though NPS and BOEM are currently developing them.

In the absence of specific requirements, agency staff often conduct VIAs with methods that have previously been used by the agency, or methods that are selected by a contractor assisting with preparation of the VIA. The methodology may be dictated or influenced by State or other agency requirements, as in California where VIAs must adhere to the California Environmental Quality Act. Contractors may choose a methodology established by a Federal agency such as the BLM as a sort of "default" VIA approach, even when the proposed project does not affect BLM-administered lands. Sometimes they establish hybrid approaches. In rare instances, they establish their own methodology. Regardless of the details of the methodology, these "scenic resource VIAs" are generally similar in their approach (Fig. 1).

Characteristics of VIAs Under NEPA

Almost all "scenic resource VIAs" for NEPA EISs use KOP-based methods for assessing impacts on views and viewers. In these methods, photorealistic visual simulations depict visual changes or contrasts,

[2] McCarty, J. 2017. Personal communication from McCarty (Chief Landscape Architect, Bureau of Land Management) to R. Sullivan (Environmental Scientist, Argonne National Laboratory), Sept. 12.

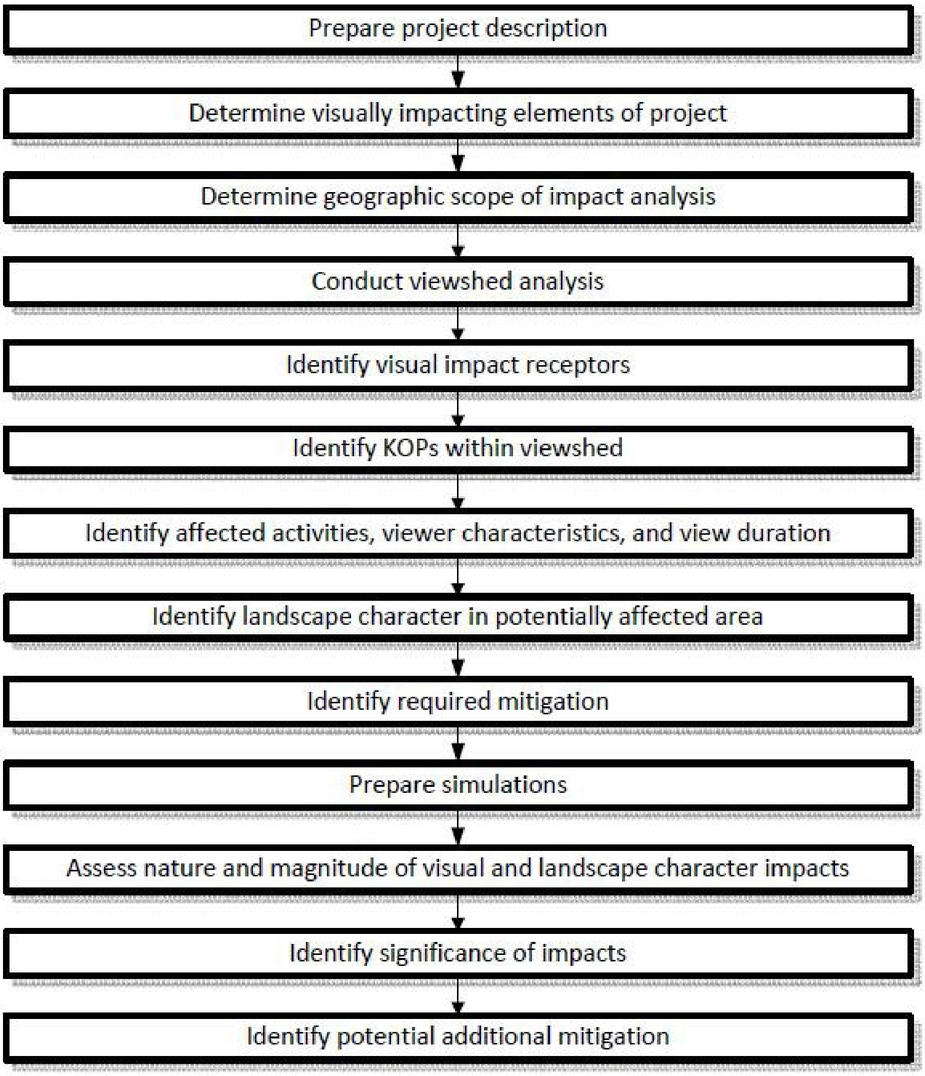

Figure 1.—Typical scenic resource VIA process under NEPA.

as seen from KOPs, that the proposed project may cause. The contrast determinations are used as a basis to determine potential impacts on viewers' visual experiences. These methods also generally include measures of viewer sensitivity that account for the number of potential viewers at a given KOP, the nature of the viewers, the activities in which they are likely to be engaged while viewing the proposed project, and the duration of the views. For example, potential differences in impacts on residents, visitors, commuters, and recreationists are factored into the sensitivity analysis. The sensitivity analysis also typically considers public concern for scenic values in the vicinity of the KOP, including special designations such as congressionally designated wilderness areas and national parks. The methods account for visibility factors, such as the distance from the project to the KOP, the presence of screening elements in the landscape, and the visual properties of the project elements (e.g., color, size, reflectivity, and motion) since these factors affect the magnitude of the visual contrast from the project. Viewer sensitivity is then typically combined with the predicted magnitude of visual contrast from the project to make a final determination of the level of impact (often described as negligible, minor, moderate, or major, or similar descriptors).

Scenic resource VIAs for NEPA EISs routinely use viewshed analyses to determine the potentially affected area. A maximum distance is established around the project within which visual impacts will be assessed. Visual impacts are usually considered direct impacts that can sometimes extend for long distances from the project; for example, proposed wind power projects may have impacts up to 30 miles away (e.g., see Bureau of Land Management 2012). The distance for potential visual impacts is usually adjusted for the type of project based on predicted visibility. Electricity transmission projects' visual impacts are usually expected to extend 5 to 10 miles from the project (e.g., see U.S. Department of Energy 2017).

Definition of Visual Impacts Under NEPA

Neither NEPA nor CEQ guidance define what "visual impacts" actually are. As with the VIA methodology, Federal agencies determine for themselves what constitutes visual resources and impacts. Several agencies (e.g., United States Army Corps of Engineers) include impacts on both viewers and visual resources in their definitions (Bureau of Land Management 2013b, Federal Highway Administration 2015, Smardon et al. 1988, Sullivan and Meyer 2014). Sullivan and Meyer (2014, p. 120) define visual impact as:

> Any modification in landforms, water bodies, or vegetation, or any introduction of structures or other human-made visual elements, that negatively or positively affect the visual character or quality of a landscape and the visual experience of persons viewing the landscape through the introduction of visual contrasts in the basic elements of form, line, color, and texture.

This clearly identifies both humans and the landscape as visual impact receptors. The definition arose from substantial consultation with visual resource professionals in Federal government, academia, and private practice, as well as review of existing literature on the topic.

While most Federal agencies with visual resource impact assessment or management responsibilities define visual impacts as including both impacts on people (through changes to views and the visual quality of views) and impacts on the underlying visual resource values, some EISs confine the VIA to identifying effects on views. This may be because there is an assumption that impacts on views are, or include, impacts on the underlying scenic resource values, or because for a given proposed project there are no inventoried scenic values to serve as a baseline for assessing effects from the project.

Limitations of Key Observation Point Analysis in VIAs Under NEPA

Using KOP analysis in a VIA to assess impacts on people's visual experience and enjoyment is clearly consistent with the NEPA mandate to assure that all people have aesthetically pleasing surroundings, in part because it addresses the interaction of humans and their aesthetic experience of the landscape. This implies that humans are the receptors for visual impacts. Relying solely on KOP analysis in VIA is problematic, however, because as land uses and people's viewing behaviors and locations change over time, KOPs and viewer sensitivities may also change. For example, the development of new roads or trails may result in new areas being opened up for scenic viewing and other recreational uses. A project that has little impact on views from current KOPs may have much larger effects if evaluated from different KOPs in the future.

Assessing visual impacts based solely on views from KOPs may also underemphasize cumulative visual effects because they focus too much on the proposed project and not the density of, and relationships between, multiple projects in the larger landscape. This is of special concern because visual impacts may cover very large areas depending on the type of facilities involved, thus increasing the potential for large cumulative effects (Sullivan and Meyer 2014). Although in theory cumulative effects should be addressed in a cumulative impact analysis, KOP-based assessment essentially ignores the very real visual impact that may affect the larger landscape when a project's impacts combine with the impacts of other projects to degrade the overall visual qualities of the area.

Of course, underlying visual resource values may also change over time, but they are not based on "snapshots" of current views from a few selected locations; rather, they reflect more stable visual qualities for a generalized area. Recording and monitoring impacts on the underlying visual resource values facilitate the emergence of a "bigger picture" associated with the effects of both the individual project and the cumulative effects of visual change at a larger scale and over a longer time period.

Landscape Character and Landscape Assessment

In addition to impacts on people and impacts on underlying scenic values, a third type of impact with a strong visual component is often referred to as "landscape effect," or "landscape character impact." Landscape character is defined as the "distinct, recognizable, and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse" (Landscape Institute and Institute of Environmental Management and Assessment 2013). Landscape character is not necessarily entirely visual in nature; it arises from the "interplay of physical, natural, and cultural elements of the surroundings and the way that people perceive these interactions" (National Cooperative Highway Research Program 2013), and includes the concept of "sense of place" (Landscape Institute and Institute of Environmental Management and Assessment 2013). It is a product of both the natural and human influences on the landscape. Typical landscape character descriptors include "natural," "rural," "suburban," and "urban," words that encompass a combination of physical elements, but also human land uses and humanmade cultural elements that suggest an overall "feel," pattern, or character of an area. Landscape effects are changes in the landscape, its character, and its quality (Landscape Institute and Institute of Environmental Management and Assessment 2013).

Assessment of landscape effects is an integral part of environmental impact assessments in the United Kingdom (UK) and constitutes a completely separate but related assessment to the VIA (Landscape Institute and Institute of Environmental Management and Assessment 2013). Under the terms of the European Landscape Convention, to which the UK is a signatory, landscape is considered a separate resource in its own right, not simply an element of visual, ecological, cultural, or other individual resources commonly associated with the landscape (Council of Europe 2017). U.S. Federal agency VIA methodologies do not require formal assessment of landscape effects, but both the NPS "Guide to Evaluating Visual Impact Assessments for Renewable Energy Projects" (Sullivan and Meyer 2014) and the FS Scenery Management System (USDA Forest Service 1995) refer to "landscape character" or "scenic character," though in a more restricted sense than the term is used in UK environmental assessments. Similarly, the NPS Visual Resource Inventory system assesses landscape character (Sullivan and Meyer 2016) but limits the assessment to those elements of character that are evident within visual elements, rather than assessing both visual and non-visual aspects of landscape character, such as sounds, or feelings of tranquility or remoteness. Landscape effects are sometimes discussed in U.S. EISs, but generally in a much more limited way than in VIAs in the UK. They may be considered as being related to effects on underlying visual values, which are inherent attributes of the landscape rather than simply being elements of views from KOPs. Figure 1 shows the steps in a typical "scenic resource VIA" including assessment of landscape character impacts.

In summary, general conclusions regarding "scenic resource VIAs" under NEPA include the following:

- Where Federal agency actions are likely to cause significant visual impacts that cannot be mitigated to a level of nonsignificance, NEPA requires that those impacts be assessed in an EIS.
- NEPA does not specify a methodology for the conduct of VIAs. Federal agencies may specify VIA methodologies as they apply to projects within their jurisdiction or rely on contractors to select or create VIA methods, and as a result, VIA methodologies in use vary somewhat.
- The widely accepted minimum standard for VIAs conducted as part of EISs under NEPA is to assess a proposed project's or action's visual contrast in a KOP-based analysis that then examines the effects of the visual contrast on the human visual experience. In this type of analysis, the impact receptors are human beings. Viewshed analysis and visual simulations are commonly used as tools for visual contrast assessment in a KOP-based analysis.
- KOP-based impact analyses usually include various measures of viewer sensitivity. These account for characteristics of the potential viewers, including their numbers, their nature (e.g., residents or tourists), the activities in which they are engaged, and the location from which they are viewing the project (including specially designated areas), as well as the anticipated length of time the project would likely be in view.

- Impacts are usually classified by importance on a graduated scale (e.g., negligible, minor, moderate, or major).
- NEPA does not specify what constitutes visual impact. Federal agencies define visual impacts as they apply to projects within their jurisdiction.
- Some EISs also assess impacts on the visual qualities of the existing surrounding landscape.
- Historically, most EISs do not include in-depth analysis of landscape or landscape character effects.

VISUAL IMPACT ASSESSMENTS UNDER SECTION 106 OF THE NHPA

The National Historic Preservation Act of 1966 (NHPA) as amended, is a Federal law intended to help preserve the Nation's historical and archaeological sites. Among other things, the NHPA established the Advisory Council on Historic Preservation (ACHP), State Historic Preservation Offices (SHPOs), and the National Register of Historic Places (NRHP). It also established a process for determining if Federal projects would affect historical properties, that is, the Section 106 review process.

Section 106 of the NHPA requires Federal agencies to consider the impacts of their undertakings on the integrity of properties either listed or eligible for listing on the NRHP. U.S. Code 36 CFR Part 800—Protection of Historic Properties—sets out the process known as the Section 106 review. Figure 2 shows the Section 106 process under which a VIA for an historic property would be conducted. Federal agencies are required to consult during the Section 106 process with SHPOs, Tribal Historic Preservation Offices, Federally recognized Indian Tribes, and Native Hawaiian Organizations.

The ACHP advises the President and Congress on historic preservation issues, develops policies and guidelines for Federal agencies, and participates in the Section 106 review process. The ACHP is an important source of guidance with respect to implementing Section 106; however, ACHP guidance is general in nature. SHPOs can and sometimes do issue their own guidance for the methodology used for implementation of the Section 106 review process within their jurisdictions. This guidance can have an important effect on the content and conduct of a VIA under Section 106, as discussed below. In addition, Federal agencies and SHPOs may create programmatic agreements (PAs) that specify how the agency will conduct Section 106 analyses, including

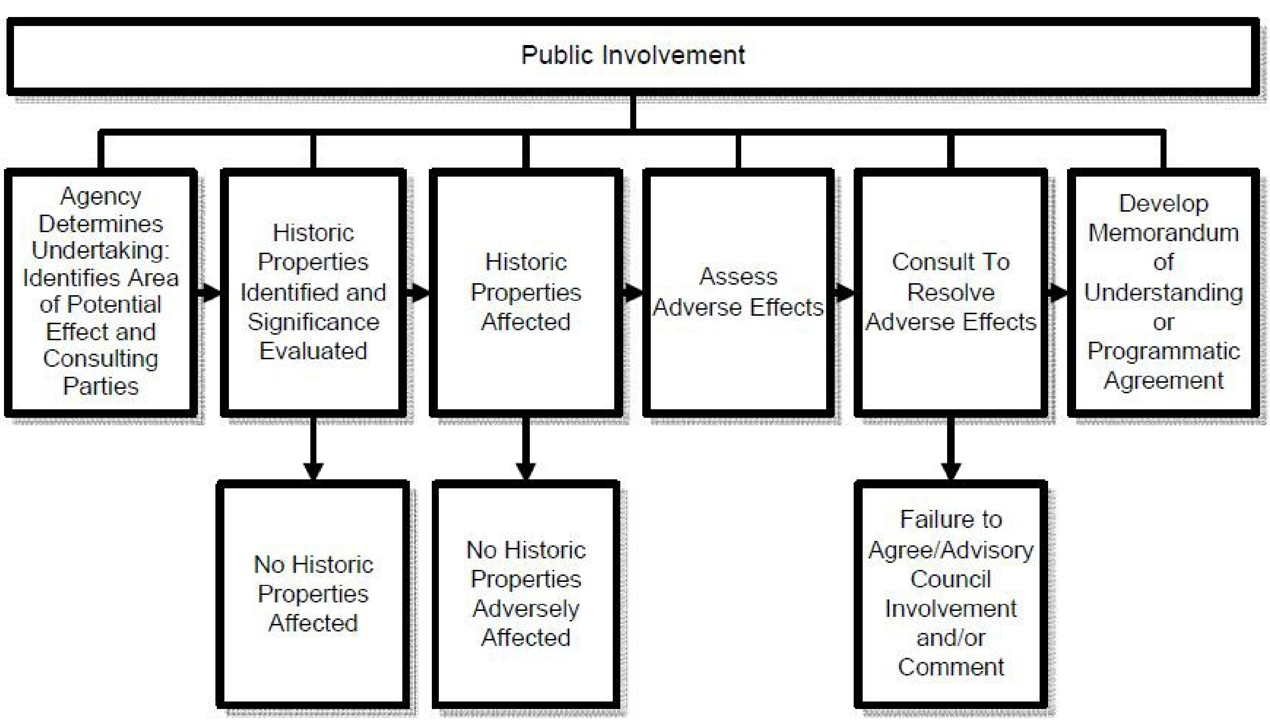

Figure 2.—Section 106 review process steps.

VIA. For example, BLM Wyoming and the Wyoming SHPO developed a PA that specified, among other things, that the BLM's visual contrast rating process is to be used to determine adverse impacts under Section 106 for historic properties on BLM lands in Wyoming (Bureau of Land Management and Wyoming State Historic Preservation Office 2014). Other entities may provide guidance on the conduct of VIA under Section 106—for example, the Virginia Department of Historic Resources' "Assessing Visual Effects on Historic Properties" (Virginia Department of Historic Resources 2010). In addition, a PA may guide the Section 106 process for a particular type of undertaking as was done for considering the effects from construction of new cell towers (Federal Communications Commission 2004).

The NRHP is the official list of the United States' districts, sites, buildings, structures, and objects worthy of preservation. The NPS administers the NRHP. In order to be listed on the NRHP, historic properties must be shown to be significant under the following National Register criteria. They must:

- Be associated with events that have made a significant contribution to the broad patterns of U.S. history
- Be associated with the lives of persons significant in our past
- Embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction
- Have yielded, or may be likely to yield, information important in prehistory or history (National Park Service 1997).

If historic properties meet one or more of these criteria, they must also possess integrity of location, design, setting, materials, workmanship, feeling, and association.

Integrity of Historic Properties

Integrity is the ability of a property to convey its significance. Under Section 106, the potential visual impacts from a proposed project or activity are considered with respect to the integrity of setting, feeling, and/or association of historic properties. Integrity of historic properties is discussed in "National Register Bulletin: How to Apply the National Register Criteria for Evaluation" (National Park Service 1997), and integrity of setting, feeling, and association of historic properties is summarized/quoted from the Bulletin here.

Setting

Setting is the physical environment of a historic property and includes the character of the place in which the property played its historical role. Setting can include natural or humanmade elements, such as topographic features, vegetation, paths, or fences, and, importantly, the relationships between buildings and other features or open space. Setting should be examined not only within the exact boundaries of the property, but also between the property and its surroundings (National Park Service 1997).

Feeling

Quoting from the Bulletin (National Park Service 1997): "Feeling is a property's expression of the aesthetic or historic sense of a particular period of time. It results from the presence of physical features that, taken together, convey the property's historic character."

Association

Again, quoting from the Bulletin (National Park Service 1997): "Association is the direct link between an important historic event or person and a historic property. A property retains association if it *is* the place where the event or activity occurred and is sufficiently intact to convey that relationship to an observer. Like feeling, association requires the presence of physical features that convey a property's historic character."

Scope and Analysis of Impacts

Under Section 106, visual impacts are often (but not always) considered indirect impacts because they do not physically impact the historic property. This contrasts with the normal practice in a scenic resource VIA where visual impacts are almost always considered to be direct impacts.

The area within which impacts are considered in a Section 106 analysis is referred to as the Area of Potential Effect (APE). Typically, the APE is determined in the context of direct impacts, so it is often much smaller than the area of impact analysis for visual impacts, which may extend for very long distances depending on the project type as noted above. However, in some Section 106 analyses where visual impacts are anticipated, an indirect effects APE may be identified that is considerably larger than the standard APE (e.g., see Bureau of Land Management and Wyoming State Historic Preservation Office 2014).

In some respects, conducting a VIA under Section 106 may resemble a VIA under NEPA. Viewshed analysis is commonly used to determine the APE. Simulations may be used, and, given that simulations require viewpoints, KOP-like viewpoints may be used in a Section 106 analysis. However, they are not necessarily selected based on viewer usage and preferences. Also, the assessment does not consider viewer sensitivity or analyze impacts on scenic values of the project area or the larger landscape, although impacts on visual quality may factor into the assessment of adverse effects on historic property integrity (see discussion below).

Adverse Effects Under Section 106

Unlike scenic resource VIAs under NEPA, the impact finding in a Section 106 review is either “adverse effect” or “no adverse effect”—the proposed project or activity either adversely affects the integrity of setting, feeling, and/or association, or it does not. There is no assessment of the relative degree of impact such as “negligible,” “weak,” “moderate,” or “major.”

Under Section 106:

> An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association. … Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative (U.S. Code 36 CFR Part 800.5).

U.S. Code 36 CFR Part 800.5 cites as an example of adverse impacts, “Introduction of visual, atmospheric or audible elements that diminish the integrity of the property’s significant historic features.” 36 CFR Part 800.5 regarding VIA analysis under Section 106 is important for several reasons:

1) It makes it very clear that visual elements, which would include a proposed project or activity, can cause an adverse effect.
2) It points out that impacts can be “removed in distance,” that is, do not need to physically contact or be at the same location as the historic property.
3) It identifies the historic property, rather than people and their aesthetic experience, as the impact receptor.

It should be noted that some historic properties include “designed landscapes” that may include purposefully designed views, vistas, or view corridors. In these cases, the view itself is a significant characteristic of the historic property. Therefore, changes to these designed views, vistas, or view corridors may adversely affect the integrity of the property’s design, not simply causing visual effects on integrity of setting, feeling, or association.

State Historic Preservation Office Guidance on VIAs Under Section 106

SHPOs may establish requirements for conducting a VIA under Section 106 and in some cases SHPO guidance may blur some of the “lines” between Section 106 VIAs and VIAs under NEPA. For example, the Delaware SHPO guidance document "Assessing Visual Effects for Historic Properties" states that adverse effects on historic property integrity can include aesthetic effects that occur “when there is an effect on the perceived beauty of a place or structure. Adverse aesthetic effects on historic properties are those that impair the character or quality of a historic property, and thus cause a diminishment of the enjoyment and appreciation of the property” (Delaware State Historic Preservation Office 2003). The guidance also states that impacts that have obstructive effects (those that literally block views of or from a historic property) may also cause adverse effects on the integrity of a historic property.

The Delaware SHPO guidance goes on to state that aesthetic effects can occur through: 1) elimination of open space or a scenic view, or 2) introduction of a visual element that is incompatible, out of scale, in great contrast, or out of character with the surrounding area. The guidance identifies as potentially adverse effects the loss of elements that "… contribute to the visual character or image of the property, neighborhood, community, or localized area with which the property is associated. ..." (Delaware State Historic Preservation Office 2003, p. 4).

In this case, the Delaware SHPO guidance introduces elements of scenic views and visual character into the Section 106 assessment, though apparently without considering viewer numbers, viewer type, view duration, and other factors that constitute viewer sensitivity. Importantly, the context for the assessment of aesthetic effects is still whether or not they cause an adverse effect on the integrity of the historic property. As such, this assessment is still fundamentally different from a VIA under NEPA where the effects are on the visual experience of viewers and the visual resource values of the surrounding area. In a Section 106 analysis in Delaware, effects on the visual experience of viewers and on the visual resource values of the surrounding area might affect the integrity of a historic property but are not impacts in their own right which must be addressed.

In general, the Delaware SHPO guidance suggests that SHPOs have considerable leeway in interpreting visual impacts under Section 106 and may introduce elements of scenic considerations and visual character into their VIA methodologies. However, the ultimate goal of the VIA is still to assess effects on integrity of the historic property.

In summary, general conclusions regarding VIA under Section 106 of the NHPA include:

- Where Federal agency actions are likely to cause adverse effects on the integrity of a historic property listed or eligible for listing on the NRHP, the NHPA requires that those impacts be assessed in a Section 106 review.
- The NHPA does not specify a methodology for conducting VIAs under Section 106. SHPOs may establish requirements for conducting a VIA under Section 106, or Federal agencies may work with SHPOs to establish PAs on the conduct of VIAs under Section 106.
- VIAs conducted under Section 106 assess a proposed project or action's effect on integrity of the historic property. In the case of visual impacts, integrity of setting, feeling, and/or association is normally the concern.
- Section 106 review may use a KOP-like visual impact analysis approach but it does not consider measures of viewer sensitivity. Section 106 analyses often use viewshed analysis and may also use visual simulations.
- In a Section 106 VIA, impacts are classified only as adverse effects or not adverse effects without using a graduated scale of magnitude (e.g., negligible, minor, moderate, or major).
- Unlike VIA under NEPA, Section 106 clearly specifies what constitutes an adverse effect.
- Section 106 specifies that the impacts are on historic properties' integrity, not on the views of historic property visitors, visual resource values, or landscape character.
- SHPO guidance may incorporate scenic considerations and other elements of VIA usually associated with VIA under NEPA. However, these effects determine impacts on historic property integrity and are not considered impacts in their own right.

DISCUSSION AND CONCLUSION

36 CFR Part 800.5 regarding VIA analysis makes it clear that alteration of certain characteristics of a *historic property* are the potential effects that are analyzed under Section 106, but there is no mention of people or their aesthetic experiences. While the impact is clearly visual in nature, and thus connected to the human visual experience, the effect is on particular aspects of the historic property, not on the viewers, even though a human judgment about integrity of setting, feeling, and association is required. Effects under Section 106 are independent of the number and types of viewers, view duration, aesthetics, and visual resource quality and condition, all of which are included in a "scenic resource VIA" under NEPA. SHPO guidance may incorporate scenic considerations and other aspects of a "scenic resource VIA" under NEPA, but the effects are still used to determine impact on the integrity of a historic property, not on people or the visual resource values of the landscape.

