NCHRP

REPORT 741

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

Evaluation of Methodologies for Visual Impact Assessments

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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FOREWORD

By Nanda Srinivasan
Staff Officer
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This report provides an evaluation of methodologies for visual impact assessment (VIA). The report (a) evaluates state department of transportation (DOT) VIA procedures, methods, and practices that satisfy or exceed National Environmental Policy Act (NEPA) and other requirements; (b) documents the use of different methodologies and approaches used by DOTs; (c) describes decision making frameworks used at state DOTs to undertake specific VIA techniques for a given project; (d) documents proven successful methods; (e) describes best practices illustrated by model case studies; and (f) documents promising new developments.

The report will be of broad interest to state, regional, and local planners, project development staff, and environmental staff.

NEPA requires that visual impacts be considered for transportation projects. In 1981, to assist state DOTs, FHWA developed *Visual Impact Assessment for Highway Projects* to provide guidance in analyzing and quantifying visual impacts for highway proposals. Throughout the country, this remains the standard methodology to identify visual impacts for highway improvements. In recent years, some DOTs have modified this methodology to meet their needs. To fully integrate VIAs with other resource assessments, there was a critical need to understand the usefulness of different methodologies for evaluating visual impacts of highway design.

This research identifies and evaluates methodologies and best practices that could benefit DOTs nationwide. Application of the results of such research would help DOTs to implement effective and streamlined VIA methodologies and integrate aesthetic considerations into a streamlined project development process.

The research was performed by Avenue Design Partners. Information was gathered via comprehensive review of the literature, interviews with practitioners, a review of completed VIAs or the visual impact section of environmental impact assessments, and a detailed evaluation of five selected VIAs to exemplify suggested practices. Six governing principles, four foundational concepts, and twelve suggestions for practices are offered.

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Note: Figures and tables in this report may have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

SUMMARY

NCHRP Report 741: Evaluation of Methodologies for Visual Impact Assessments documents the findings of NCHRP Research Project 25-33. The research sought to relieve ambiguity in the VIA process and develop a set of best practices from which state departments of transportation (state DOTs) can assemble a new, more rigorous, VIA process.

Context

Since the National Environmental Policy Act of 1969 (NEPA) was signed into law by President Richard M. Nixon on January 1, 1970, it has been the "continuing responsibility" of both federal and state governments "to use all practical means . . . to . . . assure all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings." In response to the law, the U.S. DOT and subsequently the FHWA issued policies that incorporated aesthetics into their programs and their environmental documentation process as required by NEPA. These policies have included guidelines for procedures on how to evaluate impacts to visual quality—a more qualified term than aesthetics that appears to be in alignment with the intent of Congress.

In the late 1970s, in response to the requirements of NEPA and in conformance with U.S. DOT directives, FHWA developed a set of guidelines on how to analyze changes to visual quality caused by the development of federally funded highway projects. These guidelines were initially used in training classes for personnel in state departments of transportation (state DOTs). By 1981, FHWA published these guidelines in *Visual Impact Assessment for Highway Projects* and continued to offer training.

Many states adopted the suggested FHWA Visual Impact Assessment (FHWA–VIA) policies and procedures. Other states decided to adjust the FHWA methodology or to develop their own procedures based on a different understanding of human perception, the perceived uniqueness of their landscapes or viewers, the need to accelerate environmental review, or simply to reduce costs. By the late 1980s, in response to a growing number of alternative methods being used, FHWA issued a set of clarifications and modifications to its original process. It also distributed a training video to each state of an alternative visual impact assessment (VIA) process developed by the Minnesota Department of Transportation (Minnesota DOT). However, despite its tacit acknowledgement that there were multiple ways to assess visual impacts, FHWA never altered its official recommendation that the 1981 publication be used to assess visual impacts. Given that using the 1981 process was only a recommendation, never a requirement, there are currently a variety of procedures being used by transportation agencies across the country to assess visual impacts.

Of the processes now in use, none has been shown to be more effective, more scientific, more legal, more publicly accepted, or more efficiently delivered than any other method.

Although the need to create a better VIA procedure is generally acknowledged, especially by federal agencies, no new VIA procedure has emerged.

Outside of transportation departments, the assessment of visual impacts has also become murkier. In response to criticism, the United States Forest Service (USFS) introduced its Scenery Management System, modifying its seminal Visual Resource Management (VRM) process, the very process from which the FHWA–VIA method had evolved. The procedures used by other federal land management agencies, including the Bureau of Land Management (BLM), the Natural Resources Conservation Service (NRCS), the National Park Service (NPS), and the United States Army Corps of Engineers (USACE), have also all been subjected to internal and external scrutiny and modification.

In June 2004, Scenic America hosted an invitation-only workshop in Washington, DC attended by FHWA, USFS, BLM, NRCS, NPS, USACE, and others interested in improving and standardizing the assorted VIA processes used by these agencies. Also in attendance were the EPA, the National Endowment for the Arts, and representative state DOTs. The focus of the workshop was to discuss the state of the art for assessing visual impacts and the potential for developing a single VIA process that all federal agencies could utilize. Although the promise of creating a scientifically rigorous, legally and politically acceptable, and publicly engaging VIA process did not materialize in the decade following that meeting, the need has remained. Although the focus of the Washington meeting was on federal-level VIA processes, issues also remain with other VIA processes developed by or for state DOTs. Uncertainty persists about any and all of these processes, especially after the public acknowledgment of concerns with the existing VIA processes.

Research Objectives

NCHRP Report 741 documents the findings of NCHRP Research Project 25-33, "Evaluating Methodologies for Visual Impact Assessment," which was conducted in response to the need to establish a scientifically valid, legally convincing, and administratively efficient, practical, and (most importantly) useful process for evaluating visual impacts with the confidence that the results will be considered impartial and fair. The NCHRP panel established six objectives for this research:

1. Evaluate state DOT VIA procedures, methods, and practices that satisfy or exceed NEPA and other requirements.
2. Document the use of the FHWA methodology, methodologies from other agencies, and other approaches used by DOTs.
3. Describe decision-making frameworks used at state DOTs to undertake specific VIA techniques for a given project.
4. Document proven successful methods.
5. Describe best practices illustrated by model case studies.
6. Document promising new developments and lessons learned.

Research Approach

Three general methods were employed to achieve the research objectives for Project 25-33: (1) the English language literature relating to VIA methods was reviewed; (2) a survey of state DOT employees responsible for VIA was conducted; and (3) completed VIAs or the visual impact section of environmental impact assessments (EIAs) were reviewed, and a detailed evaluation was conducted of five selected VIAs.

Literature Review

The academic and professional literature was searched for critiques of VIA methodologies used on transportation projects. The review was to include a wide range of VIA methodologies from the 40 years since NEPA's passage required federally funded or permitted projects to assess visual impacts. Although this task was performed, the number of academic or professional articles that had reviewed the efficacy of the various VIA processes used by state DOTs was small. To compensate, the search was expanded by focusing on other aspects of the effectiveness of VIAs that could be found in the literature. As a result, the search for and review of academic and professional literature concentrated on five areas of study:

1. Published discussions of legal issues related to visual impacts and their assessment.
2. Published discussions of VIA procedures.
3. Published critiques of VIAs.
4. Published discussions about landscape visual perception as it relates to assessing visual impacts.
5. Published reports on international experience with VIAs.

Nine conclusions and recommendations were developed from the literature search:

1. A set of minimum standards for conducting a VIA and a set of requirements for expert testimony can be derived from judicial decisions made by courts in the United States.
2. In the United States, VIA procedures focus on the aesthetic value of perceived naturalness and tend to disregard other visual qualities.
3. Designating visual management objectives enhances the legitimacy of VIAs.
4. Mitigation of visual impacts needs to be integrated throughout a project's design and life-cycle.
5. In the United States, VIA principles and procedures have not been updated for at least a decade, and those professionals conducting VIAs do not seem to be aware of recent academic research related to VIA.
6. In the United States, all published visual management systems and all VIA processes are based on expert judgment; public involvement is typically limited to reacting to published environmental documents.
7. In the United States, there is a preference for quantifying attributes used for determining VRM plans and conducting VIAs that is not necessarily shared by other countries.
8. In the United States, the public has little opportunity to make a meaningful contribution to the VIA process.
9. A scientifically rigorous approach to VIA methodology can be created through a transactional and contextual understanding of landscape visual quality.

State Survey

Employees of state DOTs who were identified as being involved in conducting or managing VIAs were invited to participate in a 42-question web-based survey. At least one respondent from each of the 50 states was asked to complete the survey. All 50 states responded. The following points are among the most salient results:

1. Most states indicated that they prepare VIAs. They are more common for larger projects adjacent to protected landscapes that require a full Environmental Impact Statement (EIS).

2. Over half the states (56%) identified a procedure that they typically use, but only half this number (28%) indicated that they have formally adopted a VIA procedure. The FHWA–VIA procedure was named most often (26%), though a number of states indicated that they have developed their own procedure (20%).
3. A small number of states indicated that VIA was incorporated within the mandated consideration of impacts to historic properties (Section 106). Because this result was not anticipated, additional questions about impacts to non-historic properties or sole reliance on historic integrity as the evaluation criterion were not asked.
4. Most states (76%) hired consultants to prepare VIAs, though a large number (46%) also indicated that they use state DOT staff.
5. While states indicated that landscape architects most frequently author VIAs (58%), civil engineers (42%) and planners (36%) were also common. Simulation specialists were among the authors fairly often (26%) whereas GIS specialists were less often among the authors (4%).
6. States indicated that the principal author of a VIA is generally self-taught (54%) and is learning by reviewing or cribbing from an earlier VIA (34%). In most states, contemporary VIA authorities could not recall any VIA training. In states that have provided some formal training, it was usually an introductory overview (40%) rather than a comprehensive course on the state's VIA policies and practices (20%).
7. Almost all states indicated that they evaluate changes to physical qualities that are intrinsic to the visual landscape (80%). The methods they use include describing visible properties such as color, texture and form (58%), relationships such as proportion, dominance, and scale (62%), or ecological patterns and relationships (58%).
8. Most states also indicated that they evaluate the human perception of proposed visible changes (70%). Most frequently this is accomplished through the political process, using required public meetings (82%), regulatory agencies charged to represent the public's interest (52%), comment cards (26%), or public representatives (22%). Many states also accept the judgment of professionals trained to conduct VIAs as a way to evaluate human perception (58%). Relatively few states (12%) reported evaluating human perception using scientific methods.
9. It is widely recognized that attributes commonly expected of scientific studies do not have an authoritative presence in VIAs. Less than half of the respondents thought the VIA procedures used in their state were objective (34%), accurate (40%), valid (28%), reliable (40%), pragmatic (38%), understood (28%), or useful (46%).
10. While this might be a cause for concern, no state identified a situation where the findings of a VIA were challenged in court.
11. VIAs primarily affect design development (72%) and the minimization or mitigation of impacts (78%). A VIA is much less likely to affect alternative location or selection (46%). Somewhat surprisingly, it is also less likely to affect public relations (34%), even though the public frequently is very concerned about visual impacts.

These results provided a first impression of the state of VIA practice related to transportation projects throughout the county. The survey was designed to answer questions about what is happening in state DOTs rather than why it is that way. A deeper understanding of VIA practice would require focusing on a select few of these results and conducting in-depth interviews with representative states.

Document Selection

The original project plan called for a detailed assessment of 25 projects selected by the NCHRP panel from a universe of 75 projects that were to be identified during the survey of

state DOTs. The survey yielded substantially fewer than 20 projects. Augmenting that list of projects with additional VIA documents found on the Internet yielded 50 projects. Rather than select 25 projects from this reduced universe, the research team conducted the required detailed analysis of the VIAs for all 50 projects.

The team developed a spreadsheet to compare alternatives. The spreadsheet grouped projects by the governmental agency responsible for producing the assessments, and it showed that differences in the way VIAs were conducted had more to do with the agency conducting the analysis than with the project's complexity or its landscape setting. Consequently, the technical memorandum that reported the findings of the detailed review included a summary of the governmental agencies that had been analyzed.

From the analysis, the following 16 conclusions were reached:

1. Most states claim to be conducting VIAs. In practice, states are very selective about conducting VIAs. Many report visual impacts in environmental documents without documenting the use of a VIA process. Based on the lack of VIAs offered for review, many states appear not to actually produce VIAs or only do so occasionally for selected projects.
2. In theory, the FHWA–VIA process is used extensively by states for assessing visual impacts to highway projects. In practice, most states that use the FHWA–VIA process are very selective about which parts of the process they actually follow.
3. Simulations are useful but not universally used. Where, when, and how to use simulations is extremely variable. Very few processes offer guidelines on the creation and use of simulations.
4. Viewsheds are alluded to frequently but mapped less regularly. Use of GIS and other methods to establish viewsheds typically fails to accommodate vegetation and structures, resulting in large viewsheds that may not actually exist.
5. A wide range of methods exists for evaluating visual resources, and most methods involve a combination of artistic attributes, professional judgments, and viewer preferences that vary from project to project even within the same agency.
6. Authors of VIAs are typically landscape architects or planners. Some states have historians doing the VIAs as part of their state's review of historic properties. Each profession brings a particular professional bias to their assessments: landscape architects emphasize the character of the landscape, planners utilize previous planning documents and local ordinances to ascertain scenic value and viewer preferences, and historians typically focus on only historic properties or landscapes.
7. All states identify views and viewers occupying public spaces as requiring analysis. In most states, viewers occupying private property also are evaluated, although a few states indicated that private views are not assessed as a matter of policy.
8. A few assessments emphasized the visual experience of viewers.
9. One Colorado project used urban design and spatial evaluation techniques that yielded some provocative mitigation suggestions, but a similar approach in South Africa yielded no particularly innovative mitigation proposals.
10. The use of a glossary to explain terms (as was done on a project in Colorado) probably enhances the readability of a VIA.
11. Longevity in the job, as well as frequency (and perhaps training) in the writing of VIAs may influence the thoroughness with which visual assessments were completed.
12. Separating inventory from analysis assists in communicating information.
13. A unique approach reported from South Africa required a peer review of its assessments, something required by no other governmental agency. This technique may yield more balance, but it still relies on professional opinion, not feedback from the affected population.

14. The United Kingdom assures that impacts to the visual resources of the physical environment are differentiated from impacts to people's perception of those impacts by insisting that the analysis of visual impacts be separated into two different documents. One document, which presents the discussion of changes to the physical environment, is called an assessment of landscape effects. The other document, which presents the discussion of how those changes affect viewers, is called an assessment of visual effects. This separation assures that impacts to both resources and viewers are identified, a method which responds well to current scientific understanding of how the perception of visual quality is actually is formulated by human beings.
15. Similarly the six-step VIA process used by Minnesota acknowledges the need to differentiate between visual resources and viewers by suggesting that visual quality is not only a result of the interactions between the physical and psychological environments but also that it and any subsequent impacts are expressions of the relationship between resources and people. The consequence for design and mitigation is that it is possible to intervene on either side of the relationship equation to avoid, minimize, or compensate for adverse impacts. This process also leads to an understanding of how a project could actually enhance existing visual quality.
16. Most of the processes examined rely on professionals to assess impacts. The public is typically not involved except in reaction to an assessment. The State of Washington uses a process developed by the BLM that involves the public in defining the value of visual resources during scoping so that the assessment of impacts is a result of identified public value, not the professional opinion of a landscape architect, planner, or engineer. Colorado has also used VIA methods adopted by the BLM and the USFS to determine visual quality and impacts to visual quality along its roads that thread their way through land managed by these federal agencies. These two federal approaches to assessing visual impacts are distinct from the FHWA–VIA process, especially in the use of visual quality goals.

Evaluation Criteria

Ten criteria for evaluating VIA procedures were developed based on the research findings. These evaluative criteria prescribe desirable overarching characteristics of VIA methods and procedures. The ten criteria are:

1. Objective—the procedure is designed to eliminate individual bias.
2. Valid—the procedure can be defended as measuring what it intends to measure.
3. Reliable—adequately trained professionals following the procedure reach the same conclusion.
4. Precise—the data required by the procedure are measured at a grain or scale sufficiently fine to validly measure or describe characteristics of substantive interest, and sufficiently coarse to be pragmatically implemented.
5. Versatile—the procedure supports valid assessment of different types of proposed changes from the perspectives of different viewer groups interacting with different landscape settings.
6. Pragmatic—the procedure can be easily and efficiently implemented by a trained professional.
7. Understood easily—the procedure and resultant assessments are accessible by the public and decision makers.
8. Useful—the procedure and resultant assessments affect location, design, or mitigation decisions.

9. Implemented consistently—the procedure can be applied consistently among different projects, and individual assessments are consistent with the chosen procedure.
10. Legitimate—the procedure is supported by laws, regulations or other legal mechanisms, uses socially/culturally accepted standards, and uses scientifically accepted standards.

Case Studies

Five case studies were evaluated for the degree to which they had incorporated the ten evaluative criteria as a set of best practices into a specific project's assessment of visual impacts. These case studies were selected for detailed examination based primarily on their having a wide variation in the methods used to evaluate visual impacts, including methods developed by the USFS, the BLM, FHWA, the Minnesota DOT, the State of Vermont, and the United Kingdom. They were also selected because they represented a wide range of geographic locations, landscape types, project scopes and types, and viewers.

Projects were examined in Colorado, Minnesota, Vermont, and Washington State in the United States, and Scotland in the United Kingdom. The landscape that was affected was quite different from project to project. The landscape settings ranged from mountainous terrain, flat rural farmland, a fast growing suburban landscape, to a historically important industrial landscape.

The scope of one of the projects was extremely large, with a corridor nearly two-hundred miles long. Another project was limited to a couple of hundred feet of the rock face of a canyon wall. The types of projects also exhibited the range of work with which state transportation departments frequently are involved and that can affect visual quality, from the expansion of existing facilities, to shifting routes, to new corridors, to simple maintenance projects.

Even the types of viewers varied, from tourists and commuters sharing the highway to recreationists to homeowners occupying the landscape adjacent to the highway.

Interestingly, Table S.1 shows that all five methods, most of which have been practiced for decades, do not fulfill all of the evaluative criteria adequately. Clearly, none of the current

Table S.1. Ratings of evaluative criteria for VIA document case studies.

Best Practices Criteria	Transportation Authority				
	Colorado	Minnesota	Vermont	Washington	Scotland
Objective	✓✓	✓✓	✓	✓✓	✓✓
Valid	✓	✓✓	✓✓	✓	✓✓✓
Reliable	✓✓	✓✓	✓	✓✓	✓✓
Precise	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Versatile	✓	✓✓✓	✓✓✓	✓✓	✓✓✓
Pragmatic	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Understood easily	✓✓✓	✓✓	✓✓✓	✓✓	✓✓
Useful	✓✓✓	✓✓	✓✓	✓✓✓	✓✓
Implemented consistently	✓✓	✓	✓✓	✓✓✓	✓✓✓
Legitimate	✓✓	✓✓	✓✓✓	✓	✓✓✓

Note: The more check marks given a particular criterion, the more that criterion is realized in the VIA examined.

methods are without serious limitations. If an effective method for assessing visual impacts is going to be employed by state DOTs, it will need to be created based on the findings of this report.

Study Findings

The findings listed below should be considered recommendations that require further research and testing to ensure their scientific defensibility and administrative practicality. These recommendations are, nonetheless, based directly on a review of existing research (as documented in Chapter 2 of this report) and a review of existing practices (as documented in Sections 3 through 6) and can be utilized as a working paradigm for improving the VIA of highway projects.

There are three sets of recommendations: a set of six governing directives, a set of four foundational concepts, and a set of 12 best practices. The governing directives are protocols that provide a standard structure for conducting and documenting VIAs. The foundational concepts are the fundamental ideas that provide the intellectual basis and scientific rigor for VIAs. Finally, the best practices provide a thorough, methodical approach for conducting VIAs.

To ensure that an effective, administratively practical, and scientifically defensible process is used to assess the visual impacts caused by highway projects, all of the governing directives, foundational concepts, and best practices may be woven into a state's VIA policies and methodologies.

Governing Directives

The six governing directives are protocols that provide a standard structure for conducting and documenting VIAs. These six protocols direct agencies to:

1. Document compliance with federal and state regulations that require a VIA to be conducted for transportation projects.
2. Document how the VIA contributed to location, design, or mitigation decisions, either in the VIA or in the project's environmental review documents.
3. Conduct and document VIAs in an administratively practical and scientifically defensible manner.
4. Identify the VIA process that was employed in conducting the assessment and document how rigorously the process was followed.
5. Identify who conducted the VIA, their experience, professional credentials, and authority.
6. Report accurately the findings of the VIA in the project's environmental review documents.

Foundational Concepts

The study identified four foundational concepts as the fundamental ideas that provide the intellectual basis for scientifically rigorous VIAs. These foundational concepts are:

1. Perception of visual quality is an interaction between people and their environment.
2. It is important that the public be directly involved in defining existing visual quality and visual quality management goals and in determining visual impacts.
3. Highway projects have the capacity to affect the landscape and viewers, and to alter visual quality.
4. Responding to the visual impacts caused by a highway project requires the prior establishment of corridor-specific visual quality management goals.

Best Practices

The study identified 12 interrelated best practices that provide an administratively practical and scientifically defensible, professionally useful approach for conducting VIAs. The study found no existing VIA process that included all 12 best practices. In other words, all VIA methodologies currently being used by transportation agencies could be improved by incorporating one or more of the best practices. This set of best practices could provide, therefore, a set of necessary minimum requirements for improving existing VIA methodologies as they apply to highway development and environmental review documentation.

It is important that the VIA process:

1. Establish the geographic scope of the VIA.
2. Inventory the relevant physical attributes of the existing landscape.
3. Identify whose views will be affected by the proposed project.
4. Establish what affected viewers value in the existing landscape.
5. Identify key views that will be used to analyze visual quality and visual impacts.
6. Determine the status of existing visual quality.
7. Determine what will be the "no-build" visual quality for a selected future date.
8. Document, by alternative, how the proposed project will alter the affected environment.
9. Document, by alternative, how the proposed project will alter the affected population.
10. Document, by alternative, how the proposed project will change visual quality.
11. Compare impacts to visual quality by alternative.
12. Identify mitigative strategies to avoid, reduce, minimize, or compensate for adverse impacts to existing visual quality.

Conclusions

Although the governing directives, foundational concepts, and best practices point the way to creating a scientifically defensible, administratively practical, and professionally useful VIA process, it is beyond the scope of this study to define and establish a new step-by-step methodology. It is suggested that agencies wanting to change their existing VIA process and establish a new process based on the findings of this study incorporate all 12 best practices, all four foundational concepts, and the six governing directives into any new methodology they create to assess visual impacts.

If, using the findings of this study, a template for conducting the VIA of proposed highway projects were developed and adopted nationally, it would provide a common reference for states. It is recommended that such a common reference be developed. Such a reference could be updated periodically, perhaps on a regular schedule, to include advances in the scientific understanding of visual perception, visual quality, and visual impacts, and to incorporate any changes in federal or state laws and regulations. Such a national reference would ensure consistency in conforming to NEPA and other laws and regulations.

By utilizing these suggestions, a more robust, more scientifically defensible, more administratively practical, and more professionally useful VIA process can be created and successfully implemented by state DOTs, fulfilling the mandate and responsibility that the United States Congress required of them to assure for all Americans views of an aesthetically pleasing landscape along our nation's highway corridors.

CHAPTER 1

Introduction

1.1 Research Context

Since the National Environmental Policy Act of 1969 (NEPA) was signed into law by President Richard M. Nixon on January 1, 1970, it has been the "continuing responsibility" of both federal and state governments "to use all practical means . . . to . . . assure all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings." In response to the law, the U.S. DOT and subsequently the FHWA issued policies that incorporated aesthetics into their programs and the environmental documentation process as required by NEPA. These policies have included guidelines for procedures on how to evaluate impacts to visual quality—a more qualified term than aesthetics that appears to be in alignment with the intent of Congress.

In the late 1970s, in response to the requirements of NEPA and in conformance with U.S. DOT directives, FHWA developed a set of guidelines on how to analyze changes to visual quality caused by the development of federally funded highway projects. These guidelines were initially used in training classes for personnel in state departments of transportation (state DOTs). By 1981, FHWA published these guidelines in *Visual Impact Assessment for Highway Projects* and continued to offer training.

Many states adopted the suggested FHWA Visual Impact Assessment (FHWA–VIA) policies and procedures. Other states decided to adjust the FHWA methodology or to develop their own procedures based on a different understanding of human perception, the perceived uniqueness of their landscapes or viewers, the need to accelerate environmental review, or simply to reduce costs. By the late 1980s, in response to a growing number of alternative methods being used, FHWA issued a set of clarifications and modifications to its original process. It also distributed a training video to each state of an alternative visual impact assessment (VIA) process developed by the Minnesota Department of Transportation (Minnesota DOT). However, despite its tacit acknowledgement that there were multiple ways to assess visual impacts, FHWA never altered its official recommendation that the 1981 publication be used to assess visual impacts. Given that using the 1981 process was only a recommendation, never a requirement, there are currently a variety of procedures being used by transportation agencies across the country to assess visual impacts.

Of the processes now in use, none has been shown to be more effective, more scientific, more legal, more publicly accepted, or more efficiently delivered than any other method. Although the need to create a more valid procedure is generally acknowledged, especially by federal agencies, no new VIA procedure has emerged.

Outside of transportation departments, the assessment of visual impacts has also become murkier. In response to criticism, the United States Forest Service (USFS) introduced its Scenery Management System, modifying its seminal Visual Resource Management (VRM) process, the very process from which the FHWA–VIA method evolved. The procedures used by other federal land management agencies, including the Bureau of Land Management (BLM), the Natural Resources Conservation Service (NRCS), the National Park Service (NPS), and the United States Army Corps of Engineers (USACE), have also all being subjected to internal and external scrutiny and modification.

Around 2000, FHWA, USFS, BLM, NRCS, NPS, USACE, and others interested in improving and standardizing these assorted VIA processes met at an invitation-only workshop in Washington, DC, to discuss the state of the art and the potential for developing a single process that all federal agencies could utilize. Although the promise of creating a scientifically rigorous, legally and politically acceptable, and publicly engaging process did not materialize in the decade following that meeting, the need has remained. The focus of the Washington meeting was on federal-level VIA processes, but issues also remain with other VIA processes developed by or for state DOTs. Uncertainty persists about any and all of these

processes, especially after the public acknowledgment of concerns with the existing VIA processes.

1.2 Proposed Research

For over 30 years, VIA processes have been key tools used by transportation authorities across the United States to anticipate and evaluate the potential visual impacts that may be caused by the construction of transportation projects. Conducted as part of a project's environmental review process as required by federal law, a VIA has typically been used to affect location, design, and mitigation decisions.

VIA procedures, however, are unevenly applied, not only across states and transportation modes, but also between individual highway projects within the same state. Some states require that all highway projects—regardless of scope, setting, or who is affected—have a VIA conducted as part of the project development and environmental review process. Most states, however, are more selective in applying VIA procedures. This lack of consistency in applying the use of a VIA has eroded the perception that it is necessary or even worthwhile to conduct a VIA even in states that regularly use a VIA process. These doubts have culminated in several states questioning the efficacy of these procedures, in particular asking if they are scientifically valid and legally convincing, and requesting that FHWA conduct a formal study to determine the efficacy and practicality of current VIA procedures. *NCHRP Report 741* documents the findings of that study.

1.3 Research Objectives

The objectives of this research were to identify and evaluate VIA policies, procedures, and practices as used by transportation authorities in the United States and other selected countries for their scientific validity, legal legitimacy, and best practices. In particular, the research project was to relieve the ambiguity about how to conduct a VIA and reduce consternation over its use by developing a set of best practices from which state DOTs can assemble a new, more rigorous, VIA process. To accomplish this goal, six objectives were established for the research:

1. Evaluate state DOT VIA procedures, methods, and practices that satisfy or exceed NEPA and other requirements.
2. Document the use of the FHWA methodology, methodologies from other agencies, and other approaches used by DOTs.
3. Describe decision-making frameworks used at state DOTs to undertake specific VIA techniques for a given project.
4. Document proven successful methods.
5. Describe best practices illustrated by model case studies.
6. Document promising new developments and lessons learned.

Three general methods were employed to achieve these research objectives: (1) a review of the English language literature relating to VIA; (2) a survey of state DOT employees responsible for producing VIAs; and (3) a review of selected VIAs, including a detailed evaluation of five selected VIAs. Table 1.1 illustrates which of these three methods were used to achieve the project's six objectives.

1.4 Research Program

The research project was divided into eight tasks, which were conducted in sequence from May 2010 through July 2012. The tasks included (1) a literature review, (2) a VIA review, (3) identification of candidate projects, (4) detailed assessment of selected projects, (5) preparation of an interim research report, (6) development of evaluation criteria to identify best practices, (7) identification of case studies, and (8) preparation of the final research report and an implementation plan.

Table 1.1. Methods used to achieve the research objectives.

	Methods		
Objective	Literature Review	Survey of State DOTs	Review VIA and EIS
1. Evaluate if practices satisfy NEPA requirements.	✓	✓	
2. Document VIA methods used by state DOTs.		✓	✓
3. Decision-making framework used by state DOTs.		✓	✓
4. Document proven successful methods.	✓	✓	✓
5. Describe best practices.	✓	✓	✓
6. Document promising developments and lessons learned.	✓	✓	✓

NCHRP Report 741 incorporates the content of the task reports and final report as modified in response to the panel's comments.

1.5 Documentation

The remainder of *NCHRP Report 741* documents the findings of the research project as follows:

- Chapter 2: Literature Review
- Chapter 3: State Survey
- Chapter 4: Document Review
- Chapter 5: Evaluation Criteria
- Chapter 6: Case Studies
- Chapter 7: Study Findings and Implementation Plan
- References

The chapters present the information following the same sequence as the research was conducted, recording a process of discovery that culminated with a comprehensive set of governing directives, foundational concepts, and best practices for conducting VIAs for highway projects. The references section lists references from the literature review and from each case study included in the report.

CHAPTER 2

Literature Review

The first task of the research project was to conduct a review of the academic and professional literature related to visual impact assessment (VIA), particularly critiques of VIA methodologies used on transportation projects. The review was to include a wide range of VIA methodologies that have come into use since the passage of the National Environmental Policy Act (NEPA) 40 years ago required federally funded projects to assess visual impacts. The number of academic or professional articles that had reviewed the efficacy of the various VIA processes used by state DOTs proved too small to allow for synthesizing a wide-ranging and thoroughly rigorous appraisal of these methods. To compensate, the search was expanded by focusing on other aspects of the effectiveness of VIAs that could be found in the literature. As a result, rather than focusing solely on reviews of VIA processes, the review of academic and professional literature was expanded to include five categories of issues:

- Issues of legality—published discussions of legal issues related to visual impacts and their assessment.
- Issues of methodology—published discussions of VIA procedures.
- Issues of practice—published critiques of individual VIA documents.
- Issues of perception—published discussions about landscape visual perception as it relates to assessing visual impacts.
- Issues of international policies and practices—published reports on international experience with VIAs.

The information gathered and analyzed under each of these areas of inquiry provided direction for establishing nine preliminary findings. The rest of this chapter provides a narrative that describes what was discovered in the literature as each of the five issues was examined.

2.1 Issues of Legality

The literature review of legal issues revealed concentrations of information and analysis around two main areas: (1) a discussion of legislative mandates that made conducting VIAs a legal requirement, and (2) a discussion of judicial interpretations of those mandates. The following narrative looks first at the legislative mandates and then at the judicial interpretations. The discussion concludes with a summary of the issues the literature search found related to the legality of VIAs.

2.1.1 Legislative Mandate

As the nation's interstate highway system was being constructed between the late 1950s and the mid-1970s, issues related to social, economic, and environmental impacts began to be raised by the public and its elected representatives that culminated in the 1969 passage and signing of NEPA. This federal law provides the legislative mandate for conducting an assessment of visual impacts that may be caused by transportation projects. Under NEPA, FHWA is required to evaluate visual impacts for all federally funded highway projects. Specifically, the mandate is for the federal government "to use all practical means . . . to . . . assure all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings." The method that is to be used to ensure this mandate is also prescribed by law. NEPA requires federal agencies to "utilize a systematic, interdisciplinary approach which will insure the integrated use of natural and social sciences and the environmental design arts, in planning and in decision making which may have an impact on man's environment." In response to NEPA, the United States Department of Transportation (U.S. DOT) and FHWA issued policies and developed guidelines for procedures for evaluating visual impacts. These policies and procedures have been the rules under which state departments of transportation (state DOTs) have developed their plans and assessed impacts to visual quality.

However, as noted by Smardon and Karp in *The Legal Landscape: Guidelines for Regulating Environmental and Aesthetic Quality,* environmental assessment—in particular, VIA—has rarely met the broad requirements of NEPA:

> Procedurally, visual considerations as treated in EIAs [Environmental Impact Assessments] have rarely met the requirements as stated in the National Environmental Policy Act and Council of Environmental Quality regulations. Thus, the treatment of visual and aesthetic considerations has not advanced, with a few notable exceptions in certain EIAs and environmental assessments. (Smardon and Karp, 1993)

In addition to NEPA, other state and federal laws that address visual quality sometimes apply to transportation projects, depending upon their location. For example, compared with NEPA, the Wild and Scenic Rivers Act of 1970 and state laws under the Coastal Zone Management Act of 1972 require application of more specific criteria for assessing visual impacts of transportation projects.

Since the late 1970s, FHWA has suggested that state DOTs use an assessment process that FHWA developed and, in March 1981, documented in its publication, *Visual Impact Assessment for Highway Projects.* The guidance, referred to as FHWA–VIA in this report, has been in use for nearly 30 years, but the states have considerable leeway in their methods for meeting that mandate. State laws that could affect objectives for VIA vary considerably around the nation. Although federal and state laws that require environmental impact analysis typically contain language requiring attention to aesthetic impacts, the administration and court interpretations of these laws and administrative procedures vary considerably.

The legal necessity for conducting a VIA can be understood as stemming not only from NEPA but also from other federal laws and executive orders, and from an array of other state laws. However, the VIA processes currently used by state DOTs may not meet NEPA requirements to provide an aesthetically pleasing environment for all Americans (Smardon and Karp 1993).

A key difference among the states is in whether the state courts have deemed aesthetic criteria alone sufficient for project decisions, or whether aesthetic criteria are only considered in support of other more functional criteria that are understood to be more objective (Smardon and Karp 1993). Further, different state laws and court interpretations of both state and federal law relating to environmental aesthetics do not appear to achieve federal mandates under NEPA. This leaves considerable room for discussion and decision making by FHWA about whether FHWA guidance for VIA methods should aim to meet mandates of NEPA or aim to meet only the more modest requirements of the courts.

2.1.2 Judicial Interpretation

Aesthetic issues have been the domain of judicial interpretation for over 50 years. In 1954, 15 years before NEPA, the U.S. Supreme Court established that

> [t]he concept of the public welfare is broad and inclusive. The values it represents are spiritual as well as physical, aesthetic as well as monetary. It is within the power of the legislature to determine that the community should be beautiful as well as healthy, spacious as well as clean, well-balanced as well as carefully patrolled (*Berman v. Parker,* in Bobrowski 1995).

Since this decision, aesthetics have continually been a primary rationale for many land use laws upheld by the courts.

Despite judicial support for the concept that aesthetics are sufficiently important for maintaining the public good and deserve legal protection, judicial interpretation of NEPA has *not* supported aesthetic concerns alone as sufficient for determining the level of environmental review of projects or for determining the acceptability of alternative actions. The federal courts and most state courts have interpreted aesthetic issues to be a procedural requirement rather than a substantive determinant of project impact (Tabb 1997). Furthermore, when aesthetics are pitted against issues of public health, safety, or welfare that appear to be overriding, aesthetics lose (Seale 2000). One example is a 1985 ruling of the 7th Circuit Court in the case of *River Road Alliance, Inc. v. Corps of Engineers of the United States Army*:

> In *River Road,* [the] neighborhood group and the State of Illinois mounted opposition to the issuance of a permit, by the Army Corps of Engineers, for a temporary barge fleeting facility on the Mississippi River. The principal objection was that the Corps failed to adequately consider the detriment to the aesthetics of the area if the barge facility were constructed. In upholding the agency action, the court observed: "Aesthetic objections alone will rarely compel the preparation of an environmental impact statement. Aesthetic values do not lend themselves to measurement or elaborate analysis. The necessary judgments are inherently subjective and normally can be made as reliably on the basis of an environmental assessment as on the basis of a much lengthier and costlier environmental impact statement" (Tabb, 1997).

Although aesthetic issues have the most certain and powerful legal effect on land use outcomes where the law prevents or removes extreme negatives, such as eyesores or blight (Bobrowski 1995), requiring changes to the siting and design of highways based solely on avoiding or minimizing impacts to aesthetics may be more difficult to defend.

In both federal and local tests of VIA, the defensibility of the VIA procedure as reliable and pragmatic has been viewed by the courts as most important. Validity is not articulated

as a legal concern. The courts have not asked whether VIA approaches adequately represent the experience of people. Rather the courts have asked that VIA procedures be clear in their process, consistent in their outcomes, and easy to apply. Court opinions have sometimes communicated a presumption that aesthetics are inherently products of unstable individual taste, and a concern that involving people in a process to communicate their aesthetic experiences would be an unwieldy, costly process (Tabb 1997). The courts (federal or local) require primarily that there simply be an articulated process (Bobrowski 1995). Interestingly in contrast, when cultural landscapes are considered as subject to protection under federal law (above and beyond requirements of NEPA), a bottom-up, community-based process is widely understood to be desirable (Carlarne 2006).

The courts also offer contrasting views on the issue of VIA methods and expertise, including expertise regarding environmental aesthetics. While the courts have been unconcerned about the validity of VIA methods, validity is one of the foundational criteria for establishing credentials as an expert witness in the federal courts. Palmer and Hoffman (2001) review how *Daubert v. Merrell Dow Pharmaceuticals* and *Kumho Tire v. Carmichael* apply to aesthetic assessments. Through these two landmark cases, the U.S. Supreme Court

> asserted a new standard for determining what qualifies an expert to provide factual testimony. Before accepting testimony on facts or data, the trial judge must ensure that the "expert's testimony both rests on a reliable foundation and is relevant to the task at hand." The judge must further determine that the testimony will be relevant "by demanding a valid scientific connection to the pertinent inquiry as a precondition to admissibility." The focus in Daubert was on scientific findings. The court offered four possible considerations for determining the admissibility of scientific testimony: (1) whether the theory or technique is falsifiable and has been tested, (2) whether it has been subjected to peer review and published, (3) what is its known or potential error rate and what are the standards to control it, and (4) widespread acceptance by the relevant scientific community. In Kumho the Court reaffirmed their ruling and extended it "not only to 'scientific' testimony, but to all expert testimony" (Palmer and Hoffman 2001, p. 150).

This situation puts the practitioner who prepares a VIA according to agency procedures in a potentially compromising situation. If called to testify in a federal court about the VIA, the practitioner's status as an expert might be successfully challenged if he or she cannot meet these criteria. As a result, the practitioner would only be allowed to testify as an ordinary witness, without the authority granted an expert to explain the work. In summary, the courts require an expert to be someone who employs scientific knowledge, but no court decision to date has required that the VIA process itself employ scientific knowledge.

Environmental Impact Statement (EIS) processes virtually never conclude that the preferred alternatives are those that have the greatest costs in a cost-benefit analysis, even if a greater cost alternative has greater aesthetic benefit (Goodell 2008). The law review papers suggest that their authors' knowledge of the landscape preference literature ranges from good but spotty (Bobrowski 1995) to almost none (Tabb 1997). From this, it may be inferred that the degree to which visual experience has been quantified has not yet been fully integrated into the law.

2.1.3 Summary of the Legal Issues

While the courts have generally found that aesthetic considerations alone are not decisive in assessing environmental impacts, current environmental review practices may not achieve the NEPA requirement to assure aesthetically pleasing environments for all Americans. Any set of best practices for assessing visual impacts developed as a result of this study, therefore, must either attempt to rigorously meet the mandates of NEPA or, at a minimum, meet the courts' more modest requirements to do the following:

- Remediate or prevent extreme negative aesthetic experiences (e.g., blight, neglect, etc.).
- Use a VIA procedure that is clear in process (preferably quantitative), consistent in outcomes, and easy to apply.

Beyond NEPA, other state and federal laws that address visual quality more rigorously or directly sometimes apply to transportation projects. For example, state laws in California, Minnesota, and Vermont require specific responses that may be more nuanced than any future generally prescribed approach. It will be essential that any general or national approach to VIA be sufficiently flexible to incorporate additional state and even local requirements.

Despite the courts' preference for clear, quantified VIA procedures, quantitative empirical studies of landscape preference generally have not been used in court decisions, and legal reviews of aesthetic issues in environmental law seem somewhat uninformed about this literature. The courts have not asked whether VIA approaches adequately represent the experience of people (as revealed in an empirical survey as opposed to expert opinion). In contrast, the courts appear to favor a bottom-up, community-based-process for assessment of cultural landscapes, and this could be suggestive of emerging legal perspectives on VIA.

Federal court requirements for expert testimony appear to require a greater level of rigor than do court decisions on aesthetics alone. Since expert testimony on landscape perception is frequently used, judicial expectations for expert testimony may point to a more rigorous standard than judicial

decisions regarding aesthetics alone. A precondition for expert testimony in federal court is a connection to valid science, requiring that the expert be aware of a body of knowledge: published scholarship that has been subjected to peer review, published, and accepted by the relevant scientific community. Such scholarship exists for visual perception of landscapes and will be used as a basis for integrating the science of visual landscape perception into the act of assessing visual impact.

2.2 Issues of Methodology

2.2.1 Identifying Common Methodologies

Six major VIA methodologies used in the United States and the United Kingdom were identified as frequently being the subject of critical reviews in academic and professional literature. The six methodologies, listed in the order in which they were promulgated, were:

1. **Visual Management System (VMS).** The U.S. Department of Agriculture's U.S. Forest Service (USFS) was the first federal agency to develop a VIA procedure after the passage of NEPA (USDA 1974). The VMS was primarily used to evaluate changes in land cover caused by land management practices. According to the USFS, VMS was a procedure to "inventory the visual resource and provide measurable standards for the management of it." It established prescriptive standards for planning which are used to evaluate the acceptability of visual impacts. The Forest Service has applied VMS to all of the lands they manage, an area equivalent to the combined size of Colorado and Utah (193 million acres). VMS has since been replaced by the USFS Scenery Management System (SMS), which is described later in this list.
2. **Visual Impact Assessment for Highway Projects (FHWA–VIA).** FHWA's VIA procedure provides guidance to state DOTs on how to address NEPA, but the FHWA does not require that it be used (U.S. DOT 1981, 1988). FHWA does not manage lands, but it does support transportation projects that must meet NEPA criteria. "The process facilitates the documentation of existing visual resources and visual quality within a proposed highway corridor and provides both a framework and a methodology for assessing the potential impacts that proposed alignments may have on the visual quality of a project area." The National Highway System (NHS), which is the system of state and federal highways that FHWA directly oversees, has over 5 million acres in rights-of-way.
3. **Visual Resource Management (VRM).** Developed by the U.S. Department of the Interior's Bureau of Land Management (BLM), VRM includes a process to inventory visual resources that becomes part of a resource management plan (USDI 1984, 1986a, 1986b). Visual impacts of surface-disturbing activities or developments are evaluated using a contrast rating procedure to evaluate whether the project will meet the management objectives established for the area. A VRM inventory and management objectives are prepared for all BLM-managed lands. The BLM manages an area equivalent to the size of Texas (245 million acres) and is responsible for the subsurface mineral estate of another 700 million acres.
4. **Visual Resources Assessment Procedure (the VRAP).** This method originated with the U.S. Army Corps of Engineers (USACE) (Smardon et al. 1988). The USACE constructs and manages waterway projects, such as canals, reservoirs and flood control systems. "The VRAP is a systematic method to (1) evaluate and classify existing aesthetic or visual quality; (2) assess and measure visual impacts caused by Corps water resource projects; (3) evaluate the beneficial or adverse nature of the visual impacts; and (4) make recommendations for changes in plans, designs, and operations of water resource projects." The VRAP is a recommended, not a required, procedure.
5. **Scenery Management System (SMS).** Based on over 20 years of experience, the USFS revised VMS in 1995 to create the SMS (USDA 1995). SMS provides for better integration with ecological management and the possibility of incorporating constituency information. It has replaced VMS as a required procedure.
6. **Landscape and Visual Impact Assessment (LVIA).** This method, developed in the United Kingdom (UK), takes a somewhat different approach (The Landscape Institute and Institute of Environmental Management and Assessment 1995, 2002). First, landscape character is inventoried for all of the UK and serves as a basis for planning appropriate change. Second, "landscape and visual effects are independent but related issues; landscape effects are changes in the landscape, its character and quality, while visual effects relate to the appearance of these changes and the resulting effect on visual amenity." Third, while the procedures for evaluating impact assessment are robust, they eschew numerical manipulation and rely on a descriptive analysis. This impact assessment procedure is recommended rather than required.

2.2.2 Investigation of Common Methodologies

A series of 14 questions and related sub-questions were used to investigate ideas held in common and what concepts distinguished one process from the other. This section presents the questions (and the related sub-questions) with a summary of the comparison between the six VIA processes.

How is visual impact defined?

- Is it perceived, intrinsic or both?
- Is the basis of regulating visual impacts identified?
- Is the impact of landscape change treated as an issue separate from consideration of viewer reactions to particular views?

All six procedures recognize visual impact as being the difference between the visual quality of a landscape without and with the proposed project, and they all rely on experts to inventory and evaluate visible landscape characteristics. However, in other ways there are some subtle distinctions.

All of the methods begin by identifying large areas that share similar physiographic, ecological, and/or cultural character. Most methods then shift their focus to visible characteristics, typically expressed through landscape components (e.g., land, water, vegetation, human-made), pattern elements (e.g., form, line, color, texture), and aesthetic relationships (e.g., dominance, scale, diversity, harmony, balance).

The SMS and LVIA approaches are slightly different. Although the SMS method also shifts to investigate visible characteristics, it is imbedded in a planning system that is oriented toward sustaining ecological functions. LVIA also develops a more robust and detailed description of landscape character. Based on the European Landscape Convention definition of landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors," the UK approach to landscape planning defines landscape character as a set of natural and cultural features that form a distinct and recognizable pattern in the landscape. Description of landscape character is non-judgmental and incorporates both a description of the different elements that contribute to landscape character, their relative significance in generating that character, and a description of the aesthetic and perceptual dimensions of character. Character is mapped as landscape types and/or landscape areas, which then provide the starting point for assessing landscape (but not visual) effects in LVIA.

Most systems consider scenic value an intrinsic quality of the landscape, which suggests that it is, at least in part, independent of human judgment (VRM, SMS, FHWA–VIA, the VRAP). BLM's visual contrast rating procedure is consistent with the assumption of scenic value as an intrinsic quality, although it does not state it explicitly.

The U.S. land management agencies (using VMS, SMS, VRM and the VRAP) all have systems oriented toward visual resource management that produce visual management objectives. These objectives include visual thresholds or standards that can be used to determine if the extent of visual impact is acceptable. The FHWA–VIA and LVIA do not predetermine thresholds for acceptable change but evaluate each case and its context individually.

Some procedures assign numerical values to visible characteristics and then perform mathematical operations as though these numbers were interval values (FHWA–VIA, the VRAP). Others identify the ordinal or nominal classes for several attributes and then combine them using a decision matrix (SMS, VMS). VRM has only one set of ordinal values, so they do not need to be combined. The LVIA approach is based on expert judgment, generally without employing any form of quantitative manipulation.

All methods except the VRAP compare existing conditions to a proposed future state. Only the VRAP emphasizes that the comparison should be made based on the future, not existing, conditions. That is a future with or without the project needs to compared, not an existing state with a proposed state.

Summary. There is general agreement that visual impacts are the differences between the visual quality of a view without and with the project; that is, before and after construction. All of the reviewed methods rely on expert judgments to make this determination.

How is the baseline landscape condition established?

- Is it framed on an ecological unit, landscape morphology, or watersheds?
- Is it a description of character, or an inventory of visible features (land, water, vegetation, structures)?
- Does it include making visual quality judgments, or is it just a neutral description?
- Is landscape resource character determined separate from viewer perceptions, or is it intrinsic?
- Does it include existing management classes that determine acceptable/compatible actions?

All six of the methods examined recognize the need to establish a baseline condition with which to compare the proposed project. All of the systems begin by establishing a geographic framework based on landscape physiography. All the methods use both desk studies and field investigation to document and map up to four baseline conditions, as follows:

- Landscape character—a description of the physiographic, ecological, and/or cultural features that distinguishes a landscape as a recognizable type with a "sense of place."
- Scenic value—an assessment of attractiveness or the aesthetic experience of a particular landscape type or place.
- Sensitive people—an assessment of the role scenic quality plays in people's activities and thus their sensitivity to visible change.
- Sensitive places—an assessment of the role that scenic quality plays in a place's recognized significance and thus its sensitivity to visible change.

Each of the landscape assessment procedures documents and maps some or all of these baseline conditions. A fifth characteristic, the landscape's sensitivity to change, is included in some, but not all, methods. It generally is a comparison between landscape visual quality with and without a proposed change. Because sensitivity to change depends upon what change is proposed, it cannot be assessed until a design or management proposal is made.

While the overall approach to determining baseline conditions is similar for all methods, there are subtle differences among the methods. For example:

- All of the U.S. systems—FHWA–VIA, VMS, SMS, VRM, and the VRAP—deconstruct landscape character into separate landscape resources or components (e.g., landform, water, vegetation, human-made).
- Most methods—FHWA–VIA, SMS, VRM (only color) and the VRAP (detailed procedure)—describe the pattern elements (e.g., form, line, color, texture) for each landscape component as part of its landscape character.
- Most methods also evaluate additional pattern characteristics thought to contribute to scenic quality: FHWA–VIA evaluates dominance, scale, diversity, and continuity; VMS, variety; SMS, dominance, degree of deviation, and intactness; VRM, adjacent scenery and scarcity; and the VRAP, user activity and special considerations.
- The LVIA method used in the UK focuses on an integrated approach to describing and mapping landscape character, which incorporates aesthetic and perceptual aspects as part of this character.

The currency of the baseline data may be an issue for VIA, particularly in the more rapidly changing areas where transportation projects may be proposed. The baseline data probably describes the recent past, though it may be updated to describe the existing condition. However, the appropriate landscape condition with which to compare the future with the project is arguably not the current existing condition, but the future condition without the project (but with other projects that are already planned and likely to be built). Only the USACE's VRAP procedure clearly requires the future without the project to be used as the baseline condition.

Summary. All of the VIA procedures characterize the landscape's baseline visual condition, which establishes a point of comparison for any proposed changes. In general, this baseline includes an inventory of landscape character, scenic value, sensitive people, and sensitive places. However, there are significant differences among the VIA procedures in the emphasis and approach used to establish this baseline. Only the VRAP requires that the project's future condition be compared to the future condition without the project (but with other probable changes).

How is the area of potential effects (APE) established?

- Is there a furthest extent beyond which there are no impacts?

Although none of the reviewed VIA methods describes a systematic way to determine the boundary for an area of potential effects (APE), it appears that two fundamental methods are used. The first method is based on potential visibility or viewshed analysis (although this is not explicitly stated). It limits the APE to those areas where the project is potentially recognizable if intervening vegetation and perhaps structures were removed. FHWA essentially uses the viewshed method, defining the APE loosely as the area that contains either "views from" or "views to" the road, regardless of ownership.

The second way of establishing an APE is typically used by federal land managing agencies that have prepared visual management objectives for the lands they manage. These objectives are established in advance of a project. The APE for a proposed project with existing visual management objectives is typically the land management unit, regardless of visibility.

Summary. Although no specific guidelines or procedures were found for determining the APE for the six VIA procedures reviewed, two general approaches emerge. One is derived from a viewshed analysis; the other is based on land management designations. It is reasonable to expect that the two different approaches would lead to very different results unless they can be reconciled.

How is the extent of project visibility established and represented?

- Are there distance zones?
- Is there visibility of large portions of a project?
- Has the relative magnitude been calculated?

All of the reviewed VIA methods mention visibility or viewsheds as an important attribute in determining the significance of a visual impact. For example:

- Both the FHWA–VIA and LVIA procedures include some detailed guidance about some of the subtleties in conducting visibility analysis.
- FHWA–VIA and SMS discuss the subtleties of interpreting the visibility analysis.
- The VRAP and LVIA mention distance zones only in passing.

- Four landscape procedures identify fixed thresholds for distance zones, as shown in Table 2.1.
- Distance zones do not have a strong and explicit effect on impact significance.

In the 1980s, when most of these VIA methods were written, digital elevation and land cover data were not available for the whole country and visibility analysis was limited by computer capabilities. Even the two more recent approaches—SMS, from 1995, and LVIA, from 2002—still do not fully exploit these technological advances for viewshed analysis. For example, a viewshed from a proposed route could be useful to limit the fieldwork to areas where there is a possibility of seeing the project. Viewsheds could be prepared to indicate how much of a project is visible from key locations—the top of a bridge, half of the suspension structure, or the bridge deck. The analysis can also be used to calculate the time period during which a vehicle moving at normal speed would have a potential view of the project. If several parts of a project are visible, that could also be indicated.