If a VIA for a proposed Federal action is limited to a Section 106 analysis of visual impacts on historic properties, potential effects on the visual character or quality of a landscape and the visual experience of persons viewing the landscape will not be analyzed. If these impacts are likely to occur at the level required for an EIS, the requirements of NEPA will not have been met. In short, VIA under Section 106 cannot substitute for a VIA under NEPA.

Similarly, a "scenic resource VIA" under NEPA cannot substitute for a VIA conducted as part of a Section 106 review. A VIA under NEPA does not address potential effects on the integrity of a historic property, which is the sole purpose of a VIA under Section 106.

What a "scenic resource VIA" under NEPA arguably can and should do is measure impacts on the visual experience of visitors to historic properties. Many historic properties are heavily visited and, depending on the nature of a particular property, enjoyment of it may have a strong visual component. All historic properties have a visual setting and are located in landscapes with some level of scenic quality. Views to and from the property are subject to visual impacts that are at least partially, and possibly wholly, independent of effects on the integrity of the property. Impacts that do not negatively affect integrity might still negatively affect the visual experience of visitors. These impacts cannot be analyzed in a Section 106 review in any event; they must be analyzed through a "scenic resource VIA" that assesses impacts on views and visual quality. A "scenic resource VIA" must also assess impacts on residents of the surrounding area, commuters, recreationists, and other people whose views and visual experiences are affected by a proposed project or action. These types of impacts are outside the scope of a VIA under Section 106.

Similarly, any large project or activity that could affect the integrity of setting, feeling, and association of a historic property could potentially have important impacts on the visual resources of the project area, not just on scenic views. This type of impact is not analyzed in a Section 106 review, though they might affect a historic property's integrity. Section 106 reviews also do not analyze impacts on landscape character or other landscape effects. These are the purview of a "scenic resource VIA" under NEPA, or a separate landscape assessment.

In conclusion, although there are some similarities between VIA under NEPA and under Section 106 of the NHPA, the two types of VIAs analyze different impacts on different resources. Where there are potential visual impacts on both scenic values and historic properties, both types of VIA must be applied. Currently, there is substantial variation in how both types of VIA are conducted.

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RECLAIMING VISUAL STEWARDSHIP IN TUCSON, ARIZONA: IS IT POSSIBLE?

Ellen Barth Alster, Senior Landscape Architect, Pima County Department of Transportation[1]

Abstract.—The Sonoran Desert landscape surrounding Tucson, Arizona, consists of sweeping skies punctuated by mountain ranges and saguaro silhouettes. As development occurred decades ago, land use codes and design practices were developed to protect this scenery. More recently, these codes have been ineffectual at integrating utilities into the urban landscape. Using overhead power lines in Tucson as an example, this paper discusses the decline of visual stewardship and impediments to halting this trend. As utility poles have increased substantially in size due to new regulatory requirements and efficiency standards, mitigation practices that visually integrated utility poles into the landscape have been discontinued. Additionally, old poles remain after replacement, cluttering urban streets. Visual decline related to overhead power lines is not inevitable, however. This paper discusses examples of communities that are successfully improving power line design and presents evidence that visual stewardship as a value has begun to emerge in the energy industry.

INTRODUCTION

My involvement in visual resource issues began 5 years ago when I received communication tower plans to review. Before becoming a landscape architect for the county transportation department, my work over the previous 20-plus years in the private sector focused on site design, as opposed to larger landscape concerns. The communication tower I was reviewing would be located adjacent to Saguaro National Park in a designated Scenic Route. A weathering steel pole, 15 feet taller than the existing wood pole and with an increased circumference, would replace the existing pole that was unable to support the antenna. The plans said the new pole would match the adjacent wood poles and the antenna would be painted to match the new pole. After requesting a visual simulation, I received it with the third submittal (Fig. 1). The code required visual simulations; these were provided only after several appeals. The code also required that cell towers be “stealth” by design (Pima County 2017b). As the proposed pole was conspicuously profiled against the sky, I was confused about how this design could be classified as “stealth.”

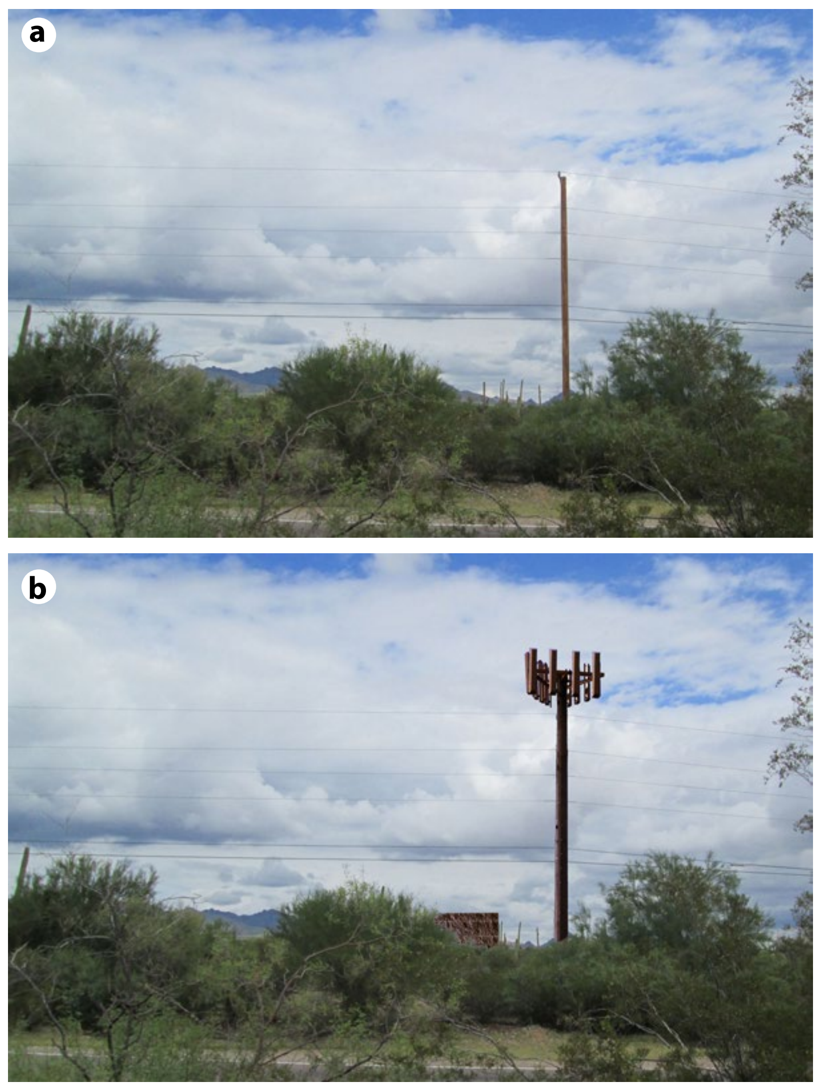

Figure 1.—Existing wood pole (a) and visual simulation of replacement weathering steel pole with communication antenna (b). Photos from permit application on file with Pima County (Arizona) Department of Transportation.

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Communication towers, while conspicuous, occur intermittently. The weathering steel poles, meanwhile, dominate the skyline along many of Tucson's urban corridors (Fig. 2). While poles were previously painted in environmentally compatible hues, minimizing contrast with the surroundings (Fig. 3), this practice was discontinued. According to Ed Beck[2], Tucson Electric Power (TEP)'s position is that painted finishes do not last and repainting processes have negative environmental impacts.

TEP adopted weathering steel for all new and replacement poles citing durability, low maintenance, and ease of use. These poles contrast with rather than blend into the landscape. It is unknown whether the switch to this material was discussed with or agreed to by urban designers, government officials, or members of the public. Increasing in both height and girth due to updated standards from the National Electric Safety Council, these taller, larger poles cause an even greater visual impact.

Redundant poles (i.e., poles that remain after the pole owner has relocated wires to a new pole) clutter roads throughout Tucson (Fig. 4). Cable and communication providers sharing the original pole typically fail to relocate to the new poles. Instead, the original pole is left in place and cut off at the height of the highest remaining utility provider, increasing the number of poles.

The Federal Communication Commission promotes the use of poles by multiple utilities, granting cable and communication carriers nondiscriminatory access to any pole, duct, conduit or right-of-way owned or controlled by a utility (Telecommunications Act of 1996). Pole modifications, both by the original utility and by cable and communication carriers attaching to the pole, add to the visual clutter (Fig. 5).

The public often requests underground utilities, especially when roads are widened and utilities are relocated. In the past 15 years, this has rarely

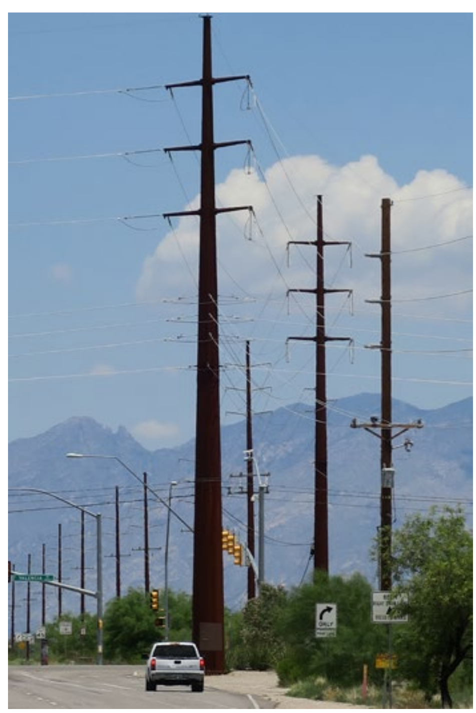

Figure 2.—Weathering steel poles in metropolitan Tucson, AZ, dominate the urban streetscape. Photos by Ellen Barth Alster, used with permission.

[2] Director of Transmission, Tucson Electric Power, Tucson, Arizona. Telephone conversation, May 27, 2015.

Figure 3—Poles around Tucson used finishes that minimized contrast, receding into the landscape. The practice of painting the poles was discontinued. Photos by Ellen Barth Alster, used with permission.

Figure 4.—Poles that remain after the pole owner has relocated to a new pole are known as redundant poles. Photos by Ellen Barth Alster, used with permission.

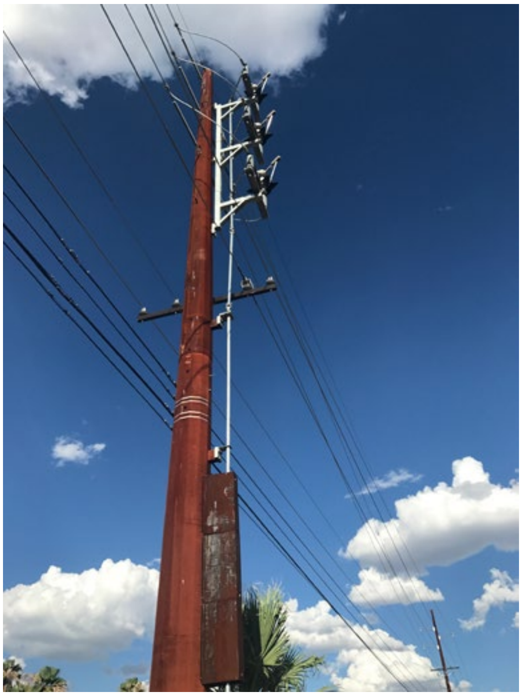

Figure 5.—Pole modifications, both by the original utility (leading to wires at top of pole [a]), and by tenants such as cable and communication carriers (leading to wires at bottom [b]), add to the visual clutter. Photos by Ellen Barth Alster, used with permission.

happened. Utilities are typically responsible for their own relocation costs when road projects occur. If utility poles are overhead, utility companies cannot be forced to relocate them underground. The added expense of undergrounding falls on the jurisdiction. Funding sources usually do not cover expenses related to utility relocation, so undergrounding seldom occurs.

How has the hodgepodge of utility poles developed? Has past planning addressed these issues? Was the current situation unanticipated?

I asked these questions to Corky Poster,[3] Professor Emeritus of Architecture at the University of Arizona and Principal of Poster Frost Metro Architects. Utility discussions occurred decades earlier, I learned, and he provided to me the urban design reports from 1986 for both Pima County and the City of Tucson, which he had helped to authorCo.

While the reports' typewritten text and hand drawn sketches seem quaint (Fig. 6), the design directives are startlingly fresh. A report notes that as far back as 1969, Tucson's citizens valued view protection: "The distant view of mountains, skies, and the surrounding desert afforded by the form of the Tucson Basin is first priority in a citizen survey of Tucson's environmental values. It should become incumbent upon all future planning that these views be kept open for the benefits and enjoyment of everyone" (Locard 1986a, p. 29).

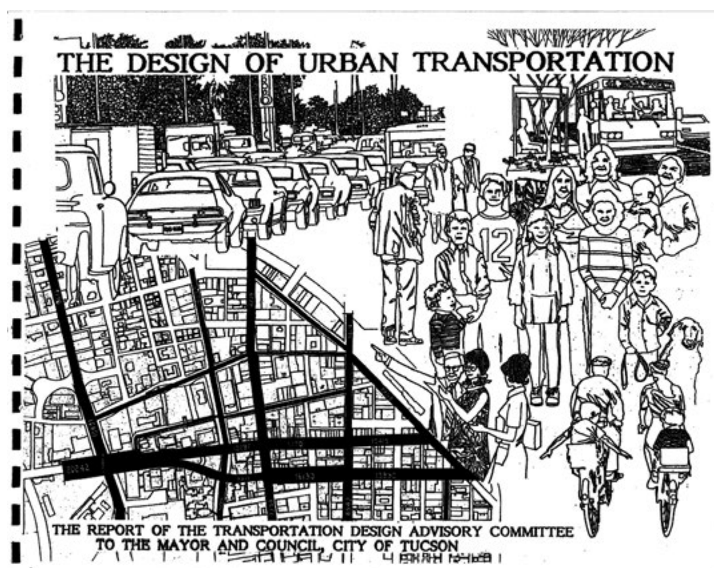

Figure 6.—Cover of City of Tucson Urban Design Report (Locard 1986b). Preservation of views is listed as a priority for Tucson's citizens in the urban design reports for both the City of Tucson and Pima County. Image courtesy of Corky Poster.

The reports include comprehensive guidelines concerning utilities. "The wires and poles of utility systems—electricity, cable TV, telephone, and public lighting—bring a tremendous clutter to the public

[3] Architect and Principal Planner, Poster Frost Mirto, Tucson, Arizona. Personal interview, July 19, 2017.

right-of-way. Prioritizing underground and sensitive location of unavoidable above ground utilities will greatly improve the visual quality of our streets" (Locard 1986b, p. 17).

Subsequent policy made its way into Pima County and City of Tucson code. Chapter 10.48 of the Pima County Code establishes Underground Utility Districts (Pima County 2017a) where overhead wires are prohibited. Scenic and Gateway Corridor designations (Pima County 2017c and 2017d) were developed, incorporating building height and color palette restrictions. However, the code abounds with exceptions for utilities. Concerning mitigating utilities' effect on the landscape, the codes' intent fails. By limiting building heights along gateways and scenic corridors to 24 feet, utility poles, often 90 feet high or more, soar above the skyline.

Why has visual awareness declined so dramatically in recent years? According to retired Tucson City Planner, Roger Howlett[4], efforts to improve Tucson's appearance began in the mid 1960s with recognition from the public and elected officials "that the built part of the city was relatively ugly." In 1970, Life Magazine branded Speedway Boulevard, a major corridor, the "Ugliest Street in America." This sparked comprehensive plans, a "Major Streets and Routes Plan", and landscape requirements in the zoning code. Howlett calls 1992 the "high water mark" of visual awareness, led by "a generation of people who came out of the '60s wanting to change the world. Since then there has been a consistent effort to chip away at these policies, codes, and funding that has escalated since the 2008 recession. Most of those people have moved on. Funding for infrastructure is in such short supply that visual quality does not even register."

STRATEGIES TO INTEGRATE UTILITY POLES INTO URBAN ENVIRONMENTS

This paper investigates strategies for integrating utilities into urban environments. Can utility design have a more holistic, context-sensitive approach than is currently in practice? Sensitive routing is often used in less populated and/or urban areas with large swaths of undeveloped open space. Urban areas frequently do not have the appropriate space to use this strategy. The use of specialty finishes shown in Figure 3 is currently in general disfavor for reasons that are discussed here. Undergrounding and improved overhead line design remain viable and will be explored.

Utilities offer rationales for discontinuing previous mitigation methods, claiming for example that underground lines cost five to ten times more than overhead lines (U.S. Energy Information Administration 2012) and that painted and/or galvanized finishes that make poles less conspicuous add additional cost and negative environmental impacts. The validity of these claims will be examined. Are there communities burying power lines and how do they overcome funding issues? Is the energy industry making any effort to address visual quality issues? If so, which companies are doing this and where? Lastly, are redundant poles inevitable?

Finishes and Coatings

Poles become less conspicuous when finishes and coatings are applied to minimize contrast with the surrounding landscape (Fig. 3), but this practice is in decline. Paint fades, peels, and has undesirable environmental impacts, according to critics. Corrosion control expert Curtis Hickcox says that utility companies consider repainting a maintenance expense. Since deregulation, utilities have capital "to build stuff" but scant maintenance money. He attributes the negative environmental impacts to delays in maintenance (Paint Square 2017).

Hickcox has written industry standards for the National Association of Corrosion Engineers (NACE) and Institute of Electrical and Electronics Engineers (IEEE) and spent over 35 years in coatings and corrosion management for the utilities industry (Paint Square 2017). In a 2017 interview, he said:

> There's a million towers in North America; in a good painting year, 5,000 might get painted. The problem is, nobody has any maintenance money to spend. The work doesn't get done, the towers get worse and worse and worse. Especially if there's lead involved, then it comes to the point where now you have to do more surface preparation; you've got to do power-tool cleaning. If you have to do power-tool cleaning, now you have to take

[4] Retired City Planner, City of Tucson, Arizona. Email correspondence, September 30, 2017.

an outage on the line. Now you have to do more containment. The cost, the effect on the worker and the environment, gets a lot more significant.

Some utilities are very proactive and have a long-term program, and paint them every year. But they're the exception. More often, it's "I'd better keep my head in the sand and let the next guy do it." Or, "I've got all kinds of capital money; I'll just replace them!" They'll spend $200,000 to replace a tower instead of $10,000 to paint it (Paint Square 2017).

Galvanizing, a process that can last up to 50 years if applied correctly, is maligned as environmentally harmful. Supporters claim contamination issues are attributable to poor clean up practices (Hinton 2017). Weathering steel and stainless steel do not require protective coatings. Weathering steel, the less costly option, has risen in popularity. According to Majid Farahani, Transmission Supervisor at TEP, weathering steel is the most versatile choice due to frequent field modifications of poles. Galvanized poles receiving field modifications require regalvanizing to protect against rusting, a costly and complicated process.[5] Weathering steel poles in the landscape are shown in Figures 2, 4, 5, 7, 11, and 20. TEP does add galvanized parts when modifying the weathering steel poles (Fig. 5).

Undergrounding

Communities often request placement of utilities underground, particularly when road widening occurs. In Tucson, during a 2013 public meeting for a road that is designated as a Scenic Route and is part of the De Anza National Historic Trail from Mexico to California, TEP's response to a question about undergrounding utilities was that they were not required to place lines underground because the utility existed prior to the Scenic Corridor Code designation. Project funding would also not cover undergrounding costs (Tucson Electric Power 2013). The built roadway is shown in Figure 7.

Successful undergrounding programs do exist in some U.S. communities, usually run by municipally owned power companies or locally based investor-owned companies with strong local government partnerships. Most of these programs began decades ago.

[5] Smith, David. Tucson Electric Power Project Manager, Resource Team. Email correspondence, September 30, 2015.

Figure 7.—Silverbell Road and Grant. Weathering steel poles are the dominant skyline feature. Photos by Ellen Barth Alster, used with permission.

San Diego Gas & Electric (SDG&E) in partnership with the City of San Diego began an extensive undergrounding program in the 1970s. It is partially funded by a 2.5 percent surcharge on utility bills that San Diego voters approved in 2003. The program is responsible for removing more than 5,000 power poles and undergrounding over 200 miles of power lines (City of San Diego 2017). Approximately 75 percent of San Diego's power lines are now underground (Fig. 8). San Diego has "the highest percentage of underground power lines of any investor-owned utility in the State with an undergrounding percentage that is three times the National average" (T&D World 2014). According to Associate Engineer Breanne Busby[6], the undergrounding program's staff of eight determines the schedule, neighborhoods, and order that the undergrounding projects are carried out. It also manages and distributes funds.

The City of Anaheim, California, also runs a successful undergrounding program through its municipally owned electric utility (Fig. 9). In 1990, voters approved a 4 percent surcharge on utility bills, funding a 50-year underground conversion program (City of Anaheim 2017a, 2017b). According to Program Manager Tim Bass[7], approximately $14 million to $15 million are

[6] Associate Engineer, City of San Diego, California. Telephone interview, August 28, 2017.

[7] Underground Conversion Manager, City of Anaheim, California. Telephone interview, July 13, 2017.

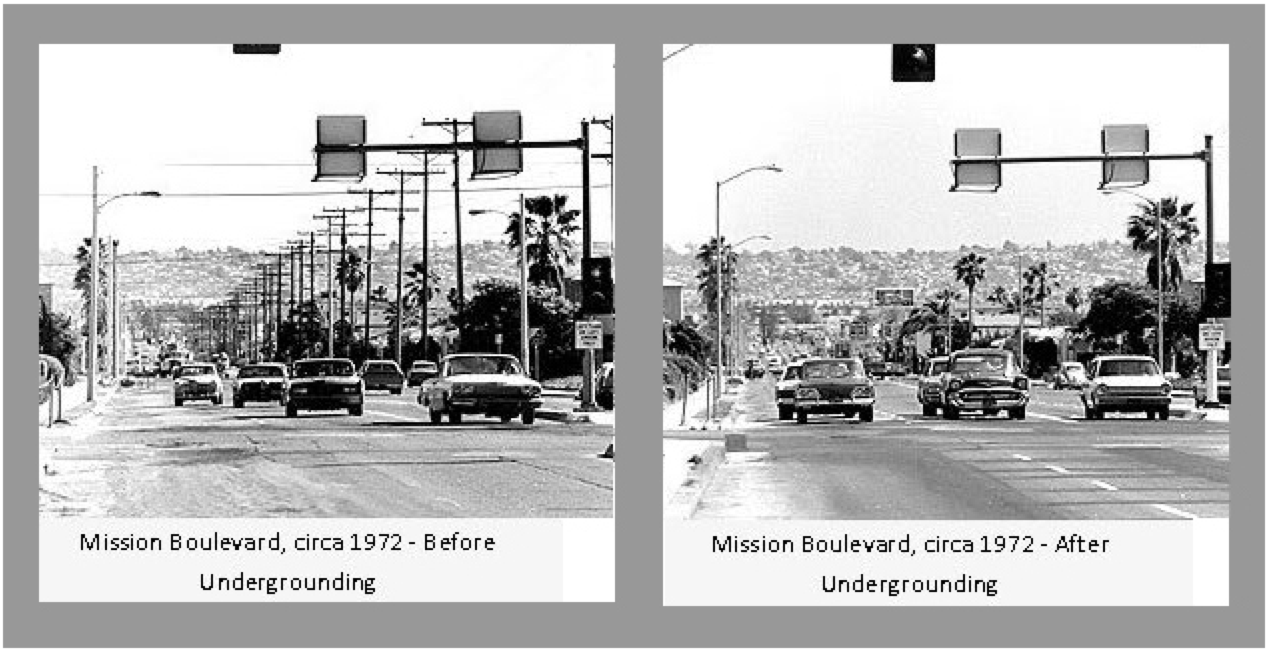

Figure 8.—Before and after illustration of Mission Boulevard in San Diego from the Master Plan, Utilities Undergrounding Program. Photos from City of San Diego 2017.

Figure 9.—Before and after photos, Underground Conversion Program, Anaheim (CA) City Council presentation, July 25, 2017. Photos from City of Anaheim 2017b.

invested in the program each year, with $8 to $10 million spent on a typical project. Undergrounding typically occurs on roads slated for repaving and is done in coordination with Anaheim's public works department.

San Francisco's undergrounding efforts have been less successful. Utility customers pay a monthly dollar amount for undergrounding but the City has gone into debt on undergrounding projects, with many more lines to bury (Ashly 2015). To speed up the effort, San Francisco allows residents to organize assessment districts where residents assume design and construction costs, which are then added to property tax assessments (San Francisco Public Works 2017). Other cities in California with underground conversion programs include Palo Alto, Rancho Palos Verdes, Costa Mesa, La Mesa, and Laguna Beach.

There are only limited examples of successful programs through which customers bear the undergrounding costs. The City of Seattle began a voluntary

Figure 10.—The design pylon, the first pylon developed by the architectural firm Bystrup, is 60 percent the size of a traditional lattice tower. This design won a Danish government design competition in 2001. Referred to by local residents as "magic wands." Photos by Bystrup Architects, used with permission.

undergrounding program 15 years ago (Seattle City Light 2012). Teif Weller[8], Residential Supervisor for Seattle City Light, the municipally owned power company that serves Seattle, says that few residents follow through after hearing the price tag, typically $30,000 to $50,000 per residence, paid by the property owner. This also includes undergrounding electric lines only. There may be additional costs to underground cable TV, telephone, and any other equipment that currently uses the overhead system.

Improved Overhead Power Line Design

Improving overhead power line design is an alternative to burying power lines and keeping them hidden. With greater design effort, could overhead power lines become a neutral visual element or even an asset, while improving function and efficiency?

Increased emphasis on overhead line design began in the last decade in Europe, moving in this decade to the United States. While aesthetics seemed to drive technical innovation in Europe, technical improvements and aesthetics appear to have begun on equal footing in the United States. The Danish architecture company Bystrup leads pylon design in Europe. American Electric Power's (AEP) subsidiary, BOLD™ Transmission, leads this movement in North America. Lastly, Choi+Shine Architects' fanciful "Land of the Giants" transmission tower design, which was entered in a design competition in Iceland in 2008, will also be discussed below.

Bystrup

In 2001, the Danish Ministry of Energy and Environment along with the Danish operator launched a competition to create a pylon design for the future. This came after numerous complaints and local protests about proposed lattice tower pylon designs over a 10-year period. The new pylons, called the Design Pylon, shrunk the traditional lattice tower to 60 percent of its original size (98 feet in height vs. 164 feet for the lattice tower). With a goal of being "more submissive in the landscape," the tops of the Design Pylon structures merge into the sky, making the tops almost invisible (Fig. 10). Energized in 2006, locals helped select the Design Pylon's material and labeled them "magic wands." Since then, Bystrup's practice has focused on the design, development, and construction of power pylons (Bystrup et al. 2017).

[8] Residential Supervisor, Seattle City Light. Telephone interview, August 21, 2017.

Figure 11.—When presented with two options, the public choose galvanized (a) over weathering steel (b) for the Bystrup eagle pylon. Photos by Bystrup Architects, used with permission.

Erik Bystrup asks: "What do we really expect from a power line structure? Is it only a technical necessity, an object of design excellence or a piece of land art?" The best answer, according to Bystrup, lies somewhere in the middle:

> In our part of the world, electricity is regarded as a basic necessity. It is a paradox that we cannot imagine living without it while we do not accept the power pylon, which distributes this electricity, as a part of our cultural landscape. "Bury them!" "Camouflage them!" or simply, "Make them go away!" is the general outcry. But why? Highways and railroads have been accepted as parts of the landscape; both are necessary in order to travel and to move. Why then can we not accept the equally vital lines of power pylons? …
>
> We put significant effort into the design of motorways and railroads, merging them carefully into the landscape. We hire talented designers to create railway stations and to design trains, overhead lines, bridges, and motorway junctions. Ignored are the power pylons that perform another vital function but which most people regard as threat. They are perceived as messengers of electricity, high voltage, and danger. To some they even symbolize the growing pollution from modern civilization. …
>
> Should we not try to create overhead transmission lines (OHTLs) that dignify the power pylon and restore it as a worthy part of the landscape around us? We could let them radiate the hope and possibilities of sustainable power production. …
>
> It is this change in our electricity production and transmission grids that presents a unique opportunity: the opportunity to make a difference in the landscape and to create new pylons with a strong design profile, allowing power pylons to be an acceptable part of our present as well as our future (Bystrup 2012, p. 36).

An estimated 100,000 pylons are needed by 2020 in Europe alone, according to Bystrup, calling for a new pylon that is "easier to erect, less costly, and better looking than the old ones" (Bystrup 2015, p. 6-7). Bystrup also discusses the advantage of using materials without protective coatings, such as weathering steel and stainless steel (Bystrup Corp. 2015, p. 32). However, as Bystrup's marketing director Mette Hauge Mikkelsen[9] admits, the public has not yet chosen weathering steel when it is presented as an option (Fig. 11).

Bystrup pylons have now been installed throughout Denmark and across the United Kingdom (Fig. 12) and are in the process of being introduced in North America. Sinopa Energy, an Ontario-based project management company that focuses on the energy sector, will soon replace lattice towers on highways leading into Toronto with pylon-type towers that are expected to be a Bystrup design. Ron Collins[10], CEO of Sinopa Energy, says energy companies in general

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[9] Marketing Director, Bystrup, Copenhagen, Denmark. Telephone interview, August 10, 2017.

[10] CEO Sinopa Energy, London, Ontario, Canada. Telephone interview, August 10, 2017.

Figure 12.—A test line using the T-pylon, by the architectural firm Bystrup, won a design competition in the United Kingdom in 2011 as its national grid expands, moving away from coal, oil, and gas, toward newer sustainable energy sources. A test line is shown here. Photo by Bystrup Architects, used with permission.

Figure 13.—The composite pylon, currently under development, is half the size of a conventional lattice tower, while carrying the same amount of power. It can be assembled on site and erected in a day. An existing line (a), with two lines each carrying 1x400 kV; the proposed improvement (b) with a single pylon carrying 2x400 kV. (Bystrup 2015). Photos by Bystrup Architects, used with permission.

are not pushed to be innovative. The Bystrup pylons require less right-of-way and are substantially shorter. Despite the decreased height, the number of towers remains the same due to improved cables with less sag. Newer designs will increase standardization among angle towers that are used when overhead utility lines change direction. Currently angle towers are designed for specific loads, resulting in differing pylons within a single viewshed. Newer towers will accommodate a range of loads and various placement requirements.

Collins attributes the lack of design innovation in the energy sector to increasing pole height and girth. The basic electricity distribution technology has not changed for decades but poles increased in size to meet newer safety standards. Older technology is proven, reliable, and low cost so providers have little incentive to change. However, today, improved insulators and new composite materials can dramatically decrease pole profiles (Fig. 13). Newer poles also incorporate wireless internet into the product line. Collins said the energy industry is being "pulled, not pushed" to be innovative.

BOLD™ Transmission

With 40,000 miles of transmission lines, American Electric Power (AEP) has the largest transmission system network in the United States. Built decades ago, a large portion of the network requires upgrade. Rather than replace declining infrastructure with old technology that would require a larger footprint to meet increased demand and newer safety requirements, AEP invested millions of dollars in research and development and set up a subsidiary called BOLD™ (Breakthrough Overhead Line Design). This approach anticipated issues related to right-of-way acquisition and public opposition. "Investing in the design of a better tower, using smart engineering that would be visually appealing, seemed a smart option to AEP leadership," says David Rupert[11], Vice President of Business Development for BOLD. "No one wants permanent scaffolding in their backyard," he said, referring to the typical lattice towers.

"If trend-setting Apple Inc. were to design a transmission line, I am pretty sure it would look like BOLD," a moderator said while introducing the design at an Edison Institute Meeting in 2015 (Fig. 14) (BOLD 2017). Because the U.S. transmission system is in the midst of its biggest building boom since the 1970s, AEP invested $9 billion between 2017 and 2019, driven by the need to increase reliability, replace aging infrastructure, improve security, relieve congestion, and accommodate generation retirements and renewable power sources (American Electric Power 2017). Developed in 2012, the BOLD design received its first patent in 2013.

Figure 14.—Robison Park-Sorenson simulation of BOLD design. Photo by BOLD Transmission, used with permission.

Figure 15.—Robison Park-Sorensen project during construction. Photo by BOLD Transmission, used with permission.

The Robison Park-Sorenson project in Fort Wayne, IN, that used the BOLD design for the first time, was energized (i.e., put into service) in November 2016 (Fig. 15). If an older technology had been used, 50 additional feet of right-of-way would have been required, expanding the width from 150 feet to 200. Instead of a 150-foot tall pylon, the newly designed pylons are 100 feet. The Robison Park-Sorenson project replaced a 1940s era 138 kV line with a double-circuit 138/345 kV BOLD line, providing five times the megawatts of the earlier line in the same corridor.

BOLD Transmission holds 14 patents (granted or pending) worldwide and is licensed to sell the technology to other utilities. The first double-circuit 345 kV application of BOLD is a line rebuild between AEP's Meadow Lake and Reynolds stations in northern Indiana that was energized in July 2017. Both BOLD and Bystrup have focused on transmission lines. BOLD plans to add lower voltage poles in the future.[11]

BOLD's work is setting new standards for the energy industry in the United States. In February 2016 the National Association of Regulatory Utility Commissioners (which represents the State Public Service Commissioners) passed a resolution supporting advance electric transmission technology.

[11] Vice President for Business Development, BOLD, Columbus, Ohio. Telephone interview, July 24, 2017.

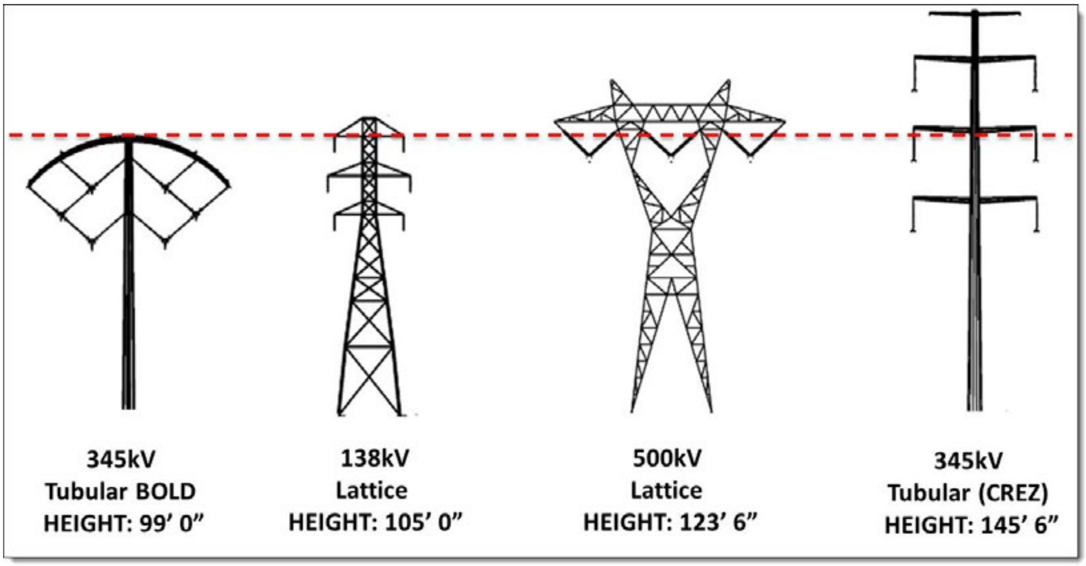

Figure 16.—Comparison of BOLD design with conventional towers. BOLD designs (far left) are significantly lower in profile than conventional designs. Photo by BOLD Transmission, used with permission.

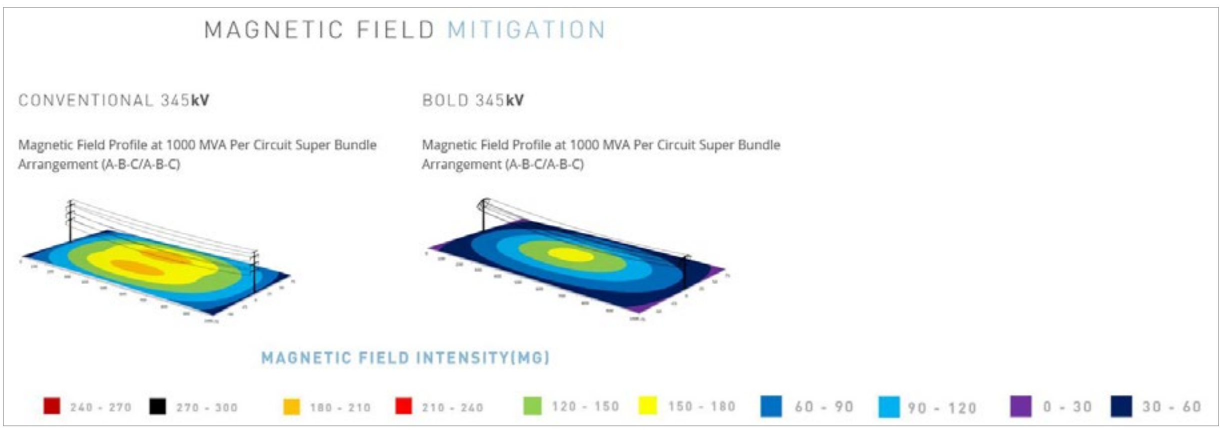

Figure 17.—BOLD designs reduce magnetic field in addition to improving aesthetics and efficiency. Photo by BOLD Transmission, used with permission.

Recognizing that a significant portion of the Nation's transmission facilities are aging and require replacement, the resolution calls for new facilities to consider new technologies that are reliable, cost effective, and more efficient, use less right-of-way, and reduce environmental and aesthetic impacts on communities (Fig. 16) (National Association of Regulatory Utility Commissioners 2017). An additional environmental benefit of the BOLD technology is that it reduces the size of the magnetic field around the towers and wires (Fig. 17).

Choi+Shine

While the Bystrup and BOLD pylons make aesthetics a primary design focus as a kind of sculpture, the forms are highly abstract. In contrast, the "Land of the Giants" transmission towers by the architecture firm Choi+Shine have purposefully representational forms (Fig. 18). In 2008, Land of the Giants won a "Recognition Award" in the Icelandic High-Voltage Electrical Pylon International Design Competition offered by Iceland's Landsnet power company (Choi+Shine 2008). Numerous other awards followed in ensuing years. Images of the figures marching across the landscape have received attention worldwide. Thomas Shine says of the project, "Construction of the Giants has been planned many times and they have been taken through engineering, but they have not yet been built. The resistance has not been to the Giants, which are almost universally loved, but to the new lines themselves. Indeed, in one district in Norway, the mayor of the town would not allow a new line to be

Figure 18.—“Land of the Giants” transmission towers take on a human-like form. Photo by Choi+Shine, used with permission.

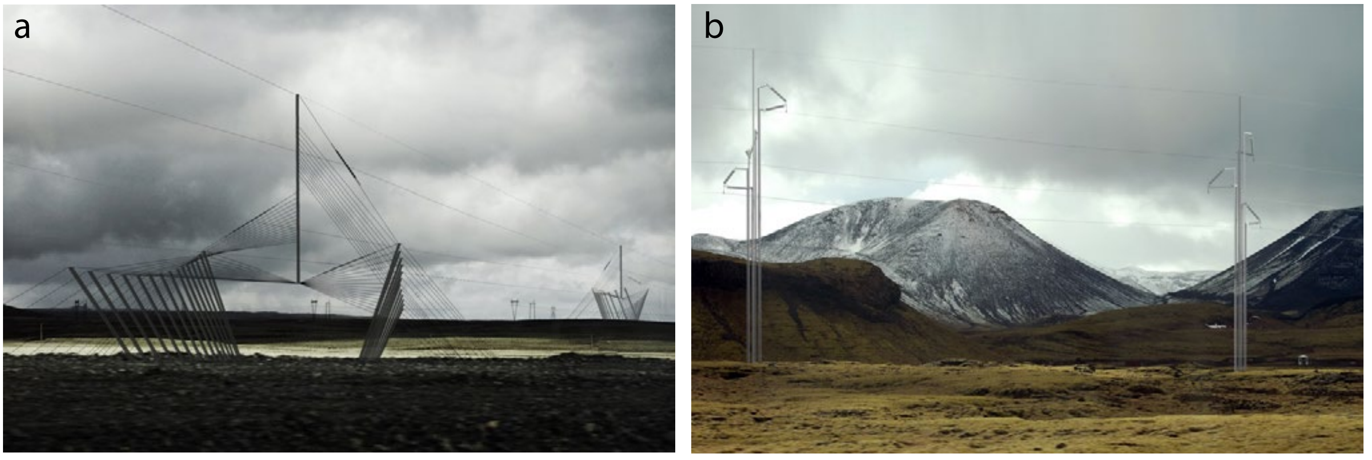

Figure 19.—Choi and Shine have developed concepts for other transmission towers, named “centipede,” (a) and “bamboo” (b). Photos by Choi+Shine, used with permission.

built through his district unless the new line included the Giants.”[12]

Choi+Shine have developed additional transmission line concepts. The names of the newer designs are suggestive: “mantis,” “centipede,” and “bamboo.” These tower designs have a higher degree of abstraction than Land of the Giants, however (Fig. 19).

Redundant Poles

While improving aesthetics in utility design appears complex, eliminating redundant poles seems straightforward. Why is it so difficult for pole tenants to relocate to new poles in Tucson and other communities? Whose responsibility is it? The original pole owner or local government?

According to David Barth[13], retired counsel for a major electric and gas company in Michigan, when utility companies in that State upgrade or replace existing poles, they require any existing pole tenants to relocate to the new pole and they typically comply.

However, this is not true in many regions of the country and some are beginning to pass legislation regarding superfluous poles. After communities in

[12] Shine, Thomas. Principal, Choi+Shine Architects. Email correspondence, August 24, 2017.

[13] Retired principal attorney, Consumers Energy Company, Jackson, Michigan. Telephone conversation, July 23, 2017.

Massachusetts complained, 2016 legislation started requiring companies to complete the transfer of wires and remove the pole within specified periods of time (Commonwealth of Massachusetts 2016).

Individual communities across New York State are also passing their own legislation. To assist the Town of Wallkill, New York, U.S. Senator Chuck Schumer sent a letter to Frontier Communications, Time Warner, and Orange and Rockland Utilities:

> I am writing regarding the 546 double utility poles that are currently out of use in the Town of Wallkill, NY. I understand that the Town of Wallkill has requested, on a number of occasions, to work with Orange and Rockland Utilities to remove these poles throughout the Town. I urge you to work closely with the Town of Wallkill to remove the poles, as they are duplicative and could reasonably pose a number of safety risks.
>
> As you can imagine, besides being unsightly, these poles are an immediate and ongoing hazard to motorists, pedestrians, and property throughout the Town. Additionally, the unnecessary poles increase the chance of power outages during storms and increase the hazard of falling poles due to storms, snow, rain, wind or other weather-related events.
>
> I respectfully request you work with the Town to identify the poles for which your company is responsible and immediately work with the Town to remove the poles and eliminate this public safety concern. Please find enclosed the list of poles, as identified by the Town of Wallkill Department of Public Works which are duplicative, potentially hazardous, and must be removed. My office stands ready to assist you to prepare a plan to remove these poles (Schumer 2016).

In February 2016, Wallkill also passed an ordinance requiring the removal of double poles (Town of Wallkill 2016). According to Louis Ingrassia, Jr.[14], Commissioner of Public Works, the redundant pole issue has significantly been resolved.

[14] Commissioner of Public Works/Highway Superintendent, Town of Wallkill, New York. Voice message, September 8, 2017.

DISCUSSION AND CONCLUSION

In numerous discussions with both design professionals (landscape architects, architects, urban planners, and engineers) and lay people over the past 2 years, I found little awareness of the many aesthetic concerns related to the design of modern utility transmission systems. After being shown several images, including those in this paper, lay people's reactions included the following:

- Resignation: They found utility clutter unsightly, but were unaware of mitigation options other than undergrounding.
- Outrage: They were outraged that utility poles were becoming a significant part of the landscape and claimed to want to get involved and initiate change.
- Indifference: They would want improved utility design only if it would come at no additional expense.
- Unanimous agreement that redundant poles should be removed.

Landscape architects' responses, in particular, were as follows:

- Lack of awareness that they could comment on aesthetics related to utilities.
- Unwillingness to get involved, since commenting on utilities and aesthetics was not part of their project scopes of work. On transportation projects, the landscape architecture scope of work as a subconsultant typically includes planting and irrigation only. Since they are often competitively selected by the engineering prime based on fee, they are not eager to add additional services or be perceived as causing delays to a project.
- Frustration: Landscape architects often do not receive utility system design information until right before final plans are due. In addition, visual impact assessments are typically done at the beginning of the project before utility impacts are part of the design. Utility-related impacts are typically not mentioned in visual impact assessments, so no mitigation options are offered.

Figure 20.—Grant Road is the first phase of a Tucson project envisioned as a "state-of-the-art, multi-modal corridor" (Tucson 2015). So far, power poles dominate the corridor. Photo by Ellen Barth Alster, used with permission.

Grant Road is a major corridor in Tucson currently undergoing expansion to increase vehicular capacity, support alternative transportation, and encourage economic development (City of Tucson 2017). The project vision statement includes the goal of creating "an aesthetically pleasing, comfortable, and inviting environment" (City of Tucson 2015, p. 11). Yet most weathering steel poles are placed at intervals ranging from 200 feet to 325 feet apart with some as close as 150 feet apart. These poles dwarf the adjacent trees, which at maturity will be a fraction of the pole height (Fig. 20). Whether Grant Road will become the vibrant "complete streets" thoroughfare envisioned in the vision statement will be seen in years ahead.

In conclusion, tools exist for Tucson and similar communities to improve visual quality related to utilities. In order for this to occur, there needs to be increased awareness among citizens and professionals about the aesthetic issues and the range of available design alternatives. While undergrounding utilities is commonly believed to cost 10 times the price of building them above ground, this is open to dispute. In places where roads are being widened, undergrounding should not automatically be discarded as an option. That said, communities with effective undergrounding programs generally began those programs decades ago and voting in assessments of a few percentage points on a utility bill seems less likely to be approved today. Experience suggests that when property owners or communities are asked to shoulder undergrounding costs themselves, undergrounding is unlikely to take place.

Above ground utility design need not be a blight on cities and landscapes. As owners and overseers of the tallest vertical element in many communities across America, energy providers and local governments should collaborate to create thoughtful designs, not just for new transmission lines, but for upgrades and replacements as well. Selecting appropriate finishes and removing redundant poles should receive greater attention. Better integration of pole modifications deserves consideration from both pole owners and pole tenants. Overhead power line design, as seen in the innovative work of the architectural firm Bystrup in Denmark, and American Electric Power's subsidiary, BOLD, remains a design frontier. This author hopes that many more companies follow the lead of these design pioneers.

ACKNOWLEDGMENTS

This research was conducted while the author was employed at the Pima County Department of Transportation. I am thankful to everyone I interviewed for this paper (listed in the footnotes), as well as multiple reviewers within Pima County, although they may not agree with all the interpretations and conclusions.

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VISUALLY INTEGRATED: LINKING VISUAL IMPACT ANALYSES, MITIGATION, AND RECLAMATION FOR LARGE-SCALE LINEAR PROJECTS

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Abstract.—With the recent approval of numerous large-scale transmission lines and pipelines that are now moving toward construction, it is critically important to ensure that these projects are implemented based on findings and assumptions of their associated impact analyses. Although this seems obvious, it has not always occurred successfully on past projects and can be challenging depending on how analysis findings and mitigation measures are applied and tracked. Specifically, degrees of impact and application of mitigation measures are often described in text and/or on forms that do not specifically spell out what portions of the project features they relate to. This paper focuses on effective and proven methods for analyzing visual impacts for linear projects including structuring the visual impact analyses in ways that will help successfully carry out mitigation measures during design, planning, construction, and reclamation.

INTRODUCTION

For large-scale construction projects such as pipelines and electricity transmission lines, there is often a disconnect between findings of the visual impact analysis done before the project and the details of the final project as built. This paper describes an approach that has proven effective at addressing this gap by directly linking project features to visual impact analysis recommendations during the design, construction, and reclamation phases of the project.

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The flow of this process is illustrated in Figure 1. It begins with tying expected visual impacts directly to landscape and project features during the impact analysis. Next, it is important to apply mitigation measures to reduce initial impacts to key landscape features and determine residual impact levels. Impact and mitigation data must then be incorporated into the plan of development (POD), which also includes specific measures for reclaiming the areas of project disturbance. As a project moves into construction, the POD provides specific direction on required mitigation measures. The reclamation plan includes monitoring protocols, standards for measuring success, and guidelines for adapting reclamation techniques to

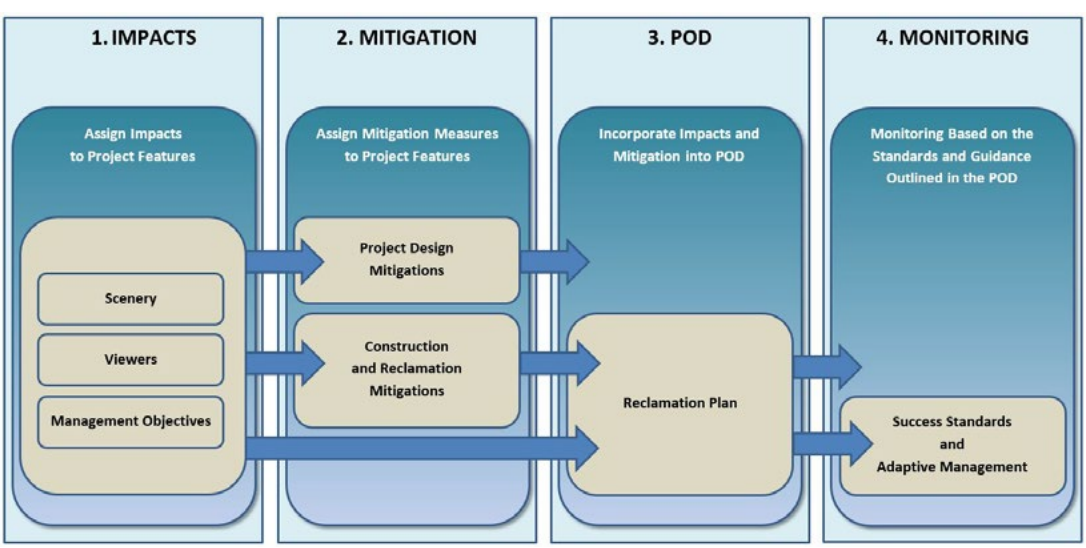

Figure 1.—Visual resource integration flow chart.

ensure that reclamation is successful. Each of these concepts is discussed in this paper with further elaboration on how each step is integrated with the next.

The need for an integrated process grew out of the incredibly complex nature of large-scale projects that cut across huge areas of the landscape, and this process has increased both the speed and precision of visual resource analysis. These types of projects often cross through multiple ecoregions, include hundreds or even thousands of individual viewpoints (residences, recreation sites, and travel routes), and affect multiple Federal and State planning areas. Analyzing each of these components individually can be incredibly time consuming, particularly for multiple design alternatives. However, by automating analysis processes with predictive GIS modeling and conditional impact matrices, potential impacts can be accurately identified and the analyses can be rerun quickly for the new or revised alternatives that tend to arise throughout the EIS process.

Indeed, the ability to establish and track automated analysis techniques is key to efficiently completing detailed analyses for large-scale linear projects. In extreme cases under severe time constraints, successful methodologies involving data simplification have been used successfully on large-scale linear projects to provide rapid, consistent results (Meyer et al. 2015). However, automated analysis techniques eliminate the need for data simplification while allowing an integrated analysis, mitigation, reclamation, and monitoring process.