Summary. All of the VIA systems mention visibility or viewshed analysis, but none recommend a standard approach to calculating, presenting and using it. Similarly, several of the VIA systems recognize that the visible characteristics of a project change with distance from the viewer, but beyond identifying somewhat arbitrary distance zones there is no discussion of how to make use of this information in a VIA. The use of currently available computer-based tools would provide a better analysis of visibility and the duration of views, something that was not as sophisticated when the six VIA methods were adopted by their various agencies.

Are sensitive receptors identified?

- If so what are they?
- Is it necessary to establish the significance of their scenic quality or not?

Locations likely to be directly or indirectly affected by a proposed change, and viewer populations likely to be concerned about landscape views, are each sensitive to landscape change, albeit in different ways. In the United States, an example of a sensitive place might be a historic site where scenic quality was influential in its being listed on the National Register of Historic Places. A sensitive population might be involved in a recreation activity for which scenery is central to their experience. A logical weakness of some VIA methods is that *places* are considered as surrogates for *people*. A more defensible choice is to evaluate places for their own sensitivity to visible change, as the LVIA landscape procedure does. None of the VIA methods requires that scenery be a major reason why a sensitive place has been so designated or identified (e.g., a National Natural Landmark designated for ecological or geological reasons without reference to scenery would be very sensitive; a highly congested section of an Interstate highway would be very sensitive). Each method describes a slightly different approach to determining how sensitive places or human populations may be. The VRAP is "supposed to focus on significant environmental considerations as recognized by technical [i.e., the VRAP study], institutional [i.e., laws and policies], and public sources [expressed public perceptions of visual impacts]" (Smardon et al. 1988, pp. 43 and 64). The VRAP places the emphasis on places rather than people. The assessment framework and VIA viewpoint assessment consider user activity, typically based on professional judgment. There is little guidance about how to incorporate sensitivity of people or places, except as being either present or absent. VMS establishes sensitivity levels to indicate "people's concern for scenic quality" (USFS 1974, p. 18). First travel routes, use areas, and water bodies are identified as having primary or secondary importance according to a general method without specific criteria (e.g., high use volume without any numerical threshold). Use areas may be private land without public accessibility. Then a level of highest, average or lowest sensitivity is determined by the proportion of users that "have MAJOR concern for scenic qualities,"

Table 2.1. Thresholds for distance zones in miles.

Landscape Procedure	Foreground	Middleground	Background	Seldom Seen
VMS	< 1/4 or 1/2	1/4 or 1/2 – 3 to 5	> 3 to 5	N/A
SMS	< 1/2	1/2 – 4	> 3	Not visible from travelway/use zone
VRM	< 3 to 5		< 15	Not visible or > 15
FHWA–VIA	< 1/4	1/4 or 3	> 3	N/A

Sources: USFS (1973), p. 57; USFS (1995), p. 4-5; BLM (1986a), p 4; Office of Environmental Policy, FHWA (1988), p. 116.

Table 2.2. VMS sensitivity levels.

Use	Highest	Average	Lowest
Primary	At least 1/4 of users have MAJOR concern for scenic qualities.	Less than 1/4 of users have MAJOR concern for scenic qualities.	
Secondary	At least 3/4 of users have MAJOR concern for scenic qualities.	Less than 3/4 of users have MAJOR concern for scenic qualities.	Less than 1/4 of users have MAJOR concern for scenic qualities.

Source: USFS (1974), p. 21.

without indicating how the proportion or major concern is determined (p. 21). Table 2.2 lists the criteria for determining VMS sensitivity levels.

SMS establishes concern levels to indicate "the degree of public importance placed on landscape viewed from travelways and use areas" (USFS 1995, p. 4-8). In a process similar to VMS, areas are classified as either primary or secondary travelways or use areas, using a list similar to VMS's and including private lands without public accessibility. Next, the level of use and the users' interest in scenery are determined to be high, moderate or low, without any clear thresholds or other procedure to make these determinations. Table 2.3 lists the criteria for determining concern levels in SMS.

VRM establishes sensitivity levels as "a measure of public concern for scenic quality" (USDI 1986a, p. 3). Five sensitivity level rating units (SLRUs) are evaluated as high, moderate or low: (1) type of users, (2) amount of use, (3) public interest, (4) adjacent land uses, and (5) special areas. "There is no standard procedure for delineating SLRUs" (p. 3), and it is "a judgmental process which requires careful analysis of all the [SLRUs]" (Illustration 8, p. 2). The only guidance is the relative sensitivity for each SLRU (e.g., "Recreational sightseers may be highly sensitive . . . , whereas workers who pass through the area on a regular basis may not be as sensitive to change" [USDI 1986a, p. 3]). The exception is amount of use, which lists thresholds in a table (USDI 1986a, Illustration 8, p. 2). The thresholds for classifying amount of use are reproduced in Table 2.4.

The FHWA–VIA specifies that viewer response is a function of four factors: (1) viewer exposure—how many people are at the location and how far away they are; (2) activity and awareness—"viewers in a recreation area [are more sensitive] . . . than viewers in an industrial zone" (U.S. DOT 1981, p.97); (3) local values and goals, which ". . . may confer visual significance on . . . areas that would otherwise appear unexceptional" (U.S. DOT 1981, p.97); and (4) cultural, significance—"formal designation . . . for its historic, wilderness, recreational, or other value" (U.S. DOT 1981, p.98). The first three factors describe sensitivity of human populations, and the last one refers to sensitivity of places. There is no description about how to assess each of these factors, how to combine them into a single measure or description of sensitivity of response, or how to then incorporate the factors into the VIA.

LVIA recognizes both places and people as sensitive receptors. It uses "the term [landscape] 'receptor' . . . to mean an element or assemblage of elements that will be directly or

Table 2.3. SMS concern levels.

Travel Ways or Use Areas		Interest in Scenery		
Use Importance	**Use Level**	**Highest**	**Average**	**Lowest**
Primary	High	1	2	2
	Moderate	1	2	2
	Low	1	2	3
Secondary	High	1	2	2
	Moderate	1	2	3
	Low	1	2	3

Source: USFS (1995) p. 4-8.

Table 2.4. VRM levels for amount of use.

Use	High	Moderate	Low
Roads & highways	> 45K visits/yr	5K–45K visits/yr	< 5K visits/yr
Rivers & trails	> 20K visits/yr	2K–20K visits/yr	< 2K visits/yr
Recreation sites	> 10K visitor days/yr	2K–10K visitor days/yr	< 2K visitor days/yr

Source: USDI, Visual Resource Inventory. BLM Manual H-8410-1, Illustration 8.

indirectly affected by the proposed development" (The Landscape Institute and Institute of Environmental Management and Assessment 2002, p. 68). The "sensitivity of the landscape resource . . . [is] the degree to which a particular landscape type or area can accommodate change" (The Landscape Institute and Institute of Environmental Management and Assessment 2002, p. 87). The LVIA articulates no standard process to determine the sensitivity of landscape receptors, but it includes both public and private property. "Visual receptors include the public or community at large, residents, visitors, and other groups of viewers as well as the visual amenity [i.e., scenic appreciation] of people affected" (The Landscape Institute and Institute of Environmental Management and Assessment 2002, p. 75). The "sensitivity of visual receptors . . . will be dependent on the location and context of the viewpoint, the expectations and occupations or activity of the receptor, [and] the importance of the view" (The Landscape Institute and Institute of Environmental Management and Assessment 2002, p. 90).

Summary. Sensitivity of response by human populations and variation in this response by the location of the viewer is a concept shared by all six assessment procedures, but one for which evaluation methods are implemented differently by each. The process for identifying sensitive receptors and determining their level of sensitivity is typically poorly specified.

What are the guidelines for preparing acceptable visual simulations?

- How is the future condition determined? Is project compared to existing or future condition?
- What is the level of realism, documentation, and metadata expected?

Visual simulations help both professionals and the public visualize what a proposed project will look like. In general, the VIA procedures treat the existing condition as the point of comparison: an existing view is compared with simulations of project alternatives in that same view. However, only the VRAP emphasizes the need to forecast a future landscape view without the project and compare that with the forecast of the same view with project alternatives. This forecast may include other changes that are unrelated to the project, such as the growth of vegetation or the completion of other developments.

By and large, the technical aspects of preparing visual simulations are not discussed by these VIA procedures. The BLM (1986b) produced an introductory manual describing a variety of then state-of-the-art visual simulation techniques, but that have long since gone out of date. The major exception is LVIA, which describes the method of creating a photomontage from a photograph of the existing view and a 3-D CAD perspective of the project that is then rendered to appear realistic. This is currently the best professional practice for creating visual simulations. It also discusses animation and virtual reality techniques.

Summary. Although visual simulations are central to evaluating visual impacts, little to no guidance is offered for determining whether a simulation is suitable or not. Yet the results of a VIA will obviously be affected by the suitability of the visual simulations. A clear statement is needed that links the preparation of simulations to the purpose of the VIA.

What are the guidelines for selecting viewpoints?

- How are the viewpoints selected?

Viewpoints must be selected to prepare visual simulations, and their selection establishes how the proposed project will be seen by others and what visual impacts will be evaluated. Only the VRAP gives guidance as to how viewpoints should be selected. The VRAP specifies that "it is important to choose viewpoints that are representative of the study area." Viewpoints should be chosen because they represent:

- Typical viewer location.
- Typical viewer activities or expectations.
- Potential project visibility.

The VRAP also states that "Any number of viewpoints is possible, but two or three should be a minimum number" (Smardon et al. 1988, p. 49).

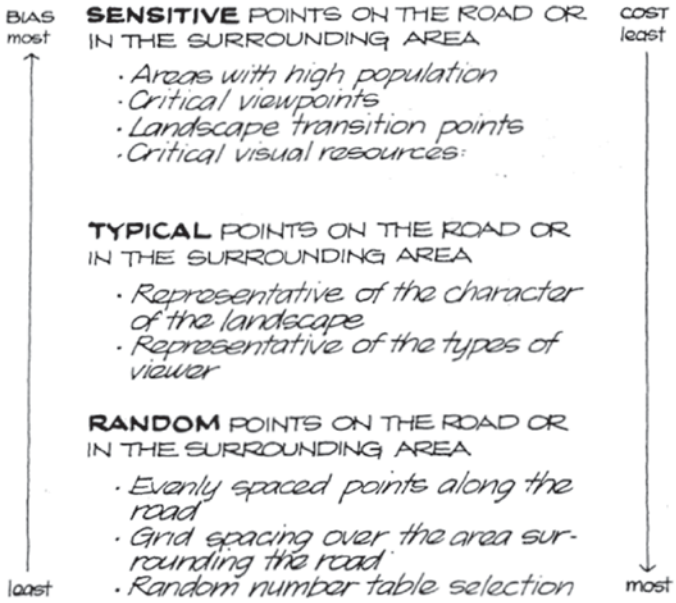
VMS and SMS are oriented toward VRM rather than VIA procedures *per se.* They require field evaluation throughout the landscape and as a result do not discuss the identification and selection of specific viewpoints. However, Litton's USFS manual, *Landscape Control Points: A Procedure for Predicting and Monitoring Visual Impacts,* describes how to "establish a network of LCPs [landscape control points] to give a reasonably continuous view of an extended area" (Litton Jr. 1973, p. 1). "Criteria for LCPs affecting their location and use involve relationships to roads, trail, air routes, areas of concentrated use, overview covering landscapes of special value, conditions that affect viewing, and over-lapping fields of view and different views of the same landscape segment" (Litton Jr. 1973, p. 21). The emphasis is on obtaining comprehensive visual coverage rather than identifying selected viewpoints appropriate for VIA.

VRM specifies that "the contrast rating is done from the most critical viewpoints . . . factors that should be considered in selecting KOP's [key observation points] are; angle of observation, number of viewers, length of time the project is in view, relative project size, [and] season of use" (USDI 1986b, p. 2). Larger projects that require several viewpoints should include:

- Most critical viewpoints (e.g., views from communities and road crossings).
- Typical views encountered in representative landscapes, if not covered by critical viewpoints.
- Any special project or landscape features such as skyline crossings, river crossings, substations, etc.

FHWA–VIA describes the selection of observer viewpoints as a trade-off between bias and cost, as shown in Figure 2.1. Sensitive points are least costly, but most biased; random points are least biased, but most costly. Typical points are representative of landscape character, and types of viewers provide a balance of cost and bias. There is no discussion of who decides what is "representative" (U.S. DOT 1981, p. 33). Further, there is no guidance on how to implement the actual selection of sensitive or typical viewpoints.

LVIA specifies that "principal representative viewpoints within the study area" be identified, but it does not give guidance on how to select them except that they "need to be impartial and objective to avoid misleading impressions . . . the choice of viewpoints should be justified" (The Landscape Institute and Institute of Environmental Management and Assessment 2002, pp. 73, 100). However, it is clear that viewpoints used for visualizations should "include conditions indicating the worst-case situation" (The Landscape Institute and Institute of Environmental Management and Assessment 2002, p. 102). There is a legal requirement for local planning authorities to contribute to scoping studies and in doing so to identify the important viewpoints from which visual impact should be considered.



Source: U.S. DOT 1981, pp. 33.

Figure 2.1. Cost and bias in selecting observer viewpoints.

Summary. There is no agreement on the best practice for selecting viewpoints, and little guidance is offered for identifying and selecting appropriate viewpoints. Yet the results of a VIA will obviously be effected by the selection of viewpoints. A clear statement is needed that links the selection of viewpoints to the purpose of the VIA.

How is the significance of a visual impact determined?

- How is existing landscape visual quality determined?
- How is visual impact determined?
- How is the seriousness of visual impact calculated/established?
- How are the results for specific points and people generalized to overall impacts?
- How are variable or conflicting results addressed?
- Are there fundamental intrinsic assumptions/biases about visual quality and impact (e.g., nature-like views are always preferred over other views, development always has an adverse visual impact, at least in nature-like settings).

Two procedures—VMS and its subsequent replacement, SMS—are primarily intended for VRM of federally owned forest land and result in visual resource objectives that establish thresholds for acceptable change. Under these procedures, the VIA process involves repeating the visual assessment

and/or sensitivity analysis, comparing the result to the baseline or desired future condition, and determining whether the change falls within acceptable limits for the area's visual management objectives.

In VMS, visual quality is a function of variety class (a descriptive framework to identify three levels of distinctiveness based on form, line, color and texture in landform, rockform, vegetation, and water forms) and sensitivity level (importance of use areas, and concern of users for scenic quality).

In SMS, as described in *Landscape Aesthetics: A Handbook for Scenery Management,* "desired condition has two components: landscape character goals and scenic integrity objectives" (USFS 1995, p. 5-9). Landscape character goals address scenic attractiveness, but also "must take into consideration ecosystem dynamics and trends" (USFS 1995, p. 5-5). "Scenic attractiveness is the primary indicator of intrinsic scenic beauty" and exhibits "the most positive combinations of variety, vividness, mystery, intactness, coherence, harmony, uniqueness, pattern, and balance" (USFS 1995, p. 1-14). Furthermore, "[s]cenic integrity objectives define the degrees of deviation in form, line, color, scale and texture that may occur" (USFS 1995, p. 5-9).

Figure 2.2 reproduces a matrix that summarizes the criteria for scenic integrity by level as used in SMS. Across the row labeled "Dominance," the columns indicate "which element [the landscape character or the deviation from it] has the strongest visual weight (or stands out visually over the others)" and the columns in the row labeled "Degree of Deviation" indicate whether this characteristic is evident and to what degree it is dominant in the assessment. The third row, labeled "Intactness," describes whether the landscape character is altered an how fully it is expressed. "Reading down each column gives a summary word picture of each level of integrity" (USFS 1995, pp. 2–6).

According to the USDA document, scenic integrity also can be used to "define the wholeness or condition of the ecosystem . . . a landscape character goal of high scenic integrity should also be one of high ecosystem integrity. One does not necessarily ensure the other. . . ." Furthermore, "providing a high level of scenic integrity may in some cases have to be achieved through establishing an 'ecological aesthetic' over time through knowledge and appreciation of how a healthy ecosystem functions and how we as humans fit into it" (USFS 1995, pp. 2–3).

Two additional federal agency procedures—BLM's VRM and the VRAP—include visual resource management but also have well-developed VIA procedures.

VRM conducts VIA through its contrast rating procedure. VRM measures visual impact as the contrast (strong, moderate, weak, or none) between existing and proposed pattern elements (form, line, color, or texture) for each landscape component (land/water, vegetation, or structures). Factors to consider in evaluating contrast include: distance, angle of observation, length of time viewed, relative size or scale, season of use, light conditions, recovery time, spatial relationships, atmospheric conditions, and motion. Professional judgment is used to synthesize these ratings, rather than arithmetic or other fixed rules. The result is compared to VRM objectives (USDI 1986b, pp. 3–5).

The VRAP uses the management classification to determine the degree and type of visual change that is acceptable. For VIA, the assessment framework is used to assign levels of visual quality (distinct, average, or minimal) to the landscape components (water resources, landform, vegetation, land use,

Criteria for Scenic Integrity of the L.C. Image/Sense of Place	(VH) Very High	(H) High	(M) Moderate	(L) Low	(VL) Very Low	(UL) Unacceptably Low
Dominance Landscape Character vs. Deviation	Landscape Character	Landscape Character	Landscape Character	Deviation	Deviation	Deviation
Degree of Deviation From the Landscape Character	None	Not Evident	Evident but not dominant	Dominant	Very Dominant	Extremely Dominant
Intactness of the Landscape Character	Landscape Character Fully Expressed	Landscape Character Largely Expressed	Slightly Altered and Character Expression Moderate	Altered and Low Expression of Character	Heavily Altered and Very Low Expression of Character	Extremely Altered

Source: USFS (1995). *Landscape Aesthetics: A Handbook for Scenery Management,* Rev. ed., p. 2-6.

Figure 2.2. Criteria for evaluating the scenic integrity class of a proposed project.

and user activity) of the forecast conditions with and without the project. In addition, ratings are given for three compatibility modifiers (compatibility, scale contrast, and spatial dominance) and the presence of special conditions. A numerical VIA value representing the degree of visual impact is compared to the level of visual impact that is acceptable within the management classification.

Two VIA systems—LVIA and FHWA–VIA—are not closely linked to pre-established VRM objectives. LVIA evaluates both landscape and visual impact. The "principal criteria for determining significance are the scale or magnitude of effect and the environmental sensitivity of the location or receptor" (The Landscape Institute and Institute of Environmental Management and Assessment 2002, p. 92). Figure 2.3 presents a table, included in the first edition of the LVIA, which provided useful guidance for determining significance. This changed with the second edition, which favored giving evaluators more discretion in determining significance.

FHWA–VIA measures VIA as the difference in visual quality before and after the project (U.S. DOT 1981, p. 92). Visual quality is obtained by averaging evaluations of vividness, intactness, and unity. Using a 7-point rating scale, vividness is rated for landform, water, vegetation and development; intactness is rated for absence of encroachment and overall integrity; unity is rated for human/nature harmony and overall unity.

Summary. There is no common understanding of the attributes or criteria for determining the significance of a visual impact. In addition, some VIA procedures compare the impact to visual management objectives, in effect planning by region, while other procedures consider each project as a unique event, which leads to incremental planning by project.

How is the public involved in the VIA process?

- Who are they?
- How are they identified?
- At what stages are they included?
- What influence does it [the public] have?

Each of the reviewed VIA procedures is based primarily on expert or professional assessment of intrinsic landscape attributes thought to compose scenic quality. However, the public is represented in these procedures in several ways.

The first way is that experts make judgments about public sensitivities as part of their analysis. Judgments are based

APPENDIX 1 FIGURE 2
EXAMPLES of Sensitive Receptors and Impact Magnitude Related to Significance of Impacts

Classification of Sensitive Landscape Receptors and Impact Magnitude		
Sensitivity	**Significance**	**Magnitude**
Key features and characteristics of landscape of distinctive character, susceptible to relatively small changes. NSAs, AGLVs	High	Noticeable change in characteristics or features over an extensive area ranging to intensive change to more limited area.
Moderately significant features and characteristics in a distinctive landscape or a landscape of moderately distinctive character reasonably tolerant of changes	Medium	Moderate or localised changes
Unimportant features or characteristics or indistinct landscape character types potentially tolerant of substantial change	Low	Virtually imperceptible changes or changes within the capacity of the landscape to absorb
Classification of Sensitive Visual Receptors and Impact Magnitude		
Sensitivity	**Significance**	**Magnitude**
Residential properties, tourist hotels, public rights of way, country parks, viewpoints etc.	High	Majority of viewers affected, major change in view
Schools, sporting or recreational facilities not related to enjoyment of the natural heritage	Medium	Many / some viewers affected, moderate change in view
Industrial, office or other workplaces	Low	Few viewers affected, minor changes in view

Source: The Landscape Institute and Institute of Environmental Assessment (1995, p. 52).

Figure 2.3. Criteria for determining the significance of impact.

on assumptions about the importance of different types of places (e.g., Interstate Highways are more important than local roads) and different groups' concerns for scenery (e.g., scenery is more important to people fishing than to people commuting).

The second way is that the public participates by submitting comments and testimony during the review period or through litigation after a decision is made. This is how the public can participate if they believe that their interests have not been represented in a decision. Project costs can escalate dramatically through this form of public involvement, due to direct legal fees, increasing costs of development over time, and failure to address the original problem. This approach is not discussed as part of any of the procedures reviewed.

The third way is to actively involve the public as a partner during the planning and design process through information meetings, workshops, and/or surveys. This approach moves beyond the assumptions that public perceptions can be judged by experts, or based on assumptions about the importance of scenery in different places or to different groups. This third approach requires experts who focus on learning about public perceptions as a basis for finding alternatives that are responsive to the public. The following excerpt from an FHWA–VIA document summarizes what all the reviewed procedures have to say about this third way:

> Local values and goals may confer visual significance on landscape components and areas that would otherwise appear unexceptional in a visual resource analysis. Highway planners can learn about these special resources and community aspirations for visual quality through project citizen participation procedures, as well as from local publications and planning documents (U.S. DOT 1981, p. 97).

Furthermore,

> Whatever the approach to the evaluation of visual quality, direct validation by project viewer groups should be obtained whenever possible. Public opinion on visual quality issues can be included in the normal community involvement program. A full representative and random sample is generally not necessary; the point is to ensure that the assessors and the general public are on the same track. Some form of public participation, and validation of professional judgment, may be particularly important where legal challenge is a possibility (U.S. DOT 1981, p. 47).
>
> Asking "project viewer groups their visual preference . . . can also have its difficulties, including time, cost, and statistical validity, particularly when there are strong differences in values between local and regional viewer groups. Viewer preference techniques can be very useful for identifying areas to avoid during project location, but are not as helpful for devising and evaluating mitigation measures for areas the project cannot avoid crossing" (U.S. DOT 1981, p. 46).

While public perceptions are clearly recognized as important, the FHWA–VIA procedure has no provisions for including the public in its VIA process, which can be completed without ever interacting with the public.

VMS made no provision for incorporating public participation, but SMS includes a lengthy discussion of the need for constituent assessment, including constituent surveys, visitor observations, constituent interviews, public participation and other sources of constituent information, and includes samples of survey questions (USDA 1995, pp. 3-3 to 3-18).

The VRAP describes several ways to include public perceptions as part of the Management Classification Assessment Framework (Smardon et al. 1988, p. 27), although the possibility of including public assessment of visual impacts is only mentioned in passing. The focus is on public meetings and workshops, and the VRAP includes examples of rating forms. While public assessment is formally included in the process flow charts, it is not required to complete the VRAP procedure. "Given planning needs, time, funding, and other constraints, judgment should be exercised in determining the extent to which direct or indirect public input is obtained and incorporated in a visual resource study" (Smardon et al. 1988, p. 27).

The LVIA method contains guidelines for consultation that include ideas about the role of the public and ways of engaging them, including new ways of seeking engagement such as citizen juries and use of the Internet (The Landscape Institute and Institute of Environmental Management and Assessment 2002, pp. 112–114). It is not prescriptive and generally considers the public alongside regulatory authorities and other specialists and interested groups.

Potential difficulties also are described, and attention is drawn to the many issues that may arise. It is worth noting that the landscape component of LVIA uses information from the separate but linked process of landscape character assessment. The separate guidance on this process discusses the role of stakeholders, defined as both communities of place and communities of interest, and discusses a range of ways of involving them actively at different stages of the process.

Summary. Some of the VIA procedures indicate that public involvement is important, but it is clearly peripheral to the core process of conducting a VIA. In most cases it is difficult to see how the public could significantly influence a VIA if one followed the process as written.

Whose values or sense of quality are represented in the process?

This question addresses whether the process aims to represent values of the public (and which segments of the public), landscape aesthetic experts, or landscape experts in other fields, like ecology, who might identify visible landscape characteristics related to ecological values. It also involves the related

question of whether those values should be quantified or even monetized for cost-benefit analysis.

All of the procedures rely primarily on professional judgment, applying a system of expert-determined criteria. In every procedure, a VIA can be completed solely using expert assessments.

While these procedures acknowledge that different types of people engaged in different types of activities may have different landscape perceptions and experiences, experts still determine the level of concern or sensitivity, and there is no requirement to contact people about their values or experience related to a particular place or potential project impact. The assumption is that scenery is more important to people engaged in recreational activities that require a natural setting (e.g., backpacking, hiking, fishing, canoeing, etc.) as compared to activities that do not (e.g., commuting to work, playing a field sport, mowing the lawn, etc.). In addition, it is assumed that places designated as historical sites, biological reserves, parks, and so forth have higher scenic value and that nationally designated places are more sensitive than locally designated ones.

Where procedures for public involvement are discussed, these procedures are not integral and are not required to complete the VIA. Where there is an apparent conflict between expert and public values, experts are charged with their reconciliation. SMS even goes so far as to suggest that the public's values sometimes may need to be overridden and the public educated to appreciate ecological values:

> In some situations, preferred scenic conditions . . . may run counter to [expert values]. . . . Providing a high level of scenic integrity may in some cases have to be achieved through establishing an "ecological aesthetic" over time through knowledge and appreciation of how a healthy ecosystem functions and how we as humans fit into it (USDA 1995, pp. 2–3).

Summary. All VIA procedures are based primarily on expert judgment; even the public is typically represented by what experts think the public is thinking.

Is the reliability and validity of the VIA process documented?

- Are key terms/actions defined clearly and unambiguously, so that they may be easily and reliably implemented?
- What is the intellectual basis of key terms, and is it documented or simply asserted?
- Is the process sufficiently clear as to be reliably followed by a knowledgeable person?
- Does the procedure include valid quantifications, and is the use of mathematics appropriate?
- If mathematics is not used to synthesize overall results, what process is used, and is it reliable and valid?
- Is there guidance about how to evaluate potential error?

The validity of these VIA procedures is asserted without any significant supporting documentation (e.g., USDA 1974, p. 2; and USDA 1995, pp. 6 and 20). For instance, the FHWA–VIA makes the following assertions (emphasis added) without any supporting evidence:

- "Several sets of evaluation criteria have been proposed and tested. One set that has proven useful includes three criteria: vividness, intactness, and unity" (U.S. DOT 1981, p. 47).
- "Expert evaluations based on these three criteria have proven to be good predictors of visual quality levels obtained from large numbers of public judgments, using the following simple equation: Visual Quality = (Vividness + Intactness + Unity) / 3. Each of the three criteria is *independent*; each is intended to evaluate one aspect of visual quality. In other words, no one criterion in itself captures visual quality" (U.S. DOT 1981, p. 53).

Reliability is not discussed, though the need for multiple expert raters (which can enhance reliability) is mentioned:

- The VRAP recommends that the detailed VIA be "carried out by three to five personnel, one of whom is a landscape architect" (Smardon et al. 1988, pp. 42, 65).
- VRM suggests that "The actual rating . . . can be done as a team effort or individually, depending on the sensitivity and impacts of the project and the availability of personnel. If done as a team, it is best to do the ratings individually and then compare the ratings" (USDI 1986b, p. 3). Of course a "team effort" or revising ratings after comparing them invalidates independence of the measurements and any opportunity to estimate reliability.
- A possible exception is LVIA, which is supported by a number of white papers and advice notes available on-line from The Landscape Institute. These documents were not included in this literature review. In any case, the book which describes the LVIA (The Landscape Institute 2002) does not document research supporting its reliability or validity.

Summary. The reliability and validity of the various VIA procedures are asserted but not well documented.

How is VIA linked to mitigation?

- When is it required?
- How is the most effective mitigation identified?
- How is mitigation evaluated?

Mitigation is the effort to reduce visual impacts from a proposed project. It can take the form of avoidance, reduction, remediation, and compensation. Two procedures—the

VRAP and the VRM—discuss how to use the assessment to guide mitigation.

- The VRAP's instruction is that "the outcome of this analysis is that the visual impact is or is not significant, given technical, institutional, and public considerations. If a project assessment is only 1 or 2 points from being within the appropriate range of VIA Values, the project assessment documentation should be reviewed to identify those visual resource components and characteristics that were most different between the with- and without-plan conditions. This information can be used to modify the alternative, and the Basic VIA Procedure could be applied again to the assessment" (Smardon et al. 1988, p. 64).
- The last step of the VRM contrast rating procedure is to develop additional mitigating measures "keep[ing] in mind the concepts of strategic location (in less visible and less sensitive areas), minimizing disturbance, and repetition of the basic elements (form, line, color, and texture). Also make sure that mitigating measures are realistic" (USDI 1986b, p. 6). Mitigation measures are evaluated to make sure that the project meets visual resource objectives.

Other reviewed procedures mention mitigation in a much more general fashion. For example, FHWA–VIA mentions mitigation, but not how to determine when it is necessary, what mitigation is appropriate, or how to evaluate it. "Mitigation encompasses the enhancement of positive effects as well as the reduction or elimination of negative effects. To be relevant, visual mitigation measures must address the specific visual impacts or problems caused by project alternatives" (U.S. DOT 1981, p. 53). FHWA–VIA does describe visual mitigation objectives as a sentence written in the form of: "Environmental management principle + Assessment of effect + Critical viewpoint + Viewer groups" (U.S. DOT 1981, p. 103). An example is: "Enhance + the visual quality + of the view of the project + for residents on Tumwater Hill" (U.S. DOT 1981, p. 103).

The VMS and SMS procedures do not include mitigation, and supplementary chapters that deal with specific applications (e.g., utilities, range, roads, timber, fire, ski areas, and recreation) describe mitigation strategies, but not how to evaluate their effectiveness.

LVIA also identifies general mitigation strategies (avoidance, reduction, remediation, and compensation) and even some specific measures, but does not discuss how to evaluate their effectiveness. There is particular emphasis on LVIA contributing to interactive design processes, noting for example that:

> Mitigation measures are generally more effective if they are designed as an integral part of an iterative process of project planning and design. Mitigation is thus used as a design approach that is, where possible, implemented from project inception when alternative designs or site options are being considered. In such circumstances it can be used to adapt and modify the development to take account of constraints and opportunities, and achieve the optimum environmental fit as part of an environmentally integrated design (The Landscape Institute 2002, page 43).

Summary. How mitigation is related to VIA is a largely undeveloped theme. For example, how can the results of the VIA be used to determine appropriate mitigation strategies? Have all reasonable forms of mitigation been taken, and how does one evaluate that? Should the conduct of VIA be independent of mitigation planning and design?

How is VIA linked to VRM?

- Does the VIA process anticipate the existence of an existing visual resource inventory and management classification system?
- Are there clear VRM objectives?

VMS, SMS, and VRM are all visual resource management systems; the VRAP was envisioned but never implemented as a visual resource management system. In each of these procedures, proposed changes to the visual landscape must meet the stated visual resource objectives (or the objectives need to be changed).

FHWA–VIA discusses how to prepare VRM objectives for a transportation corridor. However, there is no attempt to prepare a comprehensive VRM plan, and there is no discussion about how objectives developed for a specific transportation project relate to other planning efforts. LVIA does not discuss VRM, but the UK has a well-established landscape planning framework built on landscape character assessments that generally can be used to establish the context for any VIA.

Summary. The advantage of linking VIA to VRM is that it provides visual management objectives against which to compare visual impacts. VIA can be an integral part of land planning, as it is for the federal land management agencies, or it can be conducted on a project by project basis, as it is for transportation projects. In the UK land planning incorporates a landscape characterization framework, and VIA is conducted within the context of that framework.

How are cumulative and indirect impacts considered?

- Is it likely that the project will be expanded?
- Are other projects proposed or contemplated within the project viewshed?
- Will the project encourage further development by third parties?

Frequently, transportation projects are proposed with the intent of stimulating growth. Given this situation, it seems natural that the VIA not be limited to the project's direct visual impacts, but rather include the anticipated development. Cumulative impacts refer to the incremental change of several projects in one area. Indirect impacts refer to the landscape changes, such as secondary development, that are stimulated by a proposed project. By and large, however, cumulative and indirect impacts are either not mentioned (VMS, VRM, FHWA–VIA), or acknowledged without discussing how they should be considered (SMS).

LVIA indicates that the EIA regulations require consideration of cumulative and indirect impacts but not how to identify and evaluate them (The Landscape Institute and Institute of Environmental Management and Assessment 2002, p. 23).

The VRAP requires that future impacts be compared to the future condition without the proposed project. If appropriate time frames are chosen, then cumulative and indirect impacts associated with a proposed project would be evaluated, as well as future impacts not associated with the proposal.

Summary. Projects are often justified because of the indirect economic benefits they will create. However, there is little provision in the reviewed VIA procedures to identify and evaluate the visual impacts that result from indirect and cumulative development.

2.2.3 Summary of Methodological Issues

A review of existing VIA processes revealed that several inherent structural differences limit the usefulness of applying visual management procedures from federal land-owning agencies to FHWA–VIA applications. These approaches are all based on best practices from the 1970s, and more useful models may come from the current practice in Europe or perhaps selected states where VIA has continued to evolve and develop.

The review identified several important findings that were incorporated into the criteria for evaluating existing VIA documents as used in Chapter 5 of this report. These findings are briefly summarized in the rest of this section.

Management Responsibility

Perhaps the most important difference among existing VIA processes is that, in the United States, FHWA or state DOTs do not manage the land base surrounding transportation projects. The federal land management agencies all have systems for establishing VRM objectives for their lands. These objectives can be used as criteria for evaluating visual impacts. The FHWA–VIA is applied to a relatively narrow, linear transportation corridor surrounded by an extensive visible landscape of privately owned land (or public land managed for other purposes). These private lands typically do not have visual management objectives that can be used as criteria to evaluate visual impacts.

Landscape Character as a Planning Framework

A different approach is used in the UK and increasingly throughout Europe, where local government land planning includes landscape and visual quality objectives. The emphasis is not so much on picking out areas of special aesthetic, visual, or scenic quality, but on the idea that "all landscapes matter," even though some may matter more than others. The approach is to identify the existing landscape character and plan in ways that respect and enhance its integrity.

Like transportation agencies in the United States, those in the UK typically do not own or manage the land surrounding their projects. However, the UK authorities still utilize a comprehensive landscape and visual assessment framework as an important contributor to their transportation planning. This provides a context allowing transportation planning to be more responsive to local needs and landscape character, and to provide visual quality objectives that could be used as criteria for evaluating visual impacts of project alternatives.

Approach to Visual Impact

All of the procedures recognize visual impact as being the difference between the visual quality of a landscape with and without the proposed project, and they all rely on experts to inventory and evaluate landscape visual qualities. Only the VRAP expects the comparison to be made for future conditions, including the cumulative impact of other planned projects and related growth stimulated by these projects.

Baseline Landscape in VIA

All the VIA procedures compare a proposed landscape change to a baseline landscape, and all begin this with a description of landscape physiography that includes the study of the earth's surface, including topography, climate, water, soil and vegetation. However, a key difference is that some methods describe physiography using objective, denotative characteristics and others rely on connotative interpretations. Denotative means to name or designate, or to be specific and direct, such a measuring our perception of a physical quality like height or color. Connotative means to imply something in addition to what is explicit, such as a measurement of emotional response or association. The difference between denotative and connotative characteristics has important implications for the reliability of visual assessments and is discussed later in this section.

Representation of the Public

None of the VIA procedures uses a scientific method to represent public perceptions; none are based on quantitative data about the public's perception of landscape, and none are based on peer-reviewed literature. All of the procedures use expert judgment to assess visual quality, as well as people's and/or places' sensitivity to change, and these judgments are assumed to represent public perceptions. Since research has shown that expert opinion does not necessarily reflect public opinion, not involving the public in the VIA process is problematic.

Pragmatism

To be successful, a VIA procedure needs to be easily implemented using the available resources. Based on their wide application over decades, both VMS and VRM can be considered pragmatic procedures. However, the USFS system changed from the VMS to the SMS, and that change created what may be a less pragmatic method in which scientific representation of public perception is invited but a pragmatic method of gathering this information is not described. For instance, the SMS does not reflect recent dramatic advances in web-enabled public participation.

Validity and Reliability

A valid VIA procedure directly evaluates visual quality and visual impact or the attributes that determine them; a reliable VIA procedure gives the same results when two people apply it appropriately and independently. None of the VMS procedures has been tested for validity and reliability by the respective agencies. Chapter 4 of this report discusses reviews of the systems' validity and reliability in the peer-reviewed literature.

Sensitivity to Change in Cultural and Natural Landscapes

The landscape's sensitivity to change is generally expressed as a comparison between landscape visual quality with and without a proposed change. Capacity to assess the visual quality of proposed changes is a fundamental weakness in all VIA procedures except the LVIA because they assume that a natural-looking scene is always most desirable. Only SMS explicitly analyzes the natural appearance and integrates that definition of an "ecological aesthetic" into the system, allowing ecological function to "override" immediate visual impressions of a landscape. Only LVIA attempts to characterize human-constructed aspects of the landscape (including field and forestry patterns and structures) into a desirable landscape condition. Since FHWA project landscapes typically pass through human-dominated landscape corridors and are, inevitably, constructed landscapes with the right-of-way, it is essential for a FHWA–VIA to provide guidance for different alternative design and management choices (rather than identifying only a "natural" condition as desirable). Section 2.5 provides additional discussion from peer-reviewed literature on how different agencies across the globe have analyzed a landscape's sensitivity to change.

Selection of Representative Landscapes and Views

FHWA–VIA discusses the trade-off of different approaches for selecting the viewpoints from which a proposed project will be evaluated. Other procedures give some mention of viewpoint selection. However, no system provides a standard to guide the selection of viewpoints. For instance, should viewpoint selection be made in a way that supports creation of a valid index of a project's overall visual impact? Within the area around a viewpoint, should the selected view always represent the "worst case"? Should all neighborhoods affected by a project be represented among the selected viewpoints, or only those neighborhoods designated as sensitive places or as having sensitive users?

Incorporation of Current Technologies

The capabilities of current computer technologies are not incorporated into these VIA procedures. Visibility and viewshed analysis are the foundations for current professional VIAs, yet they are barely mentioned in the reviewed VIAs. At a minimum, there should be standards for the quality of data used, the variables to evaluate (e.g., screening, visual magnitude of project elements, and length of time viewed), and the appropriate communication of the analysis results.

Simulation technology has also rapidly advanced, and this advance is not yet reflected in VIA procedures. Photo-realistic simulations are now readily available. However, it is also possible to create realistic animations of a viewer moving along a transportation corridor or an interactive visual model by which a person could view a project from anywhere within the study area. Standards need to be set about communicating the veracity of simulation and how simulations are to be reproduced and viewed.

2.3 Issues of Practice

In the past 40 years, a large number of VIAs have been conducted, using a variety of methods. One might reasonably expect that there would be a substantial number of rigorous reviews of how VIAs are conducted, as well as the validity and reliability of the methods used. Although there has been a great deal of work on EIA in general, there is surprisingly little

research specifically evaluating VIAs. Nonetheless, the few studies that have been conducted offer significant insights into the procedural differences between methods and their relative validity and reliability. It is notable that the majority of the existing reviews date from the 1970s or 1980s and there has, in general, been much less work of this type in the 1990s and into the 21st century.

2.3.1 Critiques of Procedure and Method

Criticism of Environmental Planning

The systematic inclusion of aesthetic issues into modern planning practices can be traced to the passage of NEPA in 1969. One of the policy objectives of NEPA is to "assure for all Americans . . . aesthetically . . . pleasing surroundings" [42 USC 4331 § 101(b)2]. To make this happen, the law directs the federal government to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment" and "identify and develop methods and procedures . . . which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations" [42 USC 4331 § 102 (A) and (B)]. As a result, it is generally accepted that VIA strives to be an objective evaluation of a subjective phenomenon.

Shortly after NEPA was implemented, the EPA sponsored *Aesthetics in Environmental Planning* (Bagley et al. 1973), which reviewed 18 of the many aesthetic impact assessments, planning studies, and research monographs being produced at that time. These included approaches that tried to quantify the degree of impact, approaches that were more descriptive, and approaches that relied on user analysis methods. No other systematic review has attempted to be as comprehensive as this pioneering report.

While the diversity among the 18 approaches selected for review was substantial, it is worth noting that even at this early date there were widely known approaches that were not reviewed. Two important examples have particular applicability to urban areas: Lynch's (1960) *Image of the City,* with its approach to characterizing urban places (i.e., paths, nodes, edges, landmarks, and districts) and Alexander's (1977) *A Pattern Language,* which has since been adapted to landscape settings by the Kaplans and Ryan (1998). Nonetheless, Bagley's conclusions and recommendations remain very relevant to the current state of VIA practice.

Bagley et al. (1973, p. 157) writes that "all indications point to the conclusion that research in the area of aesthetics is proportionately less than other areas of environmental concern (e.g., air quality, land use planning, water quality) and yet, aesthetics is the one that is most closely tied to the appreciation and acceptance of a project. . . . The need for some nationally recognized criteria for aesthetic considerations is apparent, particularly at the federal agency level." Specific conclusions and recommendations reached by Bagley et al. (1973, pp. 1–3) include the following:

- "Research in applied theory is deficient in responding to the needs of local planners and decision makers. Quantification methodologies tend to be overly complex, in addition to being highly subjective and value-laden."
- "There is limited evidence of attempts to use the visual or user analysis methods developed by consultants and researchers."
- "The responsibilities for trying to develop aesthetic criteria and controls sift down from the federal level to the local government and private sector, providing little coordinated direction for comprehensive environmental planning."
- "The lack of significant financial support and recognition of both the subject matter 'aesthetics' and the design arts disciplines . . . places aesthetics in a tenuous position for serious consideration."
- "The research needs outlined in Section VII of this [Bagley's] report should be jointly sponsored by agencies demonstrating prime responsibility for the related subject matter."
- "Every effort should be made to elevate the status of aesthetics and the design arts in environmental planning."
- "Primary emphasis should be placed on improving the understanding of aesthetics in the socio-physical context with direct relationship to man's aesthetic needs."
- "Tolerance levels specifically related to aesthetic needs should be identified."
- "A consistent social policy (preferably interactive) should be established at various levels of planning and decision making."
- "Appropriate guidelines and standards should be initiated to ensure that aesthetic rights are protected for present and future generations."
- "Criteria should be developed for evaluating the usefulness of studies in applied theory and basic research" in environmental aesthetics.
- "Professionals in the design arts should assume the responsibility for developing communicative tools (simulation labs and the like) so that the relevant public can respond intelligently when presented with information about aesthetic conditions in the environment."

Not many of these conclusions and recommendations were incorporated into the subsequent development of federal VIA methodologies, as evidenced by the discussion in Chapter 3 of this report. Nonetheless, Bagley's critique still offers valuable ideas on how to conduct VIAs.

Criticism of Evaluation Techniques

In 1980, the U.S. Water Resources Council's Environmental Quality Evaluation Procedures (EQEP) established an approach to environmental quality assessment that involves creating a framework of important quality attributes, identifying indicators that describe each attribute, and defining units for measuring the indicators. This approach is now commonly being adopted for the purposes of comparative evaluation, including the evaluation of visual impacts by alternative. One of its strengths is a systematic and transparent way of documenting the evaluation procedures that should lead to greater reliability and increase the compatibility of VIAs with the evaluation of other environmental factors.

In 1981, the MITRE Corporation undertook a project for the USACE to demonstrate how to implement the EQEP (Leslie, McDowell, and Singley 1981). Aesthetics was one of their three demonstration attributes. They conducted a literature review to identify the terms used to classify the landscape resources within a scene (e.g., land, water, vegetation, and structures), describe scene elements (e.g., form, line, color, and texture) and other variables for each resource (e.g., distance, observer position, and scale), and visual rating criteria (e.g., vividness, intactness, and unity). Based on this review, they concluded that "there are many opinions on the subject" and "the discrepancies among terms used . . . [are] a small reflection of the personal biases and preferences that are involved" in conducting a VIA (Leslie, McDowell, and Singley 1981, pp. 6–41). Nonetheless they presented the outline of a generic classification that includes indicators and units for the whole scene as well as the separate resources. Both intrinsic/natural and participant/observer indicators are presented. The weakness is similar to the Bagley (1973) review in that the literature is based on expert opinion rather than being grounded in empirical studies of landscape perception.

More recently, Ode, Tveit, and Fry (2008) proposed a framework of indicators that is grounded in the empirical landscape perception literature. They identify nine concepts found in this literature used to describe landscape character: complexity, coherence, disturbance, stewardship, imageability, visual scale, naturalness, historicity, and ephemera. For each concept, they identify several indicators and suggest ways of measuring the indicator using four types of data: landscape photos, orthophotos, land cover data, and field observations. Complexity, for example, is a concept, and diversity of land cover is one of its indicators. This indicator can be measured by counting the number of land covers apparent in a landscape photograph or observed during field observations. Orthophotos and land cover maps can also be used to calculate diversity and evenness indices used by landscape ecologists (Ode 2008).

Additional Criticism

Arthur, Daniel, and Boster (1977) conducted an extensive literature review of descriptive inventories, public evaluations, and economic analyses used to evaluate scenic beauty. They conclude that:

> Much of what currently passes for esthetic evaluation is inadequate. However, improvement in esthetic planning tools will likely continue to be incremental, which . . . can offer certain advantages. Managers should continue to try new techniques to evaluate the effects of management alternatives on scenic perception.
>
> A technique for assessing scenic quality should be selected with the criteria relevant to the problem at hand. . . . *Generally, these criteria suggest that techniques should be based on public experience, valid and reliable (in a statistical sense), adaptable to different planning situations, and simple and inexpensive to use* (Arthur, Daniel, and Boster 1977, p. 126). [Emphasis added.]

This recommendation that the public be more directly and effectively involved in any VIA process has been a repeated critique of existing VIA methods for nearly 30 years. During the same year that FHWA began promulgating its VIA methodology, serious questions about the lack of public involvement in such processes were being raised. In 1981, and again in 1983, Palmer prepared reviews of expert and public approaches to visual quality and VIA as part of two edited volumes on social impact assessment methods (Palmer 1981, 1983). These reviews focused on demonstrating the range of methods available for expert and public landscape assessments, and the issues associated with their use.

In addition, several bibliographic analyses of the visual assessment and aesthetic impact literature have been published. Priestley (1983) evaluated the bibliographies of 81 papers published in the *Proceedings of Our National Landscape* (Elsner and Smardon 1979). His analysis led to three observations (Priestley 1983, pp. 55–57):

1. "Visual resource analysis and management is a relatively young field." The citations suggest that VRM as a field of practice began to take shape around 1968.
2. "Work by landscape architects and environmental psychologists represent two major and somewhat independent streams of endeavor in the field. . . . [M]any of the visual analysis and impact assessment methods presented by landscape architects/practitioners in the *Proceedings of Our National Landscape* do not appear to incorporate explicitly or cite the recent work of environmental psychologists. At the same time, much of the recent work of the environmental psychologists is difficult to relate in a specific way to the work of the landscape evaluators and designers."
3. "The field of visual resource analysis and management is at the pre-paradigm stage of development"; a statement

by which Priestley means that "there is no consensus on a central paradigm, so the field generally consists of competing schools of thought."

No evidence yet exists that a central paradigm has emerged. Rather, some VIA procedures are still being utilized by their agency sponsors and others are being allowed to atrophy. Priestley's second point, that the practice of VIA has little relation to the research related to environmental psychology is not only still valid, it increasingly has the potential for making the use of the existing methodologies legally, politically, and economically indefensible.

As if to emphasize this last point, Cats-Baril and Gibson (1986) employed a Delphi process with 49 practitioners and academics from various backgrounds to identify the most pressing issues facing VIA and to gather a bibliography of the most helpful sources to address those issues. The participants were asked to rank five issues facing VIA; their mean ranking is shown in Table 2.5.

These issues are not new. Arbogast (2005) compiled a list of more than 700 publications on VRM published between 1912 and 2004. She states that her program (the U.S. Geological Survey's Central Region Sustainable Development of Industrial Minerals Project) is interested in focusing on landscape aesthetics because "aesthetics is the one environmental concern that is most closely tied by the public to the appreciation and acceptance of a mining project" (Arbogast 2005, p. 3).

While the reviews and bibliographies considered in this chapter have come primarily from the peer-reviewed literature, there has been another significant source for communicating and sharing information about VRM and VIA—conferences. A series of international scholarly meetings from 1965 through 2005 are one indication of the long term international interest in the management of landscape aesthetics. They also document a shift in leadership and initiative from the United States to Europe. (A discussion on international approaches to VIA appears in Section 2.5 of this report.)

2.3.2 Critiques of VIA Credibility

As summarized earlier in this report, one of NEPA's requirements is 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 4331 § 102 (B)]. It is generally understood that this section applies to VIA, and that while not explicitly required, it would be desirable to develop quantified methods to assess environmental amenities.

The legal review in Section 2.1 also describes how the courts have required that VIA procedures be pragmatic and reliable in order to be defensible. This section summarizes what is known about the reliability of VIA methods, including how the analysis of visibility and the use of visual simulations affect reliability, with some additional comments about validity.

Criticism of Visibility Analysis

Visibility or viewshed analysis is the process of determining whether and how much of a proposed project will be visible from the surrounding landscape. The method is primarily one of geometry and is highly suited to calculation on computers; therefore, it should be quite reliable. The problem is data errors and inadequacies, which may require assumptions and generalizations that reduce the validity of model results (e.g., assigning heights to types of land cover to account for visual screening).

Researchers have proposed methods to relate the distance and size of visual objects to human perception of impacts (Shang and Bishop 2000; Iverson 1985). Kent (1986) reviews various approaches to visibility analysis and describes a method to calculate the "zone of visual influence" and "times-seen analysis." Sansoni (1996) describes a probability approach to calculating intervisibility within a study area,

Table 2.5. Major issues facing the assessment of scenery aesthetics.

Issue	Mean Rank
Development of dynamic, systematic, reliable, valid and implementable methodology.	2.26
Inclusion of social and cultural values in the modeling of aesthetic judgment.	2.38
Implementation of aesthetic judgment: legal and regulatory process.	3.06
Economic impact of aesthetics.	3.14
The balance between expert judgment and public participation/education.	3.28

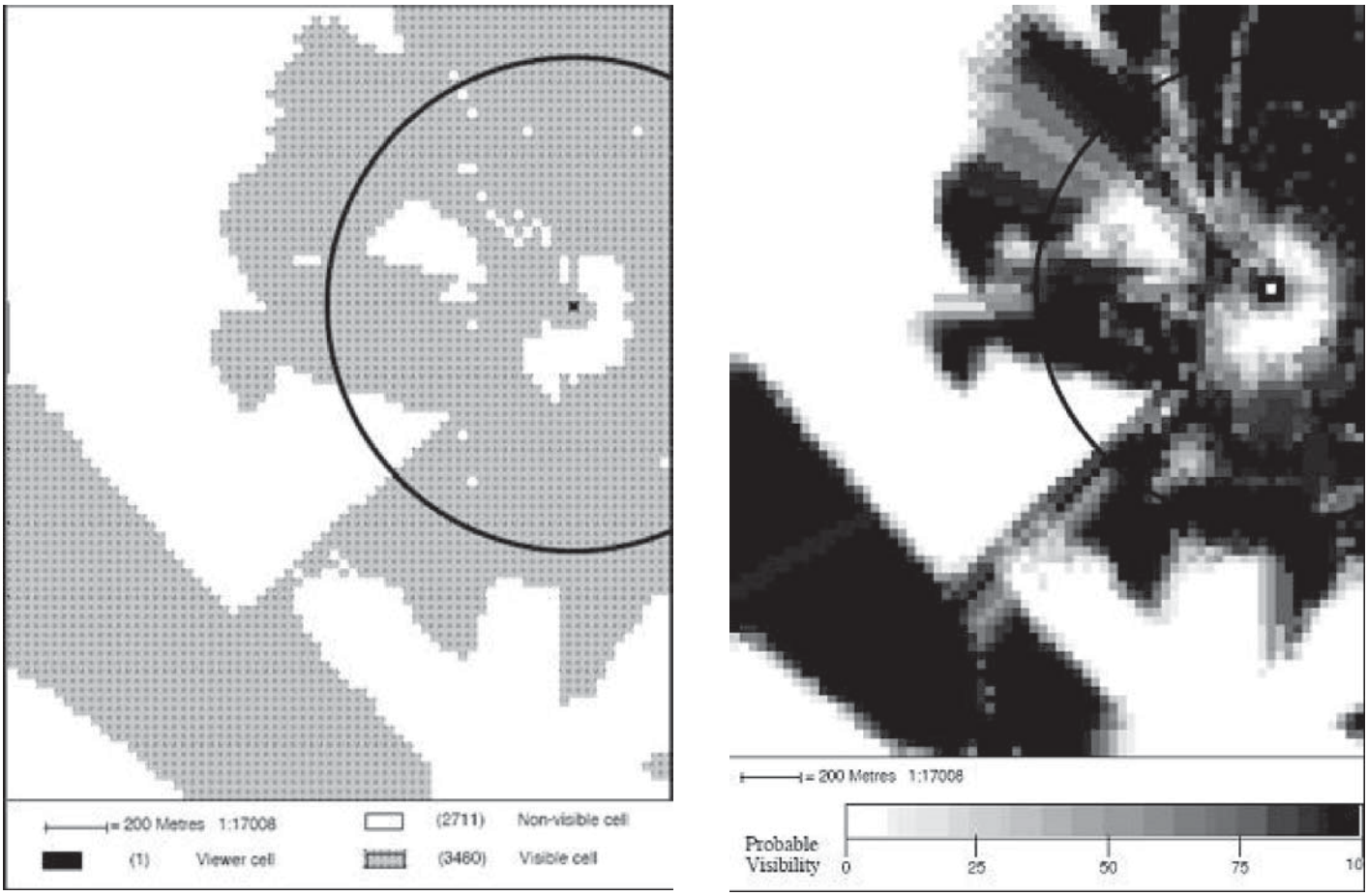
Source: Cats-Baril and Gibson (1986), p. 96.

which will aid in the identification of viewsheds. Several researchers have conducted evaluations of the accuracy of viewshed calculations (Fisher 1991; Sander and Manson 2007; van Bilsen and Stolk 2008). Other authors have demonstrated the calculation of probability or fuzzy viewsheds (Palmer and Felleman 1991; Fisher 1992, 1993; Nackaerts, Govers, and Van Orshoven 1999). Fuzzy viewsheds, as shown in Figure 2.4, would help analysts know where viewshed results were most or least reliable.