Although pieces of this integrated process have been evolving since the early 1980s, it was recently used successfully on the large-scale SunZia Southwest, Energy Gateway South, and Harry Allen to Eldorado 500 kv transmission line projects. Each of these projects began with methodologies described in "Visual Resource Impact Assessment and Mitigation Planning: A Defensible Approach for Multistate Extra-High Voltage Transmission Line Projects" (Schwartz et al. 2012). This "comprehensive and hybrid" approach to determining initial and residual visual impacts involves automated processes and GIS modeling that are key to integrating assessment results throughout the reclamation planning and monitoring efforts.

Assigning Impacts Directly to Project Features

The key to successfully integrating these components lies in first tying all impacts directly back to project features. While this is not necessarily a new concept, it is not commonly practiced. Instead, impact results are usually embedded in various forms, tables, and document narratives in the analysis report(s). Moreover, these results are often broadly defined without describing exactly what portions of the project features they apply to. By contrast, assigning impacts directly to project features ensures that project components can be mitigated and reclaimed in proportion to the impacts associated with scenery, viewers, and management objectives.

While there are several methodologies that could be used to accomplish this for both scenery- and viewer-related impacts, automating portions of this process in GIS has proven highly effective. The GIS automation process begins with setting parameters for anticipated impacts to the landscape (landscape contrast) and overall impacts associated with project features (structure contrast). In brief, landscape contrast is based on the characteristics of the existing vegetation types and varying degrees of slope, which are combined to determine expected levels of contrast related to potential ground disturbing activities. Structure contrast, on the other hand, involves comparing proposed above ground project features and existing aboveground-built features to determine expected levels of contrast with existing built features.

After combining these two types of contrast into what is known as overall "project contrast," this information can be applied in GIS to both scenery and viewer impacts using relational matrices. The advantage of this system and the use of relational tables is that the variables can be easily adjusted after a review of initial results in order to refine results and assure that predicted impacts are accurate. Preliminary results can also be manually overridden by visual resource specialists to account for specific viewing conditions such as skylining or vegetative screening.

This process of attributing impacts directly to project components is completed separately for impacts associated with scenery, viewers, and conformance with management objectives, but the process can

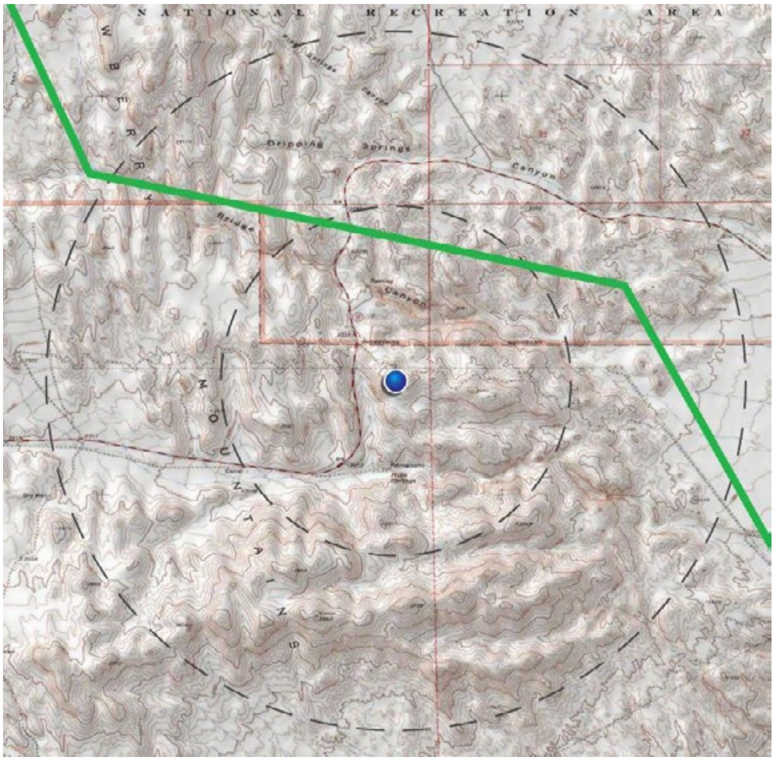

Figure 2.—Viewer (blue), project alignment (green), and influence zones (dashed lines).

also be combined to assess overall impacts for the project and compare alternatives. Impacts to viewers are generally separated into several categories such as residential viewers, recreational viewers, and viewers using travel routes. These categories often involve varying degrees of sensitivity to visual change, which can be discussed by the project team and agencies and then weighted separately within the analyses. The resulting impacts to project components can be tracked in GIS to provide rapid, consistent results. The process also allows the analyst to establish detailed tables and spreadsheets that lay out the impact levels at increments as small as tenths of miles.

As an example, the basic technique is illustrated in Figs. 2 through 4. Figure 2 illustrates linear project alignment (green), a viewer location (blue), and viewer influence zones (dashed black). The influence zones are based on distances at which the project is expected to affect the viewer and can be adjusted for each project based on the physical appearance of the associated landscape and project features. Although this example illustrates only two influence zones, additional zones can also be established at different distances.

As an initial step, Figure 3 illustrates preliminary impacts as high (red), moderate (orange), and low (green) based on conditional statements related to the project's distance from the viewer. By next overlaying a viewshed analysis from the viewing location (in which visible areas are shaded in blue), portions of the project that would not be visible can be eliminated as having no associated impacts (Fig. 4). The remaining high, moderate, and low impacts can then be verified and adjusted by a visual resource specialist based on site observations, desktop analysis, three-dimensional (3D) modeling, and/or visual simulations. This step also allows for adjustments to the conditional statements and influence zone distances if the resource specialist is consistently having to fine tune results to reflect actual conditions.

Assigning Mitigations Directly to Project Features

Once initial levels of impact are connected to the associated project features, selected mitigation measures can be applied to lower the residual impacts of the project. As with impact levels, mitigations should also be tied directly to project features. This approach often involves mitigations that are automated in GIS for application in given situations, as well as mitigations that are applied manually based on specific known conditions.

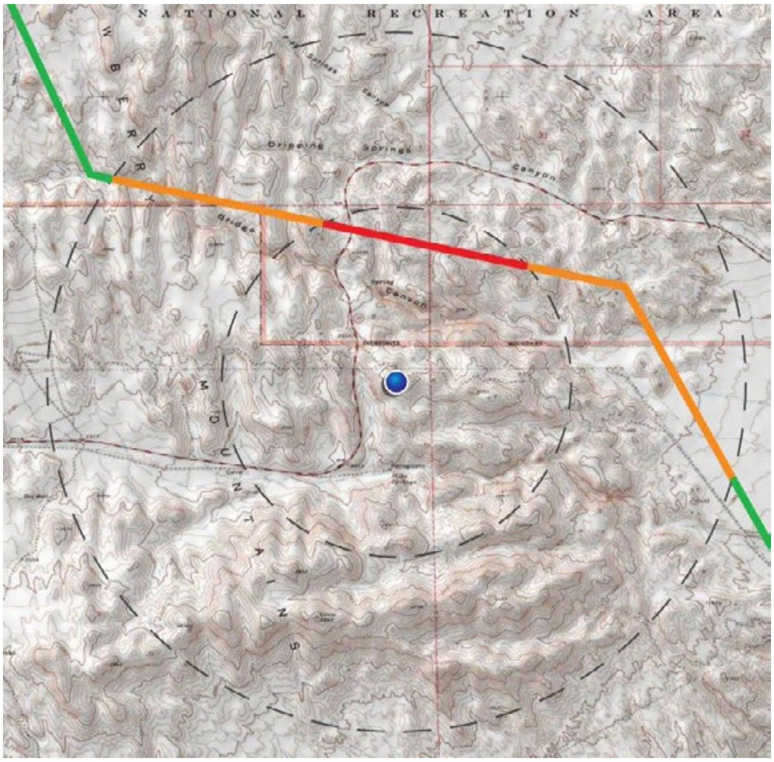

Figure 3.—Preliminary impacts are characterized as high (red), moderate (orange), and low (green).

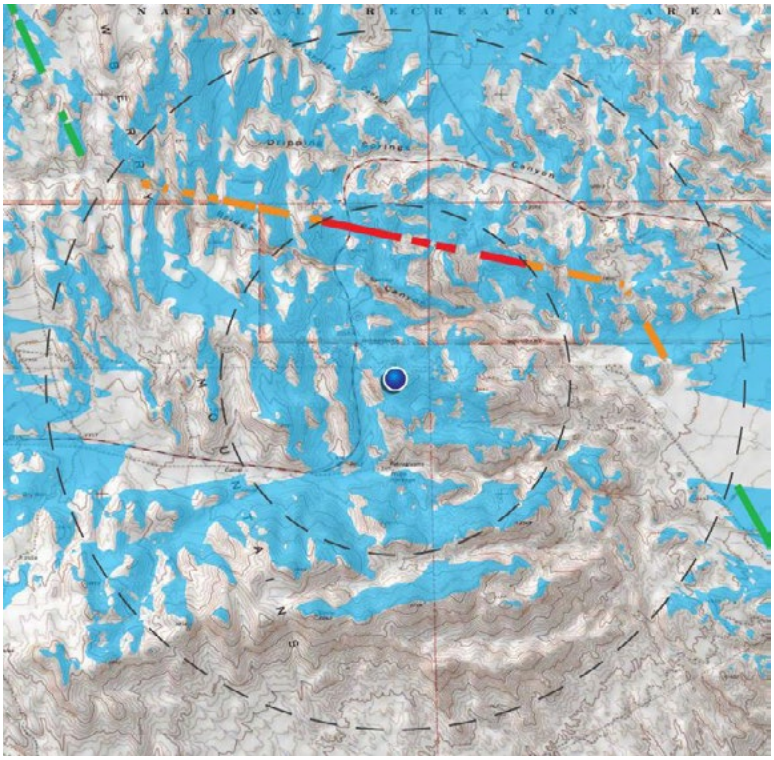

Figure 4.—Visibility and initial impacts. Visible areas are in blue; areas where no impact occurs are shaded beige.

Using a transmission line project as an example, automated mitigations could include matching spans with existing transmission lines, applying overland drive and crush techniques for sensitive areas, or maximizing tower spans in places with sensitive trail, road, or canyon/river crossings. Manually applied mitigations, on the other hand, could include modifying tower types to blend in with on-site conditions or minimizing slope cuts and requiring rock patina/staining in sensitive areas. Applying mitigation measures directly to project features not only allows for reducing residual impacts in the

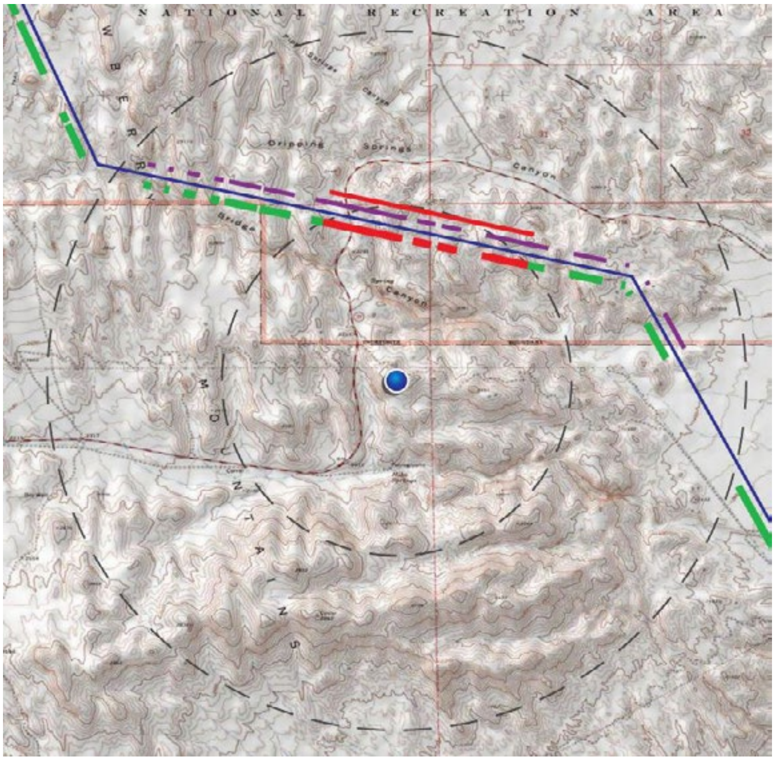

Figure 5.—Mitigation and residual impacts. The mitigation represented by the blue line is intended to be applied to all portions of the project, regardless of impact level or visibility status. The purple mitigation has been applied to all visible portions of the project within the largest influence zone. The mitigation represented by the thin red line has been applied to visible portions of the project within the smaller influence zone.

analysis, but also provides a way to track and organize mitigation data for later inclusion in the design and reclamation planning processes. As with impact results, mitigation results can be tracked and presented in a variety of outputs such as maps, tables, and spreadsheets.

Figure 5 provides an illustration of three theoretical mitigation measures (thin blue, purple, and red lines) being applied to differing portions of the project. As a theoretical example, the mitigation represented by the blue line is intended to be applied to all portions of the project, regardless of impact level or visibility status. The purple mitigation has been applied to all visible portions of the project within the largest influence zone, and the mitigation represented by the thin red line has been applied to visible portions of the project within the smaller influence zone. As a result, note that the mitigation measures in this example are expected to decrease the moderate impact to instead be low but are not expected to have a significant influence on the high impacts within the smaller influence zone. Because mitigation measures have now been applied in Figure 5, the impacts in this figure represent residual impacts.

After final mitigation measures have been determined and applied, those that relate directly to design features are passed on to the project engineers for integration into project design and engineering efforts. This could include changing structure types, spanning sensitive features, matching transmission line spans, or requiring helicopter construction and limiting access road development. The data created by assigning the mitigations to the project features enable project engineers to easily incorporate mitigations into the final project design.

Mitigation measures not related to project design are integrated into the reclamation planning and mapping processes. This integration provides both written and graphic representation of the mitigations, and it joins this information with a system of ascribing reclamation treatments to assure optimal project implementation. Examples of mitigations related to construction and reclamation include requiring overland driving and crushing, limiting slope cuts, rock staining/varnishing, and selective clearing and feathering of vegetation.

Incorporating Impacts and Mitigation Into the Plan of Development

The POD acts as the repository for both the design- and construction/reclamation-related mitigation measures. This document captures revisions to the project design based on the associated mitigation

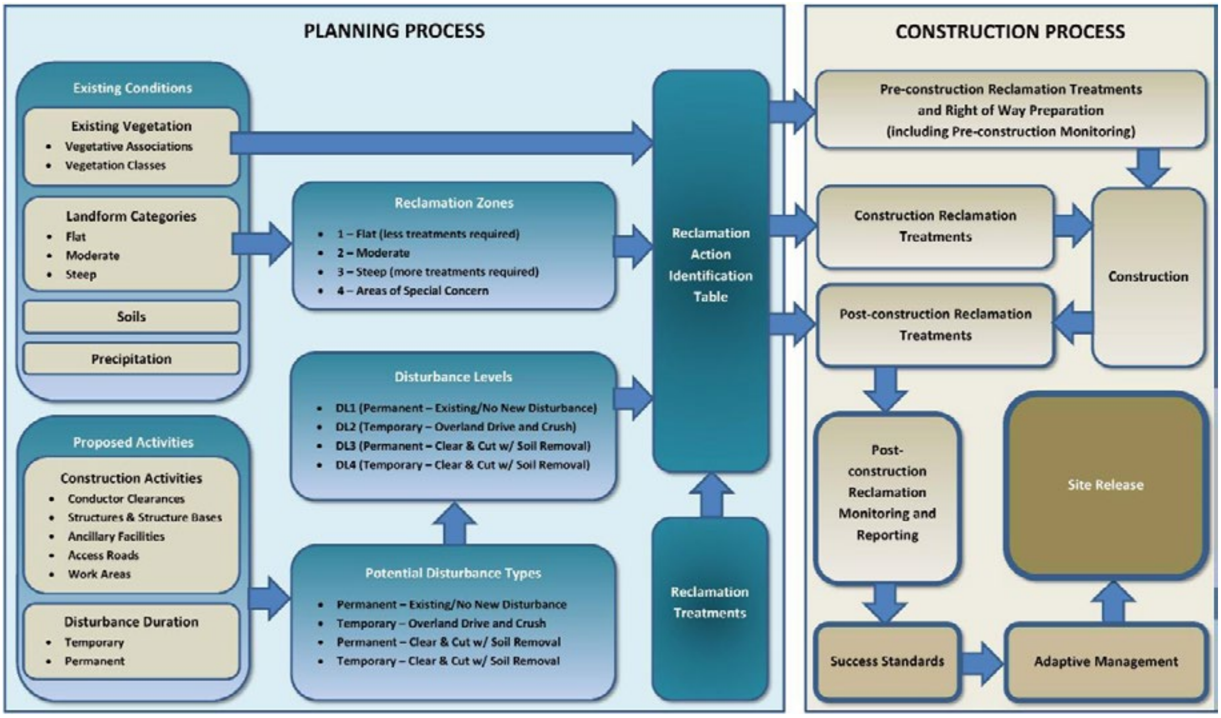

Figure 6.—Reclamation planning and construction flow chart.

measures, and it includes a reclamation plan with both the construction/reclamation mitigation measures and detailed application of reclamation treatments. The reclamation plan should also include a prioritization strategy for addressing areas that will require enhanced reclamation due to heightened visual, biological, cultural, or other sensitivities. In other words, while all areas disturbed by a project will require reclamation efforts, the prioritization strategy increases or focuses reclamation efforts in key areas to assure quicker reclamation. Acting as an additional means of tying reclamation efforts directly back to the impact analysis, the prioritization strategy should focus on areas where impacts and/or sensitivities were heightened, or in areas where the project did not comply with management objectives. With respect to visual resources, locations of amplified impacts or sensitivity may be associated with either scenery or viewers.

An example of a reclamation planning process flow chart is provided in Figure 6 and shows how each piece of a reclamation plan fits into the overall planning and construction process. The left side of this chart represents the reclamation planning steps while the right side of the chart is related to construction steps. This process begins with documenting both the existing conditions (vegetation, landforms/slopes, soils, and precipitation) and the details of the proposed activities. As the primary factor in determining the level of reclamation that will be required in this particular example, the landform categories (steep, moderate, and flat) provide the basis for the reclamation zones. An additional reclamation zone has also been included to address areas of prioritized reclamation efforts.

The details of the proposed activities in this example focus on the different types of activities and disturbances and whether associated disturbances are intended to be temporary or permanent in nature (disturbance durations). The combination of the activities and disturbance durations provide the disturbance types for the project, which are assigned disturbance level categories. The existing vegetation classes, reclamation zones, and disturbance levels are then incorporated into a reclamation identification table, which assigns reclamation treatments based on combinations of these elements. In the construction portion of the reclamation process, the different reclamation actions are incorporated prior to, during, or after construction of the project. Following the post-construction treatments, the reclamation efforts are carefully monitored.

Monitoring, Success Standards, and Adaptive Management

To ensure that the project is ultimately constructed and reclaimed per the expectations and assumptions in the project analysis, the reclamation plan must also include monitoring requirements, success standards, and stipulations regarding adaptive management. Monitoring efforts should begin with preconstruction surveys and data collection for both monitoring and control plots. While monitoring plots are established in areas planned for disturbance, the control plot locations are located in areas that will not be disturbed by the project but otherwise have similar existing conditions. Monitoring plots provide an accurate account of the existing conditions on sites that will eventually be disturbed and later reclaimed. The control plots, on the other hand, provide a continuous set of data that accounts for yearly changes in the area's vegetation, such as increased perennial growth as a result of heavier rainfall totals. Preconstruction data collection for the monitoring and control plots should include both quantitative and qualitative data and should focus on identifying the types and densities of vegetation in addition to other factors such as site stability, slope, soils, aspect, and presence of noxious weeds. Following construction and reclamation efforts, the same quantitative and qualitative data should be collected for the monitoring and control plots on an annual (or more often) basis to monitor reclamation success over time.

Success standards are established to define acceptable levels that constitute successful reclamation. These standards are generally based on achieving minimum percentages of original vegetative variety and density in addition to general site stability. A comparison of pre- and post-construction data provides the basis for evaluating whether standards are being achieved. In the event that monitoring plots are not meeting or exceeding success standards, the reclamation plan must include provisions for adapting reclamation techniques to achieve successful outcomes – also known as adaptive management. The adaptive management approach therefore focuses on increasing reclamation efforts or otherwise adapting the reclamation approach to ensure that deficient areas are improved to meet the success standards.

CONCLUSION

The process and methods described above include planning techniques that have been successful on recent large-scale linear projects and ensure that project implementation and analyses remain directly related. The key to ensuring that this process works includes having the foresight to conduct the initial impact assessments and identifying mitigation measures tied to specific project features for later integration into the POD and construction/reclamation efforts. This process is presented to share recent methodological successes and to spur further discussion on efforts to ensure that project implementations are consistent with original impact analysis results.

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MITIGATING VISUAL IMPACTS OF UTILITY-SCALE ENERGY PROJECTS

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Abstract.—Visual resources are often a focal point of controversy and uncertainty and are becoming a growing concern for agencies, developers, and the public alike for the variety of utility-scale energy projects, including transmission, substation, power plant, and renewable energy projects. Agencies are increasingly challenged to interpret and enforce regulations for visual resources and balance multiple and often conflicting purposes for public lands. Developers are challenged by uncertainties about visual impacts of their proposed projects, strong public reactions and opposition, and how impacts can best be mitigated cost effectively. The public is most often concerned about impacts to views, changes to visual character and quality, and the effects of these on their property values and quality of life. Developers and utilities are finding that facility sites and potential transmission routes are increasingly constrained and agency requirements for mitigating visual impacts are expansive and costly. This paper focuses on approaches, processes, and techniques for mitigating visual impacts of utility-scale energy projects and explores the effectiveness of some commonly employed mitigation techniques.

VISUAL ISSUES FOR UTILITY-SCALE ENERGY PROJECTS

Public concerns about how proposed projects may change the visual character and impact the visual quality of an area are often key elements of controversial projects and sometimes the focal point of controversy (Smardon and Pasqualetti 2017). Because of their industrial appearance and geometric and linear forms and lines, utility-scale energy facilities often contrast strongly with their surroundings in both natural and rural landscapes and are of particular concern for how they impact scenery in these environments. In addition to direct effects on scenic views in more natural and rural areas, the public is often concerned about how a proposed project will affect their existing views and thus impact their quality of life and property values.

Federal, State, and local government agencies are increasingly challenged to interpret and enforce policies and regulations for protecting scenic character and quality within their management jurisdiction. Generally, these challenges occur when proposed projects are considered for permitting approvals, typically with public input opportunities, through: Federal, State, or local environmental compliance processes; State siting board reviews; or local plan amendments, zone changes, or conditional use permits. Issues involving visual/scenic impacts are especially challenging for agencies, such as the Bureau of Land Management (BLM) and USDA Forest Service (FS), that are responsible for balancing multiple and often conflicting purposes for public lands. However, they can be even more problematic for State and local agencies that lack established procedures or formal systems for assessing visual/scenic impacts.

Energy project developers, including both merchant developers and public utilities, are challenged by uncertainties about the visual impacts of their proposed projects, strong public reactions and opposition, and costs to mitigate these impacts. Of particular concern for developers are unknown mitigation requirements that could prove costly and may be imposed through project approval and permitting processes. Developers are finding that potential facility sites and transmission routes are increasingly constrained, and public demands and agency requirements for mitigating visual impacts are becoming expansive and costly. As an example, one recent 250 megawatt (MW) photovoltaic (PV) solar project now operating in California had 146 conditions of approval imposed by the county (California County Planning Directors Association 2012).

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It is therefore beneficial for project developers and agencies alike to understand which visual impact mitigation techniques may be applicable and are likely to be required, which are most effective at reducing visual impacts, and what the potential costs may be. It is equally important for the public to be made aware of these parameters early in the process in order to help focus public input. Potential benefits include more accurate assessment of project feasibility, reduced public opposition and agency resistance, avoidance of project delays, and greater certainty about project design and viability.

MITIGATION

Mitigation actions are specific, feasible measures to avoid or substantially reduce significant environmental effects. For utility-scale energy projects, including transmission and pipeline projects, mitigation may consist of applicant-proposed measures that are incorporated in the project design or agency-imposed measures that are generally required as part of project approval. Agency-imposed measures are most often identified as mitigation measures but sometimes are identified as conditions of approval, a term more often associated with local government agency approvals.

Mitigation measures generally fall in one of five categories, which largely correspond to levels of mitigation effectiveness. These categories are:

- Avoid. Avoid taking certain actions or parts of actions.
- Minimize. Limit degree or magnitude of action.
- Rectify. Repair, rehabilitate, or restore.
- Reduce or eliminate. Preserve or maintain during life of action.
- Compensate. Replace or provide substitute resources (Bass et al. 2001).

Avoiding the impact altogether is generally considered most effective because it fully mitigates the impact (Apostol et al. 2017). Minimizing the impact may be the most common type of mitigation and results in reducing its intensity or magnitude, rarely eliminating it altogether. Rectifying is commonly used but is usually long-term as the impacts generally persist for some time. Reducing or eliminating impacts may be effective as long as preservation and/or maintenance activities continue. Mitigation measures involving compensation may be recommended or required where it is recognized that impacts cannot be avoided or substantially reduced. Use of compensatory mitigation measures appears to be on the increase (Smardon and Palmer 2017).

VISUAL MITIGATION MEASURES FOR ENERGY PROJECTS

Visual mitigation measures for energy projects fall broadly into three categories: siting, design, and special circumstances. Siting measures for visual mitigation generally entail effective siting that either avoids visually sensitive areas entirely or limits the magnitude of visual impacts through locating the project so that it blends with its surroundings or is fully or partially screened from important views. Design measures for visual mitigation generally entail applications of various treatments, techniques, materials, or finishes that help blend project features with their surroundings or screen them from important views. Measures for special circumstances entail various techniques that may be applied in unique situations or limited areas to avoid, minimize, or offset visual impacts. These various measures for visual mitigation of energy projects are discussed in more detail below.

Siting Measures

Siting measures for visual mitigation include techniques such as avoiding sensitive scenic areas, avoiding high visibility features such as ridge tops and focal areas, colocating facilities with other facilities of similar type and scale (e.g., siting an LNG facility or power plant in an already industrialized area or routing a transmission line close to and paralleling an existing transmission line of similar scale), avoiding “skylining” structures, and locating facilities out of primary view cones for both mobile and stationary views (Apostol et al. 2017; Bureau of Land management 2013).

Siting measures are best applied during project planning as applicant-proposed measures or possibly as siting or route alternatives. When required by agencies as conditions of project approval after project engineering and design, they can be costly or create project delays since they often involve relocating project elements, which requires additional engineering and environmental investigations, or other changes to the project footprint. Because structures and their foundations must be custom-designed to fit terrain and subsurface conditions specific to their unique locations, even a small change in location of one structure can have a substantial snow-balling effect on relocating other facility structures. This is especially true for wind turbines, where repositioning one turbine can affect the generation efficiency of other nearby turbines, and transmission structures, where repositioning one structure can have a cascading effect on the locations of adjacent structures in a whole segment of the transmission line. Even small adjustments to structure locations may entail substantial redesign and construction costs.

Design Measures

Design measures for visual mitigation may apply to mitigating visual impacts during project construction or operation or both. They may be applied during project planning and design as applicant-proposed measures or be required by agencies as conditions of project approval. Also, they may be generally applied to the entire project or to large areas or selectively applied to particular locations or activities.

The costs of design measures can vary substantially depending on the nature of the measure, how extensively it must be applied, and whether ongoing maintenance is required. Some measures require higher initial costs but little ongoing investment of time or resources through operation. Others require ongoing or periodic maintenance costs that can be expensive over time. Still others, such as site restoration, are routinely applied as best management practices and serve multiple purposes for mitigation (Bureau of Land Management 2013). As with siting measures, design measures can be costly or create project delays when required by agencies as mitigation measures or conditions of project approval.

Design measures typically applied for mitigating visual impacts of energy projects are listed below in categories of their primary application for either construction or operation (Bureau of Land Management 2013). Some of these measures may be applicable during both project phases. Rather than being comprehensive, this list is intended to summarize the types of design measures typically applied for mitigating visual impacts of energy projects. Other design measures undoubtedly exist. Furthermore, this list is not intended to provide actual wording for mitigation measures.

A sampling of typical design measures for visual mitigation during project construction includes the following:

- Use existing access roads wherever possible and minimize construction of new access roads.
- Minimize improvements to existing access roads.
- Restore access roads used for construction that are not required for operation and maintenance.
- Use overland "drive and crush" travel for access within clearly delineated routes whenever possible.
- Minimize extent of cut and fill slopes.
- Limit vegetation clearing and ground disturbance to areas required for construction.
- Minimize vegetation trimming and removal.
- Preserve/maintain existing vegetative screening.
- Select low visibility locations for laydown and staging areas or screen these when located in visually sensitive areas.
- Round slopes.
- Minimize lighting required for construction activities, laydown and staging areas, and maintenance activities; use the minimum necessary to ensure safety and security for nighttime activities.
- Light areas only as required for safety and security in accordance with Occupational Health and Safety Administration standards.
- Shield and orient lighting downward to eliminate offsite light spill; use motion-activated sensors and/or timers for construction lighting.
- Reclaim/revegetate/restore temporarily disturbed areas (including access roads, laydown and staging areas, temporary work areas, etc.).

A sampling of typical design measures for visual mitigation during project operation includes the following:

- Use finishes and products that minimize or eliminate surface glare (e.g., dulled and/or dark painted or stained surfaces, textured surfaces, nonspecular conductors).
- Select finishes and colors that are appropriate to their location and context and help blend features with the surroundings (e.g., use colors

selected from BLM's color chart [Bureau of Land Management 2013]).

- Treat exposed rock and soils to darken and reduce color contrast (e.g., Natina Products, Permeon™, desert varnish).
- Match design form, height, texture, and color of any existing structures as much as feasible.
- Minimize structure heights.
- Screen from sensitive receptors using berms, vegetation, or other techniques.
- Minimize vegetation clearing and trimming.
- Maintain access roads for operation and maintenance at the minimum standards needed for safety and accessibility.
- Create varied vegetation edges for cleared areas and rights-of-way (e.g., for pipeline and transmission rights-of-way, create edges that are sinuous horizontally and layered vertically).
- Minimize lighting required for permanent facilities; light areas only as required for safety and security in accordance with Occupational Health and Safety Administration standards.
- Shield and orient lighting downward to eliminate offsite light spill; use motion-activated sensors and/or timers for lighting.

Measures for Special Circumstances

Increasingly, public interests and agencies are recommending what may be termed innovative, progressive, or special mitigation measures to avoid, minimize, or offset visual impacts of energy projects. In some cases, agencies are requiring these measures in unique or special circumstances or limited areas as conditions of project approval (Smardon and Palmer 2017). Some of these measures may be costly and others may actually avoid or offset the costs of more traditional or standard mitigation measures. Measures for special circumstances include a variety of creative techniques to mitigate visual impacts of energy projects, including compensatory mitigation, offsite enhancement, special finishes, unique and artistic structure and screening designs, and placing transmission lines underground or underwater.

Compensatory mitigation is being applied more frequently, especially in and near urban areas where large numbers of viewers are affected; sites and routes are constrained; and views from residences, trails, parks, and other sensitive viewing locations may be impacted (Kling et al. 2017). Compensatory measures may take various forms, including monetary payments, provision of community amenities, establishment of scenic reserves, and offsite scenic enhancements. Monetary payments may be made to communities, neighborhoods, individuals, nonprofit organizations, or special interests for what amounts to a "taking" of views. Ideally, funds are applied to local efforts to provide aesthetic enhancements to offset visual and other impacts of a proposed project. In some cases, community amenities have been provided in the form of trails, trailheads, staging areas, parks (especially linear parks that parallel transmission lines), and rest areas along trails. Interpretive exhibits, plantings, restrooms, parking areas, and other features may be part of the overall amenity intended to offset or compensate for impacts to views and visual character. Decisions for some key legal cases appear to indicate that agency-imposed compensatory mitigation measures must be directly related to mitigating the actual visual impacts (Smardon and Karp 1993). However, in certain situations, discussions and negotiations with project developers in the early stages of project planning may also yield innovation solutions designed to offset visual impacts.

Another form of compensatory mitigation is the set-aside or establishment of scenic reserves where scenic quality would be protected in perpetuity (Kling et al. 2017). The intent of this mitigation would be to offset visual impacts from a proposed project that could not otherwise be mitigated effectively on site. Offsite scenery enhancement may be part of this mitigation or could occur in other areas, for example a National Forest that would benefit from visual "restoration."

In some limited areas or for certain project features where special circumstances exist (e.g., an immediate foreground view from a residence), painting all or parts of project elements may be appropriate. Painting and other special finishes can be expensive to maintain and are known to peel, fade, or otherwise lose their effectiveness over time. A commitment to long-term maintenance, a detailed maintenance program (and possibly monitoring), and recorded agreements should be included as part of mitigation measures that rely on maintenance of painting or other coloring or finishes to reduce visual impacts. For transmission lines, it can also be problematic for a utility to take a line out of operation to repaint a structure, even for a brief period. Thus, visual enhancements involving painting or other applied finishes should be used cautiously. However, innovations and advances in materials, paints, and finishes may improve the viability of this mitigation technique in the future.

Another measure that arguably could be applied in some special circumstances to mitigate visual impacts is the use of unique and artistic structure and screening designs (see Alster, this proceedings). A number of large power generation facilities in Europe and some in the United States have been designed as large art or sculptural features or "disguised" to look like office buildings. For example, the 605 MW Metcalf Energy Center near San Jose, CA, is designed to look similar to office buildings in the vicinity of the facility (California Energy Commission 2000). For some energy facilities, such as substations and transmission facilities located in urban areas, innovative and artistic screening has been employed to mitigate visual impacts and provide amenities for communities. The use of artistic screening as an alternative to more traditional vegetative screening, berms, walls, and fences has merit, especially in locations that have limited space for plantings and berms and where views may be sensitive and frequent.

In addition, design competitions sponsored by power transmission companies in Iceland and England in recent years have highlighted innovative and imaginative designs for transmission structures (Alster, this proceedings; Bustler 2011; T&D World Magazine 2011). While some are fanciful and unlikely to be feasible, others have the potential to be built and may help mitigate visual impacts by providing a more interesting and aesthetic alternative to traditional, industrial structure designs, at least for projects traversing visually sensitive areas or with high numbers of viewers. For a 2008 competition sponsored by Landsnet, an Icelandic power transmission company, and the Association of Iceland Architects, new 220 kV transmission structures were designed in the form of humans in various poses (Alster, this proceedings). The design submitted by Choi+Shine received honorable mention in the competition and a subsequent award from the Boston Society of Architects (Bustler 2011). A 2011 competition, sponsored by England's Department of Energy and Climate Change and British power company National Grid, attracted 250 entries and resulted in several designs that are being seriously evaluated to use to mitigate visual impacts of transmission projects (British Broadcasting System 2011, T&D World Magazine 2011).

One measure that is gaining traction both as a siting and design measure to mitigate visual impacts is the placement of transmission lines underground or underwater. Underwater transmission lines have been considered viable and cost effective for some time, with a variety of these lines in operation worldwide. With recent advancements in the technology, undergrounding is becoming more viable in certain situations and is being applied more often. However, construction costs for undergrounding are quoted by various sources as ranging from 4 to 20 times higher than traditional overhead transmission (Edison Electric Institute 2012, NEI Electric Power Engineering 2009, Public Service Commission of Wisconsin 2011). The higher costs are due to a variety of factors ranging from terrain types and subsurface conditions to connection and underground access requirements. Utilities also highlight difficulties accessing lines for inspections, maintenance, and repairs.

Although more expensive, undergrounding may have other advantages besides visual mitigation that include maintenance of property values; compatibility with land use requirements; political palatability; perceived reduction of exposure to electric and magnetic fields (EMFs); reduced width requirements for rights-of-way and associated lower costs for acquisition; lower costs for maintaining rights-of-way due to fewer restrictions for vegetation edge maintenance and less area to maintain; and reduced vulnerability to extreme weather events, fires, and terrorist attacks, potentially resulting in reduced outages and greater reliability (Edison Electric Institute 2012). Also, undergrounding transmission may provide viable options in dense urban areas where limited space is available for infrastructure. However, potential avoided costs and savings related to many of these advantages are difficult to calculate and are often not considered in reports of higher costs of undergrounding transmission lines; instead, the higher costs are generally calculated based on initial construction costs or costs of conversion from overhead to underground (Edison Electric Institute 2012).

With advances in the technology, underground polymer insulated cable (XLPE) is now rated up to 550 kV for AC lines; however, underground high voltage AC lines are generally limited to distances of up to about 40 miles (Faulkner 2013). Most underground AC transmission lines currently in place or being built run short distances of several hundred feet to several miles. Underground portions of AC transmission lines that have been built recently include the 6.9-mile underground segment of the 345 kV Middleton-Norwalk line in Connecticut and the 6.2-mile underground segment of the 230 kV Sunrise Powerlink line in California. Each was placed underground at a considerably higher cost than an overhead line to reduce or eliminate visual impacts.

High voltage DC (HVDC) lines can be substantially longer and carry much higher power loads (Faulkner 2013). A number of HVDC transmission lines are currently in operation throughout the world, most of which run underwater. Some, such as 320-mile 600 kV HVDC Champlain Hudson Power Express (90 miles underground and 230 miles underwater), are in the planning stages (Transmission Developers 2017). Still other proposed projects are considering alternatives for undergrounding and evaluating their feasibility.

CONCLUSION

While visual impacts are often the focus of public and agency concerns for utility-scale energy projects, a variety of techniques exists to help mitigate these impacts. Some techniques are fairly standard and routinely applied across broad types of energy projects. Other techniques can add substantial project costs but may be suitable in specific situations or limited areas. Perhaps the best mitigation derives from avoiding visual impacts to the greatest degree possible through a collaborative approach that: engages project developers, agencies, and public interests; fosters trust; improves understanding of constraints and opportunities; and helps anticipate issues early in the planning process so that feasible alternatives and appropriate mitigation solutions can be identified. Project developers are then better able to integrate applicant-proposed measures as part of the proposed project and avoid agency-imposed mitigation that can be costly and can cause project delays. This approach, if properly applied, has the potential to result in reduced public and political opposition, greater certainty and less risk for the project proponent, and a more efficient and timely process for project review and approval. Ultimately, this approach provides a greater potential for reducing visual impacts of utility-scale energy projects and protecting the visual character and quality of the landscape.

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SURFACE COLOR TREATMENT OF TRANSMISSION LINE STRUCTURES

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Abstract.—With the increasing need for reliable energy infrastructure in the United States, the once natural openness of the Wild West has evolved into a web of infrastructure scattered across the landscape. Bureau of Land Management (BLM) lands managed under a multiple-use mission are no exception. While projects built on BLM land go through in-depth environmental analysis, including making recommendations for proper design features and mitigation measures to reduce impacts to visual resources, it is often difficult for BLM staff to ensure full implementation of these measures. This is sometimes a result of not having the expertise or tools to simulate design features and mitigation measures. This paper describes the process that the BLM followed to warrant the color treatment of built structures on a recent 500 kV transmission line through a highly scenic and publicly sensitive landscape. It highlights the process of using two-dimension (2D) visual simulations to conduct a color analysis of the natural landscape. It also demonstrates how using these techniques provided invaluable information to help BLM decision makers select the most appropriate surface color treatment for the structures in this project.

ENERGY TRANSMISSION OVERVIEW

The first long-distance electricity transmission line is believed to have been built in 1889 in Portland, Oregon; since then, thousands of miles of transmission lines have been strung across the United States (Madrigal 2010). These lines are supported by structures that vary from small roughly cut wood poles to large steel structures that are capable of withstanding the most intense abuse that nature can throw at them.

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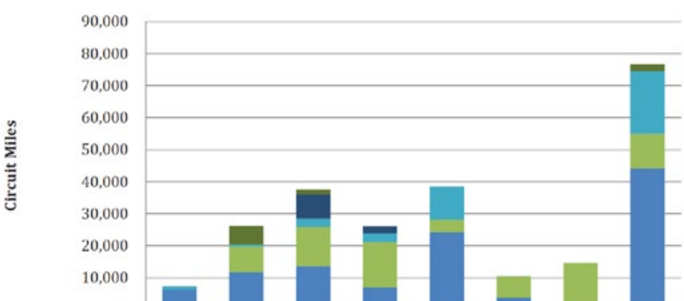
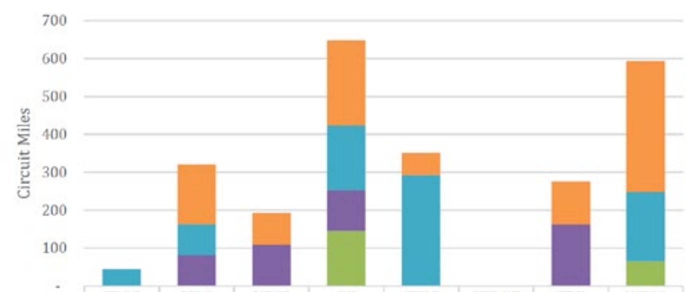
As energy demand continues to increase in the United States, there is an ongoing need to expand energy transmission infrastructure. As of 2016, there were 237,871 total circuit miles of transmission lines ranging from 200 kV to 799 kV (including DC) across the United States (Fig. 1) (U.S. Department of Energy 2016). There are plans for another 14,380 circuit miles of transmission lines to be completed by 2020 (Fig. 2) and conceptual transmission projects still in early stages of development could add 2,017 more miles between 2021 and 2025 (U.S. Department of Energy 2016).



	FRCC	MRO	NPCC	RFC	SERC	SPP	TRE	WECC
Total DC	-	5,773	1,452	66	-	-	-	2,252
600 kV - 799 kV	-	-	7,671	2,201	-	-	-	-
400-599 kV	1,201	600	2,570	2,776	10,132	94	-	19,477
300-399 kV	-	8,218	12,270	14,132	4,049	6,614	14,679	10,852
200-299 kV	6,200	11,705	13,597	7,018	24,267	3,834	-	44,171

Figure 1.—Existing transmission lines as of Dec. 31, 2015 (U.S. Department of Energy 2016).
FRCC–Florida Reliability Coordinating Council. MRO–Midwest Reliability Organization. NPCC–Northeast Power Coordinating Council. RFC–ReliabilityFirst Corp. SERC–Southeast Reliability Council. SPP–Southwest Power Pool. TRE–Texas Reliability Entity. WECC–Western Electricity Coordinating Council.



	FRCC	MRO	NPCC	RF	SERC	SPP-RE	TRE	WECC
100-199 kV	-	158	83	224	59	-	113	344
200-299 kV	45	81	-	171	293	-	-	183
300-399 kV	-	82	110	108	-	-	163	-
400-599 kV	-	-	-	146	-	-	-	66
600 kV+	-	-	-	-	-	-	-	-
Total DC	-	-	-	-	-	-	-	-

Figure 2.—New transmission lines expected to be completed by 2020 (U.S. Department of Energy 2016).
FRCC–Florida Reliability Coordinating Council. MRO–Midwest Reliability Organization. NPCC–Northeast Power Coordinating Council. RFC–ReliabilityFirst Corp. SERC–Southeast Reliability Council. SPP–Southwest Power Pool. TRE–Texas Reliability Entity. WECC–Western Electricity Coordinating Council.

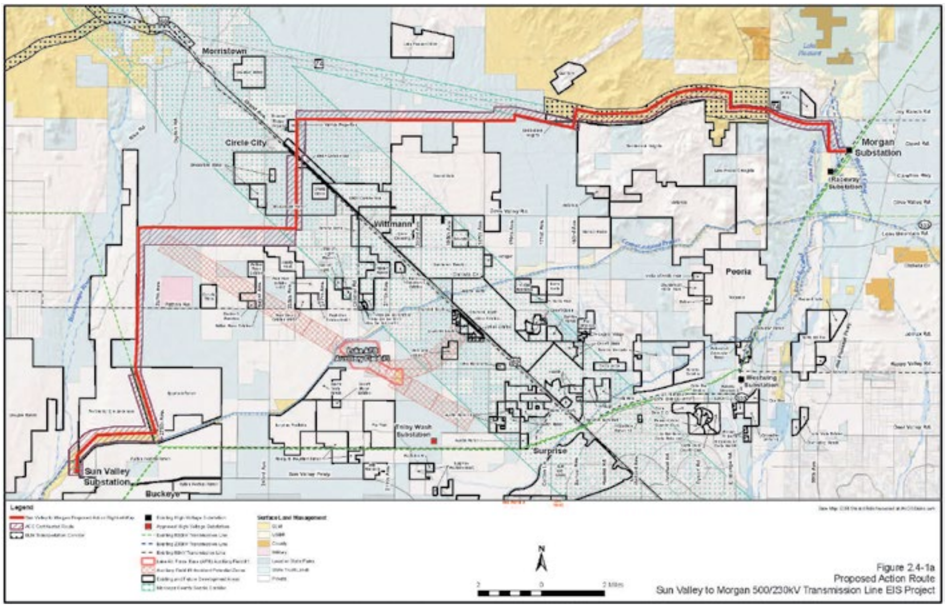


Figure 3.—Sun Valley to Morgan 500kV Transmission Line proposed action route. Source: Bureau of Land Management 2013.

As is clearly evident in these figures, reliable and efficient energy transmission, predominantly through overhead transmission lines, is a vital part of our energy dependent society.

PROJECT BACKGROUND

In the desert landscapes of Arizona, multiple electricity transmission lines are currently either under construction or in the planning stages; many of these will affect BLM lands. The Sun Valley to Morgan 500 kV Transmission Line (SV2M) is one such project. The Arizona Public Service Electric Company (APS), one of the main utility providers in Arizona, determined that they needed to build a 500 kV line to support the growing energy demand in the Phoenix-metro area. This project would provide a connection between the Sun Valley substation (north of the town of Buckeye and west of the City of Surprise) and the Morgan substation (just south of Lake Pleasant). Hence, this project is called the Sun Valley to Morgan 500 kV Transmission Line.

When the study area and proposed alignment were submitted for the project, there was significant public opposition, mainly due to proximity of the project to residential communities. This opposition led to political pressure on APS to consider a new alignment that would push the proposed SV2M route farther from the residential communities. The new proposed alignment still connected the Sun Valley and the Morgan substations but now cut across BLM-managed public lands for approximately 7 of the 38 total miles. Specifically, the newly modified alignment followed the general area of SR74 that connects I-17 north of Phoenix to Wickenburg, Arizona (Fig. 3).

This change, while placating the groups that had opposed the SV2M original alignment, led to other challenges for APS. The BLM-managed land was not designated to allow for utility-scale energy transmission. The Bradshaw-Harquahala Resource Management Plan (RMP), the document establishing BLM planning and management objectives, did not include language that would allow such a project to be built as proposed. In fact, the RMP stated that utility-scale energy projects were required to use already designated energy corridors on BLM land (Bureau of Land Management 2010).

This area was also designated in the RMP as a BLM visual resource management (VRM) class II landscape. VRM class II lands are established to retain the existing natural condition of the landscape, allowing for some minor modification that does not attract the attention of casual observers. Due to the highly scenic quality of the proposed alignment, along with the public sensitivity to change along the scenic SR74 highway, it was unlikely that a 500 kV transmission line would conform to this objective.

Because of the conflict between the proposed action and the objectives in the RMP, a plan amendment (RMPA) would have to be processed. The BLM field office decided to proceed with the RMPA and an environmental impact statement (EIS) for the proposed action (Fig. 4).

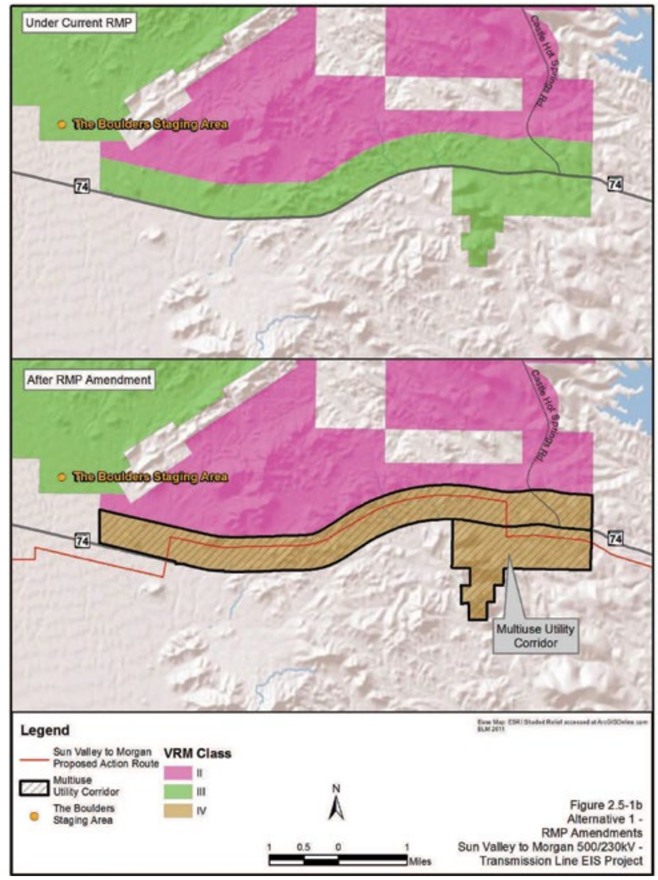


Figure 4.—Proposed RMP amendment. Source: Bureau of Land Management 2013.

ENVIRONMENTAL IMPACT STATEMENT ANALYSIS

The BLM study assessed both the impacts of amending the RMP to allow the SV2M project, and the impacts to a range of environmental features and factors if the project was approved and built, as is typically done in a NEPA (National Environmental Policy Act) compliant EIS.

Color selection was a key part of the visual resource analysis in the EIS for the SV2M project. An in-depth analysis of the existing landscape was conducted to determine the most appropriate color for transmission structures (165-foot steel monopoles) on BLM land. Where the project was proposed, vegetation was dense and the topography was varied. These factors played into the decision to require project elements like poles to be painted in BLM standard colors that have been analyzed in various landscapes and have proven to blend well, especially in vegetated desert conditions (Fig. 5).

The EIS summarized the analysis this way:

> The color of the structures or lattice towers affects how well the structure blends in the environment. Photographs of boards treated with the BLM's standard environmental colors were taken from KOPs [key observation points] representing typical topography and vegetation within the project area. The photographs were then analyzed to identify which standard environmental color would minimize visual impacts. While no one color works best in all situations and lighting conditions, the shadow gray and shale green colors blended best under front lit conditions and had low levels of contrast in back lit situations (Bureau of Land Management 2013).

Figure 5.—Existing landscape of SV2M project area. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 6.—Valmont galvanized steel samples overlaid onto BLM standard color chart. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Unfortunately, conflicting language was also included in the EIS:

> Surface treatment options for monopole structures are very limited and do not achieve much color variation. The colors available would be shades of gray ranging to almost black; no surface treatments available would resemble shale green (Bureau of Land Management 2013).

This language left a discrepancy to be worked out by the project team. In addition, the visual simulations produced as part of the EIS had only simulated a light galvanized steel finish. This made it very difficult to demonstrate the value of the shale green or shadow gray colors on the structures. Despite these conflicts, ultimately the BLM maintained the authority to approve the color of the structures (Bureau of Land Management 2014).

COLOR SELECTION MEETING

A meeting was held to discuss the color options for the steel monopoles. Valmont Industries, Inc. (Valmont), the manufacturer on contract to produce the steel monopoles, provided three samples of galvanized steel as options for the project: light, medium, and dark galvanized finishes (Fig. 6).

APS and Valmont hoped to receive BLM approval to use one of the colors shown in the samples, but the samples did not match the BLM shadow gray or shale green colors.

RESEARCH ON COLOR TREATMENT OF TRANSMISSION STRUCTURES

During the initial meeting, one of the main points of disagreement was the claim that variations in color were not possible for steel monopoles. To research this issue, I contacted steel transmission structure manufacturers throughout the United States, inquiring about their ability to color treat monopoles. While none claimed that this was a common practice, they did confirm that it was possible. In fact, some manufacturers market their ability to color treat these types of structures on their Websites.