Even though visibility analysis is central to conducting a modern VIA, only one article was identified that conducted an audit of visibility predictions in VIAs (Wood 2000). Wood determined the actual extent of visibility of four built projects through field observation and compared them to the visibility maps in the EIS. He found a wide range of accuracy, with inaccuracies being primarily explained by "the failure to adequately consider the effects of physical barriers to visibility (e.g., buildings and vegetation)" (Wood 2000, p. 553). In other words, the analysis generally errs on the side of caution, indicating potential visibility when there will be no visibility after project construction.

Criticism of Visual Simulations

Visual simulations are the primary tool used to represent how a proposed project will look, and are therefore critical to reliable and valid visual assessments. Most research in this area involves the validity of visual simulations (i.e., do people evaluate the visual simulation in the same way that they do to the real scene?). Stamps (1993, p. 117) conducted a meta-analysis of the simulation validity literature covering 1215 stimuli and more than 4200 respondents and found that evaluations of the real scene were highly correlated with evaluations of color photographic simulations ($r = 0.83$) and less highly correlated with evaluations of black-and-white photographic simulations ($r = 0.56$). Palmer and Hoffman (2001) also conducted an extensive literature review involving 19 studies that compared the scenic preferences of real sites and photographs for a total of 470 sites. They found an overall size effect (i.e., weighted average correlation) of 0.80, which seems to support the use of photographic simulations. However, a closer investigation of the project reports found several examples for which specific simulations were not valid (i.e.,



Source: Palmer (1991).

Figure 2.4. A typical visibility map and a fuzzy visibility map showing the probability of visibility.

the evaluations of the real view and the photograph differed significantly). The researchers explained these differences both in terms of respondent and landscape characteristics. The point is that overall, visual simulations are statistically found to be valid, but specific simulations may not be valid. In other words, for a practitioner to have valid (and therefore, useful) simulations, it is very critical that the right type of simulation be used.

Sheppard (1989) has extensively studied the principles of visual simulation and prepared a systematic approach to appraising their quality. His principles are:

- Representativeness
  - Are . . . important views included?
  - Are unimportant or unrepresentative views included?
  - Are typical or important viewing conditions represented?
- Visual Interest
  - Are the simulations too lengthy, brief, repetitive, numerous, or overly entertaining?
  - Legitimacy
  - Is the simulation process defensible and documented?
- Accuracy
  - Do simulations contain obvious inaccuracies?
  - Do simulations show incorrect or inadequate project content?
  - Do simulations omit or contain incorrect project components?
  - Do simulations show incorrect [location, scale, shape, color, textures, etc.]?
- Visual Clarity
  - Are simulations clearly presented?
    (Sheppard 1989, pp. 187–88)

A careful application of Sheppard's principles would increase the quality of simulations; opposition groups could also apply his appraisal protocol to evaluate simulations for their validity.

Criticism of Expert Reliability

Concerns with Reliability. Reliability concerns the extent to which two independent experts using the same criteria arrive at the same evaluation. The primary study of VIA ratings reliability was conducted in the late 1970s at the University of California, Berkeley (Feimer and Craik 1979; Smardon and Litton 1981). In one set of tests, student respondents were given a 3-hour training course similar to that given to BLM personnel. One week later, they began the first of several testing sessions. Nineteen scenes were evaluated, first describing the pre-impact condition, then the post-impact condition, and finally the contrast between the two. The average reliabilities for one rater and five raters are presented in Table 2.6 and Table 2.7.

Based on these results, the researchers offered the following general observations:

> (1) Low [reliability] for ratings based on small numbers of observers; (2) Higher [reliability] for ratings of scenes before the imposition of land use activity impacts than for ratings of scenes after the imposition of impacts; [and] (3) Higher [reliability] for direct ratings of landscape attributes than for ratings of the degree of contrast, or change, imposed upon landscape attributes by land use activities (Feimer et al. 1979, p. 286).

These results provided an early indication that the favored approach to experts evaluating visual impacts through contrast ratings might not be very reliable and might be of questionable utility. This was true both for the evaluation of form, line, color, and texture contrast as used by the BLM and for the change in vividness, intactness, and unity as used by FHWA.

Surprisingly, the basis of the FHWA–VIA process has been little studied. Only two other studies were found that evaluated the reliability of the primary VIA criteria used by FHWA: vividness, intactness, and unity. Clay and Smidt (2004) identified the landscape descriptor variables used in 19 agency visual assessment systems, primarily for scenic highway designation. They investigated "the most widely applied scenic descriptors from the programs reviewed"—naturalness, vividness, variety, and unity (Clay and Smidt 2004, p. 244). Respondents rated 36 slides from a scenic road corridor near San Luis Obispo, California. Cronbach's Alpha statistic (A) was used to evaluate reliability: naturalness (A = 0.92), variety (A = 0.71), vividness (A = 0.78), and the results for unity are not reported. However these are reliabilities for a group of 234 respondents; the reliability for the small number of experts used to conduct assessments would be much lower, which would be unacceptable for a VIA (Palmer 2000).

In the second study, Lamberti, Russo, and Dell'Acqua (2010) had seven landscape architects evaluate vividness, intactness, and unity of 45 roadside scenes from three different valleys in Italy. The scenic beauty of the same views was evaluated by 201 college students. Scenic beauty had a high correlation (r) with vividness ($r = 0.77$), and a modest correlation with unity ($r = 0.25$). However, the surprise was that there was a low negative correlation with intactness ($r = -0.08$). In addition, the visual quality index used in the FHWA–VIA ($[V + I + U] \div 3$) had a very modest correlation with scenic beauty ($r = 0.30$). The researchers also used Cronbach's Alpha to measure group reliability: vividness (A = 0.95), intactness (A = 0.94), and unity (A = 0.94). Reliabilities for scenic beauty were not reported.

A couple of additional studies investigated the reliability of contrast ratings. Kopka and Ross (1984) trained four landscape architecture students to use the BLM's approach to assessing landscape scenic quality and then use it to evaluate ten landscape photographs. Palmer (2000) had 25 landscape

Table 2.6. Reliabilities for direct and contrast ratings for single rater and five raters.

	Pre-Impact		Post-Impact		Contrast	
Rating Scale	R_1	R_5	R_1	R_5	R_1	R_5
Ambiguity	0.19	0.54	0.07	0.26	0.04	0.19
Color	0.13	0.43	0.25	0.63	0.34	0.72
Compatibility	0.07	0.26	0.28	0.67	0.03	0.14
Complexity	0.49	0.83	0.13	0.44	0.15	0.46
Congruity	0.17	0.50	0.25	0.63	0.03	0.14
Form	0.45	0.80	0.14	0.46	0.15	0.46
Intactness	0.34	0.72	0.31	0.69	0.04	0.17
Line	0.19	0.54	0.05	0.22	0.22	0.58
Novelty	0.31	0.70	0.22	0.59	0.07	0.27
Scenic beauty	0.18	0.53	0.20	0.56	0.03	0.12
Texture	0.41	0.77	0.24	0.61	0.24	0.61
Unity	0.18	0.53	0.25	0.63	0.01	0.04
Vividness	0.21	0.57	0.24	0.61	0.10	0.37

Note: There are 29 raters for the pre-impact and contrast ratings, and 17 raters for the post-impact ratings.

Source: Feimer and Craik 1979, Tables 7, 8 and 9.

architects in a 2-day VIA training course apply the BLM contrast rating system to five pairs of photographs representing the pre- and post-impact condition. Table 2.8 reports single rater reliabilities from both studies.

Improving Reliability. One possible way to increase the reliability of contrast ratings is to shift from human ratings to physical measurements. García and his colleagues have made substantial progress toward this goal for measuring contrasts between a proposed structure and the existing context for color (García, Hernández, and Ayuga 2003), texture (García, Hernández, and Ayuga 2006), and lines and forms (García-Moruno et al. 2010). Their approach uses digital imaging software to measure the contrast of a proposed project with its surroundings. For instance, measures of texture include regularity, density, and grain size; measures of color include hue, saturation, and lightness; for line, they include sharpness, complexity, and orientation; and for form, they include geometry, complexity, and orientation. The utility of these measures is being validated by comparison to public assessments of visual impacts.

2.3.3 Summary of Practice Issues

Reviews of VIA methods have consistently identified the following issues and areas of possible weakness. These weaknesses are typical of most current VIA procedures, which have not changed appreciably for more than 30 years.

Experts assess intrinsic visual qualities.

VRM and VIA procedures were established as systems in which experts assess visual quality, including scenic quality, as an intrinsic attribute of the landscape. This conceptualization of visual quality as intrinsic is consistent with an identified weakness of VRM and VIA systems: they do not seek to understand how people may react to landscape change, either by directly investigating the perceptions of affected people or by employing the results of research that suggests how affected people are likely to react.

Viewer experience an interaction of people and landscape.

This approach contrasts sharply with conceptualizing visual quality as intrinsic. Instead, a viewer's experience of visual quality is an interaction between landscape and people. This concept of people/landscape interactions is discussed in detail in Section 2.4, "Issues of Perception." It suggests that affected people must be involved in assessments of visible landscape change.

Table 2.7. Reliabilities for BLM contrast ratings for single rater and five raters.

	Feimer & Craik		Smardon & Litton	
Rating Scale	R_1	R_5	R_1	R_5
Land/Water Bodies				
Form	0.31	0.69	0.52	0.84
Line	0.20	0.56	0.35	0.73
Color	0.38	0.75	0.35	0.73
Texture	0.22	0.58	0.38	0.76
Scale			0.31	0.70
Vegetation				
Form	0.29	0.67	0.28	0.66
Line	0.49	0.83	0.24	0.61
Color	0.25	0.63	0.34	0.72
Texture	0.24	0.62	0.33	0.71
Scale			0.22	0.59
Structures				
Form	0.37	0.75	0.45	0.80
Line	0.22	0.58	0.55	0.86
Color	0.32	0.70	0.53	0.85
Texture	0.27	0.64	0.43	0.79
Scale			0.53	0.85

Source: Feimer and Craik (1979), Table 10, and Smardon and Litton (1981), p. 64.

The most natural landscape may not always be the most scenic.

Because of the type of land that they are responsible for managing, USFS and BLM treat the natural "climax" landscape state as having the highest quality. This is explicitly so in SMS. However, the LVIA and, to a much lesser extent, FHWA–VIA and the VRAP are concerned with the character and integrity of cultural landscapes, including urbanized areas. In these settings, the simple formula of "more natural = higher scenic value" does not work. Rather, this approach poses the more difficult question of what it is about each landscape that determines its character and makes it scenic. This is particularly important for FHWA, since highways in urban areas have more users and viewers.

Table 2.8. Single-rater reliability for BLM's level of influence variables.

Variable	Kopka & Ross (1984)	Palmer (2000)
Form	0.54	0.50
Line	0.63	0.56
Color	0.25	0.42
Texture	0.53	0.62

Visual management objectives are criteria for evaluating visual change.

The visual management systems employed by the land management agencies result in visual management objectives, which establish criteria for evaluating the acceptability of visual change. Most highway projects do not occur in areas with clear visual management objectives, which makes evaluating visual impacts more difficult. There may be an opportunity for transportation projects to begin establishing visual

management objectives (i.e., recommendations rather than regulations) for urban areas.

VIA methods were developed for primarily non-urban contexts.

In the United States, VIA is heavily influenced by legacy approaches. While they may have been appropriate for their time and context, these approaches are not responsive to the more urban and more agricultural cultural landscapes that form the context for most current FHWA and state DOT projects. Among American federal agencies, there has been no significant development effort to create new VIA methods that are more appropriate for this context.

Multiple independent evaluators are required for reliable results.

Reliability of a single evaluator is insufficient for professional-level assessments. This led Feimer and Craik to conclude that "for all rating formats, the use of single raters results in a level of reliability that falls far short of acceptable psychometric standards" (Feimer and Craik 1979, p. 2728). Reliability of FHWA vividness, intactness, and unity (measured from 234 responses by Clay and Smidt [2004] for the small number of experts used to conduct assessments would be much lower than would be acceptable for a VIA [Palmer 2000]).

Principles for evaluating visual simulations are well understood.

Sheppard (1989) has extensively studied the principles of visual simulation and prepared a systematic approach to appraising their quality. A careful application of Sheppard's principles would increase the quality of simulations.

Viewshed analysis often overstates project visibility.

A wide range of accuracy has been found for viewshed measurements, with inaccuracies being primarily explained by "the failure to adequately consider the effects of physical barriers to visibility (e.g., buildings and vegetation)" (Wood 2000, p. 553). In other words, the analysis is conservative; most errors represent visibility that was modeled, but where there was no visibility after project construction. It would be valuable to develop guidelines for evaluating viewshed analyses comparable to those Sheppard developed for simulations.

It may be possible to create a single EIS framework that accommodates VIA.

Using attributes, indicators, and units appears to be promising as an approach to managing the visual landscape and assessing visual impacts. It creates a framework for all environmental attributes to be considered in a similar way. It has the possibility of appropriate quantification, but it also can accommodate descriptive analysis. It does not rely on monetary value to create a common framework. This is important because many environmental qualities, including scenic quality, are not well represented or valued through an economic/market approach. The next section of this report explores what these attributes, indicators, and units may be.

2.4 Issues of Perception

Knowledge drawn from the extensive literature of empirical studies on visual perception of landscapes can address several important questions raised by the review of legal issues for VIA and the review of existing VIA systems. Related to NEPA and judicial interpretation of landscape aesthetics, this knowledge base can support quantitative comparison of landscape characteristics that provoke aesthetic pleasure. It also offers consistent conclusions about some extreme negative aesthetic effects in the landscape, an aspect of visual perception which the courts have found particularly relevant. In addition, issues raised by the review of existing VIA procedures are addressed by several thorough literature reviews, along with several studies specific to highway and road settings. These issues are:

- Representing visual quality as an interaction between viewer and landscape.
- Ensuring reliability of landscape and viewer characterizations that are employed to assess visual impacts.
- Selecting landscape characteristics that validly represent visual quality, are sensitive to relevant visual impacts, and are practical to measure as part of a VIA system.

2.4.1 Visual Quality and Aesthetic Pleasure

While the relationship between visual experience and aesthetic pleasure has been described by philosophers and critics of the arts since at least the ancient Greeks, a social science and design literature extending over more than 40 years empirically demonstrates the relationship between visual experience and aesthetic pleasure. A series of peer-reviewed literature reviews summarizes this literature (Palmer 2000; Swanwick 2009; Stamps 2004; Zube, Sell, and Taylor 1982; Nassauer 1995; Stamps 1997; Tveit, Ode, and Fry 2006; Gobster and Chenoweth 1989; Daniel 2001; Gobster et al. 2007; Daniel and Vining 1983; Matsuoka and Kaplan 2008). Each of these reviews underscores the strong association between human visual experience and aesthetic pleasure. Some reviews cite studies that also point out and, more rarely, measure the aesthetic effects of other senses (smell, sound, touch), but

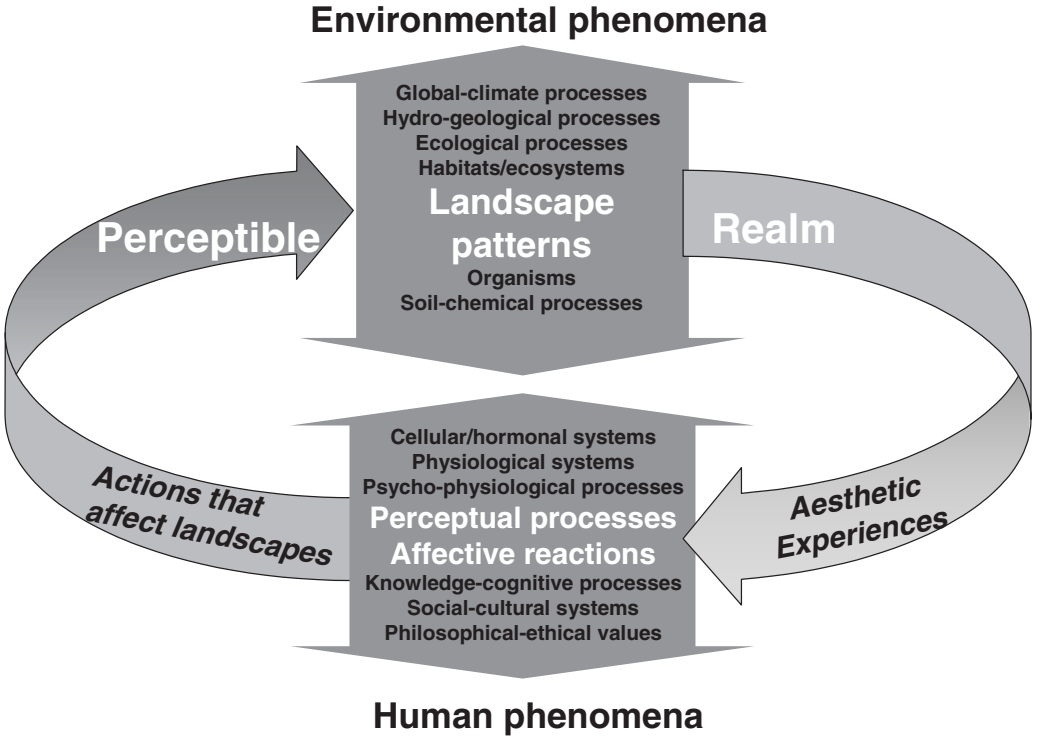
conclude that sight is the dominant sensual basis for aesthetic experience of landscapes. Several reviews also note that movement through the landscape is a complex experience that is not fully captured by a single, static view. This raises the methodological question of how to validly represent the visual experience of landscape when it is not possible actually be in the real landscape that is the topic of a VIA.

2.4.2 Visual Quality as an Interaction between Viewer and Landscape

Without exception, these reviews characterize visual quality as an interaction between viewer and landscape (e.g., Daniel 2001). Four of the senior scholars who wrote several of the most cited reviews, each of whom works in a distinctly different area of landscape perception research, collaborated to write a recent review that aimed to describe differences and similarities among theories of landscape aesthetics (Gobster et al. 2007). These scholars fundamentally agreed that a transactional theory validly describes the landscape perception process (Ittelson 1973), saying that:

> Environment and behavior are often described as transactional and contextual; transactional in that humans and the environment help to define and transform each other by their mutual interactions over time; contextual in that human behavior is shaped by the qualities of particular places and situations. Change is an important outcome of person-landscape and person-person-landscape transactions, and changes that occur within a given context and scale affect other scales of both socio-cultural and ecological systems (Gobster et al. 2007).

Their model of the human/environment interaction is reproduced in Figure 2.5. This model emphasizes that those aspects of the environment that are immediately apparent to people (the "perceptible realm") are the basis for aesthetic experiences. Aesthetic experience is the legal rationale for FHWA–VIA in NEPA (see Section 2.1). Working from concepts in environmental psychology, landscape preference research, and landscape ecology, they adopt "an inclusive definition of landscape aesthetic experience as a feeling of pleasure attributable to directly perceivable characteristics of spatially and/or temporally arrayed landscape patterns" (Gobster et al. 2007). At the same time, they identify a spectrum of human phenomena that affect aesthetic experiences, including ethical values, culture, knowledge, cognition, affective reactions, and perceptual processes. They also emphasize that context affects the interaction; humans bring different expectations to different types of places and situations. For the FHWA system, for example, the particular landscape context and the range of experiential contexts (for example, commuting to work compared with holiday travel) would affect perceived visual quality of some landscape attributes.



Source: Gobster et al. (2007).

Figure 2.5. Model of aesthetic experience in human/environment interactions.

2.4.3 Reliability of Landscape Characterizations

Several reviews of empirical research have classified different approaches to characterizing landscapes in order to predict the relationship between landscape characteristics and aesthetic experiences, and their classifications have essential similarities.

If inferences drawn from landscape characterizations are to be justified in the face of legal challenges to VIA systems, reliability of the characteristics as measures related to visual quality (or synonymous terms like attractiveness, beauty, pleasantness) is important (Stamps 1997; Palmer 2000). Section 2.2.2, "Investigation of Common Methodologies," addresses the important issue of reliability of measures within VIA systems. This section addresses the reliability of particular landscape characterizations used in empirical research. Palmer (2000) usefully distinguished three types of landscape characterizations (Table 2.9):

1. Directly measured physical characteristics, such as area, edge length, or land cover type (all characteristics for which established conventions and data sources ensure acceptable reliability).
2. Denotative physical characteristics, which are visible to all and may be reliably measured (depending in part on how they are operationally defined).
3. Connotative characteristics, which are not directly visible and require interpretation of physical characteristics to judge their presence. Both informational attributes (e.g., mystery, coherence, legibility, and complexity [Kaplan and Kaplan 1982]) and compositional attributes, which Gobster and Chenoweth describe as "artistic terms" (e.g., contrast or dominance of line, form, color, texture) are connotative characteristics.

Palmer measured the inter-rater reliability of denotative, informational, and compositional attributes as applied by citizens and environmental professionals and found that the inter-rater reliability of informational attributes was unacceptably low, that of compositional attributes was lower than desirable, and only the denotative attributes elicited ratings with acceptable inter-rater reliability. In addition, Palmer stated that physical characteristics can be assumed to have

Table 2.9. Different reviews have similarly classified different approaches to characterizing landscapes related to aesthetic experience.

<table>
<tr><th></th><th colspan="2">Physical Characteristics of Landscapes</th><th colspan="2">Connotative Characteristics of Landscapes</th></tr>
<tr><td>Palmer (2000)</td><td>Directly measured physical characteristics (e.g., percent tree or water cover, length or area of the view, relative elevation change)</td><td>Human-judged: Denotative characteristics (naturalism, development, spaciousness)</td><td>Compositional attributes (contrast of: line, form, color, texture, scale, scale dominance, spatial dominance, and visual impact severity)</td><td>Informational attributes (mystery, coherence, complexity, legibility)</td></tr>
<tr><td>Daniel and Vining (1983)</td><td>Psychophysical model</td><td></td><td>Formal aesthetic model</td><td>Psychological model</td></tr>
<tr><td rowspan="2">Zube, Sell, and Taylor (1982)</td><td colspan="2" rowspan="2">Psychophysical characteristics, numerically measured</td><td>Expert: art, design, ecology characteristics (e.g., form, line, color, texture)</td><td rowspan="2">Cognitive (e.g., psychobiological and evolutionary conceptualization, culture and personality effects)</td></tr>
<tr><td>Experiential: descriptions of everyday experience</td></tr>
<tr><td>Gobster and Chenoweth (1989)</td><td colspan="2">Physical (e.g., area, width, depth, edge, velocity)</td><td>Artistic (e.g., line, form, color, texture)</td><td>Psychological (e.g., mystery, coherence, complexity, legibility)</td></tr>
<tr><td>Stamps (1997)</td><td colspan="2">Criteria by which all judges get the same answer (e.g., standardized mean difference)</td><td colspan="2">Characterizations of feelings (e.g., respect, harmony, desirable, consistent, adequate, appropriate, consistent, good proportions, enhance, and compatible)</td></tr>
</table>

acceptable inter-rater reliability. Palmer also found modest differences between inter-rater reliability of environmental professionals compared to citizens using the same attributes. From Palmer's findings, it might be concluded that connotative attributes are of limited use in VIAs if the credibility of VIA recommendations depends on different raters, viewing the same landscape, and describing it the same way.

2.4.4 Connotative Landscape Characteristics that Represent Visual Quality

A large number of empirical studies have tested the relationship of informational attributes with visual quality. Relatively few have tested the relationship of artistic terms with visual quality (Miller 1984; Feimer and Craik 1979; Smardon and Litton 1981; García, Hernández, and Ayuga 2003, 2006; García-Moruno et al. 2010). In theory, landscapes are more attractive when they display mystery (the promise of more information as one moves through the landscape) but are legible (allow the viewer to clearly see how to move through the landscape), and that are coherent (present the viewer with a predictable pattern) but also complex (provide rich information without being confusing) (Kaplan 1982, p. 33). Many studies have found correlations between some of these four variables and preference for natural and developed landscapes. However, Stamps' (2004) review of 61 of these studies and meta-analysis of data from all those suitable for quantitative analysis ($n = 28$) concluded that there was a highly variable relationship between preference and each of these four informational attributes in both natural and developed landscapes. Since connotative landscape characteristics are interpreted by human appraisal rather than direct measurement of the landscapes, Stamps also compared the strength of relationship to preference for informational attributes when appraised by experts compared with appraisals by other research subjects. Stamps found that appraisals by experts produced weaker relationships with preference. Stamps does not conclude that the concepts (mystery, legibility, coherence, and complexity) underlying these informational attributes are valid or invalid. Rather, he suggests that operationalizing the concepts as measureable physical characteristics (area, distance, etc.) rather than connotative judgments could possibly produce different results.

2.4.5 Denotative Landscape Characteristics that Represent Visual Quality

Some denotative landscape characteristics have been related to preference in several empirical studies, but they have not always been included in reviews. While these characteristics have not always been operationalized in the same way, they do tend to be relevant to transportation issues, and they have been widely investigated. They are described in the following review papers:

- **Care.** This characteristic (Nassauer 1988; Hull, Robertson, and Kendra 2001; Gobster and Westphal 2004; Gobster et al. 2007) is sometimes described as maintenance (often in developed settings) (Rapoport 1985) or stewardship (often in rural or wilderness settings), and it is operationalized, or associated with specific visible characteristics, differently in these different settings. As maintenance, it has been operationalized as evidence of mowing, trimming, absence of trash, absence of structural deterioration or paint peeling (Kaplan, Kaplan, and Brown 1989; Ryan 1997; Henderson 1998; Hanyu 2000; Swanwick 2009). As stewardship, it has been operationalized as presence of certain agricultural conservation practices, visible water quality, forestry practices, and ecological restoration practices (Nassauer 1988; Barro 1998; Sheppard 2001).
- **Naturalness/Development.** While this characteristic has consistently been shown to relate to landscape preferences (Hanyu 2000; Gobster et al. 2007; Palmer 2000; Daniel 2001), operationalizing its definition is problematic, in part because what appears to be natural depends upon landscape context or setting (Swanwick 2009; Gobster et al. 2007). Naturalness in an urban context may have different denotative characteristics (e.g., trees and mown turf) than naturalness in a rural setting (e.g., an unmown herbaceous layer in a forest with trees of uneven ages), yet these different characteristics are valued as natural in each setting. This problem of recognizing naturalness as contingent on context is made more challenging because naturalness often has been characterized on a spectrum, with naturalness contrasting with degree of development, and sometimes operationalized by land uses, with "built" land uses inherently less natural.
- **Spaciousness.** Palmer (2000) operationalizes this characteristic as "the landscape's enclosure or expansiveness. It describes how much room there is to wander in the view, or how far you could go before you reach the boundaries." This characteristic stems from an evolutionary concept similar to the connotative characteristics of mystery, legibility, and coherence. However, it is operationalized in a way that provides stronger inter-rater reliability. Perceived spaciousness is highly correlated with physical measures, such as maximum length of view or number of landscape objects blocking a view (Palmer and Roos-Klein Lankhorst 1998; Stamps III 2005). Because it relates to the sense of potential for movement through the landscape, it may be particularly relevant to consideration of visual quality of transportation settings (Franz and Wiener 2005).

2.4.6 Physical Landscape Characteristics that Represent Visual Quality

Several review papers describe physical landscape characteristics that repeatedly have been shown to be related to

landscape preferences, with little variation among viewer groups. Based on the empirical literature, these reviews (Daniel and Vining 1983; Gobster and Chenoweth 1989; Matsuoka and Kaplan 2008; Swanwick 2009; Nassauer 1995; Daniel 2001; Gobster et al. 2007; Palmer 2004) consistently describe the following characteristics as strongly related to visual quality:

- **Surface Water (Lakes, Streams, Open Water Wetlands).** Presence and/or amount of surface water viewed are associated with higher visual quality.
- **Relief.** More relief is associated with higher visual quality.
- **Woodlands.** Presence is associated with higher visual quality, but conditioned on configuration, including spatial characteristics associated with spaciousness (e.g., area/edge index, proportion of view occupied by woodlands).
- **Land Use.** While land use classification systems vary among studies and among places across time, the land use concept is robustly associated with visual quality. This characteristic has been found to be related to preference when it is used to represent naturalism, as discussed earlier in this chapter. In that case, the more natural the land use appears to be, the stronger the landscape preference.

However, the simplicity of this spectrum ignores the essential issue of context. In addition, it provides no guidance for understanding the wide range of visual qualities that occur within developed landscapes and ranging from cities to agricultural landscapes. This problem with the relationship between land use and preference is particularly relevant to transportation corridors, since the highway right-of-way is inherently a developed landscape, even when it is located within relatively pristine settings. In addition, land use classification systems differ in their level of detail and the resolution/grain of land use/land cover data. These differences affect the degree to which fine-grain combinations of land covers that are characteristic of metropolitan landscapes are validly represented by land use as a physical characteristic. The exurbanizing metropolitan edge, where agricultural land uses are mixed with residential, commercial, and industrial development, is an important example of a landscape context in which classification detail and data resolution are important parameters for ensuring that land use validly represents visual quality.

2.4.7 Visual Perception Literature Specific to Transportation Landscapes

While the hundreds of empirical landscape visual perception studies cover a wide range of landscape contexts, most refereed studies have occurred in rural and wilderness settings. State and federal highways, in contrast, occur in highly urbanized and suburban settings as well as rural and wilderness contexts. Based on the proportion of the U.S. population that lives in metropolitan areas (83% in 2003; Mackum 2005), it can be assumed that more highway traveler hours are spent on highways in metropolitan contexts each year than on rural or wildness highways.

Consequently, empirical research on the visual perception of metropolitan landscapes is highly relevant for a FHWA–VIA. While relatively little empirical research that explicitly focuses on context-sensitive design has been conducted (Burley et al. 2009), several empirical studies do provide substantial insight into landscape preferences for transportation landscapes. Their conclusions complement and expand upon conclusions from literature reviews of the broader landscape preference literature.

Interaction Between Landscape and Viewers

Studying scenic highways, Clay and Smidt (2004) cite the overarching reviews that conclude that scenery is not only the appearance of a place, but "in actuality the resident landscape features plus the ability to experience those features in some contextual framework" (Zube 1973; Zube, Sell, and Taylor 1982; Daniel and Vining 1983). They assert that viewers' experiences are affected not only by trees and water features, but by constructed features like land uses, historic structures, and traveler variables like motivations for travel, travel speed, frequency of use; by contextual characteristics of particular views, like changes in landscape character and elevation. They emphasize that compared with other settings for VIA, transportation creates a more linear experience of movement through a landscape corridor.

Connotative Landscape Characteristics

Clay and Smidt (2004) found that unity and variety, as measured by seven experts who used operationalized landscape characteristics with the definitions shown in Table 2.10, had little relationship to scenic beauty, as perceived by 234 undergraduate students, for their study area, a 21-mile stretch of scenic highway between San Luis Obispo and Morro Bay, California. However, they found that vividness, as defined in Table 2.10, had a strong relationship with scenic beauty. They conclude that context can dramatically affect the relationships between landscape characteristics and that expert-based scenic analysis can be problematic when connotative descriptor variables are used to generate the assessments.

Denotative Landscape Characteristics

Care. Care consistently has been found to be related to preference in studies of transportation settings. Ewing et al. (2005) wanted to develop a way to describe what gave New Jersey urban highways desirable "Main Street" characteristics.

Table 2.10. General definitions for the four descriptor variables used in the expert assessment by Clay and Smidt (2004).

Naturalness	This descriptor variable measures a landscape scene's naturalness, or its perceived naturalness. It should be applied per-scene using the general guideline that the visible landscape characteristics within the scene illustrate an overall condition that seems to indicate a natural or natural-appearing condition. Put another way, the scene exhibits a general lack of visible human additions or influences. The issue of scenic naturalness should be assessed from a more generalized point of view, rather than from some scientific, or ecological perspective. Further, the concepts of natural landscapes and/or naturalistic landscapes should both be considered in the assessment. In applying this descriptor, one should consider the following question: Does some visible conflict seem to exist in the scene between the natural scenic features, and those scenic features that seem to be placed in the scene by humans?
Vividness	This descriptor variable can be defined as being the overall extent to which a landscape scene could be considered memorable. This scenic characteristic can be associated with landscape distinctiveness, which can be generally thought of as being some recognizable level of landscape diversity and/or landscape contrast that seems to visibly exist between the various elements within the scene. A vivid landscape makes an immediate and lasting impression on the viewer. This descriptor variable can be applied to either a natural/naturalistic scene, or to a scene with human elements in varying degrees.
Variety	This descriptor variable refers to the general state or quality of a landscape scene as being varied or diverse in overall scenic content. Scenic variety can also be thought of as a landscape scene having the absence of monotony or sameness. Scenic variety can also be associated with a general diversity of basic artistic scenic characteristics, such as colors, textures, shapes, masses, forms, and spaces, or other visible attributes that add a diversity or mixture of visual experiences per-scene.
Unity	This descriptor variable implies that a proper or appropriate balance or harmony of scenic elements exists within a scene. In a scenic condition with strong levels of unity, the different scenic elements in view seem to blend together into some visual landscape totality. There generally is a feeling that the individual scenic elements belong together. The intent of applying the descriptor variable unity is to assess which natural and/or human landscape elements in view are sensitive to and/or in some visual harmony with each other, and with the overall landscape scene. Scenic unity implies that a landscape will be perceived as being appropriate and harmonious to its surroundings.

Note: The definitions for the four landscape descriptors are summations of definitions for the same terms, as presented in the cited state and federal documents on scenic byways, scenic highways, and visual resource assessment. These definitions were presented to the expert pool, which used them in their deliberations per-scene.

Of the roughly 30 characteristics they empirically tested with 59 informed stakeholders, both pavement maintenance and absence of derelict properties were strongly related to desirable Main Street characteristics. Shaffer and Anderson (1983) measured perceptions of urban parking lots in Georgia and found that incorporating vegetation in the parking lot design and having it appear well maintained were strongly related to landscape attractiveness and perceived safety. As part of a system to measure relative public preference for design and maintenance choices within the highway right-of-way, Nassauer, et al. (2001) developed a protocol for DOT employees to conduct on-the-road focus groups with travelers. The first application included 63 Minnesota licensed drivers who described more than 700 views.

This study identified maintenance (and particularly any appearance of inadequate maintenance) as powerfully related to perceived attractiveness (Nassauer 2001; Nassauer and Larson 2004). A follow-up, image-based web survey of 1,108 licensed Minnesota drivers measured perceptions of regional context, vegetation design, mown area and pattern, and wall design for 114 simulated views of highway corridor landscapes (Nassauer, Dayrell, and Wang 2006). Results showed that several physical characteristics that indicate care (no apparent weeds, flowery planting mixes, a small mow strip, and no apparent deterioration of wall and bridge surfaces) were strongly associated with perceptions of attractive highway rights-of-way in both urban and rural contexts. Similarly, Gartner and Erkkila (2004) found that travelers along Minnesota scenic highways stated that mowing along the right-of-way was important. Considering town roads in the countryside of western Connecticut, Kent (1995) asked 117 local people to rate 36 slides of views from local roads and found the five scenes that "tended to be somewhat unkempt or untidy" were least preferred.

Naturalness. Both Nassauer and Larsen (2006), studying metropolitan highways in Minnesota, and Gartner and Erkkila (2004) studying rural scenic byways in Minnesota found that naturalness, as perceived by highway travelers, was strongly related to attractiveness, as perceived by the same travelers. However, Clay and Smidt (2004) found that naturalness, as judged by experts, was not significantly related to scenic beauty, as judged by students viewing slides of a California scenic highway. In Connecticut, the most preferred views from the road included a blend of "natural and cultural features, featuring views of houses, cemeteries, town greens, dairy farms, hay fields, croplands, orchards and pastures" (Kent 1995).

Physical Landscape Characteristics

Ewing et al. (2005) found that the amount of tree canopy was among the strongest characteristics used to identify desirable Main Street scenes. Kent (1995) found that the top six features related to scenic quality from country roads in western Connecticut were: water (94% rated 4 or 5), stone walls (90%), mature trees (85%), vistas or open views (84%), forests (81%), and historic residences (80%). Related to agricultural land use, different types of landscape cropping and enterprise patterns affected scenic quality differently. Surveying travelers along forested northern Minnesota scenic highways, Gartner and Erkkila (2004) found that they valued the appearance of colorful wildflowers but did not want to see more trees along the road.

The factorial design of the Nassauer et al. (2006) image-based web survey of 1,108 Minnesota licensed drivers allowed them to control for interactions among experimental variables in their effects on perceived attractiveness. Results show that context and vegetation design affect driver perception of highway corridor landscapes much more than do other variables, and that physical landscape attributes are powerful in predicting attractiveness. In particular:

- Flowery prairie vegetation is perceived as very attractive and natural, as well as adequately safe and well maintained in both urban and rural settings.
- A single, narrow, straight swath of mown turf adjacent to the roadway is seen as more attractive than any other mowing pattern, and much more attractive than a right-of-way that is completely mown turf.
- Compared with other landscape variables, wall design has less effect on perceptions. However, walls that are lightly colored and have a regular rhythm of columns are perceived as more attractive than others (Nassauer et al. 2006).

2.4.8 Implications for VIA of Highways

Quantitative Assessment of Visual Quality and Expert Testimony Drawn from Peer-reviewed Science

The landscape perception literature demonstrates that quantitative assessment of landscape visual quality is possible and has been accomplished for many decades as part of science. It further underscores that a strong peer-reviewed literature exists that is relevant to highway VIA. There is strong evidence from many studies in different settings that the landscape attributes listed in Table 2.11 are likely to affect the visual quality of transportation settings. Changing these attributes is likely to impact visual quality:

Extreme Negative Aesthetic Effects in the Landscape

Considering the courts' acceptance of arguments to avoid extreme negative aesthetic effects in the landscape, the landscape perception literature, including literature focused on

Table 2.11. Examples of landscape characteristics that are known to affect visual quality and are likely to be reliable and easy to measure.

Directly Measured Physical Characteristics of Landscapes	Human-judged Denotative Characteristics of Landscapes
Percent tree cover	Spaciousness
Length or area of the view	
Relief	
Land use	Naturalness within a land use and scale context
Percent water cover	
Visible area in flowers	Care
Visible signs that maintenance is lacking (e.g., litter, structural deterioration, unmown turf)	

highway settings, consistently identifies the presence of litter or deterioration of structures or surfaces as reducing visual quality. Highway proposals that might increase litter or deterioration of structures would certainly impact visual quality.

Visual Quality as an Interaction Between Viewer and Landscape vs. an Intrinsic Landscape Quality

Without exception, peer-reviewed literature reviews characterize visual quality as an interaction between viewer and landscape. This characterization contrasts with artistic characterizations of landscape based on assumptions of intrinsic landscape qualities. It is important to understand that an interactive understanding of visual quality does not contradict claims that some artistic or connotative landscape qualities produce positive visual experiences. Instead, it asserts that these visual experiences are an interaction between people and landscapes, and that these interactions are empirically observable and measurable. Describing visual quality without reference to the large literature that quantifies viewer's visual quality may not adequately or reliably represent that interaction.

Reliability of Landscape and Viewer Attributes Employed to Assess Visual Impacts

Physical landscape characteristics and denotative landscape characteristics have been shown to be strongly related to experience of visual quality in highway landscapes, are more reliable to measure, and are easily quantifiable. Some of these attributes are also easy to measure.

Sensitivity of VIA to Impacts Relevant to the Range of Highway Landscape Contexts

Naturalness is the standard for other U.S. VIA, but is only somewhat useful for federal highways, which run through both urban and agricultural landscapes that are not expected to look natural. Relationship of some physical landscape characteristics to visual quality will vary with context. For example, naturalness is associated with flowers in the right-of-way of urban highways in Minnesota, but a highway corridor in a mountainous forested area might not look natural if signs of clear-cutting are apparent. For the NHS, naturalness should be a criterion for evaluating visual impacts only within a particular land use context associated with particular landscape attributes, and not as a uniform standard applied across different settings.

In addition, several types of impacts that are associated with urban highway corridors are not well represented in the landscape perception literature. These include aesthetic relationships among structures (e.g., buildings, bridges, and highways), at different scales (from distant views to carefully designed and maintained landscapes within the highway right-of-way), among different transportation corridors (e.g., city streets and highways), and among different urban land uses and highways (e.g., parks and highways).

Implications for a Practical VIA System

Knowledge exists to develop a quantified, reliable system for assessing visual impacts of highway landscapes. Using the existing scientific literature alone, a system could be constructed that would be practical to use, reliable in its assessments, and justified by scientific studies. At the same time, there are clear gaps in the science as it relates to human perceptions of highway landscapes and especially perceptions of the impacts of changes in highway landscapes. These gaps include knowledge of public perceptions of aesthetic relationships among structures and among different transportation corridors, and perceptions of highways in different human-dominated land use contexts, from agriculture to dense urban areas. Until now, the often-implicit assumption that what looks natural is most attractive has served as an inadequate substitute for this missing knowledge.

The landscape perception literature also suggests a missed opportunity in practical VIA methods. Just as simulation technology has advanced far beyond its discussion in VIA guidance, technology for surveying public perceptions has also rapidly advanced in the past decade, especially with the use of web surveys. There is an opportunity to fill some of the substantive knowledge gaps about how people perceive highways and the views from highways in urban and agricultural landscapes as new survey technology is employed. Such new technology could very possibly provide practical ways to link highway decision makers with public preferences early in the planning process and throughout the evolution of planning, design and maintenance phases of a project.

2.5 Issues of International Policies and Practices

As American academic interest in issues specifically related to the study of the visual impacts of highway projects has waned over the last few decades, foreign interest seems to have increased. Section 2.5.1 provides a more detailed account of the UK's LVIA method to set alongside the range of U.S. VRM systems. The UK method has been widely documented in a published book and has been influential in other parts of the world. Other countries with processes that are examined include: Germany and New Zealand, which have documented recent detailed information on their processes, and Australia and Switzerland, which have made relevant examples of highway VIA methods available on-line. It is believed that research is being conducted in Norway and Sweden on related topics,

but as yet no reports are available. Papers have been published on the topic in China, but although short summary translations are available, these are insufficient to provide a good understanding of content.

The material presented in *NCHRP Report 741* is not a comprehensive account of all the approaches adopted in different parts of the world. It is necessarily selective, based on the information available. It must also be emphasized that inclusion of a particular method does not imply that it is a best practice or that it could be transferred, in whole or in part, to another country. Procedures evolve in very specific legislative and cultural contexts and cannot necessarily be transferred out of that context. The goal of this section of the report is simply to examine the range of approaches and reflect on similarities to and differences from the North American experience. For example:

- Unlike NEPA, with its specific legal references to aesthetics, the European legislation—notably the European Directive that introduced EIA—refers to landscape and does not mention the terms "visual" or "aesthetics."
- Some countries, notably the UK, New Zealand and parts of Australia (New South Wales for example), have pursued an approach which wholly or partly separates landscape impacts, dealing with impacts on landscape as a resource and the way it is valued by society as a whole, and visual impacts, dealing with impacts on the visual amenity of different groups of viewers.
- Internationally, there are also important differences in the extent to which criteria to judge landscape quality or value are confined to visual or aesthetic considerations or embrace a wider range of factors such as social and cultural values, or indeed wider environmental values.
- In contrast to American law, the UK has a well-developed system of statutory land use and development planning that covers the entire extent of the territory. There is therefore an interest in all landscapes.

2.5.1 United Kingdom

This section provides a summary of the legislation that informs the UK's approach to landscape planning and the essential context for landscape planning in other European Union (EU) member states. It also considers the available evidence from reviews of such assessments and any evidence on relevant studies of public perception of landscape change due to highways in the UK.

EIA Requirements and Legislation

In the UK, the legal requirement for EIA comes from European law. The original European Council (EC) Directive (Directive on "the assessment of the effects of certain public and private projects on the environment") made assessment mandatory for certain types of projects and discretionary for others.

European directives are always implemented through the legislative frameworks of individual member states. In the UK, two sets of regulatory frameworks currently apply:

- In England and Wales, the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations, 1999
- In Scotland, the Environmental Impact Assessment (Scotland) Regulations, 1999

Article 3 of the European Directive clearly states that the EIAs will "identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with the Articles 4 to 11, the direct and indirect effects of a project on" the following factors:

- Human beings, fauna and flora.
- Soil, water, air, climate and *the landscape.*
  The interaction between the factors mentioned in the first and second indents.
- Material assets and the cultural heritage.

Both the European Directive (Annex III) and the UK regulations (Schedule 4) list the information to be included in an Environmental Statement, based on Article 3. The UK regulations refer to:

> A description of the aspects of the environment likely to be significantly affected by the development, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, *landscape* and the interrelationship between the above factors.

It is therefore apparent that, unlike NEPA with its specific references to aesthetics, the European legislation refers to landscape and does not mention the terms "visual" or "aesthetics."

The Highways Agency is an executive agency of the Department for Transport (DfT) and is responsible for operating, maintaining and improving the strategic road network in England and Wales on behalf of the Secretary of State for Transport. In response to the Highways (Assessment of Environmental Effects) Regulations, the *Design Manual for Roads and Bridges* (DMRB) contains guidance on EIA of road projects in Volume 11, *Environmental Assessment,* and also contains Volume 10, *Environmental Design.* In Volume 11, Section 3, there is technical guidance on all the main subject areas required by the EIA directives and regulations, including landscape effects. An updated version of this guidance has recently been prepared and is in the consultation draft stage (Highways Agency 2010). [Note: The European Directive was revised in 2011 after the research for NCHRP Report 741 was carried out.]

The Wider Context of Landscape Planning in the UK

The UK has a well-developed system of statutory land use and development planning that covers the entire extent of the territory. There is no statutory system of landscape planning (as exists in Germany) but there is a wide range of means by which landscape and planning interact, which together form a landscape planning system that has both formal statutory parts and informal non-statutory parts. There are close links between this system and LVIA.

Traditionally, landscape planning in the UK has consisted primarily of measures to protect landscapes considered to be of special value by some form of protective designation. In England and Wales, the national designations for landscape are national parks (although these are quite different from the U.S. equivalent, as they fall into International Union for the Conservation of Nature (IUCN) Category V protected landscapes/seascapes, being predominantly "cultural" rather than "natural"). Attitudes toward the identification of valued landscapes in the UK, and notably in England, Wales, and Northern Ireland, have been dominated over the years by the concept of natural beauty that underpins much of the protected landscape legislation in these countries. The origins and theoretical underpinnings of this term and the evolution of its interpretation over the past century have been thoroughly explored in a recent review (Swanwick et al. 2006; Selman and Swanwick 2009).

Protected landscapes and landscape evaluation: Beyond the consideration of designated areas, debate has continued since the 1970s about the best way to evaluate landscapes for planning purposes. Many planners have favored approaches that focus on expert evaluations and that are based on quantitative methods in the psychophysical school of research, in which correlations are established between overall judgments of value and the presence and quantity of the different elements or components that make up the landscape. In the UK and Europe, a body of work in this field assumes that measurements of the extent of different components that make up the landscape can be used to evaluate the worth of the landscape as a whole. These are the so-called objective quantitative approaches (Iles and Swanwick 1988).

The alternative view favors a more subjective approach based on public preferences as distinct from expert ratings, and generally reflects the importance of considering landscape as a whole (Swanwick et al. 2007). This approach captures the idea that in landscape, the whole is greater than the sum of its component parts, and also that experiential value is significant. Some academics have adopted a combined approach where public preferences for landscape scenes are investigated and statistical analysis is then used to discover whether any specific components within the scene are responsible for the preferences or values that are expressed. The influence of this long-running methodological debate about the balance between quantitative and qualitative, objective and subjective, expert and public, and components or whole landscape approaches, is to some extent still apparent today in academic research and practice.

Landscape Character Assessment. Landscape character assessment developed during the mid- to late 1980s and early 1990s as a result of disillusionment with these quantitative approaches to landscape evaluation. The history of this change has been documented elsewhere (Swanwick 2002a and 2004; Jensen 2008), and the focus on landscape character assessment now prevails to varying degrees in all countries of the UK, in Ireland, and in many European countries. The approach combines both objectivity and subjectivity (Swanwick and Land Use Consultants 2002). Although part of the process is about recording or describing individual landscape components, the focus is on the way these elements come together to create character in different places, including the aesthetic and perceptual qualities of the landscape as a whole. The process separates the characterization of the landscape by mapping, classification, and description from the judgments that need to be made based on this understanding of character.

The emphasis on comparative landscape evaluation has been replaced by recognition of the need for a variety of different judgments, which may sometimes involve value but are equally likely to address the sensitivity to change or management needs of particular landscapes. Expert professional judgment of such matters is, as far as possible, informed by the involvement of different groups of stakeholders that include the general public. The process has involved continuing exploration of approaches to stakeholder involvement (Swanwick et al. 2003a).

The result is that at least for the present, quantitative landscape evaluation has all but disappeared from the landscape planning and research community in the UK. Land use and landscape planning decisions are increasingly being informed by a wide and growing range of landscape character assessments undertaken at national, regional, and local levels. Landscape character is here defined as the distinct, recognizable, and consistently occurring pattern of elements in a particular type of landscape as created by particular combinations of geology, landform, soils, vegetation, land use, field patterns, and human settlement. Character is what makes landscapes distinctive and creates a particular sense of place in a locality. Everywhere has character, and all landscapes are distinctive. This idea is now firmly embedded in policy, for example in Natural England's 2009 position statement, "All Landscapes Matter." Whether the landscapes are valued for their distinctiveness or for other reasons is now recognized to be a separate question.

This broad concept of landscape and the accompanying focus on landscape character is enshrined in the text of the European Landscape Convention (ELC) which was influenced by the work carried out in the UK over several decades. This Convention, now signed and ratified by the UK government and effective from 2007, defines landscape as:

> "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors. The term 'landscape' is thus defined as a zone or area as perceived by local people or visitors, whose visual features and character are the result of the action of natural and/or cultural (that is, human) factors. This definition reflects the idea that landscapes evolved through time, as a result of being acted upon by natural forces and human beings. It also underlines that landscape forms a whole, whose natural and cultural components are taken together not separately (Council of Europe 2000).

Thus, in the UK and most of Europe, landscape is considered in an inclusive way, rather than as a matter predominantly of scenery and aesthetics, as was the case in the first half of the 20th century and, to varying degrees, up to the 1980s. Viewed in this broader, more inclusive way, it can be seen that "Landscape is an integrating concept, because by definition it embraces all the physical, natural and social/cultural influences that shape the land, together with the ways that people interact with and perceive it to transform land into landscape," and "Landscape is also spatially comprehensive—it is everywhere, not just in highly valued landscapes that have been identified for special protection. As demonstrated by the ELC, landscape can be considered in terms of geographical areas or spatial units and therefore can provide a valuable spatial framework to underpin planning and management" (Swanwick 2009).

Judgments Based on Landscape Character. There are many different applications of landscape character assessment, each requiring particular types of judgments. For designation of valued landscapes, work has been done to identify a range of criteria that recognize the value that society attaches to landscapes. Such criteria have been established and formalized for national designations, but this has not happened in a consistent way for local designations made by local authorities. In many areas, such local designations have to a large extent been replaced by a character-based approach.