In addition, over the years, I have photographed many examples of color treated monopoles in various U.S. States while traveling for work. See, for example, Figure 7.

Having successfully identified transmission line projects across the western landscapes that were color treated, and strongly believing that color treating the monopoles for SV2M was necessary to properly reduce visual impacts, I set out to demonstrate the benefits that could be achieved by using color treated monopole structures.

Figure 7.—Color treated monopole in Boise, ID. Photo by Brandon Colvin, U.S. Bureau of Land Management.

PROJECT VISUAL SIMULATIONS

For SV2M, the visual simulations, though only shown with a light galvanized material, proved that visual simulations can contribute to making successful mitigation decisions for a project. The simulations demonstrated the location of the project, what the structures and lines would look like, and the contrast these project elements would have with the surrounding landscape (Fig. 8a). Unfortunately, they did not portray the colors that had been selected to reduce contrast and visual impacts in the analysis, so they were only useful to a certain degree.

Starting with the original simulations from the EIS, I developed multiple simulations in Adobe Photoshop, using various overlay techniques to simulate color treatment with the shale green, shadow gray, and weathered steel color tones. As seen in Figure 8b, the weathered steel does bring a more natural look to the monopole structures but it is still highly noticeable, drawing viewers' attention.

The next simulation used a shale green/shadow gray tone (Fig. 8c). These colors clearly performed the best against the existing natural landscape.

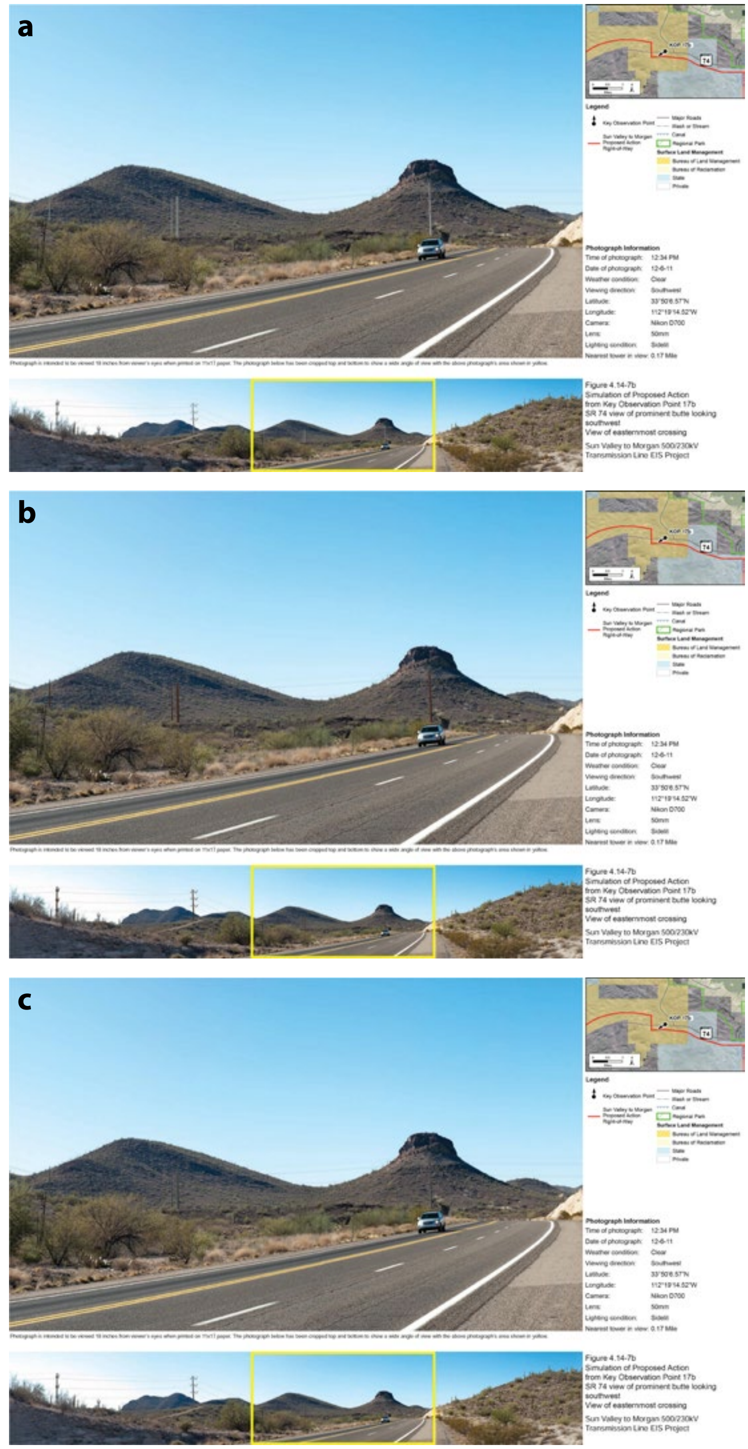


Figure 8.—Simulation of Sun Valley to Morgan 500kV Transmission Line using a) galvanized steel; b) weathered steel; c) shadow gray/shale green. Source: Bureau of Land Management 2013.

While these simulations provided good source images to gauge the performance of each color in the existing conditions, the BLM team decided to assess these colors in the field with actual product samples.

Figure 9.—Sample poles from Valmont for review by BLM. Photos by Brandon Colvin, U.S. Bureau of Land Management.

SAMPLE POLE FIELD ASSESSMENT

Once samples poles from the manufacturer were in place, the BLM team visited the field site in the morning hours as well as the afternoon to ensure that we experienced a range of lighting conditions (Fig. 9). The team quickly decided that the weathered steel finish was not a viable option. The color contrast with the surrounding landscape was just unacceptable. The galvanized material finishes were no better. They had a significant amount of reflectivity and did not blend with the surrounding landscape. They also did not match the shadow gray or shale green color boards.

We learned through this onsite assessment that the shale green and shadow gray colors, as described in the EIS analysis, blended very well with the surrounding landscape. Shale green has a slightly more gray-green base and performed especially well against the dense vegetation.

After viewing the samples both in the morning and afternoon hours, capturing images looking in eastern and western directions, it was clear that the BLM standard color shale green performed the best in this landscape condition.

VISUAL SIMULATIONS DEVELOPED USING ADOBE PHOTOSHOP

As a followup to the field tests, using various techniques and tools in Adobe® Photoshop®, I developed some rough draft visual simulations that would more accurately portray the monopole structures color treated with shale green. I also included shadow gray in the simulation. Figures 10 through 12 show a progression of simulations that I developed. They make it even more apparent that shale green was the appropriate color selection.

Figure 10.—Condition existing prior to simulation. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 11.—Simulation part 1. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 12.—Completed simulation matching color boards. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 13.—Natina Steel sample. Photo by Brandon Colvin, U.S. Bureau of Land Management.

After careful consideration and discussion among BLM staff, BLM informed APS that shale green was the approved color for the monopole structures. The method of color treatment was left to the discretion of APS, as long as it was a durable, non-reflective surface. Though this would add cost and complexity to the project, APS understood the sensitivity of the resources at hand and agreed to proceed with the shale green color treatment of the monopole structures on the BLM portion of the project.

ALTERNATIVE MATERIAL FINISH ANALYSIS

Shortly after APS learned about BLM's selection and approval of the shale green color, APS was contacted by Natina Products (Natina), a company that color treats steel with a different type of chemical finish. Natina and APS discussed the possibility of using a product such as Natina Steel to color treat the steel monopoles. Though Natina's desert varnish color was not a match for the BLM shadow gray or shale green, the BLM team felt that it would be of value to review a sample of Natina Steel at the project site (Fig. 13). The potential advantage of this type of material finish was that it was not an additional coating or layer on top of the steel. The product reacts directly with the galvanized steel so was expected to age well.

Upon initial review, it appeared that Natina Steel would be a good option. The material had a low level of contrast in the immediate foreground and seemed to blend well with the soil and scattered rock. But the team concluded that it would be helpful to review additional simulations to compare the BLM shadow gray and shale green with the Natina Steel finish. Figures 14 through 16 show the progression of this simulation, starting with the new sample material, and comparing that to similar examples using the shale green and shadow gray colors.

The Natina Steel sample did blend well with the existing natural landscape, especially in the immediate foreground. However, it did not perform as well when the pole was in the background. That pole is the only structure clearly visible in the background of the photo while the shadow gray and shale green both appear to fade from visibility.

INITIAL COLOR TREATED SAMPLE STEEL PANELS

Within a few months, APS had received steel panel samples (24 inches × 48 inches) that had been powder coated with shadow gray and shale green. They also provided standard galvanized steel panels for BLM review (Figs. 17, 18).

We transported these samples to the original site where we had conducted the onsite assessment to keep a consistent landscape for evaluation. It was amazing how well the color treated steel panels matched the BLM color boards. It was also clear that these colors blended very well with the surrounding landscape.

Figure 14.—Condition existing prior to simulation. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 15.—Simulation showing Natina steel, shadow gray and shale green. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 16.—Simulation of selected color shale green. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 17.—Sample galvanized steel and powder coated panels. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 18.—Sample powder coated panels. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 19.—Monopole production at Valmont manufacturing: a) welding; b) steel work complete; c) ready for powder coat; d) ready for transport. Photos by Brandon Colvin, U.S. Bureau of Land Management.

SITE VISIT TO VALMONT MANUFACTURING FACILITY

In the summer of 2016, the BLM was notified that production had started on the shale green powder coated monopoles. I joined APS staff on a site visit to the Valmont manufacturing facility in Nebraska. This provided a great opportunity to witness the pole manufacturing process, from initial steel shaping and welding, all the way through final finish powder coating and transport. Figure 19 shows some of the stages of production.

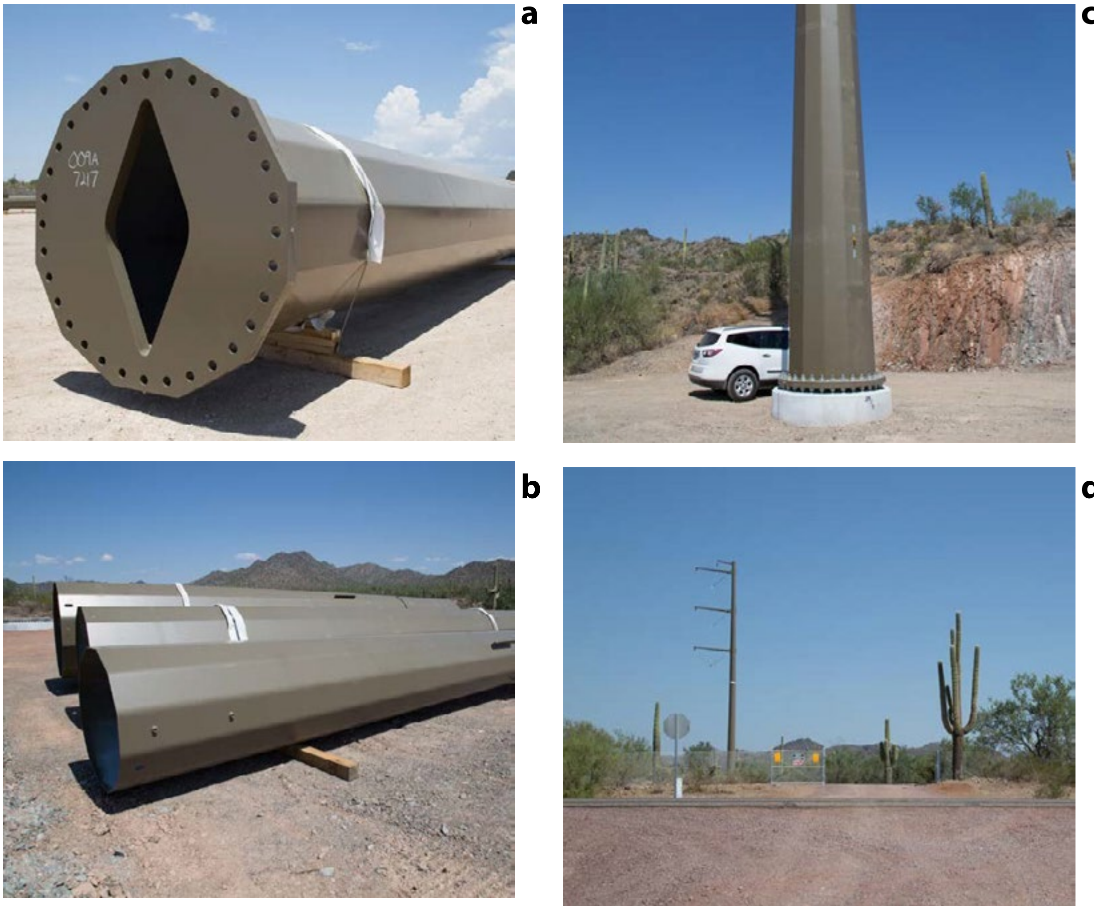


Figure 20.—Construction of the Sun Valley to Morgan 500kV Transmission Line began; a) powder coated monopole at staging yard; b) staged for placement; and c and d) erected. Photos by Brandon Colvin, U.S. Bureau of Land Management.

CONSTRUCTION PHOTOS

As of this writing, construction of the SV2M has been underway for a few months and some of the shale green powder coated poles have been installed (Fig. 20). They perform even better than expected. The poles are still noticeable from certain vantage points and are clearly seen when they are above the horizon (Fig. 21), but in all situations they fit into the landscape more appropriately than any of the other options.

The true test of the success of the color selection for these monopoles is when the structures are backdropped by the surrounding mountains (Fig. 22). In this scenario, the poles blend almost completely into the landscape. The galvanized pole on the right side of the image clearly stands out and attracts attention. The powder coated poles in the center and left side of the image often go completely unnoticed. This is exactly what BLM was working to achieve.

CONCLUSION

With so many energy transmission lines being constructed across the United States, many on public lands, it is important that we use readily available tools to simulate the visual aspects of these projects to make more informed project decisions. While simulations are often used in project analysis and assessment, they are rarely used in the initial stages of project planning and design. This leads to missed opportunities to use visual simulations to make informed decisions about what aspects of a project can be modified to reduce impacts to resources.

As the current trend of energy transmission development shows no signs of slowing in the near future, we must use simulation techniques to reduce the visual impacts of these projects. With some basic Photoshop skills, a little time, and some persistence in working with proponents, we can develop energy infrastructure that meets the needs of the public while preserving the natural scenic character of our amazing public lands in a more sustainable way.

Figure 21.—Powder coated monopoles with back lighting. Photo by Brandon Colvin, U.S. Bureau of Land Management.

Figure 22.—Powder coated poles front lit from same perspective as simulations. Photo by Brandon Colvin, U.S. Bureau of Land Management.

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ORGANIZING TRAILS: PROVEN METHODS FOR ORGANIZING THE COMPLEXITIES OF NATIONAL HISTORIC TRAIL IMPACT ANALYSIS

Craig A. Johnson, Visual Resource Manager, Environmental Planning Group[1]

Abstract.—National Historic Trail management and planning is a complex undertaking, and completing National Environmental Policy Act-related impact analyses for these trails is particularly challenging. With the involvement of multiple agencies and planning initiatives, developing an understanding of the regulatory and planning framework alone can be an arduous undertaking. Adding to the complexity, the trails involve multiple, overlapping resources with a wide variety of potential data sources that may or may not be available. However, by first organizing information into several key categories and then establishing impact thresholds that directly relate to these categories, National Historic Trail analysis can be successfully streamlined to focus on key factors. This paper introduces a proven approach to organizing and analyzing information to assess impacts to National Historic Trails, providing a concise and direct correlation between available data, analysis methods, and determinations of consistency with planning documents.

INTRODUCTION

Considering the linear nature of National Historic Trails (NHT), it is no surprise that analyzing National Environmental Policy Act-related impacts to these trails has become common for projects proposed across the country. This is perhaps most evident in the western United States where the NHT system includes a web of trails that commemorate western exploration, communication, emigration, and historic tragedies. As the National Park Service's National Trails Map illustrates, these trails often extend for hundreds of miles and cross a wide variety of land ownership types and management responsibilities. Managing and maintaining the trails involves various planning initiatives and resources, some of which extend far beyond the trails themselves.

This paper describes a method for organizing information about trails and associated resources and using this information to develop trail impact thresholds for proposed projects. This approach was used successfully to conduct recent impact analyses for projects such as the Riley Ridge to Natrona Pipeline project and the Boardman to Hemingway 500 kv Transmission Line project. The flow chart in Figure 1 illustrates how the regulatory and planning framework is related to data organization, and how this information relates to establishing impact thresholds, each of which are described below.

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REGULATORY AND PLANNING FRAMEWORK

In order to understand some of the key requirements and establish a methodology for organizing a trail impact analysis, we need to understand the regulatory and planning framework. The most directly applicable regulation is the 1968 National Trails System Act (NTSA) which was established to provide for the ever-increasing outdoor recreation needs of the expanding U.S. population. The purpose of the NTSA is to promote preservation of, public access to, travel within, and enjoyment and appreciation of outdoor areas and historic resources across the Nation.

Importantly in the realm of impact analysis, the NTSA allows for other uses along the trails but only if they do not "substantially interfere" with the nature and purposes of the trails (National Trails System Act 1993). For NHTs specifically, the NTSA states that their purpose includes identification of the historic route, associated remnants, and associated artifacts for public use and enjoyment, and that these components require Federal protection. The NTSA also established that administration and management of National Trails would be split between the National Park Service (NPS), USDA Forest Service (FS), and Bureau of Land Management (BLM).

In addition to the requirements of the NTSA, both the BLM and FS operate under multiple-use mandates that play a role in the management of NHTs. The Federal Land Policy and Management Act of 1976, otherwise

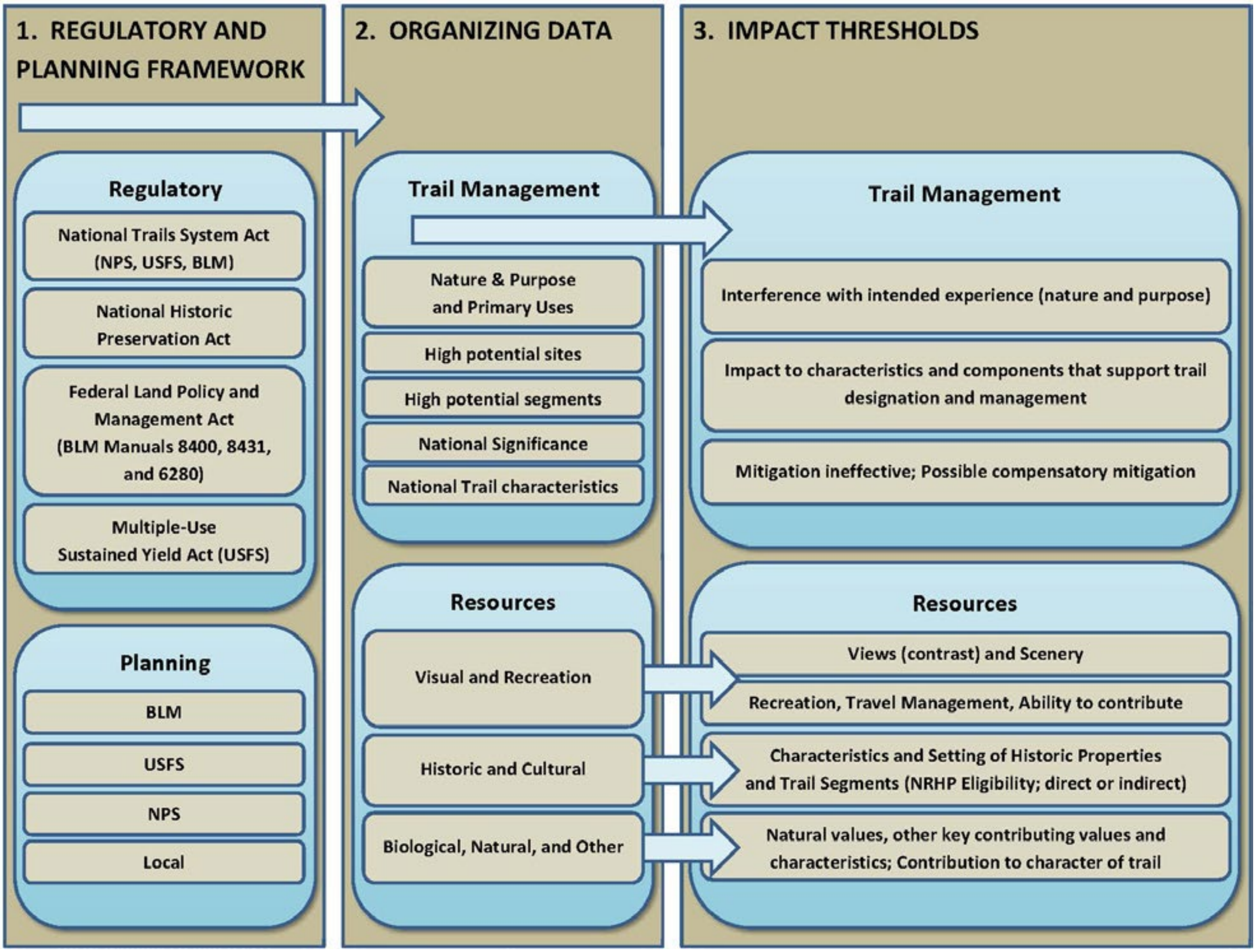

Figure 1.—National Historic Trails analysis flow chart.

known as the BLM Organic Act, established the BLM's multiple-use mandate. It defines the agency's responsibility to manage public lands and associated resources to meet the needs of the American people (Bureau of Land Management 2016). The FS's multiple-use mandate was established by the 1960 Multiple-Use Sustained-Yield Act which requires the FS to manage its natural and recreational resources in a manner that best meets the needs of the American people (Multiple-use Sustained-yield Act 1960).

Because NHT analyses include inventory and assessment of historic sites and trail segments, these efforts also overlap with Section 106 of the National Historic Preservation Act (NHPA). Established in 1966, Section 106 requires that analyses account for potential impacts to historic properties (including sites and trail segments) that are listed on (or are eligible for listing on) the National Register of Historic Places (NRHP) (National Park Service 2012).

In response to these regulations, numerous Federal and local planning documents have been developed. With regard to NHTs, this includes comprehensive management and use plans, corridor management plans, resource management plans, and general management plans developed by the BLM, FS, and/or NPS. Many local planning efforts also address NHTs including comprehensive plans for counties and municipalities near the trails.

In addition to regulations and planning documents, perhaps the most influential guidance for NHT impact analysis is the BLM's Manual 6280, Management of National Scenic and Historic Trails and Trails Under Study or Recommended as Suitable for Congressional Designation. This manual draws from the language and components of NHT-related regulations and provides a basic format for organizing data, regardless of land ownership and management boundaries.

INFORMATION AND DATA ORGANIZATION

The sheer amount of management and resource information can be overwhelming during the trail impact analysis process. However, organizing this information into four basic categories has proven to be an effective approach on recent, successful impact analyses. The four categories are: 1) visual and recreation resources, 2) historic and cultural resources, 3) biological, natural, and other resources, and 4) trail management (Fig. 1). The first three categories follow the basic format in BLM Manual 6280 (Bureau of Land Management 2012) and the fourth category is a catch-all for information about past or potential future management activities.

As a direct reflection of the regulatory and planning framework, trail management is perhaps the most complex of the categories. It encompasses the general requirements of National and Federal regulations; Federal, State, and local planning documents; and the direction provided in associated manuals, plans, and ordinances. Although trail management relates directly to NHT-associated resources, it is generally broader in focus and relates to the overall challenges of trail administration. This includes identifying impacts to the trails' nature and purpose, primary uses, and overall National significance. Federal agencies' abilities to manage the trails for public use and enjoyment, interpretation, education, appreciation, and vicarious experiences must also be taken into account. In addition, planning documents may include more specific and restrictive guidance such as exclusion areas, distance and viewing restrictions, corridor crossing limitations, and overlay zones.

With regard to NHTs, discussions regarding visual resources must include both impacts to the scenic qualities of the trails and impacts to viewers using the trails or associated trail features. Impacts to visual resources include both the degree of change and the context of the change in relation to the trails' periods of historic significance. Visual resource data may come from a variety of sources including existing or concurrent visual resource inventories and analyses (Schwartz et al. 2012). In general, this data should focus on key NHT-related viewing platforms (e.g., trail alignments, interpretive sites, and auto tour routes) and information regarding the landscape character and scenic quality surrounding the trails. Ideally, this information would be found within existing NHT inventory documents such as those required by BLM Manual 6280. However, these types of documents may not yet exist for some trails or trail segments. For example, because no NHT inventory had been completed for the Oregon Trail in eastern Oregon and western Idaho, recent efforts on the Boardman to Hemingway project required a separate inventory to ensure that basic data was available for the associated Final Environmental Impact Statement (FEIS).

Historic and cultural resources are associated with Section 106 of the NHPA and data about them can be collected from existing inventories and/or concurrent inventories and analyses. These data should center on contributing trail segments and cultural sites that are directly associated with the trail. The latter typically includes sites from within the trail's historic period of significance but occasionally includes historic monuments that were constructed later. Impacts to cultural resources can also include direct impacts to associated sites or indirect impacts to the integrity of the sites' historic visual settings (Johnson and Leonard 2013).

Biological, natural, and other resources could include features such as historic springs, other water sources, or historically characteristic vegetation communities. This category could also include resources that might have significant relevance for a particular trail but do not fit in the previously discussed categories. Data on these resources can be gathered from pre-existing and/or concurrent inventories and analyses.

Gathering and effectively organizing data about these resources and trail management activities are critical steps that create the framework and structure for establishing impact thresholds and simplify the overall NHT impact analysis process.

IMPACT THRESHOLD ESTABLISHMENT

Other local and Federal planning initiatives may influence additional thresholds if the proposed project crosses avoidance areas or violates other planning-related restrictions. Consistency with planning directives can be achieved by clearly and consistently tying thresholds to planning documents for a project area.