One of the most widespread and debated applications of landscape character assessments is in strategic sensitivity and capacity studies (Swanwick et al, 2003b). These have become very common for wind energy developments and for housing development, both the source of considerable development pressure. Sensitivity tends to be assessed in relation to specific forms of development and requires careful analysis of how the key characteristics that distinguish the landscape in question will be impacted by the particular form of development. Capacity has been used as a term to describe the amount of development of a particular type that can be accommodated in a particular landscape. The definitions of these terms, and their relationship to the idea of sensitivity as applied in LVIA is a matter of debate and consultation at present, as guidance documents are reviewed and updated.

The UK Method of LVIA

After the European Directive took effect in the UK, early advice on environmental topics was provided as guidance from Government Departments and Agencies (Countryside Commission 1991; Land Use Consultants 1992). This initial advice first indicated the treatment of landscape and visual impacts as distinct though interlinked matters. This advice was soon formalized in, and superseded by, the generic guidance on LVIA produced by two professional bodies, The Landscape Institute and the Institute of Environmental Assessment (IEA, later renamed the Institute of Environmental Management and Assessment). The first edition of this commercially published book was issued in 1995 (The Landscape Institute and IEA 1995) as part of an initiative by IEA to produce good practice guidelines for some of the specific EIA topic areas. The second edition emerged in 2002, coincidentally the same year that the current version of the Landscape Character Assessment guidance was published. LVIA is now widely accepted as an important procedure in its own right, sitting within the wider procedures of EIA.

The Highways Agency has produced its own guidance as part of the updated DMRB, but this is based largely around the same approach as the general LVIA guidance. The new consultation draft adds some useful additional comments and clarifications and includes tables that help to encourage a standardized approach to judgments about the following:

- The magnitude and nature of impacts.
- The sensitivity of receptors.
- The interaction of these two to indicate the significance of the effects/impacts, presented as a matrix of interactions.
- Typical descriptors of different levels of significance of the effects (as illustrated by Table 2.12).

Discussion continues about the use of words, particularly the words "sensitivity" and "capacity." Both words have been used in drafts of the LVIA guidance but final resolution of this debate is likely to await revisions to the LCA (landscape character assessment) guidance so that definitions and usage of terms can be aligned.

Reviews of LVIA Procedures

While there have been a number of academic reviews of EIA procedures as a whole in the UK, there have been no

Table 2.12. Typical Significance Categories and Descriptors of Effect for highways.

Significance Category	Typical Descriptors of Effect
	The project would:
Very large beneficial (positive) effect	• greatly enhance the character (including quality and value) of the landscape • create an iconic high quality feature and/or series of elements • enable a sense of place to be created or greatly enhanced
Large beneficial (positive) effect	• enhance the character (including quality and value) of the landscape • enable the restoration of characteristic features and elements lost as a result of changes from inappropriate management or development • enable a sense of place to be enhanced
Moderate beneficial (positive) effect	• improve the character (including quality and value) of the landscape • enable the restoration of characteristic features and elements partially lost or diminished as a result of changes from inappropriate management or development • enable a sense of place to be restored
Slight beneficial (positive) effect	• complement the character (including quality and value) of the landscape • maintain or enhance characteristic features and elements • enable some sense of place to be restored
Neutral effect	• maintain the character (including quality and value) of the landscape • blend in with characteristic features and elements • enable a sense of place to be retained
Slight adverse (negative) effect	• not quite fit the character (including quality and value) of the landscape • be at variance with characteristic features and elements • detract from a sense of place
Moderate adverse (negative) effect	• conflict with the character (including quality and value) of the landscape • have an adverse impact on characteristic features or elements • diminish a sense of place
Large adverse (negative) effect	• be at considerable variance with the character (including quality and value) of the landscape • degrade or diminish the integrity of a range of characteristic features and elements • damage a sense of place
Very large adverse (negative) effect	• be at complete variance with the character (including quality and value) of the landscape • cause the integrity of characteristic features and elements to be lost • cause a sense of place to be lost

Source: Highways Agency. 2010. *Design Manual for Roads and Bridges.* (Consultation draft of Volume 11, Section 3, Annex 1—Assessment of Landscape Effects, Table 4—Typical Descriptors of Significance of Landscape Effects).

such reviews of LVIA methods per se, and none that focuses on visual or aesthetic impacts to landscapes. Most practice reviews of Environmental Statements are carried out by the regulating authorities to whom they are submitted, sometimes using contractors to supply the specialist expertise. The reliability and acceptability of the judgments made about landscape and visual effects are usually debated at public inquiries and involve barristers and planning inspectors. It is the planning inspectors who finally decide where the balance of arguments lies, but they do not draw on any independent evidence in doing so and there is generally little reported case law on the validity of professional assessments of landscape and visual impacts. There has been particular debate in such inquiries about the validity of photomontages and other visualizations of landscape change, and the parties opposing development sometimes employ independent consultants to

either verify or challenge such visualizations. The academic study by Wood (2000) carried out post-project auditing of the mapping of zones of visual influence, but this study is an isolated example of this type of review.

A series of review packages for Environmental Statements as a whole have been developed to allow consistent review and judgment of their contents. These packages have been widely used, but they generally do not go into detail with individual environmental topics and there are as yet no separate review packages to judge the quality or validity of assessments of landscape and visual impacts.

Public Perception of Landscape Change

In the UK, little quantitative research has been done recently on evaluating the quality or value of landscape. It is notable, however, that this decline has been accompanied by a greater focus on qualitative work on public perceptions and attitudes. There has also been a burgeoning interest in the economic valuation of landscape change, driven mainly by the policy requirement for all projects or proposals to be accompanied by a statement of the related benefits and costs.

Qualitative Research on Responses to Change. A recent example is a substantial study (Research Box et al. 2009), conducted with members of the public who live in, work in or close to, or visit selected landscape character areas drawn from the National Character Area framework. A multi-method program, this study involved 12 public focus groups (eight people per group), four extended creativity sessions (each with eight people per group), and 16 post-experience in-depth interviews (e.g., with families after they had walked and experienced a part of the landscape in question). Among many other issues, the research examined attitudes to landscape change, drawing conclusions about the factors potentially influencing people's response to change. Among the Research Box findings were:

- The more striking changes and the more extensive developments were noticed by everyone. In addition, some participants observed isolated changes in the landscape in question and some noticed subtle changes in the landscape which were important to them (but might not have been more widely felt).
- People will be more inclined to be content with or be concerned about change depending on the effect of any change on them or people that they know. In addition, for some changes, the consequences may be indirect, diffuse, or still to be evident; thus, people may not be sure about the change.
- Whether people can, or have tried to, influence the change (successfully or not) may condition their view on the change and their understanding of the change.

Change Due to Highway Schemes. The economic valuation work is illustrated most relevantly by work for the DfT (Eftec 2007 and 2009), which set out: "to estimate transferable monetary values for the impacts individual transport schemes have on the natural landscape in England." A preliminary Phase 1 scoping study set out to prepare the ground for a study that would examine the effects of selected transport schemes on selected landscape types with different types and magnitudes of impact on the landscape. Some key findings from the focus groups used at this stage were:

- It is difficult to conceptualize the impacts of a scheme in abstract. In general, respondents need spatial information about a scheme to be able to meaningfully assess how it would affect their well-being.
- The effects of a transport scheme on well-being are a complex bundled good, comprising of both positive and negative elements that are very difficult to separate out. Respondents find it challenging to disentangle the visual and tranquility effects of a scheme from other effects, such as the perceived benefits of a new road (time savings, access, safety, etc.).
- It is difficult to focus only on the visual and tranquility effects of a new road and many participants also considered effects not stated in the scenario. Many responses were motivated by a desire to stop development rather than avoiding landscape impacts per se.
- Tranquility aspects seem as important or even more important to participants than do visual impacts, but there is considerable difficulty in separating out specific noise impact on properties from general effects on tranquility.
- The effects of a transport scheme on landscape appear to be strong if they are directly experienced by the individual and/or the scheme is very close to a property, but they seem to tail off quickly otherwise.
- Designation of the landscape may have a significant effect on well-being and people attach value to such landscapes not because they use them but because they are there.

In Phase 2, the research set out to design materials to test in a stated preference study. Photomontage visualizations of different schemes in different ranges of views were used in a number of different types of landscape. The conclusions from Phase 2 are not as reliable as those that may be expected from the proposed (and fuller) Phase 3 study, but they provide useful information from a good sample of over 300 respondents. The results are complex, but some findings are of particular relevance. The Phase 2 study found that, under the heading "perception of landscape,"

> it is notable the individuals' own assessment of magnitude of the landscape impact is found to influence their WTP. [WTP is "willingness to pay," a measure of response to the proposed

> scheme and its impact on a particular landscape.] There is also evidence that respondents with a general preference against intrusion of manmade structures on the natural landscape tend towards higher WTP. This finding is of interest with regards to adaptation to landscape impacts; the implication being that individuals may not necessarily adjust to impacts with time. [Another useful conclusion is that] the pilot survey indicates some degree of preference to prevent landscape impacts to sites that are characterized as a 'unique' landscape or feature (Eftec 2009).

It is also apparent that responses, measured in terms of WTP, are significantly influenced by socioeconomic group, by the nature of the scheme, with new routes causing more concern than on-line changes to existing routes, and by the respondents' interactions with the affected site, in terms of familiarity with it, distance from the site, and frequency of use.

Although this was an economic study, the WTP values are in some ways no more than ratings of the impact of a scheme on a landscape, and so they constitute the nearest in the UK to recent quantitative research on public perceptions.

Conclusions from the UK Experience

- In the 1970s and early 1980s, as in the United States, the UK showed a trend in the search for methods of landscape evaluation for use in land use and development planning systems. A range of quantitative, numerical methods of evaluation emerged, but they were not adopted by UK government agencies and landscape practitioners.
- From approximately 1985, this trend led to the emergence of an approach that was based on the idea of landscape character, which reflected the importance of context but also attempted to recognize all the contradictions inherent in the transactional nature of landscape. There was acceptance that working with landscape requires combinations of the more objective and subjective ways of thinking about it and that representations of landscape character must deal with descriptions of what is there, interpretation of that in terms of aesthetic aspects, and—but only in certain circumstances—recognition of the different ways that landscapes may be perceived. The relatively recent advent of the ELC, which was informed by the UK approach to LCA, has given added impetus to this approach.
- The UK method emphasizes a qualitative approach to landscape character in defining the context for change. Quantitative methods have been little used in applied assessments, although they have to a degree made a comeback in the last 5 years in areas of landscape planning work such as sensitivity and capacity studies and economic valuation methods. There was also widespread recognition of the need to engage stakeholders of different types in LCA and related work, while at the same time recognizing that there are practical constraints on how this can be done meaningfully.
- The UK approach recognizes that the components of the landscape and their aesthetic and perceptual interpretation will vary with each type of landscape, having different key distinguishing characteristics that vary from place to place. For example, diversity may not always be an important characteristic because some landscapes may be characterized by uniformity.
- LVIA is therefore based on judging the interaction between the proposed development and the key characteristics of the landscape in question. The impact on views as seen by different groups of people is analyzed separately. All of this is based largely on expert judgment and there has been no research on reliability or consistency.
- Most LVIAs are reviewed by the regulatory authority and debated at public inquiries. Recent research on public attitudes to change resulting from highway schemes tends to support the broad approach that is taken but also suggests that ways need to be found to represent effectively the range of public perceptions and attitudes to change.

2.5.2 Germany

As in the UK, the requirement for EIA in Germany is driven by the European EIA Directive. Road planning in Germany is an independent area of sectoral planning (*Fachplanung*), but Germany also has a long tradition of landscape planning (Hehl-Lange, 2011). Since the Federal Nature Conservation Act was adopted in 1976, "intervention provisions" have to be applied in the case of all new roads. The instrument dealing with the impacts on nature and landscape is the *Landschaftspflegerischer Begleitplan* (LPB), which can be roughly translated as the landscape plan or the landscape management plan, whose aim is to present the impact of the proposal on the natural ecosystem and the visual landscape and to propose measures (Wirz and Platte 1996). Major road projects have to be assessed by procedures under the EIA Act, which flows from the European Directive, but the EIA is always conducted before the LPB. Different route alternatives are compared in the EIA, whereas the LPB focuses on the best or preferred alternative.

The Intervention Provision

The intervention provision is a very important part of the Federal Nature Conservation Act and is the basis for the LPB. In the revision of the Federal Nature Conservation Act in 2002 and in the radical reform of the Federal Nature Conservation Act, which came into effect on March 1, 2010, the impact regulations were improved. Chapter 3 of the new Federal Nature Conservation Act 2009 now provides detailed

guidelines about the intervention provision. Previously, the federal government of Germany was merely responsible for adopting general provisions, and the different laws of the 16 states (*Bundeslaender*) regulated the details on their own. The implementation of compensation-pools and eco-accounts is also a new achievement of the Federal Nature Conservation Act of 2009.

Under these procedures, it must first be decided whether a planned project will have a significant impact, as defined under the intervention provision. The possible measures for responding to a significant impact are avoidance, mitigation (i.e., reduction of the impact), and compensation, and the German intervention provision follows a strict procedure of decision steps to be followed in a defined order. All defined measures in the landscape management plan are legally binding. The different levels of intervention are:

Avoidance and Minimization (*Vermeidung*). Impacts that may significantly impair ecosystems or natural scenery have to be avoided, and unavoidable impairments have to be minimized. This could mean that the whole project has to be avoided or, alternatively, that the plans must be modified.

Compensation with Mitigation Measures (*Ausgleich*). For unavoidable impacts the intervening party has to provide compensatory mitigation measures. Compensation in the sense of an identical reconstruction of the status quo is in most cases not possible. Instead, impairments to the function and value of the natural environment have to be compensated nearby. The appearance of the visual landscape has to be restored or redesigned.

Substitution (*Ersatz*). A redesign of the visual landscape should normally take place in the same visual landscape unit. If the impact cannot be compensated nearby then the impact has to be substituted. For example, if the impairment involves sealing an area for a street, then trees could be planted nearby or another street further away could be unsealed as a substitute measure.

Consideration (*Abwaegung*). If the impairment to the environment cannot be compensated or substituted, then it must be decided whether the concerns of nature and landscape are of such high value that the impact is inadmissible, or whether another interest (e.g., economic concerns) may outweigh the value of nature and landscape.

Compensation Pool and Eco-accounts. The new Federal Nature Conservation Act of 2009 provides the possibility of compensation pool and eco-accounts (Küpfer 2008). This seems to be an innovative approach to simplify and particularly optimize the planning and realization of compensation with mitigation measures and substitution measures.

Methods to Evaluate the Visual Landscape for Road Planning

In both the EIA Directive and the intervention provisions under the Federal Nature Conservation Act there is a requirement to consider effects on landscape. In the German Federal Nature Conservation Act the landscape is described in terms of the "diversity, characteristic features, and beauty of nature and landscapes" (Jessel 2006). It appears that there are no generally accepted or official methods of making such assessments but rather a wide variety of practices, depending on the approach of the particular expert (academic or consultant) who may be involved. There is also a difficulty in that long-established methods (e.g., Adam et al. 1986 and Langer et al. 1990) are unavailable in English or not easily accessible in hard copy or digital form.

To take one example where information is available, Jessel (2006) developed a method to evaluate the visual landscape for road planning involving judgment of different levels of complexity of the visual landscape and a range of criteria that can act as indicators. As a new road project is a linear project, it extends mostly beyond the area of one landscape. Consequently, a classification is necessary where visual landscape units of visually homogeneous character are defined. The character of each landscape unit is considered to be the result of the interaction between geo-morphology, soils, and land use patterns, as well as the structure and shape of the topography.

In characterizing different landscape units, Jessel et al. (2003) distinguish between elements, characteristics, and character as in Figure 2.6. The landscape and the units defined within it are assessed using the listed criteria and the impacts of road proposals on the elements, characteristics, and overall character described for each unit. Mitigation, avoidance, and compensation measures are derived for the assessed impacts and subsequently the remaining significant impacts are identified and described. Priority is given to the restoration of the impaired components of the visual landscape (e.g., to plant a new avenue as a replacement for a destroyed one). If restoration is impossible to realize, then reshaping of the landscape has to be performed, with the measures that are to be implemented designed to correspond with the character and individuality of the landscape and to integrate the project in the best manner possible.

Other Methods of Evaluating the Visual Landscape for Road Planning

Some states, such as the states of Schleswig-Holstein and Nordrhein-Westfalen, evaluate the visual landscape for road planning according to a method developed by Adam et al. (1986). Another method, developed by Langer et al. (1986), is applied by other states of Germany. In both cases, no details

Elements	Characteristics	Character
I Types of land use units and single elements	I Complexes of shapes and forms	(Holistic perception[a])
Single elements	Combinations of	Aspects that go beyond
Punctiform	patterns/sequences in land use	the visual unit:
Linear	Row/staggered	Predominant structures
Small dimensional	Group/collective	Points with visibility over
Space forming/space confining	Mosaic-like	long distances
Types of land use units	Large dimensional	Extensive view relations,
Type of utilization	Shapes	long distance effects in
Marginal structures	Relief forms	terms of perspective
Characteristics of single shapes	Water forms	Type of the space
(e.g. color, texture, locally	Settlement shape	comprehending spatial
typical and visually	Scale and proportion	pattern (open, staggered, attached)
apparent animal and plant population;	Proportions	Perceptibility/ accessibility
motions in space)	Contours, horizontal line/ silhouette	Initial level of existing encumbrance
II Visual connections and synesthetic perceptions	Differentiating the land use and biotop	
Visual connections	type according to the location	
Type of visibility possibilities and	Type of the transitions within the	
predominant lines of view relations	landscape (strict, diffuse)	
(within a space unit)	Type of space formation	
View sequence and perception of	Shape of the space parts	
(accessible) beholder perspectives	(open, panoramic)	
Experiencing synesthetic perceptions	Degree of transparence in space	
(noise, smells, touch, taste)	II Rarity	
III Temporal diversity	Uniqueness, pithiness,	
Day and night change	possibly endangerment	
Change of seasons	III Temporal characteristics	
	Time frame (visible continuity	
	of a historic landscape	
	development)	
	Relative stability (Relative	
	permanence and stability	
	of natural and	
	anthropogenic processes)	

[a] May only be described in a verbal manner.

Source: Jessel et al. (2003); Jessel (2006).

Figure 2.6. Levels of complexity of the visual landscape and criteria that can act as indicators for them.

are available. Compensation relating to impacts on the visual landscape is frequently identified in a mathematical or economic manner, which makes it easier for project proposers to estimate the costs that might occur at the outset of a project. However, the state of Nordrhein-Westfalen has recently changed from this mathematical approach to a more descriptive approach, and the state of Hessen also evaluates the landscape for road planning purposes in a descriptive way.

The use of GIS and 3D visualization are particularly important for visibility studies, to find out from which parts of the landscape the new road project will be visible, or to demonstrate which measures will make the road project less visible (Hehl-Lange and Lange 1993).

Conclusions from the German Experience

- Like the UK, the German approach to EIA is driven by the requirements of the European EIA Directive, but in Germany this is set within the context of a longstanding and statutory approach to landscape planning.
- A critical part of the German system is the intervention provision. While EIA procedures assess alternative road highway options, intervention provisions assess the preferred option and deal in a formalized way with the interventions needed to respond to significant impacts that have been identified—by avoidance, mitigation/reduction, or compensation.
- There does not appear to be one single approach to assessing impacts of roads on the landscape, and different methods may be used in different states, with the approach reflecting the experts involved and their preferences.
- The method developed and reported by Jessel (2003, 2006) is based on definition of discrete landscape units, their elements and characteristics, and overall character associated with each unit. Impacts and intervention requirements are judged in terms of the effects on these elements, characteristics, and character.

- Some states have used mathematical methods and economic valuation, but others have moved toward more descriptive approaches.

2.5.3 New Zealand

The New Zealand Transport Agency has recently commissioned a program of work through Landcare Research Ltd. to investigate the multiple values of the environmental assets of the New Zealand State Highway network. As part of this work, Lincoln University has produced two recent and highly relevant reports. One is a literature review covering New Zealand and selected international literature on "Landscape and Associated Environmental Values in the Roadside Corridor" (Clemens, Swaffield and Wilson 2010), and the other is a field investigation into the environmental values and landscape preferences of key stakeholders in relation to the management of the roadside corridor of New Zealand's State Highway network, based on the West Coast of South Island (Wilson and Swaffield 2010). These two publications have been extremely useful in summarizing relevant experience in New Zealand.

The legal, social, and environmental requirements associated with the New Zealand State Highway network are covered by provisions under the Resource Management Act of 1991 (RMA), the Land Transport Management Act of 2003 (LTMA), the Land Transport Management Amendment Act of 2008, and the Local Government Act (LGA) of 2002.

The RMA emphasizes procedures and actions to avoid, remedy, or mitigate adverse environmental effects caused by land use activities, including transport infrastructure. Changes to the existing condition of the corridor through new construction or extension both require assessment under the provisions of the RMA.

Assessing Landscape and Visual Effects

The statutory basis for managing and funding land transport activities is provided by the LTMA, and two of its purposes are (1) to provide an integrated approach that takes into account the views of affected communities, and (2) to improve social and environmental responsibility in land transport funding, planning, and management.

Environmental and landscape values are addressed in the current management framework for the New Zealand State Highway system at several levels, including strategic priorities, environmental planning, and *Guidelines for Highway Landscaping.* The guidelines, inherited from Transit New Zealand, recognize that improving visual quality must take account of the complexity of the interaction between the highway and the wider visual landscape, and the strong feelings this can engender, through visual quality approaches such as planting and earthworks within the State Highway corridor to create "viewing corridors that enable road users to appreciate the surrounding landscape" or "help integrate the highway into the surrounding landscape" (Clemens et al. 2010). Taken together, these approaches are intended to minimize the highway's intrusion on the landscape and protect the natural character of an area as well as improve "visual amenity values, particularly in rest areas, at entrances to towns and cities, and along highways in scenic or tourist areas" (New Zealand Transport Agency 2006a, pp. 2–4).

Section 3 of the *Guidelines* deals with what is called "Highway Landscape Assessment." It sets out procedures for separately assessing landscape and visual character and visual aspects of the landscape, including visual catchment, the audience, viewpoints, and sensitivity of the viewing audience. Figure 2.7 provides a summary checklist of the proposed steps.

Landscape Assessment. The landscape assessment determines:

- The distinctive nature and characteristics of the area surrounding the highway development.
- The relative significance of sections of the surrounding landscape.
- The sensitivity of landscape units to change.
- The subsequent overall effects on landscape character and quality.

The specific conclusions from the landscape assessment are used to (1) identify opportunities for maximizing benefits; (2) assist in the assessment of visual effects; and (3) determine appropriate landscape and environmental mitigation options.

The assessment has common ground with the UK method in its emphasis on landscape character. The physical, environmental, and visual attributes of the landscape, such as landform and land cover, combine with aesthetic elements to create the character or sense of place of an area or location. Aesthetic elements, such as scenic qualities, remoteness, and degree of activity or tranquility, should be noted if they are significant characteristics of the local landscape and surrounding environment.

Landscape quality is broadly defined and includes a range of environmental criteria, of which aesthetic factors are a subset. The factors to be taken into account are listed in Figure 2.8.

In addition to landscape quality, the method also requires an assessment of landscape and visual sensitivity. This is considered to be the product of combining landscape quality, as above, and visual absorption capability (VAC), which is the capacity of the landscape to accommodate change while retaining its inherent character and quality. Landscapes that are more complex are said to have a higher potential for visual

Preliminary steps	1 Collect background information	☐
	2 Complete desktop assessment	☐
	3 Complete field assessment	☐
Landscape assessment	1 Identify landscape and visual character	☐
	2 Identify landscape units of distinctive character	☐
	3 Identify landscape qualities	☐
	4 Determine landscape sensitivity	☐
Visual assessment	1 Identify/describe visual catchment	☐
	2 Identify viewing audience: use on-site observations	☐
	3 Establish viewpoints: take photographs	☐
	4 Identify the sensitivity of viewing audience	☐
	5 Identify safety and visual interest aspects	☐
Summary and evaluation of impacts	1 Assess the likely effects of the highway on landscape character including ability for the highway to integrate with the surrounding landscape context	☐
	2 Assess the visual effects of the highway on the viewing audience	☐
	3 Prepare a statement of highway development effects	☐
Mitigation	1 Identify areas where mitigation is required	☐
	2 Develop appropriate mitigation options that avoid, remedy or mitigate the potential adverse effects of the highway project	☐
	3 Incorporate mitigation options in the landscape design	☐

Source: New Zealand Transport Agency (2006a).

Figure 2.7. Checklist of steps in procedures for assessing landscape and visual effects.

absorption. Factors to be considered when determining VAC include broad contextual considerations like biodiversity, soil stability, and erosion potential. The common approach to calculating VAC uses visual diversity, slope and topography, and exposure and visibility.

The greater the visual diversity—determined by the presence of contrasting elements and the complexity of both natural and cultural elements—the higher the VAC. With regard to slope and topography, areas of varied terrain or undulating landscapes usually have a high VAC, as the landform allows for screening and visual integration. In contrast, both flat and steep landscapes usually have a low VAC, as they provide fewer opportunities for accommodating change. Exposure and visibility affect VAC because the less screening provided by natural features (e.g., trees or topography) or development (e.g., buildings), the higher the VAC.

Visual Assessment. Viewpoints are selected from within the visual catchment and at various points along the length of the highway corridor. Representative views are then obtained to assist in the evaluation of the visual effects of the highway development from a representative range of locations within the visual catchment and to assist in the evaluation of the likely visual experience of the highway user. The function of the visual assessment is to determine (1) the nature and significance of the visual effects on local residents and businesses who are most likely to be affected by any negative effects of the highway development; (2) visual and safety issues for the highway user; and (3) sensitivities of the surrounding built environment.

The nature and sensitivity of the viewing audience within the visual catchment has to be determined, distinguishing between those who view in to the road and those who view out from it. Assessment of the sensitivity of the audience is related only to

Attributes to Consider in Assessing Landscape Quality

Ecological Integrity
- Strong connectivity and linkages
- Free of plant and animal pests

Rarity
- Rarity involves assessing how rare or important the landscape unit is within the local or regional context
- Rarity may result from either natural elements (including biodiversity and ecological values) or from cultural modifications to the landscape

Aesthetic Values

Attributes to consider in determining the aesthetic value of a landscape include the following:
- Degree of modification of the surrounding environment
- Activity
- Iconic parts of the landscape
- Diversity or uniformity
- Remoteness or close connections to adjacent areas
- Physical features such as land form, vegetation and water bodies (including their specific attributes – variety, patterns, colors, composition, and scale)
- Visual attractiveness (scenic quality) including the nearby scenery

Heritage and Community Values
- Landscape heritage values may result from a combination of natural characteristics (landform, water bodies, or vegetation) or cultural influences
- Heritage values provide strong continuing links to the past and help create a sense of identity. The value of a heritage element is dependent on a number of elements, including how unique, representative or intact it is
- Consultation with stakeholders, including community groups and adjacent landowners should aim to identify the values and associations the local community has with the surrounding landscape

Source: Adapted from New Zealand Transport Agency (2006a).

Figure 2.8. Attributes thought to contribute to landscape quality.

the first of these and is considered to be determined by considering (1) whether the viewers are permanent or temporary; (2) the distance to the highway from the viewing audience; (3) the relative viewing angle, in that a highway is likely to be far more apparent when viewed from above; (4) the focus of the view, in that for locations where the main views are directed toward the highway, the visual impact will be more significant; and (5) the clarity of view, which depends on the presence (or otherwise) of visual impediments (e.g., landforms, vegetation, or structures) between the viewing audience and the highway.

Public Perceptions and Values

Transit New Zealand, the predecessor to the New Zealand Transport Agency (NZTA), recognized that many of the types of values associated with roads are descriptive and not readily quantifiable. These include both intangibles and externalities. Chivers et al. (1992) identified 27 intangibles that might be affected by road construction and operation, among which are:

- Visual effects.
- Effects on the physical landscape.
- Community severance and disruption.
- Stress of change.
- Cultural, spiritual, and historical effects.
- Loss/disruption of animal habitat.
- Water pollution.
- Air pollution, dust, and vibration.
- Traffic noise.
- Heritage effects.
- Recreational values.
- Lighting.
- Civil defense.
- Global atmospheric effects.

It has been suggested that this list appears to downplay the significance of landscape experience or meanings, unless these values are captured indirectly through other social effects on spiritual or cultural values (Clemens, Swaffield and Wilson, 2010). Visual impacts were originally covered by the terms "visual obstruction," which was based on the angle subtended by the obstruction, and "visual intrusion," which—because of its highly subjective nature—required assessment by an expert, such as a landscape architect (Chivers et al. 1992). The

quality of the view that might be lost was not considered; neither was the "view from the road," which is crucial for scenic perception as well as driver satisfaction and alertness. These shortcomings were subsequently recognized and improvements suggested for the assessment procedure. With respect to visual impact, a number of new, or improved, factors for consideration were recognized. These new factors included:

- Beneficial (positive) and adverse effects of roads.
- Views "from" as well as views "to" roads.
- The surrounding landscape context.
- The number of people affected.
- Continued place of an expert assessor, but with consideration and/or values and opinions of local people who might differ in cultural or educational backgrounds (i.e., expert and user-dependent assessment).
- Continuing interest in the development of techniques to assess visual impacts.

Clemens, Swaffield, and Wilson (2010) observe that:

> [w]ith the technological advances made in recent years in the visual simulation of the impacts of new infrastructure, there has been a tendency for visual values to dominate over other, more complex multisensory or associative values. With respect to road corridors, there is an understandable emphasis on the view from (or to) the road corridor rather than with a sense of place; to the aesthetic components of a view rather than with an attachment to a view. Therefore, perceptions of road corridors captured by means of visual imagery need to be interpreted with care, and in the context of the emotionally rich information supplied by respondents.

However, they also note that there has been a shift away from interest in the purely visual amenity values of roadside corridors (primarily from the perspective of road users) to a focus on the identification of multiple values and the more pragmatic application of these values by the road makers (Clemens, Swaffield, and Wilson 2010).

From their literature review, the authors conclude, among other things, that there are key differences in focus between "road users" and "road makers," and also that more recent research on landscape values indicates that further segregation into a wider range of stakeholder and community groups may be required to identify all the values held. The subsequent West Coast research into stakeholder attitudes (Wilson and Swaffield 2010) is mainly concerned with informed stakeholder views of the immediate environment next to the highway. It does, however, also conclude that an enhanced system of highway asset management needs to be both context sensitive and able to differentiate categories of condition and management regime that are sensitive to regional character and landscape context.

Conclusions from the New Zealand Experience

- New Zealand has a relatively recent but well-established method for assessing the landscape and visual impact of roads. This method has similarities to the UK system and distinguishes between impacts on landscape—in terms of its character, its quality, and its ability to absorb visual change, which combine as sensitivity—and visual impacts that relate to views and viewers.
- The method used in New Zealand is based on professional judgment but recognizes, especially with respect to the heritage and community values of landscape, that consultation with a wide range of stakeholders and communities is required.
- Traditionally there has been an emphasis on visual values, but increasingly there is recognition that landscapes also have a wide range of broader social, cultural, and environmental values associated with them.
- The authorities have recognized the importance of more intangible values related to highway landscapes and have supported research into stakeholder views, although so far in relation to the immediate environs of the road corridor and the management of related assets.
- The Resource Management Act, like the Federal Nature Conservation Act in Germany, brings a legal requirement for procedures and actions to avoid, remedy, or mitigate adverse environmental effects caused by land use activities, including transport infrastructure.

2.5.4 Australia

The New South Wales Roads and Traffic Authority has produced a guidance document for assessing landscape character and visual impact. *Guidelines for Landscape Character and Visual Impact Assessment* (Roads and Traffic Authority 2009) is designed to guide the carrying out of landscape character and VIA for projects under Part 3A and Part 5 of the Environmental Planning and Assessment Act 1979 and the associated Environmental Planning and Assessment Regulation 2000. A stated objective of the guidance is that such assessments should "inform the development of the preferred route and concept designed so that the proposal can avoid and minimize impacts up front" (Roads and Traffic Authority 2009). The guidance differentiates between visual assessment (the impact on views)—and LCA (the impact on the aggregate of an area's built, natural, and cultural character or sense of place). Both are stated to be equally important. The guidance acknowledges that the methodology is based on the UK guidelines for LVIA. It recognizes the potential for confusion relating to inconsistent use of terminology and includes a glossary of terms important to the process, including "aesthetics," "landscape," "landscape character magnitude," "sensitivity," "visual envelope map" (also

referred to as "viewshed" or "zone of visual influence"), "visibility," and "visual impact."

The guidelines describe eight steps required in carrying out LCA and VIA:

- **Step 1:** Analyze landscape character based on desk and field study and incorporating the main physical, natural, and built components of the landscape.
- **Step 2:** Identify landscape character zones if the size or complexity of the project suggests that this is helpful.
- **Step 3:** Assess landscape character impacts based on the sensitivity of the landscape character zone and the magnitude of the proposal in that zone. Sensitivity means how sensitive the character of the zone is to the proposed change, while magnitude refers to the nature of the project and the size of the change. The sensitivity of the landscape character zone and the magnitude of the proposal are combined in a matrix that sets out the scale of the landscape character impacts from low through moderate to high and various combinations in between. The guidelines note that the quality and extent of the design solution built into the proposal will influence judgments of magnitude and impacts.
- **Step 4:** Assess the visibility of the proposal by producing a visual envelope map, primarily related to land form but noting the obscuring effects of vegetation and buildings where possible.
- **Step 5:** Identify key viewpoints within reasonable distance (unspecified) of the project, and within the visual envelope. Key viewpoints are noted to include residential properties, public buildings, public spaces, and key businesses.
- **Step 6:** Assess visual impacts by combining judgments about the sensitivity of the view with the magnitude of the proposed project in that view. The visual sensitivity of the view is described as relating to the direction and composition of the view and may include more than one character zone. Magnitude of the project in visual terms relates to its proximity to the viewer. It is noted that assessments of visual sensitivity and magnitude and their combination in the degree of visual impact should be described in a comprehensive schedule or table with descriptions and photographs to justify the conclusions. The role of animations, photomontages, and sketches is acknowledged and the importance of realism in relation to the likely outcome is stressed.
- **Step 7:** Refine the concept design to avoid and minimize impacts at an early stage of selecting options and exploring concepts design.
- **Step 8:** Develop a mitigation strategy to minimize landscape character and visual impacts with mitigation measures that are integrated with the overall design of the project.

This method has much in common with other approaches described elsewhere in this report, although the interpretation of terminology such as "magnitude of impact" is somewhat different. There is also a strong emphasis on landscape character and VIA as an integral part of the concept design process for highways, contributing to an iterative process of design improvement. The guidelines conclude by suggesting that reporting of the landscape character and visual impact work should be integrated fully with urban design work undertaken as part of scheme design.

Main Roads Western Australia has a standard brief for VIAs that provides the basic technical specifications for engaging consultants to assess and report on the potential visual impacts associated with road projects at the planning or project development phase. It is referred to in other Main Roads documents on environmental assessment, landscape design and managing visual quality in the road reserve. The brief requires that landscape character and visual impact work should consist of:

- Concise descriptions of the existing landscape setting and values requiring identification and description of landscape character and visual character units; features of visual significance from natural, social, and historical perspectives; important vantage points; relative height differences in landform; vegetation heights, extent, and density; key viewpoint locations, providing vistas from the roadway; and the capability of the landscape to absorb visual changes associated with road works.
- Definition of visual management objectives requiring consultation and liaison with key stakeholders, identification of the types of viewer and visual expectations, identification of the locations of any priority areas or sites, and definition of concise objectives for managing existing visual quality.
- Description of the proposed road works, including details on the expense of works alignments, sizing options, and proposed timing.
- Description of the potential visual impacts associated with the proposed development, including potential changes in the surrounding landscape; description of any significant visual changes seem from key vantage points; and identification and description of any potential visual intrusion or loss of the visual amenity, and of any key viewpoints and vistas seen along the new highway.

As a result of these steps, there is also a requirement to provide key recommendations on road design as a guide to managing visual impacts. This requirement includes assessing visual quality management objectives, identifying zones and key locations for the visual management of impacts, comparing possible design options in terms of visual management objectives, and establishing design principles to minimize visual impacts and enhance visual quality.

There are similarities between the Western Australia and New South Wales approaches, with both methods emphasizing inputs to design principles and visual management objectives.

2.5.5 Switzerland

Information on the Swiss approach comes from an account by Marguerite Trocmé (2010). Measures aimed at the integration of transport infrastructure into landscape in Switzerland are regulated by the Federal Law on the Protection of the Environment (1983) and the Ordinance on Environmental Impact Assessment (1988). The Conception Paysage Suisse, approved by the Federal Council in 1997, is a spatial planning policy used for landscape issues that starts from an interdisciplinary focus, integrating the need to protect nature and landscape in different sectoral policies. The Conception establishes three principles for the transport sector that address the need to (1) assess the landscape impact of new projects; (2) minimize disruptions in biological continuity provoked by public works; and (3) take advantage of the opportunity that road transformation or road widening may offer for resolving relatively unsatisfactory situations from a nature and landscape perspective.

In 2001, the Swiss Society of Engineers created a guide that summarized these focal points, entitled *Planifier et Construire en Respectant le Paysage* (*Planning and Building with Respect for the Landscape*). According to this guide, a highway must be designed with the aim of integrating it into the surrounding landscape while keeping in mind the conservation, repair, and planning of ecologically functional settings and the introduction of constructions that make aesthetic sense. A second guide, *Esthétique du Paysage—Guide pour la Planification et la Conception de Projets* (*Landscape Aesthetics—A Guide for Planning and Conceiving Projects*) stresses the importance of taking inspiration from the reality of each context and respecting existing landscape values and avoiding threats to important local features. Training material linked to this guide prescribes a series of steps that require assessment of emotional and sensory aspects of the landscape as well as characteristic landscape features and landscape quality. The details of the method are not available in English, but it appears that landscape is assessed at the "mega, mesa and micro scales," which may have something in common with the levels of complexity in the German approach and the UK hierarchy of LCA at different scales.

2.5.6 Other Countries

Although a great deal of information is available about broad approaches to EIA in other countries, relatively little is specific to landscape and/or visual impact, and even less is specific to highways. This section briefly summarizes other examples that have been identified but for which less detailed information is available. Information on methods used in China is available in only the briefest of forms in English, and research suggests that Hong Kong is largely influenced by its British colonial past and tends to follow a UK-style approach.

2.5.7 Summary of International Experience

VIA is coming to be practiced in many countries.

A number of countries have formalized guidance on methods and procedures for assessing landscape and visual impacts of changes in land use or new development in general. Some countries also have methods specific to highways. There are indications that these approaches have been influenced by those originating in the UK and the United States.

Landscape character may be described as it physically exists or as it is experienced.

Classification and description of the landscape is a common feature of most approaches. Some common ground exists between methods in the way that landscape character is described, but variation occurs in the degree to which emphasis is placed on more factual description, based on what the elements and characteristics of the landscape are, or on trying to capture the aesthetic and perceptual dimensions of character. The terminology used in landscape description varies widely, even within those approaches from English-speaking countries.

Some approaches are more prescriptive while others provide general guidance.

Ongoing debate exists in the UK about the degree to which guidance should be prescriptive regarding methods and procedures for landscape and VIA and related procedures like LCA. Issues of reliability and repeatability are very important. Elsewhere, the guidance tends to be more open-ended, seeking to encourage a broadly consistent approach while encouraging practitioners to adapt the methods to the particular circumstances. Such flexibility can create tensions in legal situations where opposing parties may interpret and apply guidance in different ways.

The greatest variation is in ways of dealing with the quality, value, or importance of the landscape. The latest draft of the UK DMRB method, which is specific to roads, is quite generalized, but there is an implicit cross reference to the criteria used in LCA more generally and a clear indication of the importance of local public perceptions. By contrast, the FHWA method is highly prescriptive about what factors con-

tribute to visual quality and uses a scoring method to codify the judgments made.

Landscape quality or value may focus narrowly on aesthetics, or include other cultural and social values.

There are also differences in the extent to which criteria to judge landscape quality or value are confined to visual or aesthetic considerations or embrace a wider range of factors, such as social and cultural values, or indeed wider environmental values. Broadening the range of environmental criteria is demonstrated by the New Zealand approach and is also the subject of debate in the UK, where there is growing emphasis on ecosystem service approaches to environmental valuation. In contrast, the U.S. VIA procedures are almost entirely visual and aesthetic in emphasis, although other factors are often dealt with in the broader process of EIA.

There is an accepted role for both expert judgment and public perceptions in VIA.

Internationally, the tendency is to accept that professional judgments must be made about difficult issues such as landscape and visual impacts, and that descriptive approaches are acceptable. Differences of opinion over such judgments are generally debated in legal forums—for example, public inquiries in the UK. To varying degrees, there is also recognition that public attitudes have to be taken into account. Much less clarity exists about how best to achieve this, however, and about how to deal with the fact that different groups of people will have different perceptions and attitudes.

Internationally, VIA methods continue to evolve.

It is apparent that a number of the methods used internationally are relatively recent in origin and continue to evolve. In the UK, for example, the guidance on the LVIA method has been published in two editions so far and is about to be reviewed and updated. Review involves consultation and contributions from professionals involved in using the guidance. This review process encourages refinement and development based on experience. By contrast, the FHWA–VIA appears to have remained virtually unchanged since it was first introduced.

2.6 Conclusions from Literature Review

Several observations emerge from the expanded literature review. Although these observations focus on the practice of VIA in the United States, several key observations arise from the practice of VIA in other countries.

2.6.1 U.S. Judicial Decisions Suggest Minimum Standards

Existing VIA procedures used by state DOTs may be insufficient to guarantee the NEPA responsibility to "assure for all Americans . . . aesthetically pleasing surroundings" (NEPA, [42 USC § 4331] Sec. 101[b]2). However, the courts have generally sidestepped the issue of aesthetic values and instead have applied more modest standards by which to evaluate VIAs. U.S. judicial decisions suggest that minimum standards for an acceptable VIA include the following:

- A VIA must be reliable and pragmatic to employ.
- Quantitative methods and results in a VIA are desirable.
- VIA methods that focus on extreme negative effects normally have been supported by the courts.

Aesthetic standards alone have not been sufficient for determining the level of environmental review or the acceptability of a project. In addition, the courts have required expert testimony on any matter to be:

- Connected to valid and reliable science.
- Based on peer-reviewed scholarship.

At a minimum, it is important that VIA procedures credibly respond to the court's expectations.

2.6.2 U.S. VIA Procedures Focus on Naturalness

In the United States, the mandate for VIA is grounded in laws designating the significance of scenery and citizens' right to "aesthetically pleasing surroundings." Americans are justly proud of the beauty of their natural wonders, many of which are protected as national parks, national monuments, and wilderness areas. However, this fixation on scenery—and, in practice, on naturalness—requires that VIAs not consider other landscape values associated with cultural, social, and individual experience and meaning of landscape. While these other landscape values are considered during EIA, they often are not functionally linked with visual quality.

In other areas of the world, approaches to VIA incorporate attention to landscape values that are independent of scenic values. In the UK, for instance, LCA has been found a suitable framework to guide land planning where all landscapes matter, not just the most scenic landscapes. The UK's LVIA procedures evaluate how a project impacts cultural and natural landscape character separately from scenic values, which are also considered. It is noteworthy that the ELC does not mention "scenery" or "aesthetics." Rather, the emphasis is on the landscape character perceived by people; that is, on landscape character formed through the interaction of people and nature.

2.6.3 Designated Visual Management Objectives Enhance VIA Legitimacy

VIA is essentially a process for evaluating the acceptability of visual change in the landscape. In order to make this evaluation, some criterion or standard must be employed. For example, the Australian guidance recommends that, during the design process, "the basic project concept—its location, form and key elements—should be assessed" by comparison to existing design guidelines, designated visual management objectives, and other similar projects that have been well accepted by stakeholders (Road and Traffic Authority 2009). *NCHRP Report 741* has identified three basic types of guidelines or standards:

1. **Implicit Standards of Experts.** In the United States, existing VIA procedures contain implicit assumptions or biases that serve, in effect, as universal visual quality objectives. Two of the most important standard assumptions are that "more nature is good" and "change is bad." Another is that VIA is validly assessed using landscape design and art criticism concepts. Another is that people pursuing recreational activities in nature areas are more sensitive to visual impacts than people pursuing other activities in other types of areas. Since these criteria are implicit and asserted without supporting evidence, they are difficult to challenge.
2. **Implicit Standards of Stakeholders.** The landscape perception literature takes a second approach. Stakeholders are allowed to make direct judgments about the severity of visual impact without stating the criteria they are using. This measure of VIA is legitimate to the extent that the evaluators are representative of the affected stakeholders. An attempt is often made to identify the implicit criteria through statistical analysis of data from representative stakeholders.
3. **Explicit Standards of Designated Visual Management Objectives.** In the United States, land management agencies such as BLM and USFS explicitly designate visual management objectives. These objectives can be used as a standard for determining the extent of acceptable visual change in the landscape. In the UK, LCA serve a similar function, as landscape character provides a national framework that contributes to land use and development planning.

These three approaches are not mutually exclusive, and all three could and perhaps should be applied when conducting a VIA. However, there are clear advantages to using visual management objectives, since they are determined through a public process outside of any controversy over a particular landscape change. Visual management objectives inform both the public and potential developers about what would be considered an appropriate visual change.

2.6.4 Benefits of Integrating Mitigation of Visual Impacts Throughout Projects

In existing U.S. procedures, mitigation of visual impacts is not emphasized within the VIA process. An iterative approach to mitigation might be more effective when, despite thorough efforts to avoid or minimize visual impacts, a project's design leaves residual visual impacts. Integrating mitigation throughout a project's design and life cycle can help clarify the focus of the VIA. For example, the Australian guidance recommends that "[t]he residual impacts identified in the assessment would then be mitigated where possible, with the mitigation measures integrated into the concept design. This provides a more transparent approach differentiating between concept design work to avoid impacts and mitigation work to minimize impacts" (Road and Traffic Authority 2009).

2.6.5 Benefits of Updating U.S. VIA Principles and Procedures

U.S. VIA principles and procedures have not been updated for at least a decade, and VIA professionals seem largely unaware of academic research related to VIA. VRM and VIA procedures developed by federal agencies in the United States are based on best practices from the 1970s. At that time, practicing landscape architects approached visual assessment using the language and concepts of design and art criticism (USFS 1973). While an active research community was investigating the perception of landscapes, there is little indication that this research influenced the development of VRM and VIA. There seems to have been very little dialog between landscape architects in practice and research. In particular, there appears to have been little substantial evaluation by researchers of the reliability and validity of VRM and VIA procedures developed by practitioners.

The situation is somewhat different in other parts of the world. In the UK, for example, there is an ongoing discussion among professionals and academics about how best to conduct landscape and VIAs. This discussion is facilitated by non-governmental organizations (NGOs), such as The Landscape Institute, Institute for Environmental Management and Assessment, Landscape Research Group and the Landscape Character Network, as well as research oriented consultancies, such as Land Use Consultants and The Macaulay Institute. This interchange is responsible for continuous critical review and further development of the principles and procedures used for landscape planning and VIA.

2.6.6 Expert Judgment as Basis for All U.S. VMSs and VIAs

In the United States, experts make the judgments necessary to complete existing VIA procedures, whether VIA measures are expressed quantitatively or qualitatively. Despite claims to the contrary, evidence is lacking that existing VIA and VMS

are based on the existing body of scientific knowledge of visual impact systems or of public landscape perceptions. Since U.S. courts require that expert testimony be based on scientific evidence, the gap between expert systems and the literature could make VIAs legally vulnerable. VIAs should be more closely based on current scientific knowledge of landscape perception and should use current technology to continue to build that knowledge base.

2.6.7 U.S. Preference for Quantifying Attributes Used in Conducting VIAs

In the United States, NEPA requires the federal government 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." This is generally interpreted as an expression of the desirability of quantitative methods. However, the quantitative methods employed in VIA do not appear to be based on scientific literature and, in many ways, do not adhere to scientific expectations for validity and reliability in quantitative measures. Consequently, although American VIA methods are quantitative, they are not sophisticated or exemplary in their use of quantitative methods.

In the UK, there was initially a similar preference for quantification in the period before the development of the LCA and LVIA procedures. However, a move away from visual evaluation toward landscape character assessment, along with dissatisfaction with the results from the quantitative methods that were being used, led to widespread adoption in the UK of systematic qualitative descriptions of landscape character and analysis using non-quantitative comparative methods.

2.6.8 Public Contributions to the VIA Process

Although VIA experts in the United States may consult the public to various degrees, public participation virtually never takes the form of a scientifically representative survey. Ultimately, the public's only meaningful opportunity to participate in making decisions about their landscape may be after the fact, in the form of legal action. That said, existing technologies, both for visual simulation and for web-based surveys, are steadily improving, becoming more cost effective, and creating opportunities for VIA to be more directly based on surveys of stakeholders, including members of the public.

2.6.9 Toward a Scientifically Rigorous Approach to VIA

The current view among environmental psychologists and others investigating landscape perception is that visual quality is the result of an interaction between people and the landscape. This is a transactional model because people and landscape each help to form the other. It is also contextual because the interaction always involves particular people and particular places.

The transactional approach to landscape perception recognizes that there is a physical reality. Some physical characteristics of the landscape are perceivable by people and become the basis of our experience of that landscape. Although landscapes have intrinsic attributes, experience is not intrinsic to the landscape; rather, experience resides in people. In addition to the physical characteristics of the landscape, a spectrum of human phenomena (e.g., culture, knowledge, and affective reactions) influences the experience of landscape. Human actions, which are one potential result of this experience, may in turn affect the landscape.

There are many approaches to investigating these transactional dynamics using both quantitative and qualitative methods. Nonetheless, assessing the "visual experience," even if limited to just aesthetics, is not an easy task. Relevant physical and denotative landscape attributes can be measured with reliability. However, landscape experience also involves many connotative attributes that cannot be as reliably determined.

Because the existing research has been conducted in a fragmentary way, there is no comprehensive set of results intended specifically to inform the development of a revised FHWA–VIA procedure. In addition, the transactional model provides a useful way to think about people and landscape, but no useful theory yet exists that would allow us to reliably predict the magnitude and importance of visual impacts.

What is needed is a VIA procedure that allows different stakeholders to describe their experience of a place and its meaning and value to them. To the extent possible, reliably measured physical or denotative characteristics need to be identified for both people and landscapes that predict the stakeholders' landscape experience. Simulation methods need to be developed to represent landscape change in a way that accurately communicates these characteristics. The evaluation of impact involves both measurements of the changes in landscape characteristics and the stakeholders' expressions of their understanding and meaning of these changes.

Landscape characteristics that have been the subject of scientific investigation do not all have a consistently strong relationship with visual quality, and not all are reliable. A coordinated scientific research effort is needed to identify and evaluate physical and denotative landscape characteristics that can both be reliably measured and explain landscape experience in known contexts. Bearing in mind that landscape experience is contextual, this effort must be organized across the full range of U.S. landscape types, possible landscape interventions, and stakeholders.

CHAPTER 3

State Survey

This section documents the methods and results of a survey of state departments of transportation (state DOTs) related to their practices of assessing visual impacts during the development or environmental review of proposed highway projects. It also offers an analysis of those results and a set of conclusions.

3.1 Survey of State Departments of Transportation

Based on the findings of the literature review, a set of questions was developed to directly understand if and how state DOTs assessed visual impacts either as part of their environmental review process or their project delivery process. The survey was conducted as an on-line questionnaire between April and June 2011. The initial part of this section focuses on the purpose, methods, and findings of the survey. It first describes the purpose of the survey, the methods that were used to survey the states followed by the documentation and analysis of the survey's results. It finishes with a set of conclusions about the use of visual impact assessments (VIAs) within state DOTs.

3.1.1 Purpose of Survey

The survey was designed to help meet the project's general objectives listed by NCHRP in its original request for proposals. These objectives included:

1. Evaluate state DOT VIA procedures, methods, and practices that satisfy or exceed NEPA and other requirements.
2. Document the use of the FHWA (FHWA–VIA) methodology, methodologies from other agencies, and other approaches used by DOTs.
3. Describe decision-making frameworks used at state DOTs to undertake specific VIA techniques for a given project.
4. Document proven successful methods.
5. Describe best practices illustrated by model case studies.
6. Document promising new developments and lessons learned.

By directly contacting state DOTs, unfiltered responses to questions allowed for an unvarnished understanding of the state of the practice related to the assessment of visual impacts for highway projects.

3.1.2 Methods

Organizing and Conducting the Survey

Initially, the research team was supplied with two lists of potential contacts within state DOTs. One list had been compiled earlier by landscape architects from the California Department of Transportation (Caltrans) who had conducted a study on median plantings. This list consisted of landscape architects or other state DOT personnel primarily involved with the maintenance of vegetation, although some contacts also had design responsibilities. The second list had been prepared as a personal interest by a landscape architect employed by FHWA who had tried to identify any landscape architect that worked for a state transportation agency.

Merging these two lists, the research team sent e-mail invitations to individuals, mostly landscape architects, in all 50 states. Of the 50 contacts that were sent emails, thirteen responded that they would participate in the survey. Over half of the e-mail inquiries bounced back, the contact information being incorrect. To develop a more complete roster of survey participants, the research team then began the slow process of locating someone responsible for producing environmental documents or for project delivery within each state transportation agency. Completing the process took nearly six weeks.