Thresholds for NHT-related visual and recreational resources are based on several factors beginning

Table 1.—Key issues and impact threshold examples

Categories	Key issues	Examples of high impact threshold
Trail management	Degree of interference with nature and purpose and primary uses. Degree of impact to characteristics and components that support trail designation and management (high potential sites, high potential segments, national significance, National Trail characteristics). If mitigations are ineffective, compensatory mitigation may be necessary. Must include alternatives that avoid adverse impacts (BLM).	Project would substantially interfere with the intended experience of the trail, as expressed in the trail's nature and purpose and primary uses. Project would adversely affect the characteristics and components that supported the trail's designation and the agency's ability to manage the trail for the designated purposes. Impacts would not be able to be effectively mitigated, requiring consideration of additional, compensatory mitigation.
Visual and recreation	Degree of impacts to viewers Recreational Residential Travel routes Degree of impacts to scenery Degree of impact to recreational uses and access	Contrast would demand attention and dominate views from trail components (and would be incongruent with historic characteristics). Project would be highly visible and views long in duration. Project would visually dominate high-quality or rare scenery where setting is defining factor for high potential route segments or as seen from historic properties and/or interpretive areas. Intact resource values, including recreation and National Trail-related travel management opportunities and values would be substantially compromised by Project. Values would no longer contribute to trail character.
Historic and cultural	Impacts to NRHP status/eligibility Direct impacts Indirect impacts (visual, noise, scent)	Characteristics and setting of trail-associated historic properties located in the trail corridor and trail segments would be severely modified to the extent that the characteristics and setting would no longer contribute to the NRHP status/eligibility of the trail (could include direct impacts on historic properties, or indirect impacts on the setting/feeling/association).
Biological, natural, and other	Impacts to NRHP status/eligibility Direct impacts Indirect impacts (visual, noise, scent)	Biological, natural, and other values, including any key contributing NHT values and characteristics, would be substantially compromised by the Project (e.g., a riparian area adjacent to a route segment follows what would be cleared for access roads) to the extent that values would no longer contribute to character of trail.

with the degree to which a project would attract the attention of trail users. The analysis must take into account the overall experience of the viewers such as the length of time viewed, viewer orientation, and visibility conditions. The degree to which a project would dominate or substantially change rare or unique scenic quality surrounding the trail must also be considered.

With respect to recreational resources, thresholds are bound to a project's potential effect on recreational opportunities and values along various portions of the trail. Access to recreational opportunities can include both informal trail features and developed trail facilities. The public can be highly sensitive to the condition of these features and facilities, but building or maintaining them can also conflict with other public interests. An example is the National Historic Oregon Trail Interpretive Center (NHOTIC), which was considered in the Boardman to Hemingway project FEIS. During the impact assessment process, public comments were fairly evenly divided between individuals who wanted the project to be closer to the NHOTIC to avoid greater biological impacts and those who wanted it farther away.

Thresholds for historic and cultural resources focus on how much the project would modify the characteristics and visual settings of historic properties, and the extent to which the project could affect the NRHP eligibility of the trail. Again, these thresholds apply to both direct and indirect impacts. Based on experiences with the Riley Ridge to Natrona Pipeline project and others, the degree of historic setting intactness can vary widely throughout project areas. Because of patchy development patterns in the western United States, landscapes are often not fully intact unless views are limited by nearby landforms or vegetation. Different levels of intactness must be taken into consideration when describing potential impacts to historic and cultural settings.

With respect to biological, natural, and other resources, the thresholds should relate to key contributing values and characteristics that could or would be compromised, and the degree to which they would no longer contribute to the character of the trail. These thresholds, in addition to those for visual and recreational resources, historic and cultural resources, and trail management elements, provide resource analysts and reviewing agencies with clear direction on how to evaluate a project's potential impacts, and how compatible those impacts are with existing planning direction (Table 1).

CONCLUSION

Considering how complex NHT assessments can be, it is critical to establish basic data organization guidelines and impact thresholds early in the assessment process. The approaches described in this paper have been successfully implemented during recent large-scale linear projects. The intent in describing these concepts is to provide an example of what has worked and to generate additional ideas for improving the NHT impact analysis process in the future.

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MODELING COASTAL SEDIMENTATION AND EROSION FOR DESIGN APPLICATIONS WITHIN THE FIELDS OF LANDSCAPE ARCHITECTURE AND ARCHITECTURE

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Abstract.—Uncertainty of future coastline geophysical conditions is increasingly magnified by the growing severity of acute and chronic weather events induced by climate change. In the face of these threats, 21st century coastal-human relationships will be characterized by temporality, response and recovery, and restoration. Understanding these dynamics will require visual exploration and application of theoretical conditions to future scenario generation. This research examines the development of an interdisciplinary three-dimensional visual modeling methodology to simulate erosion, storm surges, and sea level rise of a beach community in southern Rhode Island. Using historic data of coastal conditions for Misquamicut, Rhode Island, the researchers identified patterns of coastal change to model and simulate future shoreline conditions that incorporate local hydrological dynamics. The resulting sedimentation and erosion patterns were translated into an emergent modeling methodology that landscape architects and allied professionals could use to test a design concept through iterative, accurate portrayals of environmental systems.

INTRODUCTION

This project involves the creation of a workflow intended to simulate coastal conditions using three-dimensional (3D) modeling and geographic information systems (GIS) software. The purpose of this project is to devise new methods of accurately simulating interrelated natural phenomena, in order to project future scenarios upon a coastal area. These processes—including wind, erosion, water movement, and the spread of vegetation—can generally be understood as acting within a range of natural variation and predictability. Yet when combined as an ecological system, they may dynamically interact in ways that elude digital capture and simulation.

Landscape architecture does not have a single method or best practice for designing within the highly unpredictable parameters of coastal flux, which is rendered even less predictable by the specter of sea level rise. Software enables rapid site analysis of existing conditions and allows the designer to execute design ideas with ease. There is a gap between these two stages of analysis and design, where the landscape architect must attempt to understand the natural forces that may act upon the design site at any point in the future and respond accordingly with the design concept. It is this territory—between analysis and design—which this project inhabits.

The Need for New Software Workflows

Twenty-first century landscape architects face challenges of enormous complexity that demand increasingly sophisticated software workflows. Rising population density in coastal areas, coupled with an imperative to design resilient landscapes that can tolerate extreme weather events, requires adaptation of traditional design processes. This adaptation necessitates technology that can quickly respond to complex parameters and illustrate their potential outcomes in visually meaningful ways that can then be interpreted by designers. Taking into account the large number of variables and algorithms embedded in the behavior of coastal ecological systems, a single software application is unlikely to capture their behavior in its entirety. Rather, a digital workflow is needed for these tasks—a series of digital processes that passes information from one piece of software to another in a prescribed manner.

Digital media in landscape architecture has historically provided computer-aided design (CAD) workflows which establish formal elements within the design such as spatial dimensions, materials, and quantities. 3D modeling software has augmented this process

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and enabled further rapid iteration of spatial design ideas. The introduction of GIS software has broadened the CAD workflow to include geospatial aspects; currently, there is a strong and established workflow interoperability between CAD and GIS software (Cureton 2017). This interoperability facilitates analysis of existing conditions as well as testing of three-dimensional (3D) design ideas; for example, performing a viewshed obstruction analysis with ESRI's Spatial Analyst. Landscape architects also now have access to tools that enable reconstruction of terrain from LiDar and aerial imagery. These tools enable us to document existing site conditions and test very simple design interventions to understand their impact from a visual perspective.

Advances in Digital Simulation

Design clients are increasingly demanding evidence of design performance outcomes in the form of digital simulations, which have historically been the territory of engineers. In the field of architecture, building information modeling (BIM) fulfills this function by embedding information into 3D models, enabling improved planning and project delivery. It is imperative that landscape architects adopt intelligent 3D modeling processes, BIM or otherwise, enabling the design process to become situated between analysis and formation. However, landscape architects will need to develop their own processes to overcome software shortcomings that do not address the complexity and irregularity of landscape geometry or the agency and flux of the natural systems where interventions will be applied. Research has shown a crucial need to position digitally proficient designers at the outset of a project to address these factors, creating "toolmakers" who enable software proficiency to inform all stages of the landscape design process (Walliss and Rahmann 2016).

Some computational design researchers have begun to address this territory, developing algorithms that emulate and visualize the behavior of natural systems. An early precedent is "The Algorithmic Beauty of Plants," which presents fractal assembly methods that effectively simulate plant growth and variation (Prusinkiewicz and Lindenmeyer 1990). More recently, several volumes mark significant increases in application of this knowledge. "The Nature of Code" provides a framework for software simulation of natural forces such as gravity, friction, and velocity, enabling the designer to visually program these elements and understand how they act upon a 3D field using "processing" (Shiffman 2012). "Generative Art," a book on creative workflows, covers methods of visualizing fractals, growth, and emergent properties of groups of organisms (Pearson 2011). And in "Dynamic Patterns: Visualizing Landscapes in a Digital Age," several digital projects explore these phenomena through generative computational design approaches to the field of landscape architecture, with an environmental site-based approach to emergence, patterns, interaction, and feedback (M'Closkey and VanDerSys 2017).

Advances in 3D simulation have focused on simulating the flow of water on terrain. Work in digitally simulating riverine flows has produced valuable ideas regarding robotically controlled computation infrastructure to manage sedimentation (Cantrell and Yates 2015). Other research uses engineering software to simulate riverine water flow using geospatial analysis, computational fluid dynamics, and parametric software, providing output that has expanded the designer's ability to guide natural processes that are difficult to detect through immediate observation (M'Closkey and VanDerSys 2017). Austin Becker and Peter Stempel of the University of Rhode Island, in collaboration with the Coastal Resources Management Council, have digitally modeled storm surges and erosion to create visualizations of potential housing damage that future storm events may cause.

The Need for the Project

Each of these projects addresses a specific aspect of simulating natural systems within the built environment, yet landscape architects still need a tailored workflow to augment the overall design process. The goal of this project is to create a workflow that enables landscape architects to simulate future conditions of a site and create a responsive design proposal. Moving beyond simple strategies for visualizing sea level rise such as the "bathtub method" (raising the water plane to a prescribed inundation level), this research collectively visualizes erosion, sea level rise, and inundation as a result of storm surge. By using a range of geospatial, image editing, 3D modeling, and animation tools, the researchers were able to successfully model a hypothetical coastal storm event using numerous factors that had previously not been considered. The result is a reusable workflow that affords the designer a holistic appreciation of the impact of changing natural systems on design for coastal areas.

PROJECT OVERVIEW

This project aimed to simulate characteristics of the natural environment in order to understand design application within natural processes. A core goal of the project was to develop a digital workflow that was flexible enough that it could be applied to a broad range of coastal sites and conditions. Designing such a workflow required initial research to understand the range of software programs used by design professionals. Given that the project's aim was to create a workflow for landscape architects, architects, and urban designers, the team felt that the project's simulations should be created with tools most commonly used within the spatial design professions.

The methodology created through this research is intended to accomplish two goals. The first is to provide a realistic animated simulation of coastal ecological conditions. The second is to evoke a visceral emotional reaction in the viewer, as such reactions may enable the designer to more deeply understand coastal complexities, to visualize the irregularity and spectrum of natural forces, and to foment design inspiration. Through this methodology, we sought to add 3-D depth to systems that are often displayed two dimensionally. This depth allows ecological systems to make use of a familiar visual language—that of the 3-D world—that is routinely utilized for understanding spatial relationships.

The methodology was designed to align with scientific principles and research on the topics of sea level rise, erosion rates, and storm surge conditions. However, this methodology should not be interpreted as a system that can predict or forecast with exactitude how these coastal systems will evolve under acute and long-term climatic stresses. The complexity of these systems, the translation of their principles into a workflow more familiar for designers, and the process of working in multiple software programs all contribute to some loss of precision. Instead of a predictive modeling tool, this methodology should be seen as an addition to growing endeavors in visualizing natural systems for design applications. Digital and physical modeling are integral to how designers perceive environments, test design strategies, and understand spatial representations. Our introduction of a new technique for modeling coastal erosion and hydrologic systems should be seen as adding to this modeling discourse by leveraging advances in computational power and efficiency to create relatively quick, iterative models of complex phenomena.

Assumptions

The team made some key assumptions in order to make the methodology more accessible and streamlined. These assumptions allowed us to focus on developing certain key aspects of the workflow. We believe that these assumptions do not hinder the integrity of the process and the final outcomes despite the uncertainty of so many future factors that could alter outcomes such as sea level rise, storm frequency, ocean warming, and coastal development trends. Regardless, in future phases of the project, some of these assumptions may be revisited and explored further in an effort to offer increased accuracy.

The first major assumption was that erosion rates would remain constant throughout the timeframe explored. Though it is known that erosion rates change frequently, to simplify the process an erosion rate spectrum was created by using a low erosion rate of 0.25 m/yr and a high erosion rate of 0.5 m/yr (which is greater than the average recorded rate in that area since 1939) (Boothroyd et al. 2015). These rates were selected to account for the variation of erosion rates throughout 50- and 100-year time frames. The erosion rates were also selected because of the uncertainty about sea level rise rates over the next 100 years. Rising seas are predicted to increase erosion rates due to a wave's ability to erode higher elevated materials and to maintain its force before breaking because of a lower seabed. Given these variables and the uncertainty of how they will play out in the real world, the team defined a single fixed erosion rate for the project.

The second assumption was that the material composition of the coastline would remain fixed with no further armoring or nourishment. Though existing armoring in the study area suggests that further construction could occur, the team felt that there was too much uncertainty about when and how it would take place. There was, for example, uncertainly about which armoring methods might be applied, when such armoring might be undertaken, and overall future development trends in the area. Coastal nourishment programs that restore naturally eroded coastline are undertaken either to mitigate chronic erosion or in response to a severe storm. Because of the high cost of nourishment programs and the uncertainty of severe storm systems, the presence of coastal nourishment programs was not considered as part of this project. However, it is possible to account for planned nourishment with the current methodology.

The accuracy of the project's methodology is to some degree limited by these assumptions. Because of this, the methodology should not be used to highlight individual real estate at risk of inundation or foundation erosion. The methodology also does not demonstrate how wind would impact the ways that water would disperse on land during storm events, and therefore it should not be used to describe the full extent that water could navigate throughout a site. Rather, it should be used for making broad inferences and discoveries about coastal ecological systems and their impacts on design sites.

METHODS

The modeling of coastal erosion, sea level rise, and storm surges to create future scenarios first required gathering a current topographical model that could be the base for further augmentation. We acquired a digital elevation model (DEM) from the U.S. Geological Survey's (USGS) National Map Viewer. The DEM of Misquamicut, Rhode Island, was imported into in ESRI's ArcMap GIS software. Using orthoimagery provided by ESRI's online database, we determined site extents and trimmed the DEM to the extent of the study area.

To create erosion scenarios for future conditions, we researched past erosion rates for the site. We examined the Rhode Island Geographic Society's historic erosion rates since 1939. From those rates, we created high and low erosion scenarios. We decided on a low erosion rate of 0.25 m/yr and a high rate of 0.5 m/yr because they represented the two extremes experienced on the site. Though 0.25 m/yr was not the lowest erosion rate in the historic data, we selected it because of the effects of climate change. We assumed that future erosion will accelerate beyond past rates as a result of higher sea levels and increased storm severity. The high erosion rate scenario of 0.5 m/yr is conservative for the same reasons. We used these erosion rates to create 50- and 100-year scenarios for both the high and low erosion rates (Fig. 1).

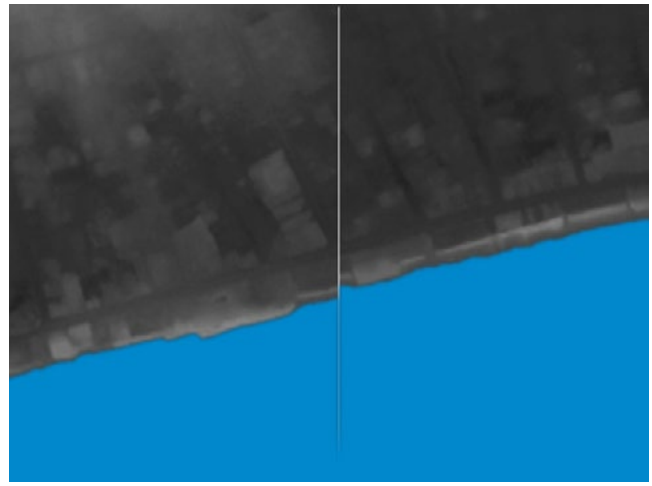

Figure 1.—Original DEM (left) and low erosion rate +50 yr scenario (right).

We then imported the DEM of Misquamicut, Rhode Island, into Adobe Photoshop using a plugin named Geographic Imager. This tool allowed us to "translate" the coastline of the DEM in response to the distance determined by the erosion rates and the timeline. We accomplished this translation using Photoshop's clone stamp and its measure tool, which allowed a fixed distance to be maintained as the coastline was modified. Using these tools, the coastline of the DEM was retreated to create basic erosion scenarios (Fig. 2).

We exported these modified DEMs from Geographic Imager and imported them into Rhinoterrain, a plugin for McNeel's 3D modeling tool Rhinoceros (Rhino). Rhinoterrain turned the imported DEMs into 3D models of the topography. We created a flat plane, which represented a simplified measurement of sea level height, at 2 ft, 4 ft, and 6 ft above current mean tide where it intersected with the terrain model. However, this method was limited in value. It would only show flooded areas that were of the same elevation as the plane and it was not able to account for a dynamic ocean that would more deeply inundate certain areas because of wave action and wind. To create a more realistic model, we needed to create an animated simulation of waves and water flow.

To create this simulation, we decided to integrate Autodesk's 3D animation modeling program Maya and its water modeling simulator Bifrost. Maya and Bifrost are more frequently used by the animation industry than by the building industry but they have value as modeling tools because they can create hydrological

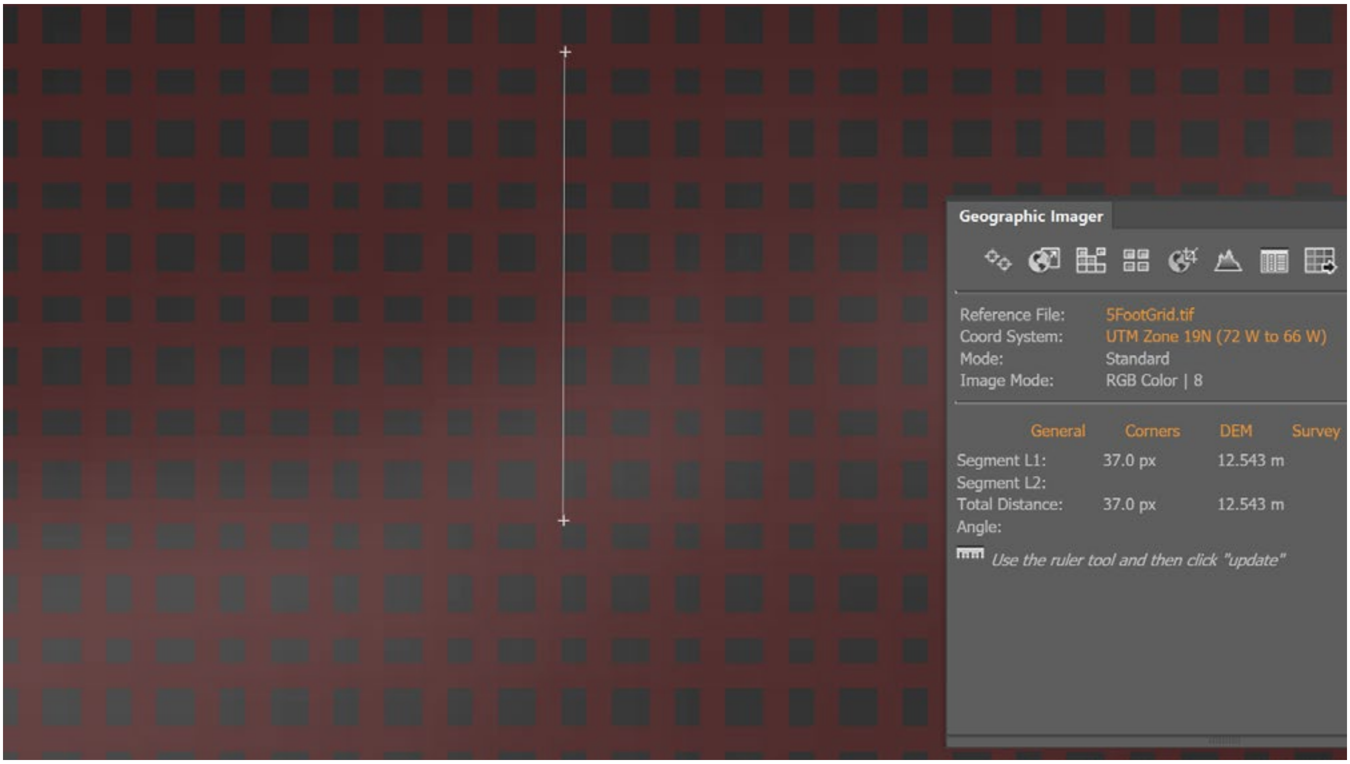

Figure 2.—Grid layout using Geographic Imager in Adobe® Photoshop® showing distance measurement overlaid onto modified DEM.

simulations that use physics-based fluid computations. This is done through Bifrost's fluid implicit particle solver for creating animations of various fluid types and scales. We understood the potential of these tools to create a large-scale body of water that could behave like an ocean, enabling us to generate more realistic storms systems and sea level rise scenarios.

To create this digital water body, we chose a storm surge scenario. The first step in modeling this scenario was to understand the potential height of such a storm surge. For this, we used the Sea, Lake, and Overland Surges (SLOSH) model from NOAA's hurricane modeling system to provide storm surge ranges for the site's general vicinity. We used a category 1 hurricane to estimate the height of a storm surge. We chose a category 1 hurricane because of its higher probability of occurrence. Because of this methodology's flexibility, it can be amended to accommodate any storm surge scenario.

Because of the computational power required to produce the animations, we divided the site into smaller sections. We exported each section from Rhino and imported it into Maya. We created a polygon to fill a basin representing the site's bathymetry and scaled it to touch a plane that represented the height of an 11 ft storm surge; the SLOSH program determined that this height was possible. We transformed the polygon into the Bifrost liquid that would interact with a geometry that would create a force to propel the water toward the beach in a fashion similar to stormy waves (Fig. 3). We used deformers to modify the geometry to create regular, semi-unique wave forms of customizable heights, shapes, and frequencies that would roll in a prescribed direction over time. We could increase or decrease their influence to modify their effect on the fluid.

To create the kind of periodic irregularity that would occur in swirling winds and turbulent waters, we added a paddle to the rear of the basin to create occasional fluctuations in the storm surge's height. We animated the paddle to oscillate along the x-axis at a speed that matched the waves. We programmed an expression into the paddle's amplitude to add a cross wave as it oscillated. This helped to create a more dynamic effect within the ocean waves (Fig. 4).

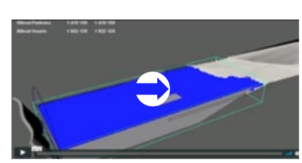

Figure 4.—Video of Accelerator + paddle with 11ft. storm surge (click to play video).

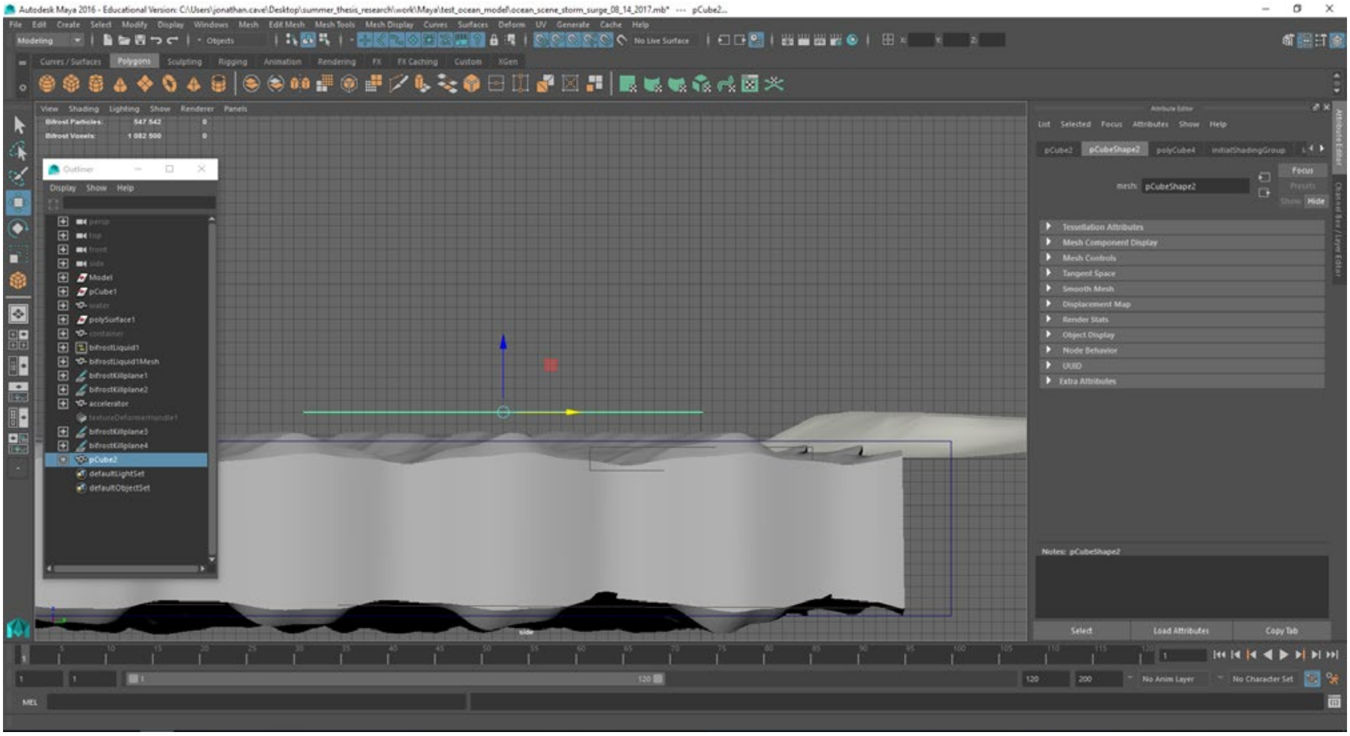

Figure 3.—Accelerator with 11 ft storm surge.

Figure 5.—Video of storm wave in Maya showing current conditions with storm surge (click to play video).

We ran a series of playblasts—short, screenshot videos—to develop draft videos before creating the animation and a mesh. We exported this animation to create the first movie depicting a storm surge on Misquamicut's current coastline condition (Fig. 5). To observe the impact of erosion on a storm surge, we imported the erosion terrain models to replace the existing terrain model. This enabled many possibilities: We could rerun the animation to visualize the difference between the two conditions under the same storm surge or modify the process to depict a higher mean tide to simulate sea level rise or a more forceful storm surge to depict a stronger hurricane or Nor'easter (Fig. 6).

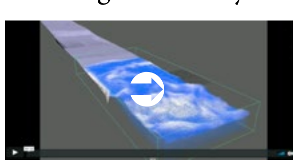

Figure 6.—Video of storm wave in Maya showing 6ft. of sea level rise + 25m/yr. erosion rate (click to play video).

FINDINGS

The use of Bifrost in conjunction with our topographic models began to demonstrate how the ocean could interact with coastal conditions at varying degrees of intensity. Once we simulated a storm surge, we could see water breaching coastal barriers, posing a risk to infrastructure, settlements, and vulnerable ecologies. The simulations were able to demonstrate how both human and natural ecologies might become more vulnerable to periodic, semi-regular, and chronic inundation. Further development of this simulation model would add structures and natural systems that would further interact with the water as it breached the natural and human barriers. For our site, this would entail adding Winnapaug Pond, Little Maschaug Pond, and the buildings that occupy the coastline.

This methodology helped us to create quick representative models of coastal change and process that improved our understanding of the coastal systems' complexities and irregularities. On a personal level, we discovered that the process of creating these animations was as meaningful and informative as viewing the final animation. Creating physical iterative models of coastal systems can be challenging because of the difficulties of generating accurate fluid simulations, especially at scale. Yet the process of modeling is an essential explorative method in analysis and design formation, a "tool people use to organize their mental perceptions of perceptible, phenomenal reality" (Centofanti et al. 2014). Through engaging in this process of digital modeling, the dynamism of the coastline becomes more observable and intellectually and emotionally understood.

The final animation that we created highlighted the strength of this new methodology as an iterative process. Because we modeled the fluid simulator independently of the coastal topography, we could change locations and scenes or augment the landscape to see how these changes would influence the interactions between the various modeled factors.

DISCUSSION

While it relied heavily on scientific data, this process contained significant trial and error. This was due to the continual translation of scientific principles that dictate natural systems for software workflows. Especially in the later stages of the project when animations were generated, results were often unexpected and surprising. To verify accuracy, the team would watch videos of coastal storm events to understand whether the exported products of our methodology shared similar properties with real-life events. Although the final animations match the visual behavior of similar water bodies, some technical discrepancies can be expected. The team believes that with the consultation of an oceanographer and a digital artist who is an expert in Maya and Bifrost, a more precise model could be created.

Through this process, we understood that there was potential to add error when retreating a coastline within Geographic Imager and Photoshop. However, because there is inevitable flux in actual erosion rates over time, we did not consider the minor distance variation a drawback to the methodology.

Although the first iteration of this workflow is complete, the team has been unable to test it at the full site scale due to the unavailability of a computer that offers sufficient computational power. While we do not believe a large scale will alter our core methodology, we cannot say for certain what effect it would have. For now, we are using representative sections of various topographies across the study site.

These challenges in the methodology do not diminish the applicability of this modeling approach but rather invite even greater collaboration. Currently, scientists use many modeling methods to explain natural systems that design professionals do not use. It is our belief that, while it is important that these methods are integrated into the design process, these models are most effective when initiated by the scientific community. We are excited about this methodology's potential to work with tools that are geared toward designers but have input and direction from the scientific community. We believe this process opens a dialogue between the parties to exchange information and methodologies that are more familiar to each discipline, with the aim of further understanding both the natural system and modeling processes.

On a conceptual level, the ability to view these dynamic natural systems in action elicited a sense of wonder, awe, and even fear in the team. This may signify the potential to augment the designer's mental approach to the tasks and provoke a more fundamental appreciation of the dynamic systems within which they plan to intervene. These systems, which are typically represented in landscape architecture as static images in plane and section, can be seen as time-based phenomena acting upon the design site. The ability to view water moving into a site repeatedly and to consider this scenario playing out over weeks, months, and years may lend the designer a deeper sense of the impact or nonimpact that their design could have.

It is our hope that a methodology like this can further the dialogue between disciplines to create more visual languages and new perspectives on ecological conditions. This methodology builds off others that are being introduced into the design professions and it is our hope that others will adapt these principles in new ways to improve our analysis and understanding of ecology and inspire new approaches to landscape design.

CONCLUSION

Adding this methodology to the existing set of computational 3D modeling workflows will help scientists and landscape designers understand the challenges of climate change in the 21st century and beyond. These kinds of techniques have the power to help designers, developers, and politicians make informed decisions about coastal settlements and natural ecologies. It is our hope that such tools will enable effective decision making that can preserve the visual, cultural, and ecological functionality of our coastlines in the midst of great climate change and uncertainty.

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EXPANDING THE USE OF VISUALIZATION TECHNOLOGY: 3D MODELING

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Abstract.—The Bureau of Land Management (BLM) uses three-dimensional (3D) models viewable in Google Earth in addition to traditional visual resource analysis tools to plan, visualize, and mitigate new landscape-altering projects. A rough model can be made in minutes, allowing for quick and inexpensive pre-planning. Even when sites are inaccessible due to winter snow, timing, cost, or other access issues, modeling gives an approximation of the look of the final project and identifies scenery concerns. Alternatives can be worked through "on the fly" during meetings with stakeholders or in the field (with an internet connection), and mitigations can be made before major time or expense has been poured into an alternative. When project proponents submit a final project design, sophisticated 3D models show the project more intuitively than any diagram or text could, since people naturally think and react to their world in 3D. As a Google Earth file, the model can be easily shared over email or Website to any stakeholders or members of the public who have this free program on their computer. Viewers can investigate how the project looks from whatever viewpoints interest them and not be limited to the handful of viewpoints chosen by the agency. Finally, models help create photographic visual simulations when working with unusual facilities or dirt work (i.e., soil grading) that cannot be simply copied and "Photoshopped in" from other projects.

INTRODUCTION

The Bureau of Land Management manages 248 million acres, approximately one-eighth of the landmass of the United States, and 700 million acres of subsurface minerals, for the benefit of current and future generations (Bureau of Land Management 2016). The Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et. seq.; 1. Section 102 (a) (8)) governs how the BLM lands are managed, and among its requirements is that "... the public lands be managed in a manner that will protect the quality of the ... scenic ... values." However, it also requires the BLM to support multiple resources that can affect scenery, including energy development, infrastructure rights-of-way, grazing, wildlife, archaeological and heritage conservation, and recreation. The National Environmental Policy Act of 1969 (43 U.S.C. 4321 et. seq.) requires the BLM to consider how a proposed project could affect the area's scenery, also called visual resources.

The BLM's visual resource management framework is similar to that of other land management agencies. First, existing visual qualities are inventoried and management goals are determined, then effects to visual resources from a particular project are predicted, and finally changes are made to the project, if necessary, to mitigate visual impacts to achieve management goals (Bureau of Land Management 1984). To predict impacts to visual resources, the BLM uses the Contrast Rating Process. First, locations of the most critical viewpoints are determined. Then, the basic features (i.e., landform/water, vegetation, and structures) and basic elements (i.e., form, line, color, and texture) of the existing scenery are documented, and the extent a project will alter and contrast each scenery element is rated. Contrast ratings are based on the professional judgment of the visual resource professional and their experience with similar types of projects. Occasionally, a two-dimensional (2D) visual simulation of the project on the landscape is created to help portray the relative scale and extent of the project (Bureau of Land Management 1986).

While contrast rating and visual simulations provide a methodical, repeatable framework to analyze visual impacts, they have some shortcomings. There can be subjectivity in determining contrast ratings and creating visual simulations, and the validity or reliability of the methods has been criticized (Feimer and Craik 1979, Smardon and Litton 1981). A project's novelty can increase the chances for inaccurate visual

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impact predictions, such as recent attempts to analyze new solar array designs (Sullivan and Abplanalp 2015, 2017). In addition, there are guidelines, but no standards, about how to select the viewpoints from which the project is judged. Finally, the public is often not effectively involved in the visual analysis process (Churchward et al. 2013).

In response to these criticisms, the BLM expanded the use of visualization technology by creating virtual 3D models of projects on a landscape. Three-dimensional computer modeling should be considered an additional tool that can increase prediction accuracy and aid in stakeholders' and the public's understanding of project impacts.

This paper describes simple and complex 3D modeling using Google Earth Pro, a free, widely available landscape imaging software. The paper then describes the benefits and disadvantages of 3D modeling compared to more traditional visual resource analysis tools.

RELATED WORK

The book Guidelines for Landscape and Visual Impact Assessment also discusses 3D modeling in conjunction with 2D visual simulations (Landscape Institute and Institute of Environmental Management & Assessment 2013). However, the utility of 3D models as a stand-alone tool is not examined and no specific software or examples are detailed. Technological innovations in computer capabilities make 3D modeling a rapidly evolving area of visual resource management.

MODELING EXAMPLES

At the simple level of 3D modeling, the user does not create a model from scratch. Instead, pre-made models of common project equipment such as power poles, recreation kiosks, or oil and gas tanks are inserted onto their project's position on the landscape. The simple level of modeling does not require the user to know how to make a model or use any modeling software. The most recent imagery in Google Earth is the baseline or existing environment, and a model (saved as a COLLADA file) of project equipment is created in the precise location using Google Earth Pro's "Add Model" command. This creates a rough model that can be inserted in a manner of minutes with very little computer expertise.

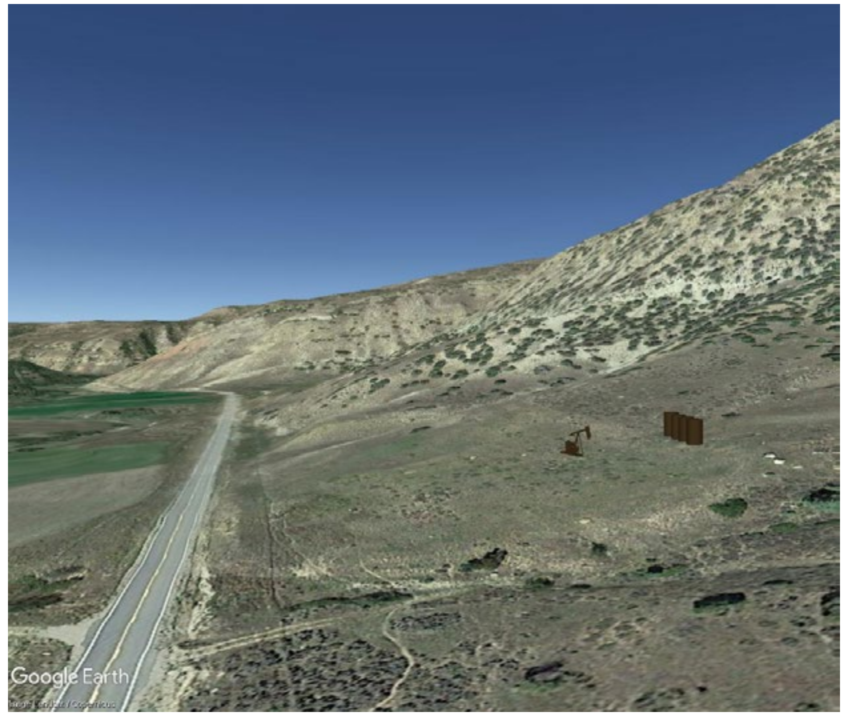

Figure 1.—Simple model of pumpjack and oil tanks. Google Earth.

These simple models are useful for low-controversy projects, for early planning of larger-scale projects, and for users without familiarity of modeling software. The model can be viewed in Google Earth, and a 2D image can be saved to share in a report or analysis. Figure 1 illustrates an image from a model for an oil well pad made in this way. The basic equipment (pumpjack and tanks) is visible, giving viewers a rough impression of where the project will be visible from, and how it contrasts with its surroundings.

At the complex level of 3D modeling, the user creates a unique and detailed model from scratch using modeling software. All aspects of a project are created, including unique features such as the shape of dirtwork cuts and fills, or unique equipment such as a novel processing plant facility. Modeling software allows the models to be made to precise dimensions and accurate colors. In addition, any trees or human-made structures around the proposed project can be modeled to more clearly show how the project contrasts with its surroundings, and a model of the existing area can be built to use as a baseline for comparison. The models can be saved as Google

Earth files (.kml or .kmz) and shared online for viewing by anyone with Google Earth. Two-dimensional images of the models on the landscape can be saved and used in reports or analyses. Figure 2 shows the same oil well pad project from Fig. 1, but this time with precise dirtwork cuts and fills, all project equipment, and the trees already present in the surrounding area.

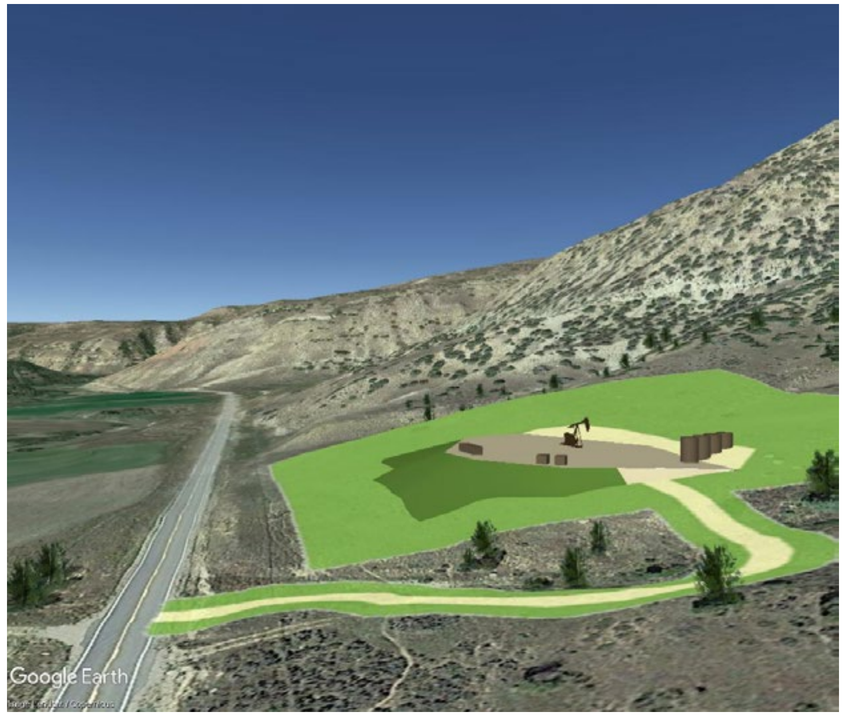

Figure 2.—Complex model of oil well pad. Google Earth.

BENEFITS

One benefit of 3D modeling is that it mimics how people naturally experience the world: in 3D. This is an improvement over both written descriptions and 2D images, which must be "translated" in the brain to create an impression of what the real-world project will look like. Also, 3D modeling allows the project to be viewable from changing perspectives, and users can create "walk throughs," "drive bys," and "fly bys" that mimic how they would likely interact with the project. The models are sharable online to anyone with Google Earth. This benefit increases the accessibility and understandability of the project and associated analysis for both the general public and experienced stakeholders.

These models are also unique in that they can be viewed from an infinite number of viewpoints. With traditional contrast ratings or visual simulations, a small handful of viewpoints are chosen and the project is analyzed from there. This is of limited usefulness to a stakeholder who is interested in how the project looks from a different viewpoint, such as from their front porch or favorite hunting spot. With a 3D model, once the model is in Google Earth, the user can "fly around" Google Earth and look at the model from anywhere.

Another benefit of 3D modeling is that no site visit is required in order to make it (although a site visit, in addition to other visual resource analysis techniques, is recommended for final analysis of higher-profile projects). A model can be made using just the construction diagrams or description of project attributes, and it can be input into a precise location on Google Earth from the comfort of your computer. This allows visual impact analysis to be completed when site visits are impossible, such as during the winter season or during road access disagreements. Many project alternatives and locations can be roughly modeled quickly, decreasing costs by identifying problems, preferred alternatives, and proper Key Observation Points before site visits and detailed design work is started.

Finally, these 3D models can complement 2D visual simulations. They can be used as checks on the placement and proper scale of equipment that is photo-montaged into landscape pictures, which is particularly useful for unique equipment or dirtwork. If no other image of equipment exists, the model can be rendered into a realistic image and input into a landscape picture. Using 2D and 3D tools in conjunction with each other can increase the accuracy of visual impact predictions.

DRAWBACKS

As with any new technology, low awareness of the tool and lack of familiarity using the tool decrease its use. Just to view a model on Google Earth, a person needs access to a computer, internet, and knowledge about use of Google Earth software. Creating a new model requires skill in a 3D modeling software. Google Earth Pro can also save a 2D image of a 3D model. However, if a user only has access to the 2D image, they lose some of the features and benefits of the 3D model.

Topography is another challenge. Google Earth creates ground contours from digital elevation model data collected by NASA's Shuttle Radar Topography Mission. This data has a vertical elevation precision of 30 meters (Wikipedia 2017). While a 30-meter difference is imperceptible for large hills and mountains in the distance, it can create noticeably wrong slopes on a specific project site. It is also difficult to show cuts or holes below the existing ground contours. In addition, the colors of the ground cover are not true-to-life and often are not available for all the seasons of the year.

The above drawbacks are technological in nature and may improve as technology improves. More fundamental drawbacks concern the misuse (intentional or otherwise) of simulations to sway decision making. As Sheppard (2001) emphasizes, visual simulations can strongly influence the public and decision makers, but there are no standards or simple checks to ensure that a model is accurate. Model inaccuracies include wrong size of equipment, unrealistically healthy or dead vegetation, or viewpoints that hide the project. These inaccuracies could over- or under-predict the impacts of a project but are hard for decision makers to detect until the project has been built. There are no widely agreed upon standards for model builders to ensure that they create trustworthy models.

Finally, while 3D modeling can show what a proposed project will look like, it does not determine whether the visual impacts are within management goals. The visual resource professional still needs to judge whether the resulting view is within some threshold level of acceptability, and identify mitigations if needed.

CONCLUSION

Three-dimensional computer modeling is an emerging technology that can increase visual impact prediction accuracy and improve stakeholders' and the public's understanding of project impacts.

ACKNOWLEDGMENTS

This work is made possible by support from the U.S. Department of Interior, Bureau of Land Management.

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ABSTRACTS

GIVING LANDSCAPES A VOICE: THE USE OF SOCIAL MEDIA AND WEB-BASED SURVEYS IN BLM'S VISUAL RESOURCE INVENTORY PROCESS

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Chris Bockey, Environmental Planner/Visual Resource Specialist, Logan Simpson
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Abstract.—In the early 1980s, the Bureau of Land Management (BLM) developed a Visual Resource Management Program to inventory and set management objectives for scenic resources on BLM lands. The visual resource inventory (VRI) provides the foundation for managing the visual landscape at a regional scale and for planning projects and activities. One of the three components of conducting a VRI is gathering information to measure or evaluate concern for scenic quality or sensitivity to change within the visual environment. Historically, this sensitivity assessment was comprised of six factors evaluated and rated by BLM staff based on their knowledge of the area and interactions with the public. As VRIs have evolved, discussions have led to creating a more comprehensive and inclusive process for obtaining sensitivity information from both the public and BLM staff.

As society has gravitated toward increased online interaction and expectations for Web-based information, the wealth of data worth analyzing and collecting has grown. As part of the Grand Staircase-Escalante National Monument (GSENM) VRI, a Web-based platform was developed to augment the sensitivity level rating process. The multi-pronged approach focused on efficient collection of BLM staff knowledge while also exploring public perceptions and attitudes about the GSENM landscape via social media platforms. A Web-based interactive survey platform was developed to capture information from GSENM staff. The project team supplemented staff survey responses with information about GSENM captured from social media and travel Websites.

Reviewing quotes, photographs, and locations shared online by the public improved the team's understanding of place-based visual sensitivity amongst social media users. When combined, the social media information and local BLM knowledge about the public provided a more robust dataset for the GSENM VRI.

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VISUALIZING LANDSCAPE IMPACTS: THE DEVELOPMENT AND APPLICATION OF A NEW SPATIAL ANALYSIS TOOL

Brent C. Chamberlain, Assistant Professor, Utah State University[1]

Abstract.—Balancing cultural and ecological planning objectives can be simultaneously rewarding and exceedingly challenging. This work highlights a custom viewshed analysis tool that has been applied in conjunction with: 1) an ecosystem service-oriented spatial analysis method to investigate the relationship between visual aesthetics, cultural significance, and ecological value of the landscape; 2) operational forest planning over large landscapes; and 3) assessing differences between highway scenic routes within the United States. The tool enables a nuanced representation of visual quality, providing a very different result than the standard (binary) representation. It combines concepts of visual magnitude, a computationally efficient algorithm, and a representation of the continuous experience, to help planners and scientists better evaluate potential visual impacts or opportunities stemming from planning projects. Visual magnitude creates a normalized value of potential impact and, when coupled with a route, offers a significant improvement over traditional viewshed methods for evaluating impact across large spaces. The tool also calculates perceived horizon and ridgelines (as opposed to geographic ridgelines). These analyses enable planners and scientists to identify possible visual obstructions or unsightly changes to important physical features, offering an expedient way to estimate possible visual impact. Currently, these analyses are often done using three-dimensional (3D) visual renderings, which can be cumbersome and expensive. Overall, this presentation provided insights learned through practical application and vetted through scientific peer-review with the aim of providing new tools to support visual resource stewardship.

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A VISUAL ANALYSIS METHODOLOGY APPLIED IN URBAN ENVIRONMENTS: PUBLIC PARTICIPATION AND ALTERNATIVES ANALYSIS

Darrin Gilbert, Senior Project Manager, POWER Engineers, Inc.[1]

Jason Pfaff, Manager of Innovation, POWER Engineers, Inc.

Abstract.—We presented a process for evaluating visual impacts and engaging the public for projects in urban areas. Currently, much of the focus on visual resource analysis is on natural or pristine landscapes. However, the greatest need and some of the most intense opposition comes from projects located in urban environments where over 80 percent of the population lives, works, and plays. Having a defensible methodology and engaging the public in the evaluating visual resources helps to inform project design and is critical not only to obtaining state and local permits, but in helping to protect our sensitive developed landscapes. We presented a case study review involving the development of a 230 kV transmission line.

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EMERGING TECHNOLOGIES FOR VISUAL RESOURCE MANAGEMENT

Shawn Jackson, Senior Project Manager, POWER Engineers, Inc.[1]
Jason Pfaff, Manager of Innovation, POWER Engineers, Inc.

Abstract.—We presented the latest tools and emerging technology for visual resource managers. Augmented reality, virtual reality, drones, and advanced visualization technology can help analyze, design, and plan for new projects in the seen environment. When used with traditional visual management systems—in the field or for desktop review—these tools can promote best practices and facilitate better communication with the public and regulatory agencies.

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3D-DSS: A NOVEL DECISION SUPPORT SYSTEM FOR COMMUNITY DIRECTED GREEN INFRASTRUCTURE DESIGN

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Victoria Campbell-Arvai, Assistant Research Scientist, University of Michigan
Alec Foster, Research Fellow, University of Michigan
Shannon Sylte, Research Assistant, University of Michigan
Frank Deaton, University of Michigan

Abstract.—Green infrastructure (GI) can have a positive ecological and social contribution in urban environments and is also seen as an essential component in efforts to rebuild the resilience of legacy cities. Despite the recognized importance of GI, there is a missed opportunity to more fully involve residents in GI planning and design, which can lead to more successful and resilient outcomes. Integrating the concept of ecosystem services (ES) into public participation processes can enhance outcomes but requires robust decision support systems (DSS) that can more effectively incorporate community needs. Complicating this integration is the challenge that the value of specific urban ES will vary greatly both between and within cities, influenced by the environmental and socioeconomic characteristics of the community in question. As such, collaboration and engagement with community members to specify the ES that are important and meaningful to them must be a part of any GI initiative and requires a DSS that is flexible and adaptable to different communities and contexts. Our presentation described the development of a novel DSS that uses structured decisionmaking to identify stakeholder needs which are then incorporated into a three-dimensional (3D) visualization-based DSS using the Unity game engine. The DSS is evaluated in the context of a greenway planning and design project Detroit, MI, that included multiple stakeholders with varying interests.

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Gobster, Paul H.; Smardon, Richard C., eds. 2018. **Visual resource stewardship conference proceedings: landscape and seascape management in a time of change.** Gen. Tech. Rep. NRS-P-183. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 279 p. https://doi.org/10.2737/NRS-GTR-P-183.

Contains 27 papers, 5 abstracts, and 7 visual case studies from the Visual Resource Stewardship Conference: Landscape and Seascape Management in a Time of Change, held at Argonne National Laboratory in Lemont, Illinois, on November 7–9, 2017. The material covers topical themes related to Federal Agency programs and policies, theory and concepts, visual quality assessment, visual impact assessment and mitigation, and visual resource management tools and technology. The visual case studies emphasize visual presentation of material with supporting text descriptions.

This document is being published in electronic format only. Any corrections or additions will be posted to the Website: https://doi.org/10.2737/NRS-GTR-P-183.

KEY WORDS: visual resource management, scenery management, landscape assessment, visual landscape inventories, landscape visualization