The team had initially assumed that most, if not all, VIAs would involve state-employed landscape architects either as authors or supervisors of VIAs. Although this was true in

many cases, the process of developing the contact roster made it apparent that other professions represented in state transportation agencies could be responsible for conducting VIAs. (A fuller discussion of who is responsible for conducting VIAs for state transportation agencies appears in Section 3.1.4.)

The researchers had chosen an on-line firm, Survey Monkey, to conduct the survey. Survey Monkey required that the researchers obtain and catalog permission from potential participants before the survey could be issued. Once permission had been granted, the researchers entered the specific contact information into a Survey Monkey database. Survey Monkey automatically sent the contact an e-mail with a unique link to the website that held the VIA questionnaire. The unique link assured that only the original contact could fill out the questionnaire. On the website, the contact would be asked to answer 42 questions. Most of the questions were multiple-choice, but respondents always had an opportunity to add comments clarifying their responses.

Upon seeing the actual questionnaire, about a dozen contacts suggested that others within their organization would actually represent their agency better than they would in answering the questions. Each new or replacement contact followed the same process. Ultimately, in approximately a half-dozen states, multiple contacts were established because it was thought no single person had all the necessary knowledge to answer the questions appropriately.

Although every contact had agreed to participate, the initial e-mail from Survey Monkey yielded participation just below 50 percent of the states. Eventually, questionnaires were submitted by 60 individuals representing all 50 states.

Raw Response Data

Table 3.1 presents each question from the survey that can be summarized in tabular form. When responses were not initially provided in codable form, comments supplied by the respondents were used to code them appropriately wherever possible. Where appropriate, the number of respondents is noted below each question, and the responses are presented in two forms: "Percent of States" and "Percent of Respondents." All 50 states responded to the survey, so in Table 3.1 each number in the "Percent of States" column simply doubles the number of responses for that item. Because not all states responded to each question, the numbers listed under "Percent of Respondents" have been adjusted to exclude states that did not respond or responded "Don't Know," "Not Applicable," or with a response that could not be coded. The symbol "–" appears in the table to indicate that "NA" and "DK" are not considered when calculating percent of respondents.

3.1.3 Preparing the Data for Analysis

A total of 60 people responded to the survey, with at least one respondent from each of the 50 states. Seven states had multiple respondents. Most often this occurred because the primary respondent requested help from a colleague to answer specific questions. In these situations, the responses were easily combined to form a single response. In a couple of states, more than one person completed the whole questionnaire. In this situation, a single response was created by reconciling the multiple responses by (1) including multiple responses where appropriate, (2) including affirmative responses over "Not Applicable" or "Don't Know" responses, or (3) giving priority to the primary respondent who was contacted to participate in the survey. Where the response was "Other" and the comment box indicated that the response fit one of the given categories, it was so coded. All other "Other" and "Not Applicable" or "Don't Know" responses were treated as not responding to the question for purposes of the analysis. The result of this effort was a dataset with a single response for each of the 50 states. This dataset is used in the following analysis.

3.1.4 Analysis of Survey Results

The following section summarizes the findings of the survey. In most cases the results are simply described in text with a note indicating the survey question being described. Most frequently the results are presented as a percentage of all 50 states. However, in some cases they are presented as a percentage of only those state DOTs that responded to the question.

Who are the respondents?

Nearly all of the respondents work at the state's DOT headquarters (98%). Their most common profession is landscape architecture (45%), followed by civil or environmental engineer (18%) and manager or administrator (14%). Other professions include natural resource scientist, environmental specialist, archaeologist or historian, and planner. No respondents indicated that they are architects or lawyers. On average they have 13.4 years of experience contributing to VIA-related work; 91 percent have more than 5 years of experience. Respondents indicated the ways in which they contribute to VIAs in their answers to Question 41 (see Table 3.1). Primarily, respondents review VIAs (51%), write or oversee the production of environmental documents (33%) or VIAs (30%), or manage the group that produces VIAs. All-in-all, these respondents appear to be well qualified to represent their agencies in a survey of the use of VIA for transportation projects.

Table 3.1. Raw response data, by question.

1. In your state, are visual issues considered an essential part of the highway development or environmental review processes? (Check one.)

Response	Percent of States	Percent of Respondents
Yes, visual issues are considered equally important to other environmental review items	16	16.3
Yes, although visual issues are typically considered only for certain types of projects or in particular settings	74	75.5
No, visual issues are typically not part of project development or the environmental review process	8	8.2
Not Applicable (NA), Don't Know (DK), Other, or Blank	2	—[a]

Number of respondents: 49.

2. Does your state department of transportation (DOT) require the assessment of visual impacts as part of its environmental review or project development procedures? (Check one.)

Response	Percent of States	Percent of Respondents
Yes, always	12	14.6
Yes, often	22	26.8
Yes, about half	2	2.4
Yes, sometimes	40	48.8
No	6	7.3
Not Applicable (NA), Don't Know (DK), Other, or Blank	18	—

Number of respondents: 41.

3. Does your state DOT have a particular VIA process that it typically uses for assessing visual impacts? (Check one.)

Response	Percent of States	Percent of Respondents
Yes	28	29.2
No	68	70.8
Not Applicable (NA), Don't Know (DK), Other, or Blank	4	—

Number of respondents: 48.

4. The VIA process that your state DOT typically uses was developed by: (Check one.)

Response	Percent of States	Percent of Respondents
FHWA	26	46.4
Other federal agency	6	10.7
Our state DOT	20	35.7
Other state DOT	2	3.6
Other organization	2	3.6
Not Applicable (NA), Don't Know (DK), Other, or Blank	44	—

Number of respondents: 28.

[a] The symbol "—" appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.

Table 3.1. (Continued).

5. How often do the following levels of government produce a VIA for the transportation projects they propose to construct in your state? (Check one answer per row.)

Level of Government	Always	Often	About Half	Sometimes	Never	NA, DK	Mean[b]
	Percent of States						
Federal	4	4	2	42	10	38	3.8
State	4	10	4	66	4	12	3.6
County	0	2	0	32	10	56	4.1
Municipal	0	2	0	34	4	60	4.0
Tribal	4	0	0	4	12	80	4.0
Toll way authority	0	2	0	4	14	80	4.5
	Percent of Respondents						
Federal	6.5	6.5	3.2	67.7	16.1	—[a]	
State	4.5	11.4	4.5	75.0	4.5	—	
County	0.0	4.5	0.0	72.7	22.7	—	
Municipal	0.0	5.0	0.0	85.0	10.0	—	
Tribal	20.0	0.0	0.0	20.0	60.0	—	
Toll way authority	0.0	10.0	0.0	20.0	70.0	—	

6. How often is a VIA produced for projects with the following levels of environmental documentation? (Check one answer per row.)

Type of Assessment	Always	Often	About Half	Sometimes	Never	NA, DK	Mean[b]
	Percent of States						
EIS (Type I-Environmental Impact Statement)	40	14	2	28	6	10	2.4
CE (Type II-Categorical Exclusion)	2	10	4	34	36	14	4.1
EA (Type III-Environmental Assessment)	14	18	4	42	12	10	3.2
	Percent of Respondents						
EIS (Type I-Environmental Impact Statement)	44.4	15.6	2.2	31.1	6.7	—	
CE (Type II-Categorical Exclusion)	2.3	11.6	4.7	39.5	41.9	—	
EA (Type III-Environmental Assessment)	15.6	20.0	4.4	46.7	13.3	—	

[a] The symbol "—" appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.

[b] Mean value ranges from 1 for Always to 5 for Never.

(continued on next page)

Table 3.1. (Continued).

7. What factors trigger the investigation of visual impacts? (Check all that apply.)

Response	Percent of States	Percent of Respondents
Level of anticipated controversy	72	73.5
Public expectations	62	63.3
Viewer sensitivity	62	63.3
Level of environmental documentation (EA, CE, or EIS)	62	63.3
Project type	50	51.0
Project setting	78	79.6
Section 106 [cultural resources] issues	76	77.6
Section 4(f) [impacts to federally funded parks] or 6(f) [impacts to LWCFA-funded properties] issues[c]	76	77.6
Scenic designation of road or adjacent landscapes	78	79.6
Not Applicable (NA), Don't Know (DK), Other, or Blank	2	—[a]

Number of respondents: 49.

8. Would your state typically conduct a VIA for the following types of projects? (Check one answer per row.)

	Percent of States						
Project	Always	Often	About Half	Some-times	Never	NA, DK	Mean[b]
Constructing a new freeway in a rapidly developing suburb	42	10	4	24	10	10	2.4
Adding paved full shoulders to a rural 2-lane highway	4	4	4	28	54	6	4.3
Adding lanes to an existing urban freeway	12	6	6	44	26	6	3.7
Constructing a major new bridge in a wilderness setting	28	20	2	30	8	12	2.7
Constructing a major new bridge in a rural setting	18	18	6	38	12	8	3.1
Constructing a major new bridge in an urban setting	18	20	8	40	8	6	3.0
Reconstructing a bridge for a local arterial over or under an urban freeway	4	14	8	40	26	8	3.8
Modifying a heavily used signalized intersection to a roundabout in a suburban commercial setting	6	18	2	40	24	10	3.6
Altering the streetscape of a small town's Main Street, including traffic patterns, parking, and sidewalks	12	20	8	44	6	10	3.1
Adding noise walls or retaining walls along an urban freeway	16	12	8	36	12	16	3.2
Constructing an off-road bike trail through a state park	14	6	0	20	22	38	3.5
Adding sidewalks to an urban collector	4	4	4	30	40	18	4.2
Constructing a major new transit line or facility	8	12	8	12	10	50	3.1
Constructing a new rest area in a rural setting	20	10	2	22	32	14	3.4
Constructing a suburban DOT maintenance facility	12	6	6	18	36	22	3.8

[a] The symbol "—" appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.

[b] Mean value ranges from 1 for Always to 5 for Never.

[c] LWCFA = Land and Water Conservation Fund Act.

Table 3.1. (Continued).

8. (Continued).

Project	Percent of Respondents: Always	Often	About Half	Some-times	Never	NA, DK
Constructing a new freeway in a rapidly developing suburb	46.7	11.1	4.4	26.7	11.1	—[a]
Adding paved full shoulders to a rural 2-lane Highway	4.3	4.3	4.3	29.8	57.4	—
Adding lanes to an existing urban freeway	12.8	6.4	6.4	46.8	27.7	—
Constructing a major new bridge in a wilderness setting	31.8	22.7	2.3	34.1	9.1	—
Constructing a major new bridge in a rural setting	19.6	19.6	6.5	41.3	13.0	—
Constructing a major new bridge in an urban setting	17.4	21.7	8.7	43.5	8.7	—
Reconstructing a bridge for a local arterial over or under an urban freeway	4.3	15.2	8.7	43.5	28.3	—
Modifying a heavily used signalized intersection to a roundabout in a suburban commercial setting	6.7	20.0	2.2	44.4	26.7	—
Altering the streetscape of a small town's Main Street, including traffic patterns, parking, and sidewalks	13.3	22.2	8.9	48.9	6.7	—
Adding noise walls or retaining walls along an urban freeway	19.0	14.3	9.5	42.9	14.3	—
Constructing an off-road bike trail through a state park	22.6	9.7	0.0	32.3	35.5	—
Adding sidewalks to an urban collector	4.9	4.9	4.9	36.6	48.8	—
Constructing a major new transit line or facility	16.0	24.0	16.0	24.0	20.0	—
Constructing a new rest area in a rural setting	23.3	11.6	2.3	25.6	37.2	—
Constructing a suburban DOT maintenance facility	15.4	7.7	7.7	23.1	46.2	—

9. How often are the findings of a VIA produced for your state DOT challenged in court? (Check one.)

Response	Percent of States	Percent of Respondents
Always	0	0.0
Often	0	0.0
About half	2	3.2
Sometimes	0	0.0
Never	60	96.8
Not Applicable (NA), Don't Know (DK), Other, or Blank	38	—

Number of respondents: 31.

11. Are there concerns within your state DOT about the resources it takes to conduct a VIA, either in terms of money, time, or staffing requirements?

Response	Percent of States	Percent of Respondents
Yes, major or constant concerns	2	2.4
Yes, average concerns	30	35.7
Yes, minor or occasional concerns	20	23.8
No, rarely	22	26.2
No, never	10	11.9
Not Applicable (NA), Don't Know (DK), Other, or Blank	16	—

Number of respondents: 42.

[a] The symbol ‘‘—’’ appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.

(continued on next page)

Table 3.1. (Continued).

12. If you answered "Yes" to the previous question, who has these concerns and what are they? (Check all that apply.)

	Percent of States				
Who is concerned?	Money	Time	Staffing	No Concerns	NA, DK
DOT leadership	30	28	16	2	62
Office leadership	20	22	20	2	66
District leadership	20	16	14	2	68
Project manager	38	42	22	0	50
Supervisor of VIA production	10	26	24	0	66
	Percent of Respondents				
Who is concerned?	Money	Time	Staffing	No Concerns	NA, DK
DOT leadership	78.9	73.7	42.1	5.3	—[a]
Office leadership	58.8	64.7	58.8	5.9	—
District leadership	62.5	50.0	43.8	6.3	—
Project manager	76.0	84.0	44.0	0.0	—
Supervisor of VIA production	29.4	76.5	70.6	0.0	—

13. Does the state DOT track the cost of doing a VIA? (Check all that apply.)

Response	Percent of States	Percent of Respondents
Yes, costs of doing a VIA are tracked if done internally by agency staff	8	10.3
Yes, costs of doing a VIA are tracked if done externally by consultants	16	20.5
No, costs are not tracked for either agency staff or consultants	58	74.4
Not Applicable (NA), Don't Know (DK), Other, or Blank	22	—

Number of respondents: 39.

14. How many hours does it typically take for your state DOT to complete either a minor or major VIA? (One answer per row.)

	Percent of States						
Size of Project	1–40	41–80	81–160	161–320	321–740	NA, DK	Mean[d]
Minor VIA (typically part of categorical exclusion or environmental assessment)	42	4	4	0	0	50	31.2
Major VIA (typically part of an EIS)	4	16	16	10	0	54	116.5
	Percent of Respondents						
Size of Project	1–40	41–80	81–160	161–320	321–740	> 740	
Minor VIA (typically part of categorical exclusion or environmental assessment)	84.0	8.0	8.0	0.0	0.0	0.0	
Major VIA (Typically part of an EIS)	8.7	34.8	34.8	21.7	0.0	0.0	

[a] The symbol "—" appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.
[d] Mean is estimated using the mid-point for each range of hours.

Table 3.1. (Continued).

15. Who typically are the author(s) of a VIA in your state? (Check all that apply.)		
Authors Typically Are:	**Percent of States**	**Percent of Respondents**
Landscape architects	58	64.4
Architects	14	15.6
Civil engineers	42	46.7
Planners	36	40.0
GIS specialists	4	4.4
Simulation or imaging specialists	26	28.9
Lawyers	0	0.0
Historian (Sec. 106)	14	15.6
Environmental specialist	12	13.3
Not Applicable (NA), Don't Know (DK), Other, or Blank	10	—
Number of respondents: 45.		

16. A VIA is typically produced for your state DOT by: (If you check more than one box, please give percentages in the comment box below.)		
Response	**Percent of States**	**Percent of Respondents**
In-house professionals or technicians	46	50.0
Collocated (in-house consulting) professionals or technicians	2	2.2
Offsite consulting professionals or technicians	76	82.6
Not Applicable (NA), Don't Know (DK), Other, or Blank	8	—[a]
Number of respondents: 46.		

17. How has the principal author of a VIA been trained in your state? (Check all that apply.)		
Response	**Percent of States**	**Percent of Respondents**
In a classroom setting	22	35.5
Self-taught from either printed or on-line materials	54	87.1
By a supervisor or colleague	28	45.2
By reviewing or cribbing from an earlier VIA	34	54.8
Number of respondents: 31.		

18. What was the level of training conducted for the principal author? (Check all that apply.)		
Response	**Percent of States**	**Percent of Respondents**
Introductory/overview	40	87.0
Comprehensive	20	43.5
Focused on a particular step in the VIA process.	8	17.4
Number of respondents: 23.		

[a] The symbol ‘‘—’’ appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.

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Table 3.1. (Continued).

19. When was VIA training last conducted for the following groups?

Group Trained	Within 2 years	Within 5 years	Within 10 years	Over 10 Years	Never	NA, DK	Mean[e]
	Percent of States						
In-house VIA authors	8	4	2	10	36	40	13.2
Consulting VIA authors	2	2	2	8	28	58	14.6
In-house authors of the environmental document	10	10	0	4	44	32	12.7
Regulatory reviewers of the environmental document	4	4	2	4	36	50	14.3
DOT administrators	2	8	0	2	44	44	14.7
DOT project managers	4	6	2	4	42	42	14.2
	Percent of Respondents						
Group Trained	**Within 2 Years**	**Within 5 Years**	**Within 10 Years**	**Over 10 years**	**Never**	**NA, DK**	
In-house VIA authors	13.3	6.7	3.3	16.7	60.0	—[a]	
Consulting VIA authors	4.8	4.8	4.8	19.0	66.7	—	
In-house authors of the environmental document	14.7	14.7	0.0	5.9	64.7	—	
Regulatory reviewers of the environmental document	8.0	8.0	4.0	8.0	72.0	—	
DOT administrators	3.6	14.3	0.0	3.6	78.6	—	
DOT project managers	6.9	10.3	3.4	6.9	72.4	—	

20. How often is a VIA produced for projects located in the following settings? (Check one answer per row.)

Project Setting	Always	Often	About Half	Some-times	Never	NA, DK	Mean[b]
	Percent of States						
Urban	6	14	6	48	6	20	3.4
Suburban/exurban	4	12	8	44	10	22	3.6
Rural	2	12	4	52	8	22	3.7
Wilderness	8	12	4	38	6	32	3.3
	Percent of Respondents						
Project Setting	**Always**	**Often**	**About Half**	**Some-times**	**Never**	**NA, DK**	
Urban	7.5	17.5	7.5	60.0	7.5	—	
Suburban/exurban	5.1	15.4	10.3	56.4	12.8	—	
Rural	2.6	15.4	5.1	66.7	10.3	—	
Wilderness	11.8	17.6	5.9	55.9	8.8	—	

[a] The symbol "—" appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.
[b] Mean value ranges from 1 for Always to 5 for Never.
[e] In Question 19, mean is estimated using 1.0, 3.5, 7.5, 12.5, and 17.5 years to represent the response midpoints.

Table 3.1. (Continued).

21. How often is a VIA produced if the landscape adjacent to the proposed project is designated as (1) a common landscape or (2) a legally protected landscape (e.g., historic property, state park, wildlife refuge, etc.)? (Check one answer per row.)

	Percent of States						
Landscape Status	Always	Often	About Half	Some-times	Never	NA, DK	Mean[b]
Common landscape	2	6	3	22	7	10	3.7
Protected landscape	14	8	3	17	3	5	2.7

	Percent of Respondents					
Landscape Status	Always	Often	About Half	Some-times	Never	NA, DK
Common landscape	5.0	15.0	7.5	55.0	17.5	—[a]
Protected landscape	31.1	17.8	6.7	37.8	6.7	—

22. What general approach does your state use to evaluate visual impacts? (Check one.)

Response	Percent of States	Percent of Respondents
It primarily evaluates changes in the physical environment	18	20.5
It primarily evaluates changes in human perception	8	9.1
It considers both changes in the physical environment and human perception	62	70.5
Not Applicable (NA), Don't Know (DK), Other, or Blank	12	—

Number of respondents: 44.

23. What resources of the physical environment are evaluated as part of your VIA process? (Check one.)

Response	Percent of States	Percent of Respondents
Resources associated primarily with the natural environment	8	9.1
Resources associated primarily with the human environment	10	11.4
Resources from both the natural and human environments are considered	70	79.5
No specific types of resources are considered	0	0.0
Not Applicable (NA), Don't Know (DK), Other, or Blank	12	—

Number of respondents: 44.

24. How are physical resources evaluated? (Check all that apply.)

Response	Percent of States	Percent of Respondents
By describing artistic properties such as color, texture, form	58	67.4
By describing artistic relationships such as proportion, dominance, scale	62	72.1
By describing ecological patterns or relationships	58	67.4
By describing the reaction or experience of viewers	72	83.7

Number of respondents: 43.

[a] The symbol "—" appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.
[b] Mean value ranges from 1 for Always to 5 for Never.

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Table 3.1. (Continued).

25. Which viewer locations are considered in your state's VIA process? (Check all that apply.)

Response	Percent of States	Percent of Respondents
People with views from the road (travelers)	84	89.1
People with views to the road (neighbors)	86	93.5
No specific viewer location is considered	6	6.5

Number of respondents: 46.

26. How is viewer perception incorporated into the VIA process commonly used by your state DOT? (Check all that apply.)

Response	Percent of States	Percent of Respondents
Through trained professionals making professional judgments based on their knowledge and experience	58	67.4
Through feedback from regulatory agencies charged with representing the public interest	52	60.5
Through feedback at required public forums such as public information meetings and public hearings	82	95.3
Through the use of statistical methods of ascertaining public opinion	12	14.0
Through the use of non-statistical methods of ascertaining public opinion, such as web-based surveys or comment cards	26	30.2
Through the use of elected or appointed representatives	22	25..6

Number of respondents: 43.

27. What modes of travel are typically considered in a VIA completed for your state DOT? (Check all that apply.)

Response	Percent of States	Percent of Respondents
Pedestrian	60	73.2
Bicycle	50	61.0
Car	82	100.0
Bus	42	51.2
Truck	52	63.4

Number of respondents: 41.

28. What types of lighting conditions are typically evaluated in a VIA? (Check all that apply.)

Response	Percent of States	Percent of Respondents
A sunny summer day is typically considered	22	57.9
Seasonal changes in light are typically considered	22	57.9
Daily changes in light are typically considered	22	57.9
The effect of artificial light is typically considered	20	52.6

Number of respondents: 19.

Table 3.1. (Continued).

29. How are cumulative impacts incorporated into your state's VIA procedures? (Check all that apply.)

Response	Percent of States	Percent of Respondents
It only evaluates the direct impacts of the project	40	54.1
It evaluates the project in context of other known or anticipated projects in the area	38	51.4
It also evaluates secondary impacts due to changes in the area encouraged by the project's presence	30	40.5

Number of respondents: 37.

30. How does your state assure quality control of VIA documents? (Check all that apply.)

Response	Percent of States	Percent of Respondents
Independent internal review	28	40.0
Outside professional peer review	2	2.9
Agency review	58	82.9
Public comments	44	62.9
Review and comments from official interveners	6	8.6

Number of respondents: 35.

31. How do the findings of a VIA affect the decision-making process within your state DOT? (Check all that apply.)

Response	Percent of States	Percent of Respondents
There are no effects	4	4.4
It affects public relation	34	37.8
It affects alternative selection	46	51.1
It affects design development	72	80.0
It affects avoidance, minimization, or mitigation strategies	78	86.7

Number of respondents: 45.

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Table 3.1. (Continued).

32. Rate the VIA procedure adopted by your state using the following dimensions. (One answer per row.)

VIA attributes	Percent of States: Strongly Agree	Agree	Neither	Disagree	Strongly Disagree	NA, DK	Mean[f]
Objective (reduces the role of personal feelings)	4	30	56	6	2	2	2.7
Accurate (captures actual impact)	4	36	54	2	2	2	2.6
Valid (would be supported in court)	8	20	64	4	2	2	2.7
Reliable (competent professionals would reach the same conclusion)	6	34	48	10	0	2	2.6
Pragmatic (easily completed by a trained professional)	8	30	56	4	0	2	2.6
Understood (easily communicated to decision makers and public)	6	32	48	12	0	2	2.7
Useful (affects location, design, or mitigation decisions)	10	36	46	4	2	2	2.5

VIA attributes	Percent of Respondents: Strongly Agree	Agree	Neither	Disagree	Strongly Disagree	NA, DK
Objective (reduces the role of personal feelings)	4.1	30.6	57.1	6.1	2.0	—[a]
Accurate (captures actual impact)	4.1	36.7	55.1	2.0	2.0	—
Valid (would be supported in court)	8.2	20.4	65.3	4.1	2.0	—
Reliable (competent professionals would reach the same conclusion)	6.1	34.7	49.0	10.2	0.0	—
Pragmatic (easily completed by a trained professional)	8.2	30.6	57.1	4.1	0.0	—
Understood (easily communicated to decision makers and public)	6.1	32.7	49.0	12.2	0.0	—
Useful (affects location, design, or mitigation decisions)	10.2	36.7	46.9	4.1	2.0	—

[a] The symbol "—" appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.
[f] In Question 32, mean value ranges from 1 for Strongly Agree to 5 for Strongly Disagree.

Table 3.1. (Continued).

33. Are the following items available for examination by the researchers who are conducting this study? (Check all that apply.)

	Percent of States			
	Printed Copy	On-line Copy	No	NA, DK
State law or other state regulations related to visual issues	6	9	10	28
State DOT policies related to visual issues	8	10	15	21
VIA methods or procedures, either in use or officially adopted by the state DOT	10	9	13	22
Examples of VIAs done either by or for the state DOT	11	4	9	27
	Percent of Respondents			
	Printed Copy	On-line Copy	No	NA, DK
State law or other state regulations related to visual issues	27.3	40.9	45.5	—[a]
State DOT policies related to visual issues	27.6	34.5	51.7	—
VIA methods or procedures, either in use or officially adopted by the state DOT	35.7	32.1	46.4	—
Examples of VIAs done either by or for the state DOT	47.8	17.4	39.1	—

38. Which of the following best describes the type of organization in which you work?

Response	Percent of States	Percent of Respondents
State DOT headquarters	96	98.0
State DOT regional or local office	2	2.0
Not Applicable (NA), Don't Know (DK), Other, or Blank	2	—

39. What is your profession? (Check the answer closest to your technical occupation.)

Response	Percent of States	Percent of Respondents
Landscape architect	44	44.9
Architect	0	0.0
Civil or environmental engineer	18	18.4
Planner	4	4.1
Lawyer	0	0.0
Manager or administrator	14	14.3
Natural resource scientist or specialist	8	8.2
Environmental specialist	8	8.2
Archaeologist or historian	2	2.0
Not Applicable (NA), Don't Know (DK), Other, or Blank	2	—

[a] The symbol ‘‘—’’ appears in Table 3.1 to indicate that NA and DK are not considered when calculating percent of respondents.

(continued on next page)

Table 3.1. (Continued).

40. How many years have you contributed to VIA-related work?		
Response	Percent of States	Percent of Respondents
1 year or less	6	6.5
2 years or less (but more than 1 year)	2	2.2
5 years or less (but more than 2 years)	6	6.5
10 years or less (but more than 5 years)	26	28.3
15 years or less (but more than 10 years)	16	17.4
20 years or less (but more than 15 years)	12	13.0
More than 20 years	24	26.1
Not Applicable (NA), Don't Know (DK), Other, or Blank	8	—

41. What label best characterizes your association with the visual impact assessments (VIAs) produced by your organization? (Check all that apply.)		
Response	Percent of States	Percent of Respondents
I produce or oversee our organization's policies and procedures related to VIA	26	30.2
I review VIA's produced for our organization	44	51.2
I conduct or write VIAs	10	11.6
I write or oversee the production of environmental documents for our organization	28	32.6
I produce visual simulations	10	11.6
I directly supervise the individuals who produce VIAs for our organization	10	11.6
As a manager or administrator, VIA production is under my jurisdiction	22	25.6

Number of respondents: 43.

What VIA process is used and are the results useful?

Only 28 percent of the state DOTs use one specific procedure to conduct VIAs; however, an additional 28 percent tend to favor a particular procedure. In Question 4 of the survey (see Table 3.1), respondents indicated who developed the VIA procedures they use. The FHWA procedure is most frequently mentioned, and a few states also referenced VIA procedures from the Bureau of Land Management (BLM), National Park Service (NPS) (Section 106), and U.S. Forest Service (USFS). Twenty percent of the states identified that they had developed their own procedure.

State DOTs require the assessment of visual impacts as part of their environmental review or project development procedures less than half the time. In Question 2, 12 percent of respondents indicated that they always require VIAs; 40 percent indicated that they sometimes do, and 6 percent indicated that they never do. In responding to Question 1, which addressed this topic in a slightly different way ("[A]re visual issues considered an essential part of the highway development or environmental review processes?"), a few states (16%) indicated that visual issues are considered equally important to other environmental review items, while even fewer (8%) reported that visual issues are typically not part of project development or the environmental review process. However, most (74%) represented visual issues as typically being considered only for certain types of projects or particular settings.

Perhaps most important, the respondents believe that VIAs affect the decision-making process within their state DOT. In a very large proportion of states, VIAs are affecting design development (80%) and mitigation strategies (87%). For a smaller proportion, it affects alternative selection (51%) and public relations (38%). In only a very small number of states (4%) is it thought not to have any effect at all.

What is the approach taken to VIA?

Responses to Question 22 suggest that the preparation of a VIA tends to be premised on one or both of two approaches:

1. An approach that focuses on evaluating changes to the physical environment's intrinsic qualities, and/or

2. An approach that focuses on evaluating human perception of changes to the physical environment.

Most states (62%) indicated that they incorporate both approaches, though a large minority (18%) indicated that they only evaluate physical changes, and a smaller minority (8%) only evaluates the perception of these changes.

In responding to Question 23 about what types of physical resources are evaluated, some states (10%) indicated they are primarily associated with the human environment and a smaller number of states (8%) indicated that they are primarily associated with the natural environment. However, a large majority (70%) indicated that they consider physical resources from both the human and natural environments.

Several methods have been proposed for evaluating visual resources, and respondents were asked which are used by their states in preparing VIAs. As mentioned above, most states (80%) use at least one method to evaluate visible changes in the physical environment's intrinsic qualities. Responses to Question 24 indicate that describing artistic relationships such as proportion, dominance, and scale is the most common approach (62%), closely followed by describing artistic properties such as color, texture, and form (58%), and describing ecological patterns or relationships (58%).

Most states (70%) incorporate viewer perceptions into their VIAs. Question 26 asked how this was done. Most states indicated that they use public meetings and hearings (82%). Over half of the states accept professional judgment as a surrogate for viewer perceptions (58%) and accepted feedback from regulatory agencies charged with representing the public interest (52%). Less frequently used approaches were non-statistical samples from public survey responses or comment cards (26%) and elected or appointed representatives (22%). A relatively small number (only 12%) used scientifically supportable statistical methods to ascertain viewer perceptions.

Several questions sought to better understand how viewers or viewer locations were incorporated into VIA procedures. Question 25 asked whether they considered travelers with views from the road (84%) or neighbors with views to the road (86%). A very small proportion did not consider specific viewer location (6%). Viewers from the road could use one of several modes of travel. The responses to Question 27 indicate that the view from automobiles is always considered (100% of respondents), and that the view of pedestrians (73%) and bicyclists (61%) also are frequently considered in VIAs.

When are VIAs produced?

Respondents also were asked what factors trigger the investigation of visual impacts. The responses to Question 7 indicate that project setting (78%) and the designated status of adjacent landscapes (also 78%) are most important. These are closely followed by the anticipated level of controversy (72%), and public expectations, viewer sensitivity, and level of environmental documentation (each 62%). Project type is the least important factor (50%). These results indicate that proximity to known scenic resources is thought to trigger a VIA more often than other factors associated with the public, level of environmental documentation, or project type.

More-detailed questions built upon these results to help develop an understanding of when VIAs are typically produced. From the responses to Question 6, it is clear that VIAs are produced more than half the time for environmental impact statements (EISs), less than half the time for environmental assessments (EAs), and infrequently for categorical exclusions.

How often VIAs are produced by various levels of government for transportation projects also was addressed in Question 5. The responses to this question suggest that VIAs are most likely to be produced for state government projects, closely followed by federal government projects. County, municipal, tribal and toll way authority projects are much less likely to produce VIAs. It should be noted that there were a large number of "Don't Know" responses in Question 5 for all levels of government except the state, which was not an unexpected response, given that the respondents were state DOT employees.

The frequency with which VIAs are produced for projects in various settings is reported in Question 20. VIAs are overwhelmingly produced "Sometimes" for all settings, though they are slightly more likely to be produced for wilderness or urban settings compared to suburban or rural settings. On the other hand, the responses to Question 21 shows that a VIA is much more likely to be produced if the project is adjacent to a legally protected landscape, such as a historic property or state park.

The frequency with which a VIA would be prepared for a hypothetical project is addressed in Question 8. Large projects, such as a new freeway or major bridge, warrant a VIA at least half the time, while very small projects, such as adding sidewalks to an urban collector or paved shoulders to a rural highway, are unlikely to have a VIA.

Finally, states were asked how they incorporate cumulative impacts into their VIAs. Responses to Question 29 indicate that this is most often done in the context of other known or anticipated projects in the area (38%), though also as secondary impacts due to changes in the area encouraged by the project's presence (30%). However, 40 percent of states only evaluate direct impacts from the project and do not consider cumulative impacts

Who prepares VIAs?

As seen in the responses to Question 16, most frequently, VIAs are conducted by offsite consultants (76% of states), though many times they are done by in-house professionals or technicians (46% of states). Only one state (2%) indicated that it uses an in-house consultant.

States were also asked about the professional background of the typical author. The results of Question 15 show that landscape architects (58%) are the most common VIA author, but that civil engineers (42%), planners (36%), and simulation specialists (26%) also are frequently among the authors. Architects, historians, and environmental specialists play a lesser role. It may be notable that, according to this survey, GIS specialists rarely are authors, and lawyers never are listed as producing VIAs.

A series of questions addressed the level of knowledge and training that principal authors of VIAs have in each state. This area of questioning received the survey's highest level of "Don't Know" or "Other" non-responses (40% to 50%). Since most respondents (84%) have typically been involved in producing or supervising VIAs for more than a decade, and a considerable number (26%) have been doing so for more than 20 years, this non-response suggests that state DOTs are not providing opportunities for their employees to remain current in VIA best practices and emerging technologies.

The responses to Question 18 indicate that the principal author in 40 percent of states had at least an introductory-level training in the VIA process (87% of respondents), with 20 percent having comprehensive training (44% of respondents). On the other hand, in some instances, the principal author only has training on a particular step in the VIA process (17% of respondents).

How principal authors obtained their knowledge of VIA was addressed by Question 17. Most principal authors are self-taught (87% of respondents) and particularly learn by reviewing or cribbing from an earlier VIA (55% of respondents). Less frequently, the principal author receives instruction from a supervisor or colleague (45% of respondents) or formal training in a classroom setting (36% of respondents).

Respondents were asked about the last time that VIA training was offered to authors, reviewers, and managers. As the responses to Question 19 indicate, in most states (76% to 88%), the respondents are unaware of any training having been offered (i.e., responded "Never" or "Don't Know"). In the past 5 years, a fifth of states have provided VIA training to in-house authors of environmental documents, while one-eighth of the states have provided VIA training for other in-house staff. It appears to be rare that consulting VIA authors (offsite authors) are offered VIA training, even though they prepare most VIAs.

How much effort and resources does a VIA require?

States were asked how many hours it typically takes to conduct a minor and major VIA. Responses to Question 14 indicate that a minor VIA typically takes almost a week of effort to complete, while a major VIA requires almost 3 weeks. Note, however, that half of the states either indicated they did not know an answer to the question or did not respond to it.

In Question 11, state DOTs were asked whether employees had any concerns about the amount of resources it takes to conduct a VIA. Only one state (2%) indicated that there were major or constant concerns. Most states had average or occasional concerns (50%), and many rarely or never had concerns (32%). Responses to Question 12 provide more information about who within the state DOT has concerns, and what the concerns are. Overall, time is the greatest concern (averaged at 27% across all listed leadership categories). This is particularly true for the project manager (42%), but it also is of concern to VIA supervisors (26%) and DOT leadership (28%). Money is the next most pressing concern (averaged at 24%), particularly for project managers (38%), but also for DOT leadership (30%). Staffing is of lower concern overall (averaged at 19%), but is most important to VIA supervisors (24%). However, many states submitted "Don't Know" and "Other" non-responses, making it difficult to evaluate these responses with precision.

When asked about whether the costs of doing a VIA are tracked, most of the respondents indicated that they thought they are not (58%). When costs are tracked, it is most frequently done for VIAs prepared by external consultants (16%) and less frequently done for VIAs prepared by agency staff (8%).

How robust is the quality of VIAs?

Seven attributes of a robust VIA were identified: (1) objective, (2) accurate, (3) valid, (4) reliable, (5) pragmatic, (6) understood, and (7) useful. In Question 32, the respondents were asked to rate the VIA procedures used in their state for each of these attributes. Their responses show that the respondents in a majority of states neither agree nor disagree that VIAs prepared in their state exhibit these attributes. Among the remaining states, there is general agreement that these positive attributes can be attributed to their state VIAs. The most agreement is for the usefulness of VIAs in affecting the location, design, or mitigation of projects (46%). The weakest agreement is about the validity of VIAs, particularly whether they would be supported in court (28%), though no state could identify a court challenge to a VIA. Respondents expressed their greatest disagreement with VIAs as being a document whose findings are easily communicated (12%) to decision makers and the public. This was closely followed by whether the VIA was reliable; that is, whether competent professionals would reach the same conclusion (10%).

Respondents were asked what measures are taken to assure quality control of VIA documents. The most common approaches reported are internal agency review (58%) and public comments (44%). A little more than one-quarter of the states utilize an independent internal review (28%). There is relatively low reliance on review and comments from offi-

cial interveners (6%). Only one state indicated that they use outside professional peer review, which is the standard for scientific reports (2%).

3.1.5 Summary of State Survey Findings

The following are eleven findings of the survey conducted to better understand how visual issues are addressed by state DOTs and particularly how they conduct and utilize VIAs.

1. VIAs are prepared in most states. They are more common for larger projects adjacent to protected landscapes that require a full EIS.
2. Over a quarter of the states responded that they have formally adopted a VIA procedure (28%), and over half identified a procedure that is typically used (56%). Among this latter group, most are using the FHWA–VIA procedure (26%), though a number of states have developed their own procedure (20%).
3. A small number of states indicated that VIA is incorporated within the mandated consideration of impacts to historic properties (Section 106). This result was not anticipated, so additional questions probing how impacts to non-historic properties with the sole reliance on integrity as the evaluation criterion were not asked.
4. Most states hire consultants (76%) to prepare VIAs, though a large number also use state DOT staff (46%).
5. While landscape architects most frequently author VIAs (58%), civil engineers (42%) and planners (36%) also are common authors. Simulation specialists also are often among the authors (26%), but not GIS specialists (4%).
6. The principal author of a VIA generally self-taught (54%) and is learning by reviewing or cribbing from an earlier VIA (34%). In most states there has never been any VIA training that can be recalled by contemporary VIA authorities; in those states that have provided some formal training, it has usually been an introductory overview (40%) rather than a comprehensive course on the state's VIA policies and practices (20%).
7. Almost all states evaluate changes to physical qualities that are intrinsic to the visual landscape (80%). The methods they use include describing visible properties, such as color, texture, and form (58%); relationships, such as proportion, dominance, and scale (62%); or ecological patterns and relationships (58%).
8. Most states also evaluate the human perception of proposed visible changes (70%). Most frequently, this is accomplished through the political process, using required public meetings (82%), regulatory agencies charged to represent the public's interest (52%), comment cards (26%), or public representatives (22%). Many states also accept the judgment of professionals trained to conduct VIAs as a way to evaluate human perception (58%). It is relatively unusual that human perception is evaluated using scientific methods (12%).
9. It is widely recognized that attributes commonly expected of scientific studies do not have an authoritative presence in VIAs. Less than half the respondents thought the VIA procedures used in their state were objective (34%), accurate (40%), valid (28%), reliable (40%), pragmatic (38%), understood (28%) or useful (46%).
10. While this might be a cause for concern, no cases were identified for which the findings of a VIA were challenged in court.
11. VIAs primarily affect design development (72%), and the minimization or mitigation of impacts (78%). A VIA is much less likely to affect alternative location or selection (46%). Somewhat surprisingly, it also less frequently affects public relations (34%), even though the public is frequently very concerned about visual impacts.

CHAPTER 4

Document Review

The research team identified more than 75 potential transportation development projects for which visual impacts had been evaluated and documented. This chapter documents the process that was used to identify qualified candidate projects and the results of that process. It also documents why and how the approach to identification and selection of representative projects was modified.

4.1 Identifying Candidate Projects

4.1.1 Surveys and Searches

A number of methods were utilized to identify potential projects. Initially, the NCHRP Panel and the research team anticipated that a set of 75 projects would be identified during the on-line survey of state DOTs (state DOTs). The survey was intended to be used to better understand if states conduct visual impact assessments (VIAs) and, if they do, the policies and procedures states use to determine such impacts.

Question 35 in the survey invited state DOTs to list up to five VIAs that could be later reviewed in detail. For each assessment, it was requested that the state DOT also record specific contact information and provide a web-address for the VIA or other environmental document in which the results of the VIA were reported.

Initial responses to this question yielded information on only a handful of projects, but follow-up inquiries by email and phone led to identification of sixteen projects from eight states (Table 4.1).

To supplement these projects, members of the NCHRP Panel recommended additional VIA reports, and a search was conducted of a database of federal environmental documents. This database, entitled *EIS: Digests of Environmental Impact Statements* (ISSN 0364-1074), lists nearly 11,000 federal environmental impact statements. About 75 statements are added weekly. The database is assembled by Cambridge Scientific Abstracts, a subsidiary of Proquest in Ann Arbor, Michigan. Although the database does not list VIAs directly, the research team anticipated that the database would contain projects for which a VIA had been completed as part of an environmental impact statement (EIS) process.

Two searches of the database were conducted. In July 2011, 127 documents were found by searching for abstracts containing the following words: "highway," "bridge," or "parkway," in conjunction with the phrases "visual resource" or "visual resources," or the words "aesthetic" or "aesthetics." In August 2011, 252 citations were identified by searching for the keywords "Roads and Railroads," then locating abstracts containing the words "visual impact," "aesthetic," or "scenic." Of the 252 citations, 239 were published works potentially available for further review.

There was surprisingly little overlap between the two searches, which yielded more than 350 projects to preview. After purging projects that had only marginal applicability to highways and merging citations for draft, final, or supplemental documentation into single records, two sets of abstracts emerged. The first set, labeled "July Search," resulted in a culled list of 69 projects. The second set, labeled "August Search," resulted in a culled list of 128 projects.

Many of the listed documents—and, more importantly, any associated VIAs—were not available on-line or in a timely manner. Accordingly, a more direct approach of searching the Internet for VIAs was conducted to secure documents to evaluate.

4.1.2 Finding On-line Candidate Projects

Starting with projects that had been identified through the survey of state DOTs, the NCHRP Panel, and the federal EIS database, several searches of the World Wide Web were conducted to find potential candidate projects. This process yielded more than 50 qualified candidate projects with on-line availability of VIAs. Because the number of qualified candidate projects was lower than the original target (75), the

Table 4.1. Responses to Survey Question 35—Examples of VIAs.

State	Project 1	Project 2	Project 3	Project 4
Alaska	Anchorage International Airport 7R Extension			
California (Caltrans)	Golden Gate Bridge Physical Suicide Deterrent System	Yerba Buena Island Ramps Improvement Project	US Route 101 Marin-Sonoma Narrow Project	Interstate 5 North Coast Corridor Project
Colorado	US 40 Berthoud Pass			
Minnesota	St. Croix River Crossing Project			
Oklahoma	SH 3 Seiling, OK			
Vermont	Pittsford Brandon Project Rte 7	US Rte 7 Shelburne Rd	Alternatives to CCCH —Chittenden County Circumferential Highway.	
Washington	I-90 Snoqualmie Pass East	US 2 Tumwater Bridges - Bridge Replacement	Eagle Creek Road Improvement Project	George Sellar West
Wisconsin	VIA for State Trunk Highway 57			

decision was made to conduct detailed reviews of all of the available, qualified projects.

4.2 Detailed Assessment of Candidate Projects

4.2.1 Introduction

The survey of state DOTs and additional research resulted in the identification of more than 50 candidate projects with on-line examples of VIAs. Detailed assessments of those VIAs were conducted. The evaluations were organized by the continent where the projects were located and the governmental agency that had conducted the VIA.

Summaries of most of these assessments appear in this chapter under subsection "4.2.2 Findings." To create the summaries, VIAs were reviewed from one country in each continent. In Africa, two projects from South Africa were reviewed. In Australia, one project was reviewed. In Europe, four projects from the United Kingdom were examined. In North America, 42 projects from the United States were reviewed. The summaries in Section 4.2.2 document projects from four continents: Africa, Australia, Europe, and North America.

For each summary, basic information about the project, such as the general nature of the project and the character of the landscape setting in which the project was to be constructed, appears under the heading, "Project Types and Settings." Each summary then describes the project in relation to four types of attributes documented under three headings, as follows:

1. The decision-making framework used for the project and a description of the procedures, methods, policies, and practices employed to assess visual impacts are cataloged under the heading. "Process."
2. The expertise and resources used to conduct the assessment are covered under the heading, "Expertise and Resources."
3. The results and lessons learned are documented under the heading, "Results and Lessons Learned."

4.2.2 Findings

Africa

South Africa

Project Types and Settings. Two documents were examined for two toll roads, one 42 miles in length and the other a 348-mile, 2-lane project. Both roads are located near oceans. The context of the shorter roadway is generally flat or rolling, with low and sparse vegetation adjacent to the road and with

mountains in the distance. The context of the longer road is mostly flat to rolling hills, incised by steep-sided valleys, and vegetated with grassland, bush, and forest.

Process. No published methodology is identified in the document, although the vocabulary used for the analysis of the shorter road seems to come from a traditional urban design approach for evaluating urban or regional environments and includes such language as "a sense of place," "legibility," "nodes and edges," and "sensuality." The analysis of the longer road uses a more technical term, "visual absorption capacity," in a manner similar to that used by agencies in the United States that manage large tracts of federal land.

Expertise and Resources. The authors of the VIA of the shorter road are unidentified. The assessment of the longer roadway was completed by a landscape architecture and planning firm from South Africa. The latter assessment makes extensive use of a geographic information system (GIS) viewshed analysis and uses ratings and visual absorption capacity (VAC).

Results and Lessons Learned. The approach and products documented in the two assessments are less sophisticated than those that appear in a typical European or North American VIA. There are no references to a standard VIA procedure, and the expert evaluations are unsupported by documentation. Each of the two documents includes an unconstrained review by professional peers.

Australia

Australia

Project Types and Settings. One project with visual issues was reviewed. The project was to develop a 2-lane divided highway for 12 km from Yarra Yarra to Holbrook in New South Wales. The existing terrain is flat with few ridgelines in the corridor. Hills outside the corridor provide a visual backdrop. Landscape character is generally pastoral, with large pockets of trees along both sides of the road. The area is rural, and most private land is pasture. There is a low density of residences and other buildings, which are generally well set back from the road.

Process. No formal VIA method is used. The document was produced by a consulting engineering firm, Connell Wagner, for the NSW Roads and Traffic Authority. The document describes existing visual character and opportunities to mitigate highway development. There is a summary of impacts to six character zones, but it seems impressionistic. The focus of the report is to identify opportunities for mitigation based on urban and landscape design guidelines prepared for the project. Only very local resources and view opportunities are discussed, mostly from the perspective of viewers from the road. The document mostly lists opportunities to preserve and introduce vegetation for screening. The approach is very pragmatic. The corridor appears to be accepted, and the focus is on ways to mitigate any undesirable effects, largely through vegetation screening.

Europe

United Kingdom

Project Types and Settings. Four recent projects were identified and reviewed.

Process. The projects normally follow the standard methodology established by the UK Highways Agency as identified in the *Design Manual for Roads and Bridges* (DMRB), Volume 11, Section 3, Part 5; plus the practices established by the Landscape Institute and the Institute for Environmental Assessment and Management's Guidance on Landscape and Visual Impact Assessment (GLVIA) and the Landscape Character Assessment (LCA) Guidance for England and Scotland. These methods separate the analysis of a project's landscape effects from its visual effects, which are typically reported in two distinct reports for large projects or two distinct sections of a single report for smaller projects.

"Landscape effects" relate to the concept of landscape as a resource. This stems from the inclusive definition of landscape used in the European Landscape Convention. In the UK, this is linked to the emphasis on landscape character that has developed since the 1980s. Landscape results from the interplay of physical, natural, and cultural elements of the surroundings and the way that people perceive these interactions. Different combinations of these elements create the distinctive character of landscapes in different places, allowing different landscapes to be mapped, analyzed, and described. Character is not just about the elements or the "things" that make up a landscape, but also embraces the aesthetic and perceptual factors that make different places distinctive. Although perception plays a part in this definition of landscape, the concept of landscape effects is mainly concerned with the landscape itself as something that can be mapped and described. It is society as a whole which has an interest in landscape as a resource, and it is one of the many key dimensions of environmental value, alongside matters such as biodiversity or cultural heritage. Landscape effects thus address issues relating to valued landscapes and why society might wish to protect them for the future, as well as the contribution of landscape character to sense of place and quality of life for all.

"Visual effects" relate to views and visual amenity and arise from a requirement in the EIA Directive and the related

country regulations to consider the interaction between population and landscape. This term introduces related, but very different considerations, notably the views that people have of the landscape and the effects of change on visual amenity. When a landscape is changed in some way, there is a probability that the change will be seen by someone and often by several different groups of people. The change may affect both particular views of the landscape and the overall pleasantness of the surroundings, which is what the term "visual amenity" addresses. Visual effects are concerned with how the surrounding individuals or groups of people may be specifically affected by change in the landscape.

In the UK, the VIA process pointedly omits a quantitative analysis, preferring to use narrative descriptions for both its inventory and analysis of landscape effects and visual effects.

Expertise and Resources. Typically, a landscape architect conducts the VIA. Local and federal planning documents are typically consulted.

Results and Lessons Learned. Visual resources can be considered much more than a collection of objects with aesthetic characteristics. Rigorously separating impacts to resources from impacts to viewers yields insights not found when all the information is combined in a single analysis. Clarity in the analysis and rigor in the results can be achieved without the aid of a numerical approach.

North America (United States)

California

Project Types and Settings. Five projects were examined that represented a wide range of project types and settings, from a 14-lane freeway in a dense urban area to a pedestrian bridge across a 2-lane road in a wilderness setting. These projects were provided by Caltrans as representative of the range of project types, scales, and settings typical of the hundreds of VIAs produced by Caltrans each year.

Process. California produces a VIA for every project, regardless of the type of project, the scale of the project, the project setting, or the anticipated impacts. They literally produce hundreds of documents each year following the FHWA guidance. Although the FHWA–VIA process is uniformly used throughout the state, within the last 5 years Caltrans identified that fidelity to the FHWA–VIA process was variable and responded by developing a comprehensive training program. Caltrans has conducted extensive training of approximately 300 professionals responsible for either producing VIAs or incorporating their findings into environmental documents. The in-class training has been converted into an on-line training program to encourage the retention of VIA skills. (Information about the on-line training is available at: http://www.dot.ca.gov/hq/LandArch/via_training/index.htm.) To ensure even better conformance with the FHWA–VIA process, Caltrans also has developed a series of templates for guiding the development of VIA documents based on the level of project complexity. An example is available for projects that require only a brief memorandum, and templates exist for three levels of projects: minor, moderate, and advanced/complex projects. An on-line questionnaire, available at http://www.dot.ca.gov/hq/LandArch/via_outlines/questionaire.htm, guides the VIA author to the appropriate template. This standardization of the process reflects Caltrans' commitment to a robust evaluation of visual impacts and their inclusion in design decisions.

The five examined projects and VIAs were all produced prior to the training program and the availability of the VIA templates, and their fidelity to the FHWA-VIA process is variable, verifying Caltrans' internal critique. Resources and viewers typically are identified, but the level of detail is not necessarily correlated to scale or complexity of project. Emphasis on numerical ratings utilizing simulations provides solid assessments, but the numerical ratings are typically done only by in-house professionals. Little public involvement is reflected in the examined VIAs. Justification for the selection of key views from which to do simulations typically is not documented. There is no or little discussion of a viewer's experience except as measurements of the terms "vividness," "intactness," and "unity." How these measurements were developed and the rigor with which they were developed is quite variable from project to project.

Expertise and Resources. VIAs are typically performed by landscape architects. Use of a "before" photograph and 3D computer modeling of the proposed project inserted and rendered into the picture to create an "after" image is prevalent in the project documents. The use of 3D modeling, ensuring that simulations reflect reality more accurately, is typical of most of the VIAs. Maps, including maps of viewsheds, also are typically employed.

Results and Lessons Learned. Establishing a preferred process for assessing visual impacts does not assure fidelity to that process by different authors in different parts of an organization. It is expected that, to ensure fidelity, the process must be easy to understand and apply. The experience of California suggests that it can be challenging to achieve fidelity to the FHWA–VIA process without extensive training and monitoring.

Colorado

Project Types and Settings. VIA documents were reviewed for three construction projects and two planning projects.

The construction projects ranged from minor projects with localized visual impacts to a widespread project along long segments of Interstate highway with major visual impacts. One planning project covered nearly one quadrant of a major metropolitan area; the other covered a narrow corridor, but was about 140 miles in length. Two distinct landscape settings are involved: high plains plateau and alpine mountain range.

Process. The process used is unique to each project. For the long corridor planning project, methods used by the Bureau of Land Management (BLM) and the United States Forest Service (USFS) are used because most of the surrounding land is managed by one of these two federal agencies. For the large area plan, an approach is employed that seems to be an amalgamation of various federal methodologies. On two other projects, the FHWA–VIA process is loosely followed. On the remaining project, the approach is best described as an urban design approach. Additional conversations with the persons who conducted the VIAs would be needed to examine why such diversity occurred in the methods chosen and how a particular method was chosen for use.

Expertise and Resources. The VIAs are mostly authored by landscape architects, although an environmental scientist is identified as the author of one assessment.

Results and Lessons Learned. Although diverse processes are used to assess visual impacts, a common practice is an attempt to include an understanding of what local populations—both neighbors and travelers—would value as a visual experience and how the proposed project would affect that experience. Using public involvement to gauge the value of existing views and resources (either by proxy through existing planning documents or directly by conducting community outreach) is a common practice of many of Colorado's VIAs and is a practice worth studying further.

Indiana

Project Types and Settings. Draft and final EIS documents were reviewed from three segments of a new 4-lane freeway that was to connect Mexico with Canada in response to the North American Free Trade Agreement (NAFTA). The cross-country freeway bisects existing mostly flat farmland and some rolling former prairie, generally on new alignment passing through suburban communities and generally upgrading existing expressways.

Process. The FHWA–VIA process is acknowledged but not followed. The preamble to NEPA is cited as requiring federally funded projects to apply planning and design arts to project development. The interpretation of that mandate is that, through a context-sensitive solutions (CSS) process, local communities will be allowed to assist in determining the architectural treatment for bridges and walls. Although other resources are identified and viewer groups are implied, few impacts are identified and little mitigation is determined necessary outside the need for a standard planting plan or the architectural treatment of bridges and walls.

Expertise and Resources. Although they are not specifically identified, consulting planners appear to have produced the VIA reported in the environmental documents.

Results and Lessons Learned. This project is an example of a VIA that acknowledges the FHWA–VIA process but does not follow it completely. By not following a process of identifying why people like or dislike a particular scene, the recommendations for mitigation become standardized and may become unresponsive to actual needs.

Minnesota

Project Types and Settings. Four projects were reviewed, running through rural landscapes, typically with at least one terminus in a mid-level city. Three projects are 4-lane expressways or freeways, with one project a 2-lane road. They pass through glaciated terrain of wooded rolling hills and agricultural fields with scattered settlement. Typically they include a suburban landscape at one terminus.

Process. The Minnesota DOT's six-step VIA process was originally developed for the St. Croix River Crossing at Stillwater. It defines "visual quality" as the interaction between visual resources and viewers. Visual resources can be placed in one of two broad categories: "natural" or "cultural." Viewers are differentiated between "travelers" and "neighbors." The status of existing visual quality is simply a function of what people like and dislike about what they currently see. Visual quality cannot be isolated to those attributes that describe visual resources or to the sensitivity of the viewer—it is an interaction between the two variables. The resulting visual quality is considered a statement about the relationship between a specific landscape being viewed and a particular set of people doing the viewing. It is not an intrinsic quality of the landscape, nor is it a mere interpretation of the human mind.

Identifying visual resources and viewers are the first two steps of the process with establishing existing visual quality the third.

Visual impacts are similarly determined by the relationship of the scale of the impact to visual resources (major to minor) and the extent of the impact to viewers (widespread to localized). When taken together, these factors result in the value of the impact being designated as "adverse," "beneficial," or "neutral." This is the fourth step in the Minnesota DOT process.

In the fifth step, different alternatives are evaluated and compared. The VIA process tends to avoid suggesting a preferred alternative. Instead, it states the advantages and dis-

advantages of each alternative in generating beneficial and adverse visual impacts.

The final step in the Minnesota DOT process is to suggest that beneficial impacts should be incorporated as enhancements into the proposed highway project and that adverse impacts be mitigated by avoiding, minimizing, or compensating for impacts. Mitigation can be applied to either the resource or viewer side of the visual quality equation.

The Minnesota DOT process requires following all six steps but, in an effort to reduce documentation, the process does not require reporting them individually. Therefore, the VIAs reviewed define only visual quality and the impacts to it, noting the visual resources and viewers as components before offering a comparison between alternatives and a listing of mitigation and enhancement strategies.

Expertise and Resources. Minnesota DOT Landscape Architects, having developed the process, initially conducted all of Minnesota DOT's VIAs. Later work was done by consultants who used landscape architects, planners and engineers.

Results and Lessons Learned. Visual quality as a statement about the value people place on their environment is a concept that could be instructive, particularly how that concept can influence mitigation and enhancement. Although this is a simple process that can be executed by professionals other than landscape architects, based on the examples studied, it appears that the sensibilities of a trained landscape architect may provide more thorough evaluations.

New York

Project Types and Settings. A wide range of projects were examined, including new highways on new alignments, expanding existing highways, and replacing bridges.

Process. References to FHWA procedure and NYS DOT VIA Procedure EI 02-025 appear on many but not all project documents; on some, no particular methodology is identified. Some of the reviewed VIAs use the artistic attributes that the FHWA–VIA process employs to describe visual character (e.g., form, line, texture, dominance, scale, diversity, and continuity). The terms, "vividness," "intactness," and "unity" are less commonly used, and are not used at all in some of the VIAs. When done, viewshed and key view analysis are extensive. Similarly, the VIAs make extensive use of simulations, including both eye-level and birds' eye-level views. A wide range of viewers are typically identified, including expanded categories for neighbors and travelers.

Expertise and Resources. Typically the profession of the author of the VIA is not identified, although the process is overseen by landscape architects within the NY DOT.

Results and Lessons Learned. Further study is needed to determine if there is a process for deciding when to conduct a viewshed analysis. Also, a better understanding is needed of how effective the use of simulations have been in evaluating visual impacts and predicting viewer perceptions.

North Carolina

Project Types and Settings. Three bridge projects were evaluated that connect coastal islands to each other or the mainland. The landscape setting is coastal, with a flat to rolling (dune) terrain and sheltered sounds. The level of development is mostly rural, but is becoming increasingly suburban (hence the need to expand the highway, interchanges, and bridges). The emphasis is on describing land form and there is little native vegetation description except for a few wooded areas.

Process. These are EISs that essentially use the FHWA–VIA process, though that process is not always specifically acknowledged or rigorously followed. Viewshed analysis typically occurs only from sites with noted visitor interest, like state parks and national monuments.

Expertise and Resources. Two of the three documents are authored by planners; the author of the third document is unidentified. No simulations, maps, or other resources are included in the assessment.

Results and Lessons Learned. One of the more thorough documents attempts to understand how local residents value the existing scenery by reviewing municipal planning documents and by holding public meetings to gather such information. The result is a less than usual emphasis on visual resources and viewers who are travelers (except when they are off the road and become tourists at a particular site like a state park or Kitty Hawk). Without a mandated process, a wide range of analytical rigor is displayed.

Oregon

Project Types and Settings. One state highway project was examined that passed through a National Forest. It is a heavily used road through wilderness that was to be upgraded from a 2-lane facility to a 4-lane roadway with a wide median. The landscape setting is composed of rolling volcanic terrain dominated by a thickly growing coniferous forest.

Process. To coordinate with existing forest management plans, the author of the VIA uses a dated method for managing visual resources—Visual Resource Management (VRM)—that was in use when the forest plans were originally conceived. As requested by USFS, the analysis is somewhat augmented with references to the Scenic Management System (SMS) that is now used by USFS. Although the analysis involves no direct public involvement, management plans

are used as a surrogate. The needs of viewers, especially tourists at tourist sites, are analyzed. Statements about mitigation are rather generic, addressing fitting the road and other construction into the landscape with only substantial detail provided about how to use vegetation as mitigation.

Expertise and Resources. Consulting landscape architects and planners are listed.

Results and Lessons Learned. The use of documents or the involvement of landscape architects who are responsible for managing properties and representing users of property adjacent to the roadway is helpful in understanding the value neighboring viewers would place on views from neighboring attractions. Although in this case there was a reason to use the earlier evaluation technique (VRM), using a more contemporary evaluation technique throughout (e.g., SMS) might have resulted in a better understanding of the landscape and viewers and resulted in a less generic prescription for mitigation.

Tennessee

Project Types and Settings. Four projects were reviewed. The landscape setting is not described in the VIAs, though settlement pattern is described. Most projects are in rural areas, with some having a terminus in a small town. One project is in a major metropolitan area with significant historical and tourist attractions.

Process. No process is identified and there is little indication that visual issues were analyzed beyond a statement that these projects were performed using context-sensitive design principles to ensure the public was adequately engaged. Mitigation is limited to suggestions that the project be landscaped.

Expertise and Resources. No person or profession is identified in the projects' environmental documents as conducting a VIA. No simulations, viewsheds, or other tools appear to have been used.

Results and Lessons Learned. The federal and state policies that require visual impacts to be assessed do not typically dictate a particular process be used but only provide guidance. Some states have interpreted these policies to mean that they only need to discuss visual impacts in environmental documents without conducting or documenting the process used to ascertain those impacts. Uncertainty about when and how to conduct and document a VIA needs to be clarified.

Vermont

Project Types and Settings. Two documents were reviewed for one project that involved ten alternative scenarios for relieving congestion in the Lake Champlain Valley, a rolling landscape covered with agricultural fields and deciduous forests. Settlement patterns range from historic villages and rural settings to suburban residential and commercial uses.

Process. The FHWA–VIA process and Vermont's Quechee Analysis Criteria are used to determine "undue" adverse affects. The public was involved in identifying potential visual impacts during public design workshops. The analysis identifies as "important" views of distant mountains, rivers, agricultural land, forested hills, and historic villages and structures. Mitigation is addressed, with specific actions identified and tailored to each alternative. There is no mapping of viewsheds and there is no evaluation of impacts using typical FHWA terms such as "vividness," "intactness," and "unity."

Expertise and Resources. Information is not listed in the document about expertise and resources.

Results and Lessons Learned. Finding a method to accurately include viewers in defining visual impacts can be accomplished using orchestrated public involvement techniques.

Virginia

Project Types and Settings. One project was reviewed that involved relocation of a 4-lane divided expressway on new alignment. The landscape setting is not described. The settlement pattern is primarily rural between two urban areas.

Process. In the example reviewed, no specific process is identified or implied through a discussion of visual impacts. Despite the lack of evidence of analysis, conclusions related to visual impacts are noted in the project's environmental document.

Expertise and Resources. No authors are identified; no specific resources are mentioned in the documentation.

Results and Lessons Learned. It may be that the lack of an identified VIA process contributes to conducting a minimal VIA.

Washington State

Project Types and Settings. Nine projects were reviewed, representing a wide range of project types, landscape settings, and settlement patterns. Project types include the addition of driving and turn lanes, slope stabilization, replacement of bridges, and adding a pedestrian bridge. One project is on a scenic byway. The settings are primarily wilderness, but vary from alpine mountains to high plains. Settlement patterns are either wilderness (no residential or commercial structures) or rural (scattered residential or commercial structures).

Use of the term "wilderness" as defined by resource management agencies like BLM and USFS implies that an area is roadless. *NCHRP Report 741* does not follow that distinction.

To the typical viewer, the context of a road like the Going-to-the-Sun Road in Glacier National Park is wilderness, regardless of the presence of a road or how much the landscape is managed. In this case, what matters is the viewer's impression of the area surrounding the road, not the presence or absence of the road.

Process. An interpretation of the FHWA–VIA process is used that emphasizes the use of defining attributes of visual quality, such as vividness, intactness, and unity, with descriptions of the artistic traits of visual character, such as line, form, color, and texture. FHWA terms describing artistic relationships, like dominance, scale, and diversity are not used. Modifying the FHWA–VIA process further, the process uses these concepts of visual quality to analyze four types of landscape attributes: landform, vegetation, water forms, and structural elements.

The FHWA approach to understanding viewers is essentially followed, with additional input from local planning documents and citizen adversary groups. As allowed by the FHWA–VIA process, many of the VIAs done by Washington DOT expand the analysis of neighbors and travelers to include specific viewer groups that may be impacted. Next, the authors pick several key views and use the concepts of visual character to numerically rate the existing and future views for the viewer group most affected by the change. This unique interpretation of the FHWA–VIA process seems to have more in common with VIA processes developed by BLM and USFS, where visual goals are used to determine the scale and value of impacts.

Expertise and Resources. The assessments are completed mostly by landscape architects, both consultants and employees of the state DOT.

Results and Lessons Learned. These nine reports are examples of the most consistently produced products done by any state DOT. The consistency in producing the assessment of visual impacts probably results from having the same professional staff either produce or oversee the production of VIAs repeatedly over an extended period. It would be interesting to determine if this consistency in following a particular process by a select set of professionals has generated credibility for the product and the professionals producing it.

4.3 Discussion

4.3.1 Initial Findings

Differences are notable between governmental agencies that conduct VIAs and may be insightful. Emphasizing and further interpreting those findings already noted in the previous chapters of this report, a few concepts stand out:

1. Most states claim to be conducting VIAs. In practice, however, states appear to be very selective about conducting VIAs. Many report visual impacts in environmental documents without documenting the use of a VIA process. Based on the lack of VIAs offered for review, many states appear to produce few VIAs or only do so for selected projects.
2. At least in theory, the FHWA-VIA process is used extensively by states for assessing visual impacts to highway projects. Most states that use the FHWA-VIA process are very selective about which parts of the process they actually follow, however.
3. Simulations are useful but not universally used. Where, when, and how to use simulations is extremely variable. Very few processes offer guidelines on the creation and use of simulations.
4. Viewsheds are alluded to frequently but are mapped less regularly. Use of GIS and other methods to establish viewsheds typically fails to accommodate vegetation and structures, resulting in large viewsheds that may not actually exist.
5. Widely ranging methods are used to evaluate visual resources. Most methods involve varying combinations of artistic attributes, professional judgments, and viewer preferences. Methods and combinations of attributes can vary from project to project even within the same agency.
6. Authors of VIAs typically are landscape architects or planners. Some states have historians doing the VIAs as part of their state's review of historic properties. Each profession brings a particular professional bias to their assessments, with landscape architects emphasizing the character of the landscape; planners utilizing previous planning documents and local ordinances to ascertain scenic value and viewer preferences; and historians focusing on only historic properties or landscapes.
7. Views and viewers occupying public spaces are identified in all states as requiring analysis. Viewers occupying private property also are evaluated in most states, although a few states indicated that private views are not assessed as a matter of policy.
8. Some assessments emphasize the visual experience of viewers.
9. Use of urban design and spatial evaluation techniques may yield mitigation suggestions. One Colorado project that took this approach did yield some provocative mitigation suggestions; however, a similar approach in South Africa yielded no particularly innovative mitigation proposals.
10. The use of a glossary to explain terms may enhance its readability by the uninitiated.

11. Longevity, frequency, and perhaps training may influence the thoroughness with which visual assessments are completed.
12. Separating inventory from analysis assists in communicating information.
13. A unique approach from South Africa requires a peer review of its assessments. This technique may yield more balance but still relies on professional opinion, not feedback from the affected population.
14. The United Kingdom assures that impacts on the visual resources of the physical environment are differentiated from impacts on the perception by people of those impacts by insisting that the analysis of visual impacts be separated into two different documents. The discussion of changes to the physical environment is called "landscape effects." The discussion of how those changes affect viewers is called "visual effects." This differentiation assures that impacts to both resources and viewers are identified, which responds well to current scientific understanding of how the perception of visual quality is actually formulated by human beings.
15. Similarly the six-step VIA process used by Minnesota acknowledges the need to differentiate between visual resources and viewers by suggesting that visual quality is not only a result of the interaction between the physical and psychological environments but that it (and any subsequent impacts) is an expression of the relationship between resources and people. The consequence for design and mitigation is that it is possible to act on either side of the relationship equation to avoid, minimize, or compensate for adverse impacts. This approach also leads to an understanding of how a project could actually enhance existing visual quality, a strategy purposefully rejected by other governmental agencies as not being sufficiently egalitarian and therefore, outside the scope of projects.
16. Most of the processes examined rely on professionals to assess impacts. The public is not overly involved except in reaction to an assessment. The State of Washington uses a process developed by BLM that involves the public in defining the value of visual resources during scoping so that the assessment of impacts is a result of identified public value, not the professional opinion of a landscape architect, planner, or engineer. Colorado has also used VIA methods adopted by BLM and the USFS to determine visual quality and impacts to visual quality along roads that thread their way through land managed by these federal agencies. These two federal approaches to assessing visual impacts are distinct from the FHWA–VIA process.

4.3.2 Focus on Agency VIA Approach

After a detailed examination of nearly 50 projects and their associated environmental review documents, including VIAs, it became apparent that it would be advantageous to identify the best practices of at least five governmental agencies for additional review, rather than present the best practices of five projects.

The governmental agencies that appeared to provide the most comprehensive range of best practices are from Europe and North America, specifically from the United Kingdom, California, Colorado, Minnesota, New York, Vermont, and Washington. VIAs from the UK use an approach that strongly differentiates between resources and viewers, unlike those most used in the United States, with the possible exception of the Minnesota VIA process. California, Colorado, New York, and Washington all have used the standard FHWA-VIA process for most of their assessments. Within this category, however, practices regarding how to implement the FHWA-VIA process range widely from state to state and even from project to project within a particular state. To establish a set of best practices will require the review of several projects.

Some VIAs, especially selected assessments from the United Kingdom, Minnesota, Colorado, and Washington, evaluate the experience people perceive when interacting with the environment. In particular, several examples from Colorado and Washington used VIA processes developed by federal land management agencies, such as the BLM and USFS. Including assessments that used BLM and USFS VIA processes will be essential in developing a robust set of best practices.

Finally, some states have developed their own VIA processes. Incorporating an evaluation of these state processes may invigorate any set of best practices by bringing in ideas from sources outside the federal government.

As was reported in the findings of the literature review, fidelity to the chosen process is of paramount concern to the courts and therefore to the agencies implementing the process. As was found in the state survey, however, uniformity in utilizing the chosen process, although desired by published policy directives, is rarely achieved in practice.

Although a specific VIA process may be officially established by a particular governmental agency, its application is frequently subject to interpretation. Consequently, how a specific VIA process is implemented differs not only by agency but even within an agency. Within an agency, it can vary by project type, project location, and authorship. It also can vary over time, as lessons learned from one project tend to be codified into how future VIAs should be completed.

4.3.3 Reorganizing the Data

The research team reorganized the data and developed the following synopsis.

State Commitment to Assessing Visual Impacts

In the state survey, 45 of 50 states (90%) declared that they considered visual issues an essential part of the highway development or environmental review process. This response was aligned with the expectations of the NCHRP Panel and the research team. However, as the research progressed, it became apparent that an assertion of the importance of visual issues did not necessarily correspond to frequent assessment of visual impacts or high numbers of VIAs.

The second question of the survey asked about the frequency with which a state requires VIAs as part of its environmental review or project development procedures. Only six states indicated that they conduct a VIA on all of their highway transportation projects. Nearly three-fifths of the states indicated that they conduct a VIA only sometimes or less often. Most of these states had answered the first question of the survey in a way that indicated visual issues were considered only on selected projects.

Answers to the third question further eroded the assumption that states are regularly conducting VIAs: Only fourteen states indicated that they have a particular VIA process that they typically use. Somewhat confusingly, in response to Question 4, 28 states name a particular VIA process that they typically use. Regardless of this discrepancy, it appears that half the states could be construed as having a commitment to evaluating visual impacts, and then probably only on selected projects.

This interpretation of the survey data—that very few VIAs are being conducted—is supported by the lack of documented VIAs discovered by the research team (see Table 4.2).

Effect of the VIA Process on Decision-Making

Although the commitment to conducting VIAs may be low, the effect of VIAs is surprisingly high, as expressed by Question 31, "How do the findings of a VIA affect the decision-making process within a particular state?" One explanation may be that when answering this question, the effect of just considering visual issues (as evidenced by the nearly universal affirmative answer given to the first question) even without an actual VIA affects decision-making. But this is speculation and would need to be verified with follow-up questions of previous subjects.

Thirty-nine states suggested that conducting a VIA affects how a project avoids, minimizes or otherwise mitigates adverse visual impacts. Thirty-six claimed that a VIA affects design development. Half declared that a VIA affects alternative selection. Only seventeen suggested that it affected public relations.

Two states indicated that a VIA did not have any effects on a project, although one of those states also claimed that it had tremendous effect of public relations, alternative selection, design development, and mitigation. An additional five states had no response to Question 31. Therefore out of 50 states, nearly 90 percent claimed that a VIA had some sort of effect on a project (see Table 4.2).

Perceived Effectiveness of the VIA Process

Each state was asked, as Question 32, to evaluate how effective their VIA process was for the agency using it. In particular, Question 32 asked if the VIA process was objective (was the role of personal feelings reduced); was it accurate (did it capture actual impacts); was it valid (would it be supported in court); was it reliable (would competent professionals reach the same conclusion); was it pragmatic (was it easily completed by a trained professional); was it understood (easily communicated to decision makers and the public); and was it useful (did it affect location, design, or mitigation strategies)?

About one-half of the states indicated that they had a positive perception of the effectiveness of their VIA process. However, this approval was rather mild with only two states, California and Washington, indicating full support for their VIA process. Three other states—Alabama, Missouri, and Tennessee—also scored the effectiveness of their VIA process as being relatively high. Less than a dozen states had negative opinions on how effective their VIA process was for them. About two-fifths could be said to be neutral in their evaluations (see Table 4.2).

4.4 Summary of State Level Practices

Questions 32 and 4 provide an accurate summary of the VIA practices of state DOTs. Table 4.2 provides a quick reference and comparison between states as evaluated by those professionals responsible for administering VIAs in their state. The table lists states according to their self-rating of the quality of their VIA process and documentation. To make the results of the table more obvious, the ratings individual states gave themselves for each part of Question 32 were color coded. Blue was used for positive responses, gold for negative responses. Neutral responses received no color. The darker the color, the more extreme the rating. (Correspondingly, in the printed copy of *NCHRP Report 741,* positive responses are backed by the darkest gray shading; negative

Table 4.2. Perceived effectiveness of the VIA Process at the state level.

SUMMARY OF STATE LEVEL PRACTICES • TABLE 3: THE PERCEIVED EFFECTIVENESS OF THE VIA PROCESS												
State	***Question 32:*** *How did the individual filling out the survey rate their state's VIA process as being:*							**Total**	**Average**	**Rating**	**Ranking**	**Question 4:** The VIA process that your state DOT typically uses was developed by: (check one)
	Objective (reduces the role of personal feelings)	Accurate (captures actual impact)	Valid (would be supported in court)	Reliable (competent professionals would reach the same conclusion)	Pragmatic (easily completed by a trained professional)	Understood (easily communicated to decision makers and public)	Useful (affects location, design, or mitigation decisions)					
California	2	2	2	2	2	2	2	14	2.00	1	1	FHWA
Washington	2	2	2	2	2	2	2	14	2.00	1	1	FHWA
Alabama	1	1	2	2	2	2	2	12	1.71	3	2	
Missouri	1	1	0	1	2	1	2	8	1.14	4	3	FHWA
Tennessee	1	1	2	1	1	1	1	8	1.14	4	3	FHWA
Connecticut	1	1	1	1	1	0	2	7	1.00	6	4	
Florida	1	1	1	1	1	1	1	7	1.00	6	4	Own State DOT
Idaho	1	1	1	1	1	1	1	7	1.00	6	4	FHWA
Maine	1	1	1	1	1	1	1	7	1.00	6	4	
Vermont	1	1	1	1	1	1	1	7	1.00	6	4	
Indiana	0	1	1	1	1	1	1	6	0.86	11	5	
New Hampshire	1	1	0	1	1	1	1	6	0.86	11	5	
Iowa	1	1	1	0	1	1	0	5	0.71	13	6	Own State DOT
Mississippi	1	1	0	1	1	0	1	5	0.71	13	6	Own State DOT
South Dakota	1	1	0	1	0	1	1	5	0.71	13	6	Other Organization
Colorado	0	1	1	1	0	0	1	4	0.57	16	7	FHWA
Maryland	1	0	0	1	1	1	0	4	0.57	16	7	Other Federal
Massachusetts	0	1	0	1	0	1	1	4	0.57	16	7	
New Jersey	0	0	0	1	1	0	1	3	0.43	19	8	
New Mexico	0	0	1	1	0	0	1	3	0.43	19	8	FHWA
Arizona	1	1	-1	-1	0	1	1	2	0.29	21	9	Own State DOT
Arkansas	0	0	0	0	1	1	0	2	0.29	21	9	FHWA
Delaware	0	0	0	0	0	1	1	2	0.29	21	9	Own State DOT
New York	0	1	0	1	-1	-1	1	1	0.14	24	10	FHWA
South Carolina	0	0	0	0	0	0	1	1	0.14	24	10	
Utah	0	0	0	0	0	0	1	1	0.14	24	10	Other Federal
Alaska	0	0	0	0	0	0	0	0	0.00	27	11	FHWA
Illinois	0	0	0	0	0	0	0	0	0.00	27	11	FHWA
Kansas	0	0	0	0	0	0	0	0	0.00	27	11	
Kentucky	0	0	0	0	0	0	0	0	0.00	27	11	
Louisiana	0	0	0	0	0	0	0	0	0.00	27	11	
Nebraska	0	0	0	0	0	0	0	0	0.00	27	11	
Nevada	0	0	0	0	0	0	0	0	0.00	27	11	
North Dakota	0	0	0	0	0	0	0	0	0.00	27	11	FHWA
Pennsylvania	0	0	0	0	0	0	0	0	0.00	27	11	
Rhode Island	0	0	0	0	0	0	0	0	0.00	27	11	
Texas	0	0	0	0	0	0	0	0	0.00	27	11	
Virginia	0	0	0	0	0	0	0	0	0.00	27	11	
West Virginia								0	0.00	27	11	
Wisconsin	0	0	0	0	0	0	0	0	0.00	27	11	Other State DOT
Wyoming	0	0	0	0	0	0	0	0	0.00	27	11	Other Federal
Hawaii	1	0	0	0	1	-1	-2	-1	-0.14	42	12	Own State DOT
Michigan	0	0	0	0	0	-1	0	-1	-0.14	42	12	
Montana	-1	0	0	0	0	0	0	-1	-0.14	42	12	Own State DOT
Ohio	-1	1	-2	0	1	1	-1	-1	-0.14	42	12	Own State DOT
Oklahoma	0	0	-1	0	0	0	0	-1	-0.14	42	12	
Georgia	0	-1	1	-1	0	-1	0	-2	-0.29	47	13	Own State DOT
Minnesota	-1	0	0	-1	0	0	0	-2	-0.29	47	13	Own State DOT
Oregon	-2	0	0	-1	0	-1	0	-4	-0.57	49	14	FHWA
North Carolina	0	-2	0	-1	-1	-1	-1	-6	-0.86	50	15	
Total	*14*	*19*	*14*	*18*	*21*	*16*	*24*	*126*	*18.00*			
Average	*0.29*	*0.39*	*0.29*	*0.37*	*0.43*	*0.33*	*0.49*					

Source: NCHRP Project 25-33 Interim Report.

responses, appear in a lighter gray; and neutral responses have no background shading.) Professionals associated with the California and Washington DOTs expressed the most confidence in their VIAs. Few states recognized their VIA process as being superlative. Most, it can be inferred, believe that a better process is needed.

4.5 Conclusions

4.5.1 VIAs Are Uncommon

VIAs for highway projects are relatively uncommon in comparison to the number of highway projects developed and the environmental impact documentation completed each year.

The research team was surprised that there were not more VIAs available for transportation projects available. While projects could be identified for which visual issues played an important role, identifying additional technical reports was challenging. The research team interprets this to mean that visual impact investigations are being conducted without formal reports beyond the short sections in the environmental impact documents. An alternative explanation may be that VIAs do exist but are not being made public or placed online, perhaps because of cost or file size limits.

4.5.2 Current VIA Performance Is Not Robust

Respondents judge the overall quality of the VIAs they produce to be of modest quality. One issue not addressed by this study is whether damage is being done because of this mediocre performance. Potential damage could be to the landscape, viewers, the validity of the VIA process, or the trustworthiness of government and transportation agencies in understanding and responding to public concerns.

4.5.3 Visual Issues Are Being Considered

Some states appear to have decided to address and minimize visual impacts through context-sensitive design (CSS), visual management, or other practices. Other states seem to consider visual impacts to be adequately addressed by the Section 106 (cultural and historic properties) review, even though the criteria for such a review are based on the impact to the cultural or historic resource's integrity (and leave out visual impacts to other resources and people).

4.5.4 Rigorous Assessment of Visual Impacts Remains Necessary

NEPA requirements may not be adequately addressed, given the state of the practice. There is no uniformity among the states in the rigor of the methods by which visual impacts are considered. While some variation may seem appropriate for a federal system that is managed largely by the states, NEPA is a national law, and minimum standards for acceptable consideration of visual impacts would also seem appropriate. Such minimum standards may be implied by current FHWA policy and practices, but they have not been adopted by states uniformly.

CHAPTER 5

Evaluation Criteria

Ten criteria were developed for evaluating highway visual impact assessment (VIA) procedures based on the analysis of the literature and legal precedent, the results of a survey of state DOT staff who manage highway VIA procedures, and the results of the research team's review of publicly available highway VIAs as documented in previous chapters of this report. The evaluation criteria prescribe desirable overarching characteristics of VIA procedures and are used to evaluate specific VIAs and VIA procedures as documented in Chapter 6 of this report.

5.1 Establishing Evaluative Criteria

The overarching evaluative criteria and their relationship to the research team's previous research is described in detail in Table 5.1. The table is the key roadmap to understanding the evaluation criteria. Column 1, "Normative Evaluative Criteria," lists desirable characteristics of VIA procedures and methods. It describes what a VIA procedure should be: objective, valid, reliable, precise, versatile, pragmatic, understood easily, useful for making decisions, implemented consistently, and legitimate.

Column 2 describes "ways to achieve" each criterion. Paying attention to whether a particular VIA report employs these ways to achieve a criterion offers a rough gauge as to how adequately a VIA procedure meets the expectations and needs suggested by the research.

These expectations and needs are summarized in Columns 3, 4, and 5. Column 3 describes how the peer-reviewed literature or legal precedents support the criterion. Column 4 describes how the results of the 50-state survey supports the criterion. Column 5 describes how the research team's review of documented VIAs supports the criterion.

While the ways to achieve the criteria listed in Column 2 can serve as checklists to help assess a particular VIA and the procedure on which it is based, no claim is made that the list in Column 2 is exhaustive. Additional ways to achieve a particular criterion exist but are not listed in the table, and more ways can be developed. The conceptual advantage of employing the ten overarching criteria is that it allows for and invites innovation.

5.2 Background Principles and Assumptions

These criteria were developed to conform to widely accepted principles for employing scientific information in societal decision making (Clark and Majone 1985, Cash et al. 2003, Mitchell et al. 2006, Scavia and Nassauer 2007). The principles have been applied successfully in other assessment and policy applications related to environmental impacts and planning recommendations, and they are highly consistent with the normative criteria that are described in the table. These larger principles suggest that assessments should achieve:

- **Adequacy.** Adequacy addresses whether the VIA uses best practices implemented through state-of-the-art methods and techniques to assure quality of information and is credible in the context of scientific knowledge. This project supports the adequacy of VIA procedures by its basis in a thorough review of the peer-reviewed literature and legal precedents, by conclusions drawn from a representative sample of experts who actually conduct highway VIAs, and by reviewing all readily available highway VIA reports to assess the state of the art. In addition, to enhance the adequacy of future VIA procedures, the overarching criteria in Table 5.1 use the same terminology employed in the scientific literature or in existing assessment procedures to facilitate future use of that literature as new procedures and applications are developed. The adequacy of a VIA is determined by its ability to fulfill the normative evaluation criteria defined in this section, especially if it is *objective, valid, reliable, precise, consistently implemented,* and *legitimate.*
- **Relevance.** Relevance addresses the salience and value of the assessment for decision making (i.e., whether all of the

Table 5.1. Support for normative evaluative criteria and the ways to achieve them based on conducted research.

Normative Evaluative Criteria—Ideally, VIA procedures will be:	Ways to Achieve Each Criterion	Peer-Reviewed Literature or Legal Precedent Support	State Survey Support	Review of VIAs Support
1. Objective (Designed to eliminate bias.)	Use an explicit measurement system of quantities or qualities of the landscape and viewers.	Legal precedent supports this criterion (2.6.1, 2.6.7).*	Only 34% of survey respondents thought their state's procedure was objective. 80% of states described intrinsic qualities of the landscape as part of VIA, but at least 60% described qualities that are not objective (e.g., dominance, proportion, or scale).	Most VIAs did not do this. VIAs from Washington and Minnesota did.
	Explicitly describe relevant landscape characteristics.	Peer-reviewed literature suggests that these approaches help to achieve objectivity.		Descriptions were typically included but not uniformly applied to all of a project's alternatives or between projects within a particular state.
	Explicitly describe relevant characteristics of the public.			Character of the public was frequently not identified.
	Specify visual management objectives.			Management objectives were rarely used, and then typically only by states using BLM or USFS VIA methods.
	Explicitly define visual impact as a way to measure proposed change.			Discussions of changes to baseline conditions were frequently muddled by descriptions of changes without having initial descriptions of baseline conditions.
	Use an explicit, transparent, replicable model for systematically combining factors in the VIA procedure.	Legal precedent supports this criterion (2.6.1, 2.6.7).		

* Numbers in parentheses indicate subsections in *NCHRP Report 741*.

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Table 5.1. (Continued).

Normative Evaluative Criteria—Ideally, VIA procedures will be:	Ways to Achieve Each Criterion	Peer-Reviewed Literature or Legal Precedent Support	State Survey Support	Review of VIAs Support
2. Valid (Can be defended as measuring what it intends to measure.)	Specify the legal basis for assessing visual quality and/or regulating visual impacts in a particular locale.	Legal precedent supports this criterion (2.6.1).	Only 28% of survey respondents thought the VIA procedures used in their state were valid.	Some states referenced NEPA as the basis for conducting a VIA; a few cited local ordinances. California cited state law (the California Environmental Quality Act, or CEQA) and Vermont has a specific procedure defined by law.
	Do not limit landscape visual values to what looks scenic or natural.	Peer-reviewed literature documents several dimensions of visual landscape value beyond scenic value. These include: apparent care, stewardship, legibility, overall appropriateness as judged by stakeholders (Ch. 2).		
	Do not rely solely on expert opinion or art/design traditions to construct concepts for assessment of visual quality.	Peer-reviewed literature empirically demonstrates that these concepts are of questionable validity for VIA and may not be reliable in application (2.6.3).	82% of states indicated that they use public meetings to include or represent viewers. It would be difficult to ensure that this alone validly represents affected publics. Only 12% of states employ scientific sampling techniques to assess public values and perceptions.	Most VIAs reviewed relied on an expert asserting their judgments.
	Incorporate viewer response as a factor affecting visual impact.	Peer-reviewed literature conclusions emphasize the validity of assessing visual quality in its broader landscape and cultural context and considering visual experience as a transaction between viewers and landscapes (2.6.3, 2.6.9).		Except for feedback at public meetings or from comments on a draft document (usually the environmental document that has a summary of the VIA), public input—especially from affected viewers—was rare.

Table 5.1. (Continued).

Normative Evaluative Criteria—Ideally, VIA procedures will be:	Ways to Achieve Each Criterion	Peer-Reviewed Literature or Legal Precedent Support	State Survey Support	Review of VIAs Support
2. Valid (Continued) (Can be defended as measuring what it intends to measure.)	Directly involve affected people by using public meetings to gather data.	Peer-reviewed literature strongly supports validity of a wide range of empirical techniques.	82% of states indicated that they use public meetings to include or represent viewers. It would be difficult to ensure that this alone validly represents affected publics. Only 12% of states employ scientific sampling techniques to assess public values and perceptions.	Orchestrated public meetings were successfully used in Vermont and Washington State.
	Directly involve affected public groups by engaging them in surveys, including web-based or intercept surveys.	Peer-reviewed literature reports success in efficiently using web surveys to measure public perception.		Surveys apparently are not being conducted.
	Ensure inter-rater reliability for survey variables.	Peer-reviewed literature describes how to achieve this criterion.		Only Caltrans verified rating of impacts by having panelists rate them separately and then averaging their ratings. However, inter-rater reliability was not measured.
	Use existing, easy technology (i.e., visual simulations and web-based surveys) as part of VIA to measure public perceptions.	Peer-reviewed literature emphasizes the need to measure public perceptions in order to validly measure visual quality. Section 2.6.8 concludes that current VIA processes create little opportunity for meaningful public input.		Simulations were infrequently used. No web-based surveys were used.
	Describe how simulation and evaluation viewpoints are selected to be representative. Test representational validity of simulations by comparing with responses to actual view.	Peer-reviewed literature supports the validity or simulation technology, but particular framing and image manipulation choices could affect response to particular scenes.		Where simulations were used, the process for selecting viewpoints was rarely identified.

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Table 5.1. (Continued).

Normative Evaluative Criteria—Ideally, VIA procedures will be:	Ways to Achieve Each Criterion	Peer-Reviewed Literature or Legal Precedent Support	State Survey Support	Review of VIAs Support
3. Reliable (Adequately trained professionals reach the same conclusion.)	Measure inter-rater reliability for each VIA and/or across VIAs for similar projects in the agency.	Peer-reviewed literature provides standards for achieving this criterion.	40% of respondents thought their state's VIA procedure was reliable.	VIAs did not report their implementation process adequately to allow reliability to be judged. Note that Caltrans did have multiple panelists provide ratings, but did not measure inter-rater reliability. Extreme negative effects were not given particular attention.
	Make results of the procedure replicable by different users who apply it.			
	Ensure that the most extreme negative effects are reliably identified.	Legal precedent supports this criterion (2.6.1).		
4. Precise (Measured at the right grain or scale to validly measure or describe characteristics of substantive interest.)	Specify project-relevant characteristics of the landscape and affected people (e.g., local people, travelers, recreationists, etc.). Represent the existing landscape and proposed changes. Include cumulative and indirect effects of project proposals. Explicitly describe how the future condition is determined. Then develop a sampling strategy to adequately represent variation of those characteristics for landscape and affected people.	Peer-reviewed literature provides guidance on this criterion related to sampling of viewers, sampling of landscapes in simulations, and in viewshed delineation.	40% of respondents reported that their state's procedure adequately represents variation among affected people.	Relevant characteristics of project area and affected people were seldom documented.
	BASELINE—Explicitly specify the baseline landscape condition against which effects of proposed changes are measured. Is it the current or projected future condition?	Peer-reviewed literature demonstrates the necessity of comparing a future alternative to the present in order to measure the effect of change.		If baseline and future conditions were described, a narrative description was used. States using the FHWA–VIA process used a more standardized descriptive process.

Table 5.1. (Continued).

Normative Evaluative Criteria—Ideally, VIA procedures will be:	Ways to Achieve Each Criterion	Peer-Reviewed Literature or Legal Precedent Support	State Survey Support	Review of VIAs Support
4. Precise (Continued) (Measured at the right grain or scale to validly measure or describe characteristics of substantive interest.)	SIMULATIONS—Choose views to represent relevant variation in the landscape (baseline and proposed). Describe how the views were selected. Provide sufficient information to demonstrate that the viewsheds were properly calculated.	Peer-reviewed literature uses standard, easy technology for representing alternative landscape changes.		Simulations were not employed in most VIAs.
	VIEWSHEDS—Map relevant viewsheds with attention to validity of viewpoint and terrain/cover data precision and modeling assumptions for the proposed project.	Peer-reviewed literature suggests that the assessment report about how the area of effect was established and on what basis.		Washington State and Colorado employed viewshed analysis. Most states did not.
5. Versatile (Supporting valid assessment from the perspectives of different viewer groups interacting with different landscape settings, and different types of proposed changes.)	Be applicable to different land uses (wild, rural, suburban, urban, commercial, recreational, etc.)	Peer-reviewed literature emphasizes that different land uses are valued for different characteristics, importantly implying that "naturalness" is not a sufficient criterion for assessing visual quality, especially in urban or agricultural landscapes (conclusion, 2.6.2).		The procedure employed varied among land use types and ecoregions, even within a state. This may indicate that available procedures are not sufficiently versatile.
	Be applicable to different project types at different scales.			
	Characterize and be applicable to different ecoregions.	Peer-reviewed literature emphasizes that different ecoregions are valued for different characteristics.		

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Table 5.1. (Continued).

Normative Evaluative Criteria—Ideally, VIA procedures will be:	Ways to Achieve Each Criterion	Peer-Reviewed Literature or Legal Precedent Support	State Survey Support	Review of VIAs Support
6. Pragmatic (Easily and efficiently implemented by a trained professional.)	Ensure adequate training of competent professionals.	Sections 2.6.5 and 2.6.6 emphasize that professional visual impact assessors seem to have little knowledge of relevant research, yet the courts assert that consistency with peer-reviewed literature is a criterion for judging the defensibility of the procedure.	38% of respondents thought their state's VIA procedure was pragmatic. Section 4.5 notes that most visual impact assessors are self-taught, learning from looking at completed VIAs. Only about 58% are landscape architects. About 75% of states employ consultants for VIAs and about half use in-house staff. Only 1 in 5 states provides comprehensive training for VIA.	Apparently, many states frequently do not conduct a VIA (at least it is not publicly available or referenced in the EA/EIS). Instead, they may address mitigating visual impacts using context-sensitive solutions, visual quality management, or by conducting a Section 106 historical property assessment.
	Encourage repeated application of the procedure by the same team of competent professionals.			
	Make the procedure as simple as possible to provide useful results in a timely fashion.	Legal precedent emphasizes that the procedure should not be too costly (2.6.1).		
7. Understood easily by the public and decision makers		Legal precedent supports this criterion. Peer-reviewed literature (2.6.8) notes that the public currently has little opportunity for meaningful input to VIAs.	Only 28% of respondents thought their state's procedure was understood by the public, and only 34% thought that VIAs affected public relations in their state.	It is not known from the review if VIAs were readily understood; a few environmental documents that reported VIA findings had evidence of public review and comment, suggesting at least a level of understanding.
8. Useful (Affects location, design, or mitigation decisions.)	Iteratively develop mitigation approaches that relate to specific visual impacts that might occur, even after a thorough effort to avoid visual impacts.	Peer-reviewed literature demonstrates the necessity of comparing a future alternative to the present in order to measure the effect of change (2.6.4).	Some 46% of respondents thought their state's VIA procedure was useful in affecting decisions. In 72% of states, VIAs were reported to affect design development; 78%, the mitigation of impacts; and 46%, alternative selection.	It is unknown how effective these documents were, since most were completed in the preliminary design stage and most carefully avoided making direct recommendations that could be compared to the final outcome.

Table 5.1. (Continued).

Normative Evaluative Criteria—Ideally, VIA procedures will be:	Ways to Achieve Each Criterion	Peer-Reviewed Literature or Legal Precedent Support	State Survey Support	Review of VIAs Support
9. Implemented consistently (Consistent with the procedure and consistent among different projects.)	Identify and explain the VIA procedure used.		States where assessors have longevity in their responsibilities have greater consistency in procedures.	Washington State seems to have achieved this criterion by being explicit about what procedure was being used. More typically, it was unclear what procedure was being used and how it was modified.
	Follow all aspects of the procedures or provide a valid justification for changes made.			
10. Legitimate (Supported by laws, regulations, or other legal mechanisms; uses socially/culturally accepted standards; and uses scientifically accepted standards.)	Encourage professional accountability by identifying VIA authors and their professional credentials.			This information was often missing, making accountability difficult.
	Only professionals educated in the appropriate discipline conduct VIAs.		Section 4.5 notes that landscape architects conduct VIAs in only about half the states.	Where landscape architects conducted VIAs, greater consistency was achieved: Washington State, Colorado, and Minnesota.
	Specify visual management objectives and link these to landscape and viewer characteristics to be monitored.	Peer-reviewed literature suggests that monitoring protocols would be necessary to assess change over time. Section 2.6.3 emphasizes the need to establish visual management objectives against which ongoing or proposed changes can be measured.		Management objectives were included only where study areas occurred adjacent to BLM or USFS lands for which management objectives had already been determined.

truly important visual impact issues are addressed, whether the spatial and temporal scales of the study match what is needed for decision making, and whether the results of the assessment are clearly communicated). Some aspects of relevance may vary from one VIA to another, depending on the specific project; others may be inherently important for assessing visual impacts of any highway project. The relevance of a VIA is determined by its ability to fulfill the normative evaluation criteria defined in this section, especially if it is *pragmatic, easily understood,* and *useful.*

- **Legitimacy.** Legitimacy addresses the capacity of the assessment to be fair and unbiased while incorporating potentially diverse views and experiences. The legitimacy of a VIA is determined by its ability to fulfill the normative evaluation criteria defined in this section, especially if it is *objective, valid, versatile, easily understood, consistently implemented,* and *legitimate.*
- **Effectiveness.** Effectiveness addresses the actual impact of the assessment on decisions and actions. The effectiveness of a VIA is determined by its ability to fulfill the normative evaluation criteria defined in this section, especially if it is *easily understood, useful,* and *legitimate.*

The ten normative criteria conform to these broader principles, and could provide a basis for developing a single highway VIA procedure common to all states—an ideal that would help to achieve adequacy and legitimacy. Such a procedure would need to be objective, valid, adequately precise, and reliable (meeting criteria 1 through 4 in Table 5.1), and also sufficiently versatile (meeting Criterion 5 in the table) to be suitable for assessing impacts of different types of proposed changes (i.e., different project types) to different landscape settings, including different land use contexts in different ecoregions. The procedure also would need to validly convey the perspectives of diverse viewer groups. The survey of states showed that VIA procedures are not being employed consistently (Criterion 9) from state to state and, sometimes, from project to project within a state. Only a quarter of the states have formally adopted a VIA procedure (28%). About half (56%) identified a procedure that was typically being used:

- The FHWA–VIA procedure was reported as being used by about a quarter of all states (26%).
- State-developed procedures were reported as being used by a slightly smaller number of states (20%).
- The remaining states indicated that they are either emulating procedures used by other state or federal agencies or relying on local plans and ordinances to infer visual impact (10%).

That almost half of all states did not identify a VIA procedure typically in use—and the rest employed such a wide array of procedures—suggests that, currently, VIA procedures across the country could be more objective (Criterion 1), more consistent (Criterion 9), and more legitimate (Criterion 10).

It is important to note that the ten normative criteria could apply to any VIA, but the ways to achieve those criteria are likely to vary among different legal frameworks and cultural and policy contexts, especially when considering VIA procedures in different nations, but even when considering VIA procedures employed by different agencies with different land ownership and planning responsibilities. For example, the research conducted for *NCHRP Report 741* involved a search of VIA peer-reviewed literature and legal precedents from around the world, and the VIAs that were reviewed included several outstanding international examples. However, before considering what those international examples can teach us about potential VIA procedures in the United States, it is helpful to understand that the international examples have been developed in the context of cultural traditions for interpreting the value of landscapes, as well as land use law and planning contexts that are very different from those in the United States. For example, the tradition of broad cultural appreciation for particular characteristics of different landscape regions in the UK dates from before the founding of America. This UK tradition has been articulated and refined through the development of landscape characterization over the past 30 years. In the United States, we have not yet developed a similar clarity about what different regional landscapes are "supposed to look like"; consequently, the VIA procedures will need to take a different approach to establishing landscape quality in different land use and ecoregional contexts. In addition, the legal basis for ascribing property rights and adopting land planning conventions in the UK is quite different from that in the United States. Consequently, ways of achieving a VIA procedure that meets criteria for objectivity, validity, reliability, and legitimacy (criteria 1, 2, 3, and 10) may differ between the UK and the United States. At the same time, US VIA procedures may benefit from critically considering the way in which UK VIA procedures are, on the whole, versatile, pragmatic, and understood relatively easily (criteria 5, 6, and 7). While differences among nations reflect these varying contexts, differences among states within the United States should be amenable to treatment by a single, versatile highway VIA procedure that could be adapted to widely varying highway VIA situations.

5.3 Reading the Table

To understand the evaluative criteria, some ways to achieve the criteria, and the basis for establishing each criterion and the ways to achieve it, read Table 5.1 from left to right. To meet all ten criteria, the ideal highway VIA will be objective,

valid, reliable, precise, versatile, pragmatic, understood easily, useful, implemented consistently, and legitimate.

5.3.1 Objective

An objective VIA procedure is designed to eliminate individual bias. Ways to achieve this criterion include using an explicit measurement system of quantities or qualities of the landscape and viewers. This approach is strongly supported by legal precedents in the United States. It does not mean that all VIA procedures and each of their components must be reduced to a mathematical formula, but rather that explicit measurement on some scale (nominal, ordinal, interval, or ratio) should be employed, and that the ways in which the procedure specifies that different factors and their classes be combined should be unambiguous and defensible.

Such measurement can be achieved if the procedure (1) explains how to determine and explicitly describe relevant landscape characteristics and relevant characteristics of the public, and (2) explicitly describes how to measure proposed visual changes and their impact. The peer-reviewed literature includes several examples and conclusions that suggest how to do this.

This criterion also can be achieved by specifying visual management objectives for a landscape where change is proposed. Doing so supports objectivity by separating the determination of appropriate visual standards for an area from controversy of any specific proposed change. For example, USFS specifies visual management objectives for all national forests.

Currently, survey respondents in only 34 percent of states judge their VIA procedure as objective. Eighty percent of states describe intrinsic qualities of the landscape as part of VIA, but at least 60 percent describe qualities that are not objectively measured (e.g., dominance, proportion, scale).

5.3.2 Valid

A valid VIA procedure can be defended as measuring what it intends to measure. While legal precedents related to VIA in the United States are not abundant and are somewhat ambiguous in their implications for decision making, those identified and described in Chapter 2 of this report point to this definition of validity as essential to the legal defensibility of a VIA procedure. Legal precedents indicate that environmental assessments should be based on peer-reviewed science, but all three aspects of the research in this project (the literature review, the state staff survey, and the review of VIAs) suggest that the practice of VIA does not appear to be drawn from the rather substantial scientific evidence on visual preferences for landscapes, landscape representation techniques, and techniques and methods for measuring viewer preference. Consequently, it may be important to increase the validity of highway VIA procedures. Several ways to achieve validity are based on conclusions from the peer-reviewed literature. These include:

- Assess all the factors that determine landscape visual quality, going far beyond judgments of naturalness or scenic value. For example, landscape visual quality also involves distance from the viewer, legibility of sequential landscape experiences, apparent ecological stewardship, and responsiveness to cultural sensibilities for the appearance of care.
- Incorporate viewer response as a factor affecting visual impact. Many reliable techniques and valid standards for measuring viewer response have been demonstrated in the peer-reviewed literature and are called out as ways to achieve validity in Table 5.1.
- Incorporate professional assessment of intrinsic landscape attributes that have been demonstrated to effect visual quality in similar landscapes and contexts to that being evaluated in the VIA.
- Ensure that the items being evaluated (e.g., viewpoints and viewers) are appropriately sampled to be representative of the larger issue being analyzed.
- Synthesize the separate analyses in an explicit evaluation procedure that is defensibly grounded in the peer-reviewed literature.

Currently, only 28 percent of survey respondents from 50 states consider the VIA procedures used in their state to be valid, according to the survey conducted for this report. While 82 percent of states do include viewer response by using public meetings to include or represent viewers, it would be difficult to ensure that public meetings alone validly represent affected publics. Currently, only 12 percent of states (six states) employ scientific sampling techniques to assess public values and perceptions.

In general, to support validity of VIA, a coordinated scientific research effort is needed to identify and evaluate physical and denotative landscape characteristics that explain landscape experience in varying contexts and can be reliably measured. Bearing in mind that the central conclusion from decades of landscape perception research is that landscape experience is contextual, this effort must be organized across the full range of U.S. landscape types, possible landscape interventions, and different stakeholder groups.

5.3.3 Reliable

Using a reliable VIA process, adequately trained professionals can be expected to reach the same conclusions. This fundamental standard for science applies to assessments of all types. It is achieved partly by having an explicit, unambiguous procedure. It is ensured by testing the inter-rater

reliability of different measures employed within the procedure. Among the aspects of reliability that are likely to be most important to the courts, based on legal precedents, is reliable identification of the most negative impacts. At a minimum, different users of VIA procedures should always be able to identify when, where, and why the most negative impacts occur. The VIAs reviewed in the research for *NCHRP Report 741* did not report their implementation process or underlying procedure adequately to allow their reliability to be evaluated. Consequently, reliability could be a weakness of current VIA procedures.

5.3.4 Precise

A precise VIA procedure uses measures at a grain or scale sufficiently fine to validly measure or describe characteristics of substantive interest, and sufficiently coarse to be pragmatically implemented. This criterion describes a fundamental principle of applied measurement that would be relevant to almost any empirical assessment or model used in a VIA procedure. Achieving it directly affects the reliability and validity of a VIA procedure. Some ways to achieve it are:

- Specify project-relevant characteristics of the landscape and affected people.
- Represent both the baseline future landscape without the project and the future landscape as changed by the proposed project.
- Explicitly describe how the future condition is determined.
- Include cumulative and indirect effects of project proposals.
- Develop a sampling strategy to adequately represent variation in relevant characteristics of landscape and affected people.

For VIAs, adequate precision is particularly relevant to establishing the baseline landscape condition, representing proposed landscape change in visual simulations, and identifying viewpoints and landscape conditions that affect the determination of viewsheds.

The questions on the state survey focused primarily on precision as it relates to representing affected people. Only 40 percent of respondents reported that their state's procedure adequately represents variation among affected people. Related to precision of simulations and viewshed analysis, only two states (Washington State and Minnesota) reported the results of viewshed analyses in the review of VIAs.

5.3.5 Versatile

A versatile VIA process supports valid assessment of different types of proposed changes from the perspectives of different viewer groups interacting with different landscape settings. This criterion relates to validity and reliability. It points to the need for a VIA procedure to be designed so that it is valid for assessments in different landscape contexts for different types of proposed changes. This means a VIA should not only work to assess changes in perceived naturalness or scenic beauty, but also be equally effective in assessing visual impacts in human-dominated landscapes or landscapes that are not scenic but are well cared for. Versatility also means that a VIA should be designed anticipating that different stakeholders, publics, and viewers will not only have different values and perspectives, but also will have capacities to participate in VIA processes in different ways. In the review of VIAs, the research found that the specific VIA procedure employed varied among land use types and ecoregions, even within a state. This finding may indicate that available procedures are not sufficiently versatile to be pragmatic to use in different conditions.

5.3.6 Pragmatic

A pragmatic VIA process is easily and efficiently implemented by a trained professional. This criterion emerges from legal precedents that emphasize that VIA should not be too costly. At the same time, legal precedent asserts that VIA must be consistent with conclusions of the relevant peer-reviewed literature. The intersection of these two factors—sophistication of knowledge and reasonableness of cost—point to three ways to achieve this criterion:

- Make the procedure as simple as possible to provide useful results in a timely fashion.
- Ensure adequate training of competent professionals in order to conduct objective, reliable, and precise VIAs.
- Encourage repeated application of the procedure by the same team of competent professionals.

While the goal of making the procedure simple is self-evident, the value of using "competent professionals" to employ the procedure emerges primarily from the survey of state staff and review of VIAs. Currently, only 38 percent of state DOT staff see their state's VIA procedure as pragmatic. Furthermore most VIA assessors are self-taught, learning from looking at completed VIAs. Landscape architects have a professional background that creates familiarity with VIA concepts, but currently only about 58% of VIA authors are landscape architects. About 75 percent of states employ consultants for VIAs and about half use in-state DOT staff. Only one in five states provides comprehensive training for VIA.

This constellation of professional and training characteristics may relate to what the research team observed in reviewing

VIAs in the United States. Apparently, many states frequently do not conduct a VIA (at least it is not publicly available or referenced in the EA/EIS). Staff may treat mitigating visual impacts using context-sensitive solutions (CSS), visual quality management, or by conducting a Section 106 historical property assessment as obviating the need for a separate VIA. There seems to be substantial advantage to employing landscape architects as VIA assessors and a need for training all VIA assessors.

5.3.7 Understood Easily

If a VIA process is easy to understand, it will be accessible by the public and decision makers. This criterion is a key test of relevance and effectiveness of any assessment procedure. It emerges specifically from legal precedents, and the peer-reviewed literature has noted that the public currently has little opportunity for meaningful input to VIAs. Currently, only 28 percent of states judge their VIA procedure to be understood by the public and only 34 percent think that VIAs affected public relations in their state (34%). While objectivity, validity, versatility, and pragmatism can contribute to helping the public and decision makers understand a VIA, they do not ensure understandability. As part of the next task in Project 25-33, how to achieve understandability will be more specifically detailed, based on the assessment of specific VIAs.

5.3.8 Useful

In evaluating a VIA process, usefulness relates to how it affects location, design, or mitigation decisions. This criterion is the ultimate test of effectiveness. While many circumstances affect whether a VIA is useful, this report identifies the need for a VIA procedure to iteratively develop mitigation approaches that relate to specific possible visual impacts. This recognizes that even given a rigorous assessment process, changes proposed in highway projects sometimes create visual impacts. The peer-reviewed literature demonstrates the necessity of comparing a future alternative to the present in order to measure the effect of change. Results of the state survey show that while staff may not always feel that VIA procedures in their state affect the choice of alternative decisions (46%), they are more confident about VIA procedures affecting design development (72%), and the mitigation of impacts (78%).

5.3.9 Implemented Consistently

An ideal VIA process is consistent with the chosen procedure and consistently applied among different projects. This criterion is fundamental to the legal defensibility of VIA results, and it also is likely to affect the confidence with which professional staff and the public view results. Having an objective, reliable, versatile, and pragmatic procedure will help the VIA to be implemented consistently. Additional ways to achieve consistency are:

- Follow all aspects of the procedures or provide a valid justification for any changes made. According to the survey of state DOT staff, states where assessors have longevity in their responsibilities have greater consistency in procedures. This points again to the benefits of training and professional competence for achieving effective VIAs.
- Identify and explain the VIA procedure used. Surprisingly, few of the VIA documents that were reviewed did this. The VIA from Washington State did, and Washington had a consistently implemented VIA procedure. Identifying and explaining the VIA procedure within the VIA document underscores the benefit of knowing the purpose for which the VIA is being conducted.

5.3.10 Legitimate

A legitimate VIA process is supported by laws, regulations or other legal mechanisms, uses socially/culturally accepted standards, and uses scientifically accepted standards. This criterion echoes an overarching principle for all forms of assessment. While it combines aspects of nearly all the other criteria, it emphasizes that assessment must occur against standards, not against personal opinions or feelings.

Achieving legitimacy is an essential and reachable goal for VIA procedures. In general, the survey of state staff suggests that no single professional standard is widely applied. The most indisputable basis for judging legitimacy is laws and regulations. Legal precedents for interpreting NEPA and state laws addressing visual impact since Smardon and Karp's (1993) landmark book are rather thin and scattered. Legal precedents addressing expectations for assessments in general are applicable and helpful. For now, perhaps the most substantial basis for judging the legitimacy of a VIA procedure is the peer-reviewed literature, which supports the conclusion that visual quality is the result of an interaction between people and the landscape. This is a transactional model, because people and landscape each help to form the other. It is also contextual, because the interaction is affected by particular people and particular places.

The basis for legitimacy in VIA procedures should evolve to more completely compare laws, legal precedents, and conclusions and applications drawn from peer-reviewed literature. The existing review of the peer-reviewed literature suggests that more work that explicitly aims to integrate policy applications in VIA with the peer-reviewed literature

could be very helpful to the quality and defensibility of VIA procedures.

5.4 Conclusions

Table 5.1 provides a roadmap to the evaluative criteria developed in this research. It identifies ten evaluative criteria that are in keeping with four general and widely accepted principles for assessment: adequacy, relevance, legitimacy, and effectiveness. It is grounded in previous research investigating legal precedents, the peer-reviewed literature, reports from staff in all 50 U.S. states that implement VIA procedures, and a review of all available highway VIAs for the United States, as well as several international examples. It details many ways to achieve the evaluative criteria. Chapter 6 presents these "ways to do it" as a prototypical checklist and uses the checklist for in-depth evaluation of several VIAs that represent different types of VIA procedures. The process of evaluating the VIAs will, in turn, suggest ways to further refine and add rigor to the evaluative criteria.

CHAPTER 6

Case Studies

The visual impact assessment (VIA) documents from five projects were examined to determine a set of best practices for assessing the visual impacts that may be caused by highway projects. Four of the projects were in the United States, in the states of Colorado, Minnesota, Vermont, and Washington. The fifth project was in Scotland, United Kingdom.

The following narratives discuss the methods and results of these five case studies. The narratives are arranged in a similar manner to facilitate comparison. Typically where the discussion addresses the ten evaluation criteria introduced in Chapter 5 of *NCHRP Report 741,* the discussion is primarily about that particular VIA. However, if the review of the project VIA has been augmented by a review of additional agency documents, such as a VIA policy directives, a VIA procedural manual, or references to VIA-related documents of other agencies, those documents also may be included in the discussion. For all case studies, the ten evaluation criteria are understood to be defined as follows:

- **Objective:** The VIA procedure is designed to eliminate individual bias.
- **Valid:** The VIA procedure can be defended as measuring what it intends to measure.
- **Reliable:** Adequately trained professionals using the VIA procedure reach the same conclusion.
- **Precise:** The VIA grain or scale is sufficiently fine as to validly measure or describe characteristics of substantive interest, and sufficiently coarse as to be pragmatically implemented.
- **Versatile:** The VIA procedure supports valid assessment of different types of proposed changes from the perspectives of different viewer groups interacting with different landscape settings.
- **Pragmatic:** The VIA procedure is easily and efficiently implemented by a trained professional.
- **Understood Easily:** The VIA procedure and an explanation of the process is readily available to stakeholders (i.e., understood easily by the public and decision makers) and is clearly articulated.
- **Useful:** The VIA procedure affects location, design, or mitigation decisions.
- **Implemented Consistently:** The VIA is consistent with the chosen procedure and the procedure is consistently applied among different projects.
- **Legitimate:** The VIA procedure is supported by laws, regulations, or other legal mechanisms, and uses socially/culturally accepted standards as well as scientifically accepted standards.

These narratives apply only to the projects analyzed; they do not necessarily represent the process or procedures of the state departments of transportation (state DOTs).

6.1 United States

6.1.1 Colorado

Sources

Agency: Colorado Department of Transportation (Colorado DOT)
Project: I–70 Mountain Corridor
Citation: Colorado Department of Transportation (2010). *I–70 Mountain Corridor Programmatic Environmental Impact Statement Visual Resources Technical Report.*
Web Addresses of Reviewed Materials:

- *Visual Resources Technical Report.* Available at: http://www.coloradodot.info/projects/i-70mountaincorridor/final-peis/final-peis-documents/technical-reports/Vol5_I-70_Mntn_Corridor_Final_PEIS_VisualResources_TR.pdf/view.
- *Draft PEIS Visual Resources Section* (pages 3.11-1—3.11-8). Available at: http://www.coloradodot.info/projects/i-70mountaincorridor/2010-revised-draft-peis/Revised_Draft%20_PEIS.pdf/view.

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- *Final PEIS CSS Appendix.* Available at: http://www.coloradodot.info/projects/i-70mountaincorridor/final-peis/final-peis-documents/20_App_A_CSS_Rev50.pdf.

Short Project Description

Highway. The project is for the only east-west Interstate highway in Colorado, consisting of 144 miles of I–70 extending between Denver in the east and Glenwood Springs in the west. The cross section of the highway is typically four-lanes with a median, although in several locations, physical restrictions reduce the median to a median barrier and the roadway is placed on structures. Recreational and tourist traffic mixes with cross-country freight and passenger traffic.

Landscape Setting. The landscape setting is varied, including mountainous terrain from steep-walled canyons to alpine meadows. The road passes through five counties and several small cities. Except for pockets of concentrated urban areas, this segment mostly passes through public wilderness, including three national forests and other public lands managed by the federal government.

Viewers. Three types of viewers are identified: Residents (occupants of buildings near the freeway); recreationists (people pursuing recreation, usually outdoors, on public or private property, adjacent to the freeway); and motorists (travelers in vehicles on the freeway). Although the Colorado DOT identifies these three viewer types, the VIA primarily concentrates on issues of concern to recreational viewers, claiming they would be the most sensitive to visual impacts caused by changes to the highway corridor.

Transportation Issue. Increasing congestion caused by escalating tourist and commercial traffic required expansion of the existing facility to meet the need to increase passenger and freight capacity.

Proposed Solution. Several configurations are evaluated, from adding driving lanes to constructing exclusive bus lanes or installing a rail line.

Purpose of VIA. The purpose of the VIA is to evaluate and compare visual impacts associated with and between alternative solutions.

Alternatives Examined. Thirty alternatives are examined, including a minimal action alternative (with minor spot improvements); transit alternatives (bus and rail); highway alternatives (adding lanes at two different design speeds and use of reversible lanes); and various combination alternatives, resulting in a minimum preferred alternative (initial build-out) and maximum preferred alternative (complete build-out).

VIA Procedures

The Colorado DOT developed a VIA for the I–70 Corridor between the cities of Glenwood Springs and Denver, a distance of 144 miles, as Tier 1 of a tiered highway design and environmental review process. The focus of the Tier 1 process was on general corridor and overarching concerns. A subsequent Tier 2 process will focus on more detailed concerns as specific segments become final design projects.

Recognizing that most of the lands adjacent to the corridor are either managed by the U.S. Forest Service (USFS) or the Bureau of Land Management (BLM), the Colorado Department of Transportation (Colorado DOT) elected to merge the VIA procedures of the two federal agencies to evaluate visual impacts that may be caused by changes to this segment of I–70. In the VIA report, the Colorado DOT compares the two methods and defines how it will proceed with a three-phased process. The first phase was to conduct an inventory of existing conditions.

Phase 1—Inventory. The first step of the inventory phase identified existing visual character in terms of landform, vegetation, and the value society assigned the landscape through legal protections. The corridor was divided into distinct scenic landscape units, by viewshed (or other landscape commonalities) and its existing visual condition and scenic attractiveness were evaluated using USFS and BLM methodologies.

"Existing visual condition" is a concept developed by USFS for "rating existing disturbances and their effect on the integrity of the landscape setting, regardless of scenic attractiveness" (Colorado DOT 2010, page 2.) If a natural landscape is untouched by human activities, it is rated "I." If nature remains dominant but human activity is visible, the landscape is rated "II." If human activity dominates nature, such as in a town, the landscape is rated "III."

The Colorado DOT claims these ratings must not be confused with scenic attractiveness, which is a completely separate rating. However, as used by the Colorado DOT on this project, scenic attractiveness was tied directly to a preference for natural landscapes, making the two ratings somewhat redundant. Indeed, except for a general explanation of the ratings, the Colorado DOT did not use the I to III ratings of existing visual condition in its analysis of scenic landscape units. It only used the concept of "scenic attractiveness."

"Scenic attractiveness" is a classification system used by BLM. Class A landscapes are natural landscapes that are rare

in the corridor. Class B landscapes are natural landscapes that contain some distinctive features but are fairly typical of landscapes seen in the corridor. Class C landscapes are natural landscapes that are common and homogeneous. The Colorado DOT uses this system exclusively to inventory what it calls "existing visual character." This classification does not seem to accommodate the existing Interstate highway, which is a significant engineered structure accommodating large numbers of motorized vehicles through this landscape.

The second step of the inventory phase identified viewers, their key viewpoints, and their proximity to proposed changes. The purpose of this effort was to determine who would be affected, from where, and their sensitivity to change. Using a geographic information system (GIS), Colorado DOT identified key viewpoints and calculated the proximity for the three types of viewers: residents, recreationists, and motorists. Proximity was categorized into three distance zones: foreground, middleground, and background. Foreground was defined as being within ½ mile of the observer who is able to differentiate individual objects by form and color. Middleground, defined as views between ½ mile to 3 miles, allowed the observer to see larger landscape patterns, including recognition of the relationship (if any) between natural and cultural landscapes. Background views, scenes that extended beyond 3 miles, allowed an observer to see only the outlines of larger shapes without texture, detail, or even color differentiating the shapes. Background views, due to enclosing landforms, were rare in the corridor.

Despite the clear distinctions between distance zones, in practice the concept is only applied to static key views. For travelers (those viewers moving along the highway), the discussion of distance zones is more complicated, as a particular scene changes relatively quickly from being background or middleground to foreground as a traveler approaches it. To avoid confusion, distance zones are established only at key viewpoints.

The inventory phase concluded with an identification of key viewpoints based on the sensitivity of viewers for each scenic landscape unit. Colorado DOT identified three types of views that might be affected by the proposed project as being critical to the experience of motorists, recreationists, and residents: (1) gateway views, which provide a sense of entry or arrival to key portions of the corridor; (2) focal views, which are dramatic views dominated by a dominating landmark or characteristic; and (3) canyon views, or views of the enclosed landforms and dramatic settings typical for the corridor.

In addition to a thorough narrative of the landscape character and scenic attractiveness for each scenic landscape unit, Colorado DOT used expert opinion to map the locations and areas of the scenic landscape units and the locations of key viewpoints for each of the five counties in the project corridor landscape. Dozens of key viewpoints for each landscape unit were established.

Phase 2—Identifying Visual Management Objectives. Following the inventory phase, Colorado DOT reviewed the visual management prescriptions that had been assigned to the corridor. Most of these prescriptions were based on goals established either by USFS or BLM for managing federal lands adjacent to the corridor. Where federal management goals were not applicable, such as in towns and cities, local ordinances, rules, and regulations were examined for evidence of visual quality goals.

USFS determined visual management goals for the three forests in the corridor using the scenery management system (SMS). (SMS evolved from a process used by USFS from 1973 to 1995, called the visual management system (VMS), expanding constituent input and concepts related to the management of ecological systems.) The SMS process defines "scenic integrity objectives," which are used to evaluate proposed changes to the forest. SMS defines five categorical levels of integrity:

1. Very high.
2. High.
3. Moderate.
4. Low.
5. Very low.

Landscapes that warrant a very high level of protection are intact landscapes where existing landscape character and sense of place is superbly expressed. A high level of protection is warranted for landscapes that are mostly intact and the scale of unnatural intrusions does not dominate the scene and for which the introduced forms, lines, colors, textures, and patterns mimic the native environment so effectively that they are unobtrusive. Moderate protection is applied to landscapes where the natural environment appears to be slightly altered but the intrusions are still subordinate to the native environment. A low level of protection applies to landscapes that have been substantially altered by human activity and artifacts, although the composition of the landscape must be complementary with larger landscape patterns.

BLM also uses a five-level system to establish management prescriptions. Class 1 landscapes must be managed to preserve the existing wilderness character, and development must be avoided or be very non-intrusive. Class 2 landscapes must be managed to preserve the appearance of no human intervention to the casual observer. Any development must mimic the forms, lines, color, and texture found in the surrounding native environment. The management of Class 3 landscapes allows human activity and artifacts, but they must mimic natural elements so that they do not dominate the views of a casual

observer. Although the native environments can be substantially changed in Class 4 landscapes, such changes should be minimized through careful location and design. The native character of Class 5 landscapes has been so disturbed that rehabilitation is necessary to restore it to its natural condition (or at least to one where the native and cultural environments are compatible).

In addition to these federal management objectives, Colorado DOT conducted an extensive review of local plans and legal restrictions related to the management of the visual environment, contacting local authorities to verify its interpretation of these plans and rules.

Phase 3—Determining Visual Impacts. After completing the inventory of existing conditions and establishing visual management objectives for the landscape units that compose the corridor, Colorado DOT assessed the potential visual impacts that may be caused by each of the proposed alternatives. Conducted in three steps, this phase determined (1) visual contrast ratings, (2) viewer sensitivity, and (3) mitigation strategies.

Visual contrast ratings were developed to assess the visual contrast between the existing landscape conditions and the project elements that composed each of the proposed alternatives. Two primary categories of project elements were identified, "landform" and "structures." Project elements assessed under the landform category included retaining walls, roadside cut-and-fill slopes, and medians. Project elements assessed under the structures category included elevated platforms (for transit stations), piers/columns, catenaries, barriers, and fencing. For each project element that composed a particular alternative, visual contrast was assessed as having one of five levels: very strong, strong, moderate to strong, moderate, or weak.

Within each landscape unit, project elements that significantly altered the existing scene, specific to each alternative, were selected to determine the contrast rating. Several such contrast ratings—one for each key viewpoint—were identified. The number of highway miles associated with that rating was also recorded. For documentation and comparison, a bar chart was created that recorded all of the contrast ratings for all of the key viewpoints within a landscape unit by alternative. The bar chart allowed the visual contrast ratings for various alternatives to be compared simultaneously for each landscape unit.

No methodology was identified for determining the actual contrast ratings. Although the VIA contains no definitive statement that the ratings were determined solely by professional opinion, there is no evidence that the public was involved in determining the level of visual contrast either. Regardless of their source, the ratings were qualitative and not quantitative.

After determining the visual contrast rating, viewer sensitivity was examined by determining who would be affected and their proximity to the proposed project. Based on previous studies, Colorado DOT determined that a majority of viewers in the corridor were recreationists and, depending on the area, ¼ to ⅓ were sightseers consuming scenic views. The recreationists were generally located either along the highway as tourists or outdoors on adjacent public property. Colorado DOT determined that since recreationists were the most sensitive to changes in the landscape, they would serve to measure sensitivity for representative views typically found in the corridor and focal views of selected scenery. Recreationists were not, however, the only viewer group identified as being sensitive. Colorado DOT also identified that residents would be particularly concerned with gateway views from and to their towns.

Using a matrix, Colorado DOT identified the level of visual impact by crossing visual contrast ratings with viewer sensitivity. As with the data for visual contrast, Colorado DOT used a bar chart to record ratings for visual impact by alternative for each landscape unit. The bar chart also displayed the proportion a particular impact rating occurred in a specific landscape unit by identifying how many miles that rating occurred in that landscape unit.

Mitigation strategies were not fully developed as part of the Tier 1 study. However, Colorado DOT did explain that mitigation would be part of any Tier 2 projects and based on lessening impacts caused by an increase in visual contrast. Specifically, the VIA identified the following potential mitigation strategies:

- Repair of past visual impacts and scarring.
- Preservation of views.
- Minimal use of highway signs, lights, guardrails, and other design elements.
- Minimum grading.
- Reduction, minimization, or compensation for other project-specific visual impacts.

Colorado DOT also developed a companion context-sensitive solutions (CSS) guidance for Tier 2 final design projects. This guidance was reported in the Final Programmatic Environmental Impact Statement (FPEIS) in March 2011. The guidance established methods for ensuring that the core values identified by stakeholders would be incorporated into the final design, including the desire to ensure an aesthetically appropriate design. In particular, the CSS guidance required that the aesthetics of the project be "inspired by the surroundings, protect scenic integrity, and incorporate the context of place." The design was to "continue the corridor's legacy" using the following aesthetic principles:

- Connect to the setting; harmonize with the surroundings; and be a light touch on the land, subservient to the landscape;
- Reflect the I–70 highway as a major regional and national transportation Corridor;
- Celebrate crossing the Rocky Mountains with a high-country travel experience;
- Respect urban, rural, and natural settings; [and]
- Draw upon and regenerate the context of place (Colorado DOT 2010).

The CSS guidance further required that aesthetic design treatments would:

- Support safety and mobility.
- Support communities and regional destinations by providing direct and subliminal messaging for gateways, connections, access, and identification.
- Maintain a sense of the greater whole.
- Respect the current time and place.
- Integrate with functional elements.
- Borrow materials from the landscape.
- Showcase key views while buffering inconsistent views.
- Include maintenance considerations and responsibilities (Colorado DOT 2010).

Evaluation Criteria

The ten evaluation criteria defined in Chapter 5 of this report were applied to the Colorado DOT VIA document.

Objective. The VIA procedure Colorado DOT used to evaluate impacts to visual resources and viewers on the I–70 is objective to a large extent. The procedure is an amalgamation of VIA procedures developed by USFS and BLM. It uses an explicit qualitative (or ordinal) measurement system to evaluate the visual character of the existing landscape, the sensitivity of viewers to change, and the impression viewers would have to changes in the landscape. However, it overtly emphasizes natural landscapes, following the focus of the two federal agencies for managing wilderness. It is unclear whether the evaluation of the existing condition includes the influence of the existing Interstate highway in the viewshed.

The VIA document provides only a limited discussion of cultural landscapes, and the interests of those viewers who use these wilderness landscapes for recreation are emphasized over the interests of viewers who use the corridor for other purposes. This results in a limited discussion of the relevant landscape characteristics of landscapes and viewers and reduces objectivity. Nonetheless, the process adopted by Colorado DOT uses specific visual management objectives both for wilderness and developed landscapes. It explicitly defines visual impacts as a measure of proposed change. It also uses a transparent and replicable VIA process.

Valid. Although the VIA for this project acknowledges the interest the public, federal land management agencies, and local jurisdictions have in maintaining or enhancing the perception of visual resources, it does not identify specific federal or state laws or regulations requiring that a VIA be conducted as part of the environmental documentation of state-managed highway projects. It does note that management practices of both USFS and BLM require the management of visual resources and notes that the lands potentially impacted by the proposed project have existing management plans for maintaining or enhancing visual resources and their perception by viewers.

For the I–70 corridor, Colorado DOT primarily was interested in evaluating scenic resources and justified that narrow approach to conducting a VIA by providing evidence that the majority of viewers were recreationists and that up to 1/3 of those viewers were purposefully visiting the corridor to see the scenery. Although not specifically addressed in the VIA document studied, it appeared to the research team that the assessment used expert opinions of what recreationists would prefer rather than expressed preferences of actual recreational viewers. Although dozens of viewpoints were selected for each landscape unit, the document did not specify how they were selected beyond general criteria related to resource interest and viewer sensitivity. This Tier 1 assessment did not use simulations, nor was it suggested that the Tier 2 project-specific studies would or should use visual simulations.

Reliable. Colorado DOT employed two VIA processes—one produced by USFS, the other from BLM—to assess and compare visual impacts caused by a range of alternatives. The use of USFS and BLM procedures to assess visual impacts caused by highway projects is atypical. For Colorado DOT, the use of this merged process was unique to I–70 where federal land dominates the corridor. Given that these procedures were prescribed and defined by years of their application to the management of wilderness areas, it seems reasonable to conclude that adequately and similarly trained professionals would reach similar conclusions. However, no independent checks of this assumption were made for this project. (BLM has tested the reliability of their process on their own projects, however.)

Precise. The VIA process adopted by Colorado DOT is very good at establishing baseline conditions. It has a thorough methodology for performing this task for existing conditions. The future condition without the project is treated like another alternative, however, not as the base from which to judge the build-alternatives. Simulations are not used as a way to infer and judge impacts. Viewsheds, particularly

the use of key viewpoints, are essential to the analysis but are amalgamated into landscape units, which form the basis for the assessment. For this project, relevant characteristics of the affected environment were documented using a narrative augmented with maps and photographs. Characteristics of the affected population were documented as a narrative. A GIS process was used during the analysis to determine the proximity of viewers to the proposed improvements. For a Tier 1 study, the determination and analysis of baseline conditions seemed adequately precise.

Versatile. The Colorado DOT process merges the VIA and visual management processes of USFS and BLM, which have a strong bias toward natural landscapes. Given this focus, it is unclear how a major structure such as an Interstate highway could be seen as a positive scenic element. In addition, the process almost exclusively focuses on the scenic attractiveness of the landscape to recreational users. Colorado DOT argues that this focus is appropriate for this corridor, tacitly acknowledging that the process might not be versatile enough to use in other locations. As used by USFS or BLM, however, the process has been shown to be sufficiently versatile to be applied to a wide range of ecological regions. Because the process has demonstrated applicability to such a wide range of natural settings, it would seem that, with some creativity, it could also be applied to less natural settings. The primary limitation on using this process more universally may be the lack of definitive aesthetic goals and visual quality management (VQM) practices for urban landscapes, not the process itself.

Pragmatic. This procedure was pragmatic for the I–70 corridor primarily because the adjacent property was almost exclusively under USFS and BLM management. These lands already had visual management goals and objectives assigned to them, making the analysis efficient. Training in how to conduct the USFS/BLM VIA process was not identified as an activity that Colorado DOT would provide to practitioners. According to the FPEIS, the person who prepared the visual resource section had 3 years of experience and the person who prepared the CSS section had 25 years of experience. It appears that only the section on mitigation strategies related to a CSS approach to corridor aesthetics and visual quality was particularly advantaged by the previous experience of its authors.

Understood Easily. Colorado DOT reported its findings in a manner that makes the VIA understood easily by the public and decision makers. Meeting this criterion is especially impressive for this project, given that up to 30 alternatives were being studied. Colorado DOT reported the findings of the VIA by county with a discussion comparing impacts by groups of visually similar alternatives. In the appendices to the report, the detailed analysis was presented by landscape unit. By developing a reporting structure that was sufficiently general and sufficiently detailed, Colorado DOT tailored its report to the varied needs of a wide and diverse audience.

Useful. As evidenced by the creation of a CSS manual with a section dedicated to corridor aesthetics, the VIA does appear to have affected design and mitigation decisions. As a significant component of the PEIS, it also appears to have been instrumental in the selection of a preferred alternative. Therefore, the VIA procedure and its application to I–70 appears very useful.

Implemented Consistently. Although BLM and USFS processes have been used repeatedly to manage federal lands, they have rarely been used on highway projects. Colorado DOT explains the use of this process because of the dominance of federal lands in the project corridor. Although this process has not been implemented consistently by Colorado DOT, it can be said that, as a process, it has been applied consistently to federal lands in Colorado and throughout the nation.

Legitimate. Legitimacy is enhanced by the use of USFS and BLM VIA processes on this particular project because of the amount of federal land involved. However, this is not a procedure normally used or recognized by Colorado DOT. Colorado DOT indicated that they incorporated local laws and regulations into the process, though it was not explicitly clear where or how this was done. To the extent that these policies, procedures, laws, and regulations are legitimate, Colorado DOT's procedure is legitimate.

Visual management objectives directly linked to visual resources and viewers are used in the VIA with the expectation that these objectives will be followed as design proceeds from a Tier 1 programmatic approach to Tier 2 project-specific implementation. Authors are not identified in the VIA. Authors are identified in the FPEIS; however, only the length of the authors' professional service is indicated. Information about the nature of authors' responsibilities and experience could have been helpful.

Summary

The use of USFS and BLM VIA processes appears to be an appropriate response by Colorado DOT for a project that traverses so much federal land managed by those two agencies. However, by abrogating the need to examine visual impacts with a process geared to the particular needs of a transportation agency, Colorado DOT seems to have inadvertently skewed its examination of visual impacts to scenic resources and the needs of recreationists. Although Colorado DOT apparently tried to overcome this bias by inserting a discussion of planning documents, ordinances, and other regulations of

local units of government, the result is still an emphasis on the views of neighbors who are dependent on tourists desiring pleasant views of scenery, including views of picturesque historic structures and quaint mountain villages. The visual quality needs of the average commuter are not analyzed and are not addressed, even though the percentage of commuters may approach nearly 50 percent of the traffic volume.

The process itself is thorough and requires a high level of effort. Given that the scenic and recreational value of the I–70 corridor is recognized nationally, and possibly internationally, utilizing such a process makes sense, especially given the geographic scope of the project. However, it will be instructive if the VIA process coupled with the mitigation strategies outlined in the Colorado DOT's CSS guidelines for the corridor provide sufficient detail to develop actual final design plans. It is anticipated that additional site-specific VIAs and VQM studies will probably be required as part of final design. If the Colorado DOT elects to continue its use of USFS and BLM methodology during final design, the emphasis on scenery and the visual needs of tourists will only be increased. The Colorado DOT makes no indication if it will continue on that path or if a more comprehensive approach will be incorporated into the Tier 2 final design process.

A summary of the evaluation criteria ratings for the I-70 Mountain Corridor project VIA appears in Table 6.1. A similar table appears in the summary of each case study.

6.1.2 Minnesota

Sources

Agency: Minnesota Department of Transportation (Minnesota DOT)

Table 6.1. Evaluation criteria ratings for the I–70 Mountain Corridor PEIS Visual Resources Technical Report.

Criteria	Rating
Objective	√√
Valid	√
Reliable	√√
Precise	√√√
Versatile	√
Pragmatic	√√√
Understood easily	√√√
Useful	√√√
Consistently implemented	√√
Legitimate	√√

Note: The more check marks given a particular criterion, the more that criterion is realized in the VIA examined.

Project: Trunk Highway 14 Mankato to Smiths Mill
Citations:

- Minnesota Department of Transportation (circa 1989). Draft Visual Impact Assessment Special Study. Technical Services Division, Environmental Services Section, in cooperation with District 7, Mankato.
- Minnesota Department of Transportation (circa 1989). Draft Environmental Impact Statement.
- Minnesota Department of Transportation (August 25, 2010). Highway Project Development Manual, Scoping, Subject Guidance, Visual Quality.

Web Addresses of Reviewed Materials: Reviewed materials are not available on-line.

Short Project Description

Highway. Trunk Highway 14 (TH 14) is a major cross-country highway passing through Illinois, Wisconsin, Minnesota, South Dakota, and Wyoming between Chicago and the east entrance to Yellowstone National Park in western Wyoming. Roughly parallel to Interstate 90, it connects several key southern tier cities in rural Minnesota which are not connected by freeway from Winona (on the Mississippi River) through Rochester, Owatonna, Mankato, and New Ulm in the center of the state before continuing through several small towns in western Minnesota.

Landscape Setting. Rural, fairly flat, Midwestern farmland corridor with a small suburbanizing hamlet in the center of it.

Viewers. Generic neighbors with views to the road and travelers with views from the road. Some attempt to identify special categories of viewers particular to the corridor and their needs, such as cemetery visitors.

Transportation Issue. Incorporated into the National Highway System in 1926, TH 14 had been considered for upgrading to a 4-lane freeway or expressway east of Sleepy Eye since the 1960s. A segment of freeway was constructed around the north side of Mankato during the 1970s. The section from Mankato east to Smiths Mill was intended to extend this 4-lane segment another 9 miles to the junction with Trunk Highway 60.

Proposed Solution. This project was to be the first step in completing a 40-mile, 4-lane upgrade connecting Mankato to I–35, the state's major north-south connector at Owatonna. This first phase, which was built in the early 1990s, was divided into western and eastern segments. The western segment was constructed as a freeway (controlled access,

4-lane highway with grade-separated interchanges) between Mankato and Eagle Lake. The eastern segment, east of Eagle Lake, was constructed as an expressway (controlled access, 4-lane highway with at-grade intersections).

Purpose of VIA. Contribute to alternative selection and identify needed mitigation.

Alternatives Examined. Various options from no-build to upgrading the existing route to four-lanes to several alternatives for a new route on a new but parallel nearby corridor.

VIA Procedures

In 1989, the TH 14 Mankato to Smiths Mill project was one of the first for which the Minnesota Department of Transportation (Minnesota DOT) conducted a VIA using its then recently developed six-step VIA process. The TH 14 VIA was one of several special studies conducted by the Minnesota DOT in advance of producing a Draft Environmental Impact Statement (DEIS) for the project. These special studies were developed by professional staff within the department.

The Minnesota DOT VIA procedure was in its formative stages and was not yet codified into Minnesota DOT's Highway Project Development Process (HPDP) manual when the TH 14 Mankato to Smith's Mill project VIA was conducted. In fact, the VIA process was being developed concurrently with the writing of the department's HPDP manual. Therefore, a few procedural differences exist between what became Minnesota DOT's official VIA process as documented in its HPDP manual and the VIA process used to assess visual impacts for the TH 14 Mankato to Smiths Mill project.

For this evaluation of the TH 14 Mankato to Smiths Mill VIA, the VIA process as defined in the HPDP manual will be referred to as the "HPDP VIA." The actual VIA document developed for this project will be called the "TH 14 VIA." The HPDP VIA represents Minnesota DOT's prescribed approach to conducting a VIA, while the TH 14 VIA represents how the approach was initially applied.

The TH 14 VIA describes the steps that are documented in the special study. However, for a more robust understanding of the process, it is still instructive to examine the HPDP manual to more fully comprehend the thinking behind the TH 14 Mankato to Smiths Mill VIA Special Study. By examining both, a better understanding emerges regarding Minnesota DOT's VIA process and how it was applied to this project. This evaluation will utilize both documents.

The TH 14 VIA was conducted as part of the project's preliminary design process to assess the visual impacts that would be caused by the project and to identify potential mitigation strategies. The TH 14 VIA examined several alternatives—no-build, reconstructed 2-lane, and several 4-lane options on new alignments—assessing, comparing, and documenting the impacts to visual resources, viewers, and visual quality caused by these alternatives.

The VIA process outlined in the HPDP has three distinct phases: Inventory, Analysis, and Design. A complete VIA, as defined by the HPDP VIA process, includes, and usually documents, all three phases. However, for this special study the level of documentation was purposefully left to the discretion of the VIA's author. The HPDP does not require that all steps, or even all phases, be reported in the VIA document. The TH 14 VIA labeled the three main phases of its assessment as "Inventory," "Analysis," and "Mitigation." The difference between what the HPDP VIA calls design and what the TH 14 VIA calls mitigation appears to be primarily a difference in labeling. The mitigation directives suggested in the TH 14 VIA Mitigation section are primarily instructions to final designers, although some of the directives also apply to the operation and maintenance of the roadway. Therefore, there is no fundamental discrepancy between the methodological phases found in the HPDP VIA and the TH 14 VIA.

Although all three phases of the HPDP VIA process were identified and were apparently used by Minnesota DOT when it produced the TH 14 VIA, no separate section in the document reports the first-phase inventory. The inventory is reported only by implication as part of the second-phase analysis. This complicates this evaluation of the TH 14 VIA and further justifies examining both the HPDP VIA and the TH 14 VIA simultaneously.

Phase 1—Inventory. The first phase of the VIA process as outlined in the HPDP is to conduct an inventory of visual resources, viewers, and existing visual quality. The inventory phase answers three of the six questions of Minnesota DOT's six-step VIA process. The first three questions of the HPDP VIA process are:

1. What visual resources will be affected by the proposed project?
2. Which viewers will be affected by the proposed project?
3. What is the existing visual quality of the project area?

The TH 14 VIA answered these three questions but did not document the answers in the same order in which they were asked. In fact, the documentation of the inventory phase did not occur as a separate section in the TH 14 VIA document, but rather was reported as part of the analysis of alternative alignments.

Although the discussion of impacts by alternative is typically the fifth step of Minnesota DOT's six-question VIA process, the HPDP VIA gives an author latitude in documenting the steps, suggesting that streamlining the reporting of the VIA is more desirable than a rote following of the HPDP VIA

methodology. Consequently the reporting of the inventory as part of the analysis should not be considered a failure to follow the prescribed procedure. In fact, it should be considered as following one of the overarching dictates of the HPDP VIA, to streamline documentation.

Step 1: Inventory of Visual Resources. As its first step, the HPDP VIA process asks and answers the question, "What visual resources will be affected by the proposed project?" This step defines the physical objects that compose the visible landscape as visual resources. It suggests that all visual resources can be assigned to one of three categories: natural visual resources, cultural visual resources, or project visual resources.

To be consistent within a single document and to provide continuity between all of Minnesota DOT's VIA documents, the HPDP VIA process suggests that authors retain fidelity to the three types of visual resources identified in the HPDP VIA. However, at the time of the development of the TH 14 VIA, only two categories of visual resources were being used by Minnesota DOT, natural and cultural. Probably since it was not a particular category to inventory at the time of the development of the TH 14 VIA, no project visual resources—except for one railroad overpass—were distinctly identified in the TH 14 VIA. This exception, which was cataloged as a cultural visual resource that was part of the corridor's railroad heritage, provided some of the most panoramic views to travelers.

As previously noted, the documentation of the inventory, including the documentation of visual resources, was woven into the TH 14 VIA as part of the analysis of visual impacts. As part of the analysis phase of the VIA, the documentation of visual resources included maps, photographs, and a narrative.

The locations and types of visual resources found in the project corridor were labeled on two rudimentary maps. The first map labeled the types and locations of natural visual resources. These included resources typical of a rural landscape—flat fields, wetlands, shelterbelts, native vegetation, lakes, ditches, streams, rolling terrain, tree farms. The second map labeled the types and locations of cultural visual resources which were also typical of a rural landscape—power lines and electrical substations, radio towers, commercial and industrial buildings, pipeline storage tanks, water towers, farmhouses, barns, churches, cemeteries, railroads, railroad trestles and overpasses, and townscapes.

The visual resources were also documented in the TH 14 VIA as labels on oblique aerial photographs. The photographs, on which the alignment of the alternatives had been drawn, illustrated not only the location and character of each visual resource, but also its proximity to each of the various alternatives.

The narrative describing visual impacts provided a thorough list of natural and cultural resources, identifying, describing, and documenting the character of visual resources by alternative for neighbors and by alternative and direction of travel for travelers. The narrative provided a description of the visual resources that were illustrated on the maps and photographs contained in the TH 14 VIA. By inventorying which visual resources were affected by which alternative, the narrative efficiently provided the reviewer and decision maker with the information needed to compare impacts to visual resources by alternative.

Step 2: Inventory of Viewers. The second step of the HPDP VIA asks and answers the question, "Which viewers will be affected by the proposed project?" This step defines viewers as the affected population. It divides viewers into two general groups: people who view the adjacent landscape from the road as travelers and people who view the road from the adjacent landscape as neighbors. Although the HPDP VIA allows for subdivision of both groups (travelers by mode of travel and reason for travel, and neighbors by land use), the TH 14 VIA used only the basic dichotomy, travelers and neighbors.

The HPDP VIA acknowledges the arbitrariness of dividing viewers into these two categories, noting that an actual person may, in the course of even a typical day, be both a neighbor and a traveler. The HPDP VIA suggests that the division of viewers into these categories and additional subcategories is only an analytical tool for understanding the visual preferences of "viewer groups." The HPDP VIA defines a viewer group as a collection of people with similar reasons for being in the vicinity of the transportation facility (e.g., land use for neighbors, or reason for travel or mode of travel for travelers). The HPDP VIA process eventually evolved into providing a description of the expectations and needs of the most frequently found viewer groups. Originally, however, these descriptions were based on the professional opinions of landscape architects who worked for the department and who based the descriptions on their conversations with social scientists in the department and outside academics, and on their experiences interacting with the public and regulatory agencies while conducting previous VIAs. These original descriptions, or "aesthetic preferences," are no longer used by Minnesota DOT.

By the time the TH 14 VIA was produced, however, the descriptions and visual preferences had become more general, referring only to travelers and neighbors. Travelers were defined as commuters typically concerned with maintaining existing landmarks that guide them to their destinations. Neighbors were defined as rural residents typically involved with agricultural production and primarily concerned with maintaining the existing rural character of the landscape. These visual preferences were established by the author of the report, providing a basis for evaluation of impacts that may be caused by the proposed highway project.

Step 3: Inventory of Visual Quality. The third step of the HPDP VIA asks and answers the question, "What is the existing visual quality of the project area?" As defined by the HPDP VIA process, visual quality is a product of the interaction between the viewer and visual resources. The Minnesota DOT defines visual quality as a transactional process—the idea that what people perceive (in this case, what they find visually pleasing or displeasing) is based on the many interacting environmental and psychological factors that form a person's experience. Perception is to be considered a system involving the inherent physical attributes of the landscape and the particular neurological and psychological nature of the viewer, particularly their visual preferences. Visual quality, the HPDP VIA process insists, cannot be isolated in the environment or in the viewer; rather, it is defined as the nature of the relationship between the visual resources and the viewer.

This relationship between viewers and visual resources is measured on three different dimensions: (1) natural harmony, (2) cultural order, and (3) project coherence. Moreover, each dimension can be measured using a simple binomial (Yes/No) scale. Natural harmony is defined by the relationship between a viewer and the corridor's natural visual resources. Viewers judge the natural harmony of the existing scene as being either harmonious or disharmonious. Cultural order is defined by the relationship between a viewer and the corridor's cultural visual resources. Viewers judge cultural order as being either orderly or disorderly. Project coherence is defined by the relationship between a viewer and the project's visual resources (in this case, the transportation facility itself). Viewers judge project coherence as being either coherent or incoherent.

These binomial scales recognize no ordinal gradations (such as very harmonious, slightly orderly, or partially coherent) between the two identified states. The author of the VIA is instructed to choose one state for each dimension (harmonious or disharmonious; orderly or disorderly; coherent or incoherent) and to avoid any descriptive modifiers.

The viewers' judgment is based on how closely the existing state of visual quality matches the ideal state desired by a particular viewer group. If the existing scene is judged to match viewer expectations and needs, the scene is characterized as being a positive visual experience, with the elements that compose the existing scene appearing harmonious, orderly, and coherent. If the existing scene is judged not to fulfill viewer expectations or needs, it is seen as being a negative visual experience, with disharmonious, disorderly, and incoherent elements composing the scene.

The HPDP VIA recognizes that different viewer groups may evaluate visual quality of the existing scene differently. It is also possible for a particular viewer group to consider one dimension, such as cultural order, as being positive or orderly, and another dimension, such as project coherence, as being negative or incoherent. The dimensions are independent. It is not necessary for all of the dimensions to be positive or negative for a particular viewer group. The author of a VIA is encouraged to identify and document such differences.

The HPDP VIA suggests that authors use only the three binomial scales listed in the HPDP VIA (harmonious/disharmonious; orderly/disorderly; coherent/incoherent) when describing existing visual quality. The HPDP VIA emphasizes the need to keep these terms distinct, implying that it is not appropriate to combine the three measures into a single measurement of existing visual quality, such as "high visual quality" or "low visual quality."

Although the TH 14 VIA did not document existing visual quality separately, it implied the state of existing visual quality by identifying changes that would be caused by the construction of the project. The VIA labeled these changes as being "beneficial" or "adverse" impacts to visual quality and recorded these distinctions in the second phase of the assessment.

Phase 2—Analysis. The second phase of the HPDP VIA process includes two more steps of Minnesota DOT's Six-Step VIA Process, Steps 4 and 5. Step 4 is an analysis of the types of impacts by view groups. Step 5 is a summary of that analysis which compares impacts by alternatives. The analysis phase answers questions 4 and 5 of the Minnesota DOT's six-step VIA process:

4. How does the proposed project affect existing visual quality?
5. How do different alternatives affect visual quality?

The TH 14 VIA reports the first five steps of the HPDP VIA process as a narrative, supplemented with maps and photographs. Although the VIA does not document each step separately, it thoroughly describes each step with what is an appropriate level of detail for determining the presence of existing visual resources (Step 1), the types of viewers (Step 2), existing visual quality (Step 3) and changes to existing visual quality (Step 4), essentially reporting these first four steps as a discussion of impacts by alternative (Step 5). Interestingly, the TH 14 VIA conducts and documents its evaluation not only by alternative but by direction of travel, recognizing that direction of travel affects not only the sequencing of perception but in some cases the actual ability to see something. Analyzing impacts by direction of travel is not required by the HPDP VIA process but is, nonetheless, an effective addition to the TH 14 VIA.

Step 4: Identify Impacts to Visual Quality. For Step 4, determining visual impacts by viewer group, the HPDP VIA suggests that visual impacts need to be identified first by type and then by degree of impact for each viewer group. Visual impacts can be assessed for each viewer group independently, but the reporting is typically done by creating a composite

viewer. This composite viewer can be referred to generically as the "affected population."

A composite viewer is an abstraction. It has the complete range of all of the sensitivities that are attributed to all viewer groups. It is an amalgamation that combines all viewer groups into a single viewer group or, more typically, two viewer groups—neighbors and travelers. The concept is premised on the idea that all viewers belong to more than one viewer group. Each viewer and each population of viewers are actually composite viewers.

The TH 14 VIA generally refers only to travelers and neighbors. Nonetheless, it also identifies several distinct viewer groups beyond those two (e.g., cemetery visitors and business neighbors) and examines how a particular alternative would specifically affect their viewing experience.

In determining the type of impact, the HPDP VIA defines impacts to visual quality as changes that the proposed project will cause to existing visual quality—that is, changes to natural harmony, cultural order, and project coherence. Despite pre-dating the final development of the HPDP VIA, the TH 14 VIA follows this formula with a high level of fidelity.

Once the type of impact has been identified, the degree of impact is determined for each viewer group. The degree of impact to visual quality is defined by the value of the impact, measured as being beneficial, adverse, or neutral. The degree of impact to visual resources is defined by the scale of physical changes to visual resources, measured as being either minor or major. The degree of impact to viewers is defined by the extent of impacts to viewers (essentially the number of viewers and views affected by the project) and measured as being either localized or widespread. Although these three dimensions define the nature of the visual impact and they are interrelated, there is no absolute correlation between them; they are independent variables.

The value, scale, and extent of an impact is determined by the professional judgment of the VIA author. Except for public and agency feedback on the VIA itself, the HPDP VIA process does not measure dimensions by actual viewers. It does, however, suggest that the public should be involved in the measurement process on complex or controversial projects.

The TH 14 VIA reflects the professional judgment of a staff landscape architect, with limited comments from other Minnesota DOT professionals. Its measurements are limited primarily to impacts to existing visual quality.

Step 5: Summarize Visual Impacts by Alternative. For Step 5, the TH 14 VIA lists the visual impacts by alternative but does not provide a comparative summary of impacts by alternative. The list of visual impacts in the TH 14 VIA is extensive and complete, including those that affect visual quality, visual resources, and viewers. However, the analysis is presented primarily as a narrative augmented by a map and photographs that depict visual resources and alternative alignments and the VIA does not include a comparative summary of impacts by alternative. A summary comparing impacts does occur in the TH 14 Mankato to Smiths Mill Draft Environmental Impact Statement (TH 14 DEIS). Therefore, the HPDP VIA requirements for Step 5 to provide a summary of visual impacts by alternative was completed as part of the project's environmental process. It would have been preferable, however, to have included this analysis in the actual VIA.

Phase 3—Design. The third phase of the VIA process uses the analysis of impacts to determine how visual quality in the project area can be (1) maintained by mitigating adverse impacts or (2) enhanced by ensuring the inclusion of beneficial impacts. In the third phase, the sixth question of the Minnesota DOT six-step VIA process is asked:

> 6. How are adverse visual impacts mitigated and beneficial impacts incorporated into the proposed project?

The HPDP VIA defines three types of impacts to visual quality: adverse, beneficial, or neutral. The design phase includes developing design concepts that mitigate adverse impacts or incorporate opportunities to include enhancements to visual quality created by beneficial impacts. Mitigation avoids, minimizes, or compensates for adverse impacts to visual resources or to the views of viewers. Enhancements are additions to the project (beyond those typically included in a transportation project) that improve visual quality by enhancing visual resources or the view for viewers.

Mitigation of Adverse Impacts. Avoidance is the preferred mitigation practice. It typically means selecting the alternative which has the fewest inherent adverse visual impacts to visual resources and viewers. Avoidance is difficult to achieve in practice because adverse impacts to one visual resource or viewer group may be neutral or even beneficial to another resource or viewer group. Frequently, regardless of which alternative is chosen, adverse visual impacts increase for some resources or viewers and decrease for others.

Minimization is used when avoidance is not possible. Typically, minimization means that the project has been designed in a manner that lessens unavoidable adverse impacts. Minimization is usually possible in practice by saving, to the greatest extent possible, those visual resources or views that the affected population values highly.

Compensation is required when minimization and avoidance are insufficient to maintain existing visual quality. Compensation is the addition of elements that replace or substitute for visual resources or views that were lost as part of the project. Compensation is mitigation and should not be confused with enhancements, according to the HPDP VIA. If avoidance and

mitigation inadequately rectify adverse impacts, compensation is required.

Professional judgment is typically used to make a decision on how to mitigate adverse impacts, although public involvement is preferable.

Enhancements Incorporating Beneficial Impacts. Although they may be good public policy and a good social, economic, or environmental investment, enhancements are optional. Specific transportation enhancement funds may be available to partially fund an enhancement, but enhancements frequently include investment by organizations not receiving funds directly from a department of transportation. The identification of enhancement opportunities in a VIA alerts potential partners to the prospect for improving particular visual resources or views as part of the transportation project. Identifying such opportunities provides a mechanism for other organizations to leverage their capacity for improving resources and views.

For the TH 14 VIA, enhancements were limited to visual improvements of adjacent wetlands, creating views of selected cultural resources, and integrating park and ride lots into the construction of the roadway.

Evaluation Criteria

Objective. The HPDP VIA guidance uses an explicit, nominal method for measuring the qualities of the landscape. This nominal method establishes a set of distinct and objective categories from which an author of a VIA can choose for defining existing visual resources, viewers, and visual quality. It also establishes distinct and objective categories for defining impacts to visual resources, viewers, and existing visual quality that would be caused by the proposed project.

Visual resources are divided into three categories: natural, cultural, or project resources. Viewers are divided into two categories: travelers or neighbors. Visual quality, which is a product of viewers interacting with visual resources, is defined on three dimensions: natural harmony, cultural order, and project coherence. Natural harmony is categorized as being either harmonious or disharmonious; cultural order is either orderly or disorderly; and project coherence is either coherent or incoherent.

In a similar manner, impacts to visual resources are categorized as being major (involving many or large resources) or minor (involving few or small resources). Impacts to viewers are categorized as being widespread (involving many people) or localized (involving few people). Impacts to visual quality are categorized as being beneficial (adding to visual quality), adverse (subtracting from visual quality), or neutral (no change to visual quality).

The HPDP VIA assumes that the selection of categories should be obvious and consistently assigned regardless of personal bias. It provides guidance on how to best differentiate between categories where defining the division may be fuzzy. It particularly impresses the importance of consistently categorizing the same element across all Minnesota DOT documents. (As an example, a pasture arguably comprises both natural and cultural visual resources. *How* it is defined is less important than that it be *consistently* defined within the VIA document and, subsequently, across all of the Minnesota DOT's VIA documents.)

The HPDP and the Minnesota DOT VIA training originally gave guidance for differentiating categories of visual resources and viewers that had fuzzy boundaries. To ensure greater consistency, this guidance has now been modified, the training film is no longer available on-line, and the teaching of the VIA process has been replaced by training in CSS and VQM.

The TH 14 VIA divided the environment into natural and cultural resources. It identified travelers and neighbors. It implied a baseline for existing visual quality by stating how visual quality may change as a result of the construction of a particular alternative. It did not, however, identify the actual baseline for visual resources, viewers, or visual quality. Nor did it document how the baseline was determined. The baseline is merely implied in the section describing project impacts.

Although the TH 14 VIA documented impacts, it did not adequately document the existing status of visual resources, viewers, or visual quality. The HPDP VIA clearly indicates that baseline conditions for visual resources, viewers, and visual quality need to be established. By using distinct and distinguishable categories for visual resources, viewers, visual quality, and impacts to visual quality, it provides a replicable, objective process. However, it does not require that these baseline conditions be recorded in the project VIA.

At the time of the writing of the TH 14 VIA, the Environmental Studies Unit and its landscape architects, who were part of the Minnesota DOT's Office of Environmental Services, were responsible for administering the department's VIA process. Today, under a new administrative arrangement, a VIA is rarely required. Visual issues are discussed in the general environmental documents for a project, but without a VIA being conducted.

Valid. The HPDP VIA guidance thoroughly lists the laws and rules that provide the legal basis for requiring the assessment of visual impacts for Minnesota DOT projects. It particularly states that the Minnesota DOT VIA process was developed in response to NEPA requirements. These mandates were not referred to in the TH 14 VIA document, which potentially reduces that document's appearance of validity. Project VIAs produced by Minnesota DOT since the formal

implementation of the HPDP VIA process have tended to identify these legal obligations.

The Minnesota DOT VIA process does not limit its analysis to what appears scenic or natural. It does not solely rely on art or design tradition. In practice, however, it relies almost exclusively on expert opinion. Although it incorporates viewers and viewer responses into its determination of existing visual quality and impacts, it rarely uses the actual public to ascertain these responses or other existing conditions or impacts. The reliance on a single expert's opinion, rather than that of a group of experts, can exacerbate the potential for an idiosyncratic approach. The public's role is relegated to responding to a VIA, not participating in its creation. Involvement of the public or other agencies is limited to commenting on the lone expert's assumptions and findings. The potential of the Internet or other methods for gathering information from the public or other constituents is typically not utilized.

Separately conducted research supports what and how the HPDP VIA measures in relation to visual impacts (Colorado DOT 2010); however, this approach misses the opportunity to discover if what the public thinks about a particular corridor and project differs from or coincides with the opinions derived by the designated authors of the VIA. Although the research that led to the HPDP VIA process has influenced Minnesota DOT's understanding of what is valued by viewers, the public information-gathering technique used in that research is rarely applied to individual projects.

In the past, the Minnesota DOT has used simulations as part of its VIA process. This also was done in a rudimentary way in the TH 14 project to make location decisions, and it has been done on other projects for structural decisions. Currently, simulations are typically used as part of Minnesota DOT's VQM process as a method for determining the aesthetic details of landscaping or architectural treatments of structures.

Reliable. The Minnesota DOT has established a process that is reliable by creating a procedure by which an adequately trained professional will typically identify the same visual resources, viewers, visual quality, and impacts as any other adequately trained professional. The results are generally replicable, and the most extreme negative effects are identified. However, since the VIA process does not require documentation of the process and proof that the process has been followed, it is frequently not known if the process was followed accurately. The TH 14 VIA did not document all of the steps used to assess visual impacts. Therefore, it is difficult to know it the HPDP VIA process was adequately followed.

In addition to these reporting difficulties, the VIA process currently available on-line for guidance is missing a few key components, such as a listing of the aesthetic preferences of selected viewer groups, which is critical in analyzing impacts to existing visual quality.

Although the use of objective binomial variables promotes replicability during the inventory and analysis phases, reliability depends on training and expertise in the use of the process. Furthermore, results may be more variable for identifying required mitigation and enhancement opportunities. Advanced design skill or more design experience may result in one VIA author identifying better mitigation options and more enhancement opportunities than another author. To support reliability, the HPDP VIA guidance provides categories for the author to consider when developing mitigation and enhancement strategies, guiding different authors to identify similar strategies. Nonetheless, the third phase of the HPDP VIA process—design—is the phase that is most subject to variability due to the experience and knowledge of a VIA's author.

Precise. The level of precision appropriate for a Minnesota DOT VIA process is inherently related to the extent of the project. The process works well for large, complex projects and for small, simple projects. The level of detail used to record the inventory or analysis of a particular category of visual resources, viewers, visual quality, and visual impacts can be adjusted to fit the project scope.

In an attempt to streamline documentation, the Minnesota DOT VIA process does, however, allow VIAs to record only the findings of impacts, not the process that was necessary to reach the findings. In other words, a VIA document may not record all six steps that were followed to reach its findings. This limits others' ability to review the process for errors or omissions. The TH 14 VIA, for example, only reported impacts, which limits the ability to review whether the process adequately identified baseline conditions for visual resources, viewers, and existing visual quality.

How and when to use simulations is generally identified by the HPDP VIA guidance, which includes a suggestion that a wide range of techniques can be employed, depending on the circumstances. Specific methods for choosing the most appropriate locations, season, and time of day for images to be used as a basis for simulations is not included in this advice, however. The TH 14 VIA used an appropriate level of simulation for determining locations, which were the focus of the DEIS.

Versatile. The Minnesota DOT's VIA process is inherently versatile since it is premised on first identifying the visual resources and viewers affected by the proposed project. It is not dependent on a certain range of visual resources or viewers to be effective. However, it does create only three types of categories for resources (natural, cultural, and project) and only two general categories for viewers (travelers

and neighbors), and the small number of categories may limit versatility. Nonetheless, within those general categories, subcategories can be created by the VIA author, fostering versatility.

In addition to being applied to the rural and small-town settings of the TH 14 VIA, the Minnesota DOT's VIA process has been applied to projects in a wide range of settings, from wilderness settings to the urban core of metropolitan areas. The process also has been used on a wide range of transportation project types, from adding turn lanes to an existing roadway to the construction of a new freeway on new alignment. It also has been used for non-transportation projects, including assessing the visual impacts that would be caused by the construction of a dam on a tributary of a national scenic river in Ohio.

Pragmatic. The Minnesota DOT's VIA process is designed to be used easily by any adequately trained professional and can be understood readily by decision makers, regulatory authorities, and the general public. Although in practice it has been primarily the domain of trained, on-staff landscape architects, the on-line directions for how to conduct a VIA potentially allow anyone to prepare a VIA for Minnesota DOT. Consulting landscape architects or planners and on-staff preliminary engineers or planners have conducted VIAs in the past 2 decades following the Minnesota DOT process. An introductory training session was originally regularly given as part of Minnesota DOT's environmental or CSS training programs. At the request of FHWA, this classroom introductory session was converted into a video tape that was distributed nationally to each state's department of transportation and was also available on-line until recently. A few states—notably Ohio—adopted the process.

Although the on-line directions for how to conduct a HPDP VIA still exist, they have been edited and certain critical concepts, especially those differentiating viewer groups, have been removed. The VIA process is no longer part of any Minnesota DOT training program. Training on how to handle visual issues has switched from an analysis of impacts to creating opportunities for improving corridor aesthetics through a stakeholder involvement process. This process, called visual quality management (VQM) and administered primarily by Minnesota DOT's Bridge Office, focuses almost exclusively on determining the aesthetic detailing of bridges, retaining walls, and noise walls.

Environmental documents now typically state that visual issues will be resolved as part of a CSS and public engagement process during the development of construction documents. In practice, this has narrowed the focus of visual issues to determining planting designs and architectural detailing of structures.

Understood Easily. The six-step VIA process, with each step based on answering six simple questions, is understood easily by practitioners, decision makers, regulators, and the public. At a minimum, in this particular case, it seems to have affected decision makers.

The phrasing of the six questions may seem to ask for an opinion rather than a statement about how a person engages the environment. (For example, the training video suggests that the question associated with Step 3 is "What do viewers like and dislike about the existing scene?") Although they are easily understood, if the questions that form the basis of the VIA process suggest that answers are merely opinion, they may create confusion and actually undermine the intellectual basis for the VIA process. Rephrasing the questions could be helpful in avoiding that pitfall.

Useful. The Minnesota DOT process has proved itself helpful in identifying preferred locations and alternatives, particularly the avoidance, minimization, and compensation of adverse impacts to visual resources, viewers, and visual quality. It has also been useful in identifying potential opportunities for enhancing visual quality by incorporating impacts beneficial to the experience of visual quality into Minnesota DOT projects. However, the practice of reporting only if a project will cause impacts to designated scenic resources in the department's environmental documents may have reduced the standing of the VIA process, which is still theoretically required by the department.

Implemented Consistently. The Minnesota DOT VIA process as established by the HPDP was still under development at the time of the TH 14 project. The evaluation of consistency for the TH 14 VIA had to be inferred, given that none of the first four steps of the HPDP VIA process were recorded in the TH 14 VIA document. Although the TH 14 VIA essentially followed the concepts of the Minnesota DOT process to assess visual impacts, it did not use the category "project visual resources" and that omission may have limited the discussion of visual resources associated with the highway. Also, in examining impacts in both directions of travel, the TH 14 VIA varied from the HPDP guidance. However, the innovation actually yielded a more thorough discussion of visual impacts, and suggests a path that was not taken when the process was codified by the Minnesota DOT.

Today, consistent use of the HPDP VIA process is not mandatory. Increasingly, Minnesota DOT's VQM process is substituted for conducting a VIA. However, the VQM process focuses on public involvement in generating solutions to a very limited set of design issues that relate to architectural treatments of walls and bridges and planting design. The VQM process may lack the ability to discern impacts and

identify opportunities for avoidance, minimization, compensation, or enhancement.

Legitimate. Legally, the Minnesota DOT VIA process was developed in response to the requirements of NEPA, several presidential Executive Orders, and FHWA policy guidelines. Scientifically, it was formulated from an understanding that the perception of the environment and visual impacts needed to be broader in its approach than merely using an artistically picturesque approach to aesthetics. The process recognizes that a picturesque approach may satisfy tourists in a scenic wilderness setting but would fail to identify impacts that would concern the majority of travelers, especially the average commuter.

The TH 14 VIA does not identify its legal or scientific pedigree. The HPDP VIA guidance does a good job of identifying the legal basis of the process but is less forward in establishing its scientific basis.

Summary

The Minnesota DOT VIA process uses a nominal measuring system to inventory, analyze, and mitigate visual impacts. It also identifies enhancement opportunities. The process does a fairly good job of identifying visual resources, viewers, existing visual quality, and visual impacts. The use of categories is legitimate and expedites the inventory and analysis. However, clarifying the domains of these categories is critical to the success of the process. Definitions that used to be in the HPDP VIA guidance but that have been removed over the last 20 years need to be restored using the latest research available for establishing scientifically valid categories. Similarly, training needs to be updated and regularly offered to practitioners writing, reviewing, or simply reading VIAs.

The questions that form the basis of the DOT's unique six-step VIA process could be phrased in a manner that does not insert subjective opinion into the assessment of visual impacts. The six questions must be aligned with the premise that particular viewers have distinct visual preferences based on their relationships with visual resources, particularly as these relationships relate to their objective needs and expectations.

It is suggested that language addressing the legal requirements for conducting a VIA be incorporated into Minnesota DOT policy and procedures, including language that strengthens the enforcement of those requirements. A VIA must be conducted for any project requiring an environmental review. Conducting a VIA is not optional; it is a required part of federal environmental documentation.

Public involvement in the Minnesota DOT VIA process could be re-imagined. The current process is based on objective relationships between abstract viewer groups and visual resources rather than on the opinions of actual viewers. Nonetheless, it is important to develop a way for the public to become involved with defining the general aesthetic preferences of viewer groups and/or become involved with a VIA being conducted for an individual project.

The use of maps, photographs, and simulations is a key part of taking inventory and analyzing visual impacts, and is critical to formulating mitigation and enhancement strategies. The HPDP should continue to suggest the use of these tools in assessing visual impacts.

Maintaining document consistency is important. Rather than perpetuate a uniform approach to conducting a VIA in its HPDP manual and re-instituting a VIA training program, the DOT could re-establish the primacy of a single office with staff dedicated to overseeing the use of the Minnesota DOT VIA process.

Responding to the findings in *NCHRP Report 741* will help the Minnesota DOT fulfill all ten criteria for an effective VIA process. A summary of the evaluation criteria ratings for the HPDP VIA guidance appears in Table 6.2.

6.1.3 Vermont

Sources

Agency: Vermont Agency of Transportation
Project: Champlain Parkway
Citation: Jean E. Vissering (2011). Champlain Parkway Assessment of Visual Impacts. City of Burlington, Vermont.
Web Addresses of Reviewed Materials: Federal Highway Administration, Vermont Agency of Transportation, and City of Burlington (2009). Southern Connector/Champlain Parkway Project, Chittenden County, Vermont, Final Supplemental EIS (FHWA-VT-EIS-77-02-FS). Available at: http://www.

Table 6.2. Evaluation criteria ratings for the HPDP VIA guidance.

Criteria	Rating
Objective	√
Valid	√√
Reliable	√√
Precise	√√√
Versatile	√√√
Pragmatic	√√√
Understood easily	√√
Useful	√√
Implemented consistently	√
Legitimate	√√

Note: The more check marks given a particular criterion, the more that criterion is realized in the VIA examined.

champlainparkway.org/_resources/documents/2009FSEIS/FSEIS.pdf. Accessed (August 22, 2012).

Short Project Description

The Burlington Belt Line was proposed in 1965 as a freeway running the entire length of the city. The northernmost segment was funded and built in 1971; however, the remainder became bogged down in right-of-way acquisition, lack of funding, and concerns with residential displacement in the Old North End neighborhood. A revised Southern Connector was approved in 1979 for a 4-lane arterial street with at-grade intersections linking Burlington's city center to Route 7 and I–189. Construction began, but was halted due to the unanticipated extent of hazardous waste contamination in the right-of-way. Remediation and interim alternative routes were explored through the 1980s, but public opposition to these plans began to surface and grew through the 1990s. In response, the City of Burlington investigated additional options, referred to as the Champlain Parkway, including a 2-lane at-grade route that avoided the Superfund site. The objectives of the redesigned proposal were (1) to remove trucks and through traffic from residential streets, and (2) create a better fit with adjacent neighborhoods by using only 2 lanes, narrowing lane widths, lowering design speed and speed limits, improving the streetscape, and providing for safe pedestrian crossings. Numerous public meetings were held in the 2000s, leading to various adjustments. A DEIS was prepared in 2006, the Final Environmental Impact Statement (FEIS) was submitted in 2009, and a Record of Decision was made in 2010.

The 2009 FEIS briefly describes the affected visual setting and visual impacts, but it does not reference a VIA or identify the procedures that were used to evaluate visual impacts. However, the City of Burlington commissioned a separate VIA to fulfill the requirements of Vermont's Act 250, known as the Land Use and Development Act. It is this VIA that is reviewed here.

VIA Procedures

The VIA is intended to address Criterion 8 of Vermont's Act 250, which requires that projects "not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites, or rare and irreplaceable natural areas (10 V.S.A § 6086(8))."

The procedure to determine if an aesthetic effect has an "undue adverse effect" was defined by the State Environmental Board's 1985 Quechee Lakes Decision (*Quechee Lakes Corporation.* #W04-110A-EB (11/4/85)). Called the "Quechee Lakes test" or "Quechee Analysis," this assessment has two parts: (1) determination of whether an aesthetic effect is adverse and, if so, (2) determination of whether the adverse effect is undue. The Quechee Analysis may be unique in the United States as the only VIA procedure defined primarily through court order.

Under the Quechee Analysis, the standard for assessing whether a project has an adverse scenic effect is its harmony and fit with its surroundings. If a project fits with its context, it will not have an adverse effect. The elements considered in the determination of whether an effect is adverse are the context of the surrounding landscape; the project design, color, and materials; the project visibility; and effects on open space.

Once an effect has been defined as adverse, one of the following three questions must be answered affirmatively for the adverse effect to be considered undue:

> "1. Does the project violate a clear written community standard intended to preserve the aesthetics or scenic natural beauty of the area?
>
> "2. Does the project offend the sensibilities or the average person . . . when viewed as a whole is (it) offensive or shocking, because it is out of character with its surroundings, or significantly diminishes the scenic qualities of the area?
>
> "3. Has the applicant failed to take generally available mitigating steps which a reasonable person would take to improve the harmony of the proposed project with its surroundings?" (Vermont ANR 2007).

Evaluation Criteria

Objective. A Quechee Analysis is typically qualitative in nature, and is frequently the work of a single landscape architect. The court has provided ample description of the standard and criteria, though there are no established procedures for how to measure or document them and no thresholds for evaluating them. This ambiguity appears to be more of a problem for determining whether the impact is adverse; the two criteria for determining if it is undue (i.e., violating a clear community standard, and taking generally available mitigation steps) are relatively straightforward. However no method is suggested for determining if the impact is shocking or offensive to an average person. In practice, a Quechee Analysis typically presents a rationale built around descriptive text and photographs that address the Quechee criteria. It is normal that landscape architects representing the different parties will provide different descriptions and reach different conclusions.

In the case of the Champlain Parkway VIA, the project description and determination of adverse effects are brief and straightforward. It is accepted that the impacts will be adverse, though limited justification is given for this judgment. In considering whether these impacts are undue, substantial documentation is provided to show how the project fits with local standards and the extent to which the impacts

have been mitigated. However, that the change will not be shocking to typical viewers is less well supported. For example, reference could have been made to comments made at the several public meetings, or an independent survey could have been conducted. Instead, the primary reasoning is that the project has been under development for decades; therefore, how could anyone be shocked?

Valid. The Quechee Analysis evaluates the harmony and fit of a project with its surroundings. The criteria seem to be reasonable for this purpose, though no peer-reviewed research has ever been presented to justify the approach. However, the assumption appears to be that harmonious fit results in no scenic impact, which is the standard for Act 250's Criterion 8. This may not be adequate in situations where there is agreement that scenic quality needs to improve, or that a land use change is desirable.

The Champlain Parkway VIA presents a cogent description of the project and its setting, but lacks a justification for its determination of adverse scenic impacts. No process of synthesis or determination of thresholds is identified. The discussion of congruence with written community standards and reasonable mitigation are adequate, but the determination that the project will not be shocking or offensive to average viewers is not strongly justified.

Reliable. Experience with the Quechee Analysis indicates that trained professionals can reach very different conclusions, in part because there are no explicit, unambiguous procedures. While no evaluation has been conducted of the Quechee Analysis' reliability, it is reasonable to expect that landscape architects representing the developer and opponents could reach very different conclusions after evaluating the same criteria.

The landscape architect responsible for conducting the Champlain Parkway VIA is identified in the document. It appears that the VIA fieldwork, analysis, and reporting are the work of one individual. There is no discussion of whether the VIA is a reliable assessment, however, or whether it should be considered the professional opinion of a single landscape architect.

Precise. The Quechee Analysis provides no guidance for making measurements, and as a result there is no discussion of the appropriate grain or scale at which to conduct the assessment.

The length of the Champlain Parkway is approximately 2.3 miles. The VIA divides the corridor into three segments, each of which represents an area of relatively homogeneous use and visual character. Based on the descriptive text and the reviewer's familiarity with the corridor, the grain and scale of this analysis are very appropriate. Residents appear to be the only viewers considered, though clearly there will be travelers using this route. While various viewpoints are mentioned, there is no systematic evaluation of any specific viewpoints.

Versatile. The Quechee Analysis applies to commercial or industrial construction on more than 10 acres of land (1 acre in towns with appropriate subdivision and zoning laws), subdivisions with ten or more residential units, or roads that are 800 feet long or provide access to five or more lots. Even though this applies to a very broad range of projects, in practice the Quechee Analysis has been successfully scaled to reflect the magnitude and significance of the potential scenic impacts. Part of the credit for this is due to the Environmental Court, which has recognized the need for a procedure that is appropriate to the circumstances encountered. However, the descriptive and qualitative nature of the Quechee Analysis also contributes to its flexible versatility.

Pragmatic. Pragmatism can be thought of as the interaction of two factors: sophistication of knowledge and reasonableness of cost. This VIA appears to have been prepared by one individual with familiarity of the study area. From this standpoint, the VIA appears to have been very cost effective.

On the other hand, the only specialized VIA analysis is the inclusion of three photosimulations; there are no visibility maps, interviews with randomly sampled viewers, or measurements of visual qualities associated with scenic quality or impact. The level of sophistication of this VIA is modest, but the VIA still thoroughly addresses the criteria to determine whether the impacts are undue or merely adverse.

Understood Easily. This criterion involves the interaction of public involvement and their understanding of the project. The VIA makes only one mention of public comments (concerning sound barriers), even though dozens of public information meetings were held in the past decade to provide the public opportunities to learn about and comment on the project. Since there is no on-line record of what transpired at these meetings, it was not possible to determine if scenic impacts were not an issue or if they were being ignored.

The text describing the scenic impacts and mitigation employed for each segment of the project are clearly descriptive and easily understood. A photo essay that describes the visual character of each segment and three eye-level simulations are included as appendices to the VIA. Finally, the text is noticeably absent of jargon and there are no esoteric analyses.

Useful. A Quechee Analysis requires a thorough and systematic consideration of the three factors thought to create an undue scenic impact: violation of a clearly written community standard, being shocking or offensive to an average person, and failure to take generally available mitigating steps to improve the harmony of the project with its surroundings.

This focus on specific criteria rather than an abstract analysis is one of the reasons that the Quechee Analysis is useful.

The process of environmental review has significantly changed the Burlington Beltway as it has evolved in response to environmental conditions and public concerns into the Southern Connector and finally the Champlain Parkway. The reviewed VIA appears to have been prepared after the FHWA Record of Decision was signed, so it could not have been involved in that decision. However, it will be part of the State's Act 250 review, which is also required and still under review.

Implemented Consistently. One of the strengths of the Quechee Analysis is that it provides for judgment about how to address the criteria based on the magnitude and significance of the potential scenic impact. As a result, specialized analyses, such as viewshed maps and photo-realistic simulations, are prepared for larger projects but not required for smaller ones. Similarly, alternatives may be evaluated for controversial projects but are not required. Though the standards and criteria are the same for every Quechee Analysis, they are not consistently addressed in the same way or with the same rigor for projects with very different potential scenic impacts.

A moderate level of rigor is used in Champlain Parkway's Quechee Analysis. For instance, the five criteria used to determine whether the scenic impact is adverse are not systematically considered one at a time. As a result, color and materials are not really considered, and compatibility with the surroundings and areas with visibility of the projects are addressed in a very general way. This seems appropriate, however, for a project where the controversy surrounds how to direct traffic intensity rather than the scenic impacts per se.

Legitimate. The Quechee Analysis was established by judicial case law to clarify the provisions of Act 250. It is required for all but very small development projects in Vermont. After more than 25 years of experience with this approach, it has come to be widely accepted as legitimate by developers, environmentalists, and the wider public. It is generally accepted that smaller developments, such as a new church on a 1-acre parcel, will be required to prepare a modest descriptive VIA. On the other hand, projects with a greater potential for scenic impacts, such as wind energy developments, require lengthy VIAs that rigorously address all of the Quechee Analysis criteria and include visibility maps and photo-realistic simulations to be considered complete. The rigor of the Champlain Parkway VIA is appropriate to the level of concern about the potential scenic impacts.

Summary

Vermont's Act 250 requires that the environmental effects of all development projects larger than 10 acres evaluate potential environmental impacts. The approach to evaluate scenic impacts has been specified through judicial review, and is known as the Quechee Analysis. It is based on a series of questions that are used to determine if the scenic impact is adverse, and then if an adverse impact is also undue. While these questions do not preclude sophisticated quantitative analyses, it is more typical that they are answered through qualitative descriptions that are understood easily by the public. This approach has proved to be very versatile and pragmatic, generally resulting in a level of rigor and sophistication appropriate to the magnitude and significance of the potential scenic impact. However, the individual nature of the qualitative description and lack of standard measurements tends to reduce the objectivity and reliability of the analysis. A summary of the evaluation criteria ratings for the Champlain Parkway VIA appears in Table 6.3.

Table 6.3. Evaluation criteria ratings for the Champlain Parkway VIA.

Criteria	Rating
Objective	√
Valid	√√
Reliable	√
Precise	√√
Versatile	√√√
Pragmatic	√√√
Understood Easily	√√√
Useful	√√
Implemented consistently	√√
Legitimate	√√√

Note: The more check marks given a particular criterion, the more that criterion is realized in the VIA examined.

6.1.4 Washington State

Sources

Agency: Washington State Department of Transportation (Washington State DOT)
Project: US 2 – West of Leavenworth – Slope Stabilization Project
Citation: Visual Discipline Report, US 2 – West of Leavenworth – Slope Stabilization Project, Washington State Department of Transportation, September 2010.
Web Addresses of Reviewed Material: http://www.wsdot.wa.gov/publications/fulltext/roadside/Leavenworth.pdf.

Short Project Description

Highway. The Stevens Pass Scenic Byway is a 3-mile segment of a 2-lane arterial highway serving cross-state and

cross-country travel connecting Spokane with the Seattle metropolitan area.

Landscape Setting. The landscape setting is a narrow mountain pass through the alpine wilderness of Wenatchee National Forest in the Northern Cascade Range adjacent to the Wenatchee River, designated under the Wild and Scenic River Act as a federal recreational river.

Viewer Groups. Two major viewer groups were identified: tourists and "business travelers." Tourists frequent the corridor in both summer and winter. Business travelers are primarily commuters going to and from work, also throughout the year.

Transportation Issue. Falling and fallen rock create hazards for motorists and damage the highway.

Proposed Solution. The proposed solution involves stabilization using a combination of shotcrete, rock anchors, and cable netting to constrain and control loose rock from falling on the highway. Moving the road out of harm's way and widening the ditch to better serve as a catchment area was determined not to be a practical alternative due to the physical and regulatory constraints.

Purpose of VIA. This VIA evaluates and compares visual impacts associated with alternative stabilization methods to determine a set of preferred methods and mitigation measures.

VIA Procedures

The Washington State DOT considers the assessment of visual impacts essential to its analysis of the environmental impacts that may result from the construction or reconstruction of transportation facilities. The department's Environmental Procedures Manual states that a visual impact analysis is to be conducted for all types of transportation projects, including "highway, ferry, rail, and aviation projects." It recognizes that this analysis must be conducted in accordance with procedures established by its federal partners, suggesting that different federal agencies have distinct requirements and methods for conducting such an analysis.

For highway projects, Washington State DOT has adopted, with some clarifying modifications, the VIA process that FHWA has distributed to the states as guidance. It calls the document that records the process and the findings of a VIA a "Visual Discipline Report." The policies and procedures that Washington State DOT uses to guide an individual in writing a Visual Discipline Report are accessible on-line, extensive, and fully integrated. Key components published by the Washington State DOT include:

- Environmental Procedures Manual, Chapter 459, "Visual Impacts" (June 2011). Available at: http://www.wsdot.wa.gov/publications/manuals/fulltext/M31-11/459.pdf#page=(page45-11). This document provides an overview of how the Washington State DOT would like a VIA conducted and reported. It introduces the concept of visual impacts, briefly asserts why they are useful, addresses how they are conducted by the Washington State DOT, and provides a glossary of terms and a comprehensive listing and explanation of the applicable federal and state statutes and regulations that require the Washington State DOT to evaluate visual. The document also includes on-line and other references to additional policy and technical guidance.
- Environmental Procedures Manual, Chapter 456, "Historic, Cultural, and Archaeological Resources" (June 2011). Available at: http://www.wsdot.wa.gov/publications/manuals/fulltext/M31-11/456.pdf. This document provides further guidance on assessing and documenting visual impacts to historic and cultural resources.
- Roadside Classification Plan (Publication No. M 25-31, last updated November 2011). Available at: http://www.wsdot.wa.gov/Publications/Manuals/M25-31.htm. This publication defines the Washington State DOT roadside policy of ascribing not only a distinct landscape category to every state highway but a particular visual character that must be maintained or enhanced. This plan, consequently, serves as a fundamental basis for determining the visual impacts of a highway project.
- Visual Discipline Report Examples. Available at: http://www.wsdot.wa.gov/Design/Roadside/Visual.htm. These on-line samples of Washington State DOT VIA reports provide a template to guide authors, administrators, and reviewers. Washington State DOT environmental documents for individual projects, which typically include at least a summary of an assessment of visual impacts, are also available on-line to provide additional practical guidance. (For example, see the January 2012 DEIS for SR 525, Mukilteo Multimodal Terminal, available at http://www.wsdot.wa.gov/NR/rdonlyres/5B6748B1-B215-4CF8-A41F-38C2C07D4877/81386/FinalMukilteoDEIS_Chpt4_1of3.pdf.) Together, these on-line examples illustrate how the Washington State DOT prefers to conduct and record a VIA for a wide range of project types and settings, providing authors with useful templates to complete their work skillfully and accurately.
- Visual Impacts Discipline Reports Checklist (June 2010). Available at: http://www.wsdot.wa.gov/NR/rdonlyres/4F50855B-A15F-497B-BAC6-EF10AB5A11B0/0/DIscRpt_Visual.pdf. This checklist provides an outline of what Washington State DOT requires and also is an excellent quality assurance/quality control form for verifying if the document fulfills the Washington State DOT requirements for adequately assessing visual impacts.

- Visual Impact Assessment for Highway Projects, 1981/1988, FHWA Publication No. FHWA-HI-88-054. Available at: http://www.wsdot.wa.gov/publications/fulltext/Roadside/fhwavia.pdf. Although this document provides the original basis for the state DOT's approach to assessing visual impacts, Washington State DOT has modified the methodology as identified in previously noted on-line documents.
- Additional guidance for other social, economic, and environmental issues that may, on any particular project, be related to visual quality issues can be found in documents on the Washington State DOT's NEPA/SEPA Guidance web page, available at: http://www.wsdot.wa.gov/Environment/Compliance/.

Washington State DOT directions for conducting a VIA and subsequently reporting it in a Visual Discipline Report are thorough and demanding. According to the Visual Impacts Report Discipline Checklist, each report is to have nine sections:

1. **Executive Summary,** a summary of items 2 through 6 below.
2. **Introduction,** providing a general overview including (a) legal justification for report; (b) project purpose and need; and (c) a description of project and alternatives.
3. **Methodology,** identifying (a) the name of the methodology used to conduct the assessment; (b) threshold criteria used to scope the need to conduct the assessment; and (c) a description of the process and criteria used to conduct the assessment.
4. **Affected Environment,** including identifying (a) the existing and designated landscape setting; (b) the viewers and their attributes; and (c) the viewing experience with key views.
5. **Potential Effects,** determining direct, indirect, and cumulative impacts by viewer groups at key views using the Washington State DOT reporting forms.
6. **Mitigation,** including a discussion of how best to avoid, minimize, or compensate for adverse impacts and how to incorporate beneficial impacts as enhancement opportunities.
7. **References,** which are to be noted.
8. **Appendices,** including all pertinent documents and forms—especially the completed Washington State DOT visual analysis form.
9. **List of Preparers.**

This outline fits with the reporting requirements and nomenclature of most environmental documents. In practice, the Washington State DOT Visual Discipline Reports follow this outline very accurately, including the Visual Discipline Report for the US 2 – West of Leavenworth – Slope Stabilization Project.

Evaluation Criteria

Objective. The Washington State DOT VIA procedure is objective to the extent that it is designed to eliminate individual bias. Washington State DOT provides thorough directions and a set of templates on how to conduct a VIA. This standardizes much of the approach to assessing visual impacts regardless of who is conducting the assessment. However, the Washington State DOT VIA process is dependent on professional judgment, and the assumption that all adequately trained professionals will assess existing and proposed visual quality (and therefore impacts) similarly, if not identically, is not tested by the process—there is no third-party verification built into the process. However, this issue has been mitigated by having the same individual responsible for overseeing and reviewing all VIAs for over a decade.

The Washington State DOT VIA process uses an explicit, normative rating system in which a professional assigns numerical labels to define values for (1) the character of the landscape before and after construction, (2) the sensitivity of viewers to change, and (3) the visual quality of the landscape as thought to be perceived by viewers. The process follows the FHWA–VIA process, which incorporates quantitative analysis. It treats the numerical labels as if they are quantities; however, the numbers used in the Visual Discipline Report for the US 2 – West of Leavenworth – Slope Stabilization Project do not reflect actual measurements. Treating numerical labels as quantities introduces a risk that readers of a VIA may interpret the labels as measured quantities. It is important that the narrative language be extremely clear if numerical labels are used in this way. The use of numerical labeling is further discussed under the criterion "Legitimate."

The Washington State DOT VIA method uses a narrative, photographs, maps, and simulations to describe relevant characteristics of the landscape, viewers, visual quality, and visual impacts, allowing a reviewer to understand the process and its findings.

Through the use of the Washington State DOT Roadside Classification Plan, the Washington State DOT has specified visual management objectives for every segment of highway on the Washington State DOT system. These management objectives are identified and used as a baseline for determining if impacts caused by the proposed project need to be mitigated or if there is an opportunity for the proposed project to enhance visual quality in the project corridor if the corridor's existing visual quality currently does not meet its management objective.

Valid. The legal basis for conducting a VIA is clearly documented by the Washington State DOT, both in its policy and procedural manuals and in each VIA. The Washington State DOT's environmental guidance specifies that local ordinances, plans, and policies are to be included in devel-

oping a VIA. For the VIA conducted for the US 2 – West of Leavenworth – Slope Stabilization Project, only the legal requirements of federal and state laws are invoked to justify conducting a VIA; no local jurisdiction requirements were identified. Since the highway was located in a national forest, was adjacent to a federally designated river, and was part of a nationally designated scenic byway, the VIA document acknowledges federal agency requirements related to scenic quality, and that impacts to visual quality would be a concern to those agencies having jurisdiction over these scenic designations.

The Washington State DOT VIA process, although perhaps skewed toward analyzing what is considered scenic—it certainly emphasizes the scenic value of nature in its guidance and in practice—is not solely interested in scenic quality and does not mistake visual quality as being equal to scenic quality or what appears natural. Nonetheless, for the US 2 – West of Leavenworth – Slope Stabilization Project, the visual qualities that are analyzed are exclusively scenic.

The Washington State DOT process primarily relies on trained, expert opinion. Its guidance documents assert that expert opinion—contrary to the studies our research previously discovered—accurately identifies those visual issues that the general public would be concerned about if they had been asked. The expert's opinion, following the guidance provided by FHWA and subsequently adopted by the Washington State DOT, relies on the professional tradition of aesthetics as defined by the practice of art and design. In particular, the concepts of vividness, intactness, and unity are used almost exclusively to define visual quality and visual impacts.

Viewer response is identified as a factor in the determination of visual impacts in the Washington State DOT process but is determined by the expert conducting the VIA procedure, including assumptions about viewer sensitivity and duration of the views. Local planning documents are used as a surrogate for public input. Surveys of actual viewers are not suggested by the Washington State DOT guidance, nor were they conducted as part of the project VIA under study. Viewer input appears to be limited to reacting to public review of the project's environmental documents. Such documents only include a summary of the VIA process and its conclusions. There appears to be no feedback mechanism for the Visual Discipline Report itself, however.

Reliable. The Washington State DOT VIA process is very prescriptive. The required VIA procedure is well documented by a set of interrelated policy and procedural manuals that explain and reinforce the Washington State DOT preferred VIA process. It is likely that an adequately trained professional who follows the Washington State DOT procedures would reach similar if not identical conclusions as any other adequately trained professional following these procedures.

Washington State DOT policy and procedural methods require the identification of those persons who conducted the VIA. Washington State DOT uses a quality assurance/quality control process with checklists and a designated in-house reviewer to ensure consistency throughout the state, regardless of project setting, type, or size. The repeated use of the same personnel conducting the VIAs seems to have made the subsequent products progressively more thoroughly executed. As a fairly recent document, the US 2 – West of Leavenworth – Slope Stabilization Project Visual Discipline Report, benefits from these generational improvements. However, this consistency may be due to the VIAs being authored by only a few individuals.

Precise. The Washington State DOT policy, procedures, and practice related to assessing impacts to visual quality—as exemplified by the project under study—assert that any corridor must be divided into sufficient landscape units to be able to judge impacts. In this regard, the Washington State DOT follows the FHWA–VIA procedure. In practice, however, the Washington State DOT diverges from FHWA–VIA procedure as practiced in other states. This divergence appears to make the process more pragmatic and efficiently executed.

Washington State DOT tends to define landscape units by landscape type rather than by viewshed. For the US 2 – West of Leavenworth – Slope Stabilization Project, the whole corridor was considered a single landscape unit with several key views. This reduced redundancy in analysis and documentation without reducing the value of the VIA.

Since viewsheds are not specifically measured, there were no calculations of physical areas that may be adversely impacted by the proposed project. This lack of objective measurements was replaced by a narrative assessment describing impacts to the landscape and the experience of viewers.

In practice the Washington State DOT uses two baseline conditions from which impacts are assessed. The first baseline is the condition of the existing landscape—but this is supplemented by an assessment of whether the corridor is retaining its visual character as described in its assigned management strategy. The highway design process employed by the Washington State DOT includes a goal of retaining the landscape character established for the corridor. The extent of the improvement is dependent on the type of project, and less is expected of a minor project than a major project. If the existing condition is at par or above, the project is required to maintain the existing condition by restoring the disturbed area. Depending on the types of funding available and specific needs within the project corridor—which may relate to maintenance issues as well as visual impacts—a road project may thus become more than a road project, involving policies and practices related to establishing and maintaining a particular level of environmental protection and landscape aesthetics.

For the US 2 – West of Leavenworth – Slope Stabilization Project, simulations where chosen in accordance with the Washington State DOT policy; they addressed key views that were either representative of the road and its context or were areas of particular sensitivity to certain viewers.

Versatile. Although the Washington State DOT policy, procedures, and practice consider primarily scenic values of natural areas, the process is adaptable to other landscapes and the diversity of ecological regions found in Washington State. The process is sufficiently versatile to be applied to minor projects (as evidenced by the US 2 – West of Leavenworth – Slope Stabilization Project) as well as large freeway projects on new alignment (as evidenced by other project examples accessible from the Washington State DOT website).

Pragmatic. The Washington State DOT policy and procedures, and their application in conducting the VIA under study, show a high level of pragmatism. Policy and procedures are well documented and readily assessable on-line, providing for easy and efficient implementation by a trained professional. The same professional team appears to perform (or at a minimum, review) most of the Washington State DOT VIA documents, which ensures a sophistication and presumed efficiency in their development. The near-universal incorporation of a visual quality discussion based on a Visual Discipline Report in the draft and final environmental documents examined by the research team and the survey as reported in Chapter 3 implies that visual issues are being analyzed in a timely fashion to the satisfaction of the project managers and department administrators.

Understood Easily. The Washington State DOT makes its VIA-related policies and procedures easily available on-line using clearly articulated language that is arguably more easily understood than the original guidance from which it was derived. Individual Visual Discipline Reports and their incorporation into projects' environmental documents are also easily comprehended. It is not known if it is standard practice to post every VIA (or every Visual Discipline Report) on-line. Projects' environmental documents, along with the synopsis of the Visual Discipline Report, seem to be regularly posted. It is presumed that providing the complete Visual Discipline Report would also be helpful to those stakeholders attempting to understand the visual impacts which may be caused by a particular project.

Although documents containing directions on how to conduct a VIA and even documents pertaining to an analysis of visual impacts for a particular project are available on-line, public participation appears to be limited to feedback provided at general project meetings or comments made on completed documents. The Visual Discipline Report for the US 2 – West of Leavenworth – Slope Stabilization Project does not indicate any public feedback or comments to a draft of that report. It is not known if the project's environmental documents contain such comments.

According to information provided in the Roadside Classification Plan, the public was not involved in recording the landscape character and the goal of retaining that character for the state's highways. The determination of visual quality goals was made by experts from the Washington State DOT central office with input from district personnel. No public input is required. For the US 2 – West of Leavenworth – Slope Stabilization Project, no public or outside agency input from stakeholders is documented. Regardless of the presence or absence of documented comments, however, it is apparent that the public has input into Washington State DOT's VIA process (e.g., through local government comprehensive plans or forest plans and through public reactions to published documents or to professional assertions made at public meetings).

Useful. The Washington State DOT's policy and procedures are oriented to generating an action, particularly in helping form design and mitigation decisions. Although it was not evident in the example studied, it is conceivable that location decisions could also be affected by a Washington State DOT VIA. The establishment of corridor visual quality goals and the goal that projects maintain or attain landscape character mandate a high level of usefulness for a Washington State DOT VIA.

Implemented Consistently. On its web page devoted to Visual Quality, the Washington State DOT lists links to several examples of its Visual Discipline Reports. These reports follow an almost identical format (albeit with some incremental reporting improvements from earlier to later versions) regardless of project type or landscape setting. The report under study, the Visual Discipline Report for the US 2 – West of Leavenworth – Slope Stabilization Project, is consistent with the general process and the other on-line examples.

Legitimate. The Washington State DOT VIA process measures changes to the vividness, intactness, and unity of the project area that may result from the construction of the proposed project. Existing and future vividness, intactness, and unity are described and assigned numerical labels. The labels function as short-hand substitutes for descriptive qualities and relate to categories, but they are not actual quantities or quantitative measurements.

It is important to distinguish normative numerical labels from quantitative measurements. Normative labeling systems that rely on the use of categories—such as *very low* to *very high* or even *1* through *7*—have limited computational capabilities. Mode (the most common answer) can be determined, but finding a mean (the average answer) or median (the middle answer) can be problematic when dealing with categories

as opposed to measured quantities. When numerical labels are summed, averaged, or otherwise treated in ways that parallel or suggest quantitative analysis, the numerical labels may become confused with quantitative measurements.

In the case of the Visual Discipline Report for the US 2 – West of Leavenworth – Slope Stabilization Project, the use of numerical labeling is moderated and clarified by a parallel reliance on a descriptive narrative. It is the description of existing visual quality, impacts, and potential mitigation that gives the Washington State DOT process its legitimacy.

Summary

As documented in the Washington State DOT's policies and procedures and in the various examples that have been posted on-line, the Washington State DOT VIA appears to be highly effective. By the definitions used by the research team, the Washington State DOT VIA process is highly reliable, precise, versatile, pragmatic, useful, and implemented consistently. It is somewhat valid, objective, and capable of being understood easily by stakeholders. The state DOT relies primarily on expert opinion in its assessment of visual impacts. Although local government comprehensive plans and public sector planning documents such as forest and park management plans are examined when going through USFS or National Park Service (NPS) lands, the public appears not to be directly involved in developing the assessment. Feedback to a specific VIA seems to be limited to comments on the general environmental document rather than to the VIA, which is conducted as a separate Visual Discipline Report. The Washington State DOT indicates that landscape architects who conduct the assessments are often local and may talk about the project with homeowners when capturing views from residences; however, such "behind-the-scenes" discussions are not always documented in the reports.

The legitimacy of the Visual Discipline Report would be improved by relying less on numerical labels and more on descriptions of impacts and by including more formal documentation of public involvement and feedback in the analysis. A summary of the evaluation criteria ratings for the US 2 – West of Leavenworth – Slope Stabilization Project VIA appears in Table 6.4.

Table 6.4. Evaluation criteria ratings for the US 2 – West of Leavenworth – Slope Stabilization Project Visual Discipline Report.

Criteria	Rating
Objective	√√
Valid	√
Reliable	√√
Precise	√√√
Versatile	√√
Pragmatic	√√√
Understood Easily	√√
Useful	√√√
Implemented consistently	√√√
Legitimate	√

Note: The more check marks given a particular criterion, the more that criterion is realized in the VIA examined.

6.2 United Kingdom

6.2.1 Scotland

Sources

Agency: Transport Scotland (UK)
Project: Forth Replacement Crossing (FRC)
Citations: *Forth Replacement Crossing: Environmental Statement* (Chapter 12, "Landscape," and Chapter 13, "Visual," plus Chapters 1 through 4 describing the scheme and Chapter 21, "Cumulative Effects.")
Web Addresses of Reviewed Materials:

- Forth Replacement Crossing: Environmental Statement. Available at: http://www.transportscotland.gov.uk/strategy-and-research/publications-and-consultations/j11223-000.htm.
- Chapter 12 available at: http://www.transportscotland.gov.uk/files/documents/reports/j11223/j11223-12.pdf.
- Chapter 13 available at: http://www.transportscotland.gov.uk/files/documents/reports/j11223/j11223-13.pdf.

Short Project Description

Highway/Bridge. To construct a new bridge to replace the existing bridge crossing the Firth of Forth. The FRC is a major road infrastructure project proposed by Transport Scotland, an agency of the Scottish government. The project is driven by uncertainty over the future viability of the existing Forth Road Bridge, to the northwest of Edinburgh, and is designed to safeguard a vital connection in Scotland's transport network. It comprises a new cable-stayed bridge across the Firth of Forth, to the west of the existing Forth Road Bridge, and associated new and improved road infrastructure to the north and south of the bridge.

Landscape Setting. The Firth of Forth is a maritime landscape of intertidal shores, islands, and harbors providing a dramatic setting for the iconic Forth Road Bridge and

Forth (rail) Bridge. To the north, the landscape of Fife's coastal terrace is dominated by settlements and industry. Infrastructure is also prominent, with roads and railways cutting through the steep wooded cliffs and braes (hillsides). South of the Firth of Forth, the historic town of South Queensferry is surrounded by rolling arable farmland and the wooded estates of Dalmeny, Hopetoun and Dundas.

Alternatives Examined. A technical study showed that it would be possible to replace the bridge's cables. This would not be feasible, however, without a replacement bridge being put in place because of the severity of the impact on road users and the wider economy. A Forth Replacement Crossing Study (FRCS) was undertaken during 2006 and 2007 to identify the most favorable option for a replacement crossing. Five potential crossing corridors were identified from an original list of 65 potential crossing solutions. Each of the five corridors was appraised for its suitability for a tunnel or a bridge crossing. The appraisal process considered environmental issues alongside other factors and concluded that a bridge option in a corridor east of Rosyth and to the west of South Queensferry was the best option due to lowest construction costs, shortest construction program, lowest construction risk, and greatest economic benefit. Various connecting road options were also considered.

VIA Procedures

In common with most UK landscape and visual impact assessments (LVIAs), the procedure applied here dealt separately with landscape effects and visual effects, and applied well recognized methods for LVIAs in general, as set out in *Guidelines for Landscape and Visual Impact Assessment* (Landscape Institute and Institute of Environmental Management & Assessment 2002) and for LVIAs applied to transport projects as set out in the *Design Manual for Roads and Bridges* (DMRB), Volume 11, Section 3, "Landscape and Visual Effects." The national guidance was supplemented by specific Scottish guidance (Supplementary Guidance, Scottish Executive 2002) and the detailed methodology was also developed in consultation with Scottish Natural Heritage, the government agency in Scotland with responsibility for landscape matters.

The distinction between assessment of landscape and of visual effects can be summarized as follows:

- Assessment of landscape effects consists of assessing changes to the landscape as a resource in its own right, by answering these questions:
  - What is the nature of the landscape resource in the area potentially affected (overall character, key characteristics, elements, aesthetic/perceptual qualities, condition and value)?
  - What will happen to the landscape in the future without the proposal?
  - What will happen to the landscape if the proposal takes place? (What effects will it have?)
  - Taking all of this into account, are any of the effects the proposal will have on the landscape considered to be significant?
- Assessment of visual effects consists of assessing changes in specific views and in the general visual amenity experienced by particular people in particular places, by answering these questions:
  - From what viewpoints will the proposed project likely be visible, and what are the views like?
  - Who experiences the views from those viewpoints?
  - How will the views experienced at those viewpoints be changed by the proposal? (What effects will it have?)
  - Taking all of this into account, are any of the effects the proposal will have on the landscape considered to be significant?

Although landscape and visual effects are dealt with separately, there is some overlap in that the photomontages showing the appearance of the new bridge crossing are included in the chapter on landscape effects when usual practice is to include them in the visual effects section. There is also a broadly common approach to each assessment that includes the following steps:

Step 1: Scoping, in consultation with the competent authority and statutory consultees, to make an initial determination of possible effects, identify an appropriate study area, and set important parameters of the work to be done.

Step 2: Conducting baseline surveys to determine existing baseline conditions relevant to either landscape or visual effects.

Step 3: Identifying the effects that are likely to occur.

Step 4: Assessing the significance of the likely effects based on a standard procedure using judgments of the sensitivity of the resource and the magnitude of the effect.

Step 5: Identifying proposals for mitigation of the identified effects, in addition to any measures that have already been incorporated into the design of the scheme through an iterative design process.

Step 6: Stating the residual effects after mitigation and their significance.

Landscape Effects Assessment. The initial stage of landscape assessment involved the collection of baseline data related to the individual elements and characteristics of the landscape. As far as possible, use was made of existing landscape character assessments (LCAs) covering the study area, which have been carried out using the national Guidance on Landscape Character Assessment. These LCAs divide the

study area into various areas of particular landscape character types. Further desk-based and field assessments—referred to as local landscape character assessments (LLCAs)—were undertaken to refine the boundaries of the landscape character areas and allow them to be considered at a more local scale. Once the LLCAs were identified, the sensitivity of each area to change as a result of the proposed scheme was assessed. In accordance with the Landscape and Visual Assessment Supplementary Guidance (Scottish Executive 2002), evaluation of sensitivity to change combines a review of "susceptibility" (i.e., the vulnerability of the area to change arising from the proposed scheme) and "value" as applied to the main elements of the landscape. Susceptibility and value take into account information about the various factors considered in arriving at the sensitivity evaluation, such as key features and characteristics, quality, and value/importance, which together create a sense of place.

Assessing the Significance of the Effects. This part of the assessment combined the sensitivity of the receptors with the magnitude of the proposed changes on the landscape. Judgments of magnitude involved a review of the nature and scale of the changes, together with the duration and degree of permanence.

Landscape effects of the different components of the scheme were identified and classified as positive, negative, or neutral, and the significance of each was assessed on a scale ranging from negligible to severe (or major). An initial indication of impact significance was obtained by combining the sensitivity to change and magnitude of change assessments using a cross-classification matrix that was adjusted, if necessary, using professional judgment. Moderate or greater adverse impacts were considered to represent key landscape changes, and mitigation would generally be required to reduce these where practicable.

The approach to mitigation followed the standard UK/European practice of identifying measures to prevent/avoid, reduce, or offset the significant adverse landscape effects. Measures include earthworks, rock cuttings, and sustainable drainage solutions, but perhaps most important from a landscape perspective, planting to enhance local landscape character based on species mixes typical of the immediate landscape context.

In the summary of significant residual landscape effects, tabular summaries and text are used to summarize the effects of the different scheme components on the local landscape character areas identified in the baseline surveys. The report concludes that on the north side of the Firth of Forth, the landing of the Main Crossing and northern road connections will have significant adverse impacts for the landscape of Ferry Hills and St. Margaret's Marsh, an area of reclaimed coastal flat west of North Queensferry. South of the Forth, the landscapes of South Queensferry and the farmland to the west will be adversely affected by the Main Crossing landing and southern connecting roads. The impacts of the Main Crossing are considered to be adverse in this location because of the presence of the bridge abutment and approach road structures. The designed wooded landscape of the Dundas Estate will also be adversely affected by significant impacts from the proposed scheme. Elsewhere, impacts on the surrounding landscape will not be significant.

Visual Effects Assessment. The visual effects assessment starts with baseline studies, primarily desk-based Zone of Theoretical Visibility (ZTV) mapping to identify land from which the development can theoretically be seen. In this case, separate computer-generated ZTVs were prepared, using a model of the existing topography "surface" based on contours at 5-m intervals, represented by a high resolution grid of 5-m^2 cells, to identify areas from where the proposed scheme would be visible or where the Main Crossing would be visible to an observer with an assumed eye-level height of 1.75 m within a 5-km radius. Adjustments were made for the assumed height of existing buildings and woodland. Associated gantries were included as key elements in the production of ZTVs to reflect their potential contribution to the proposed scheme day and night as illuminated, elevated features. In agreement with guidance from Scottish Natural Heritage (SNH) the potential visibility of the Main Crossing towers was considered to be comparable with the potential visibility of wind turbines. Guidelines developed for windfarm assessment (SNH 2007) were therefore applied. This guidance indicates that the tallest wind turbines of 130 m require ZTVs with a radius of 35 km to include all those areas within the wider landscape where visual impacts are likely to occur. This principle was therefore applied to determine the extent to which the Main Crossing towers (a 207-m high central tower and 200-m high towers to the north and south) would potentially be visible, and a 35-km ZTV was produced exclusively for the Main Crossing. To allow comparison, the relevant ZTVs were combined and mapped. A series of ZTVs for nine scenarios were prepared, based on daytime and nighttime views, in winter and summer, in the year of opening and 15 years after opening, for the Main Crossing only and the full scheme. This selection ensured that the worst-case scenario (winter in the year of opening) was covered as well as less adverse scenarios.

The baseline assessment also identified both built and outdoor visual receptors. Within the study area, all identified receptors that would gain views of the proposed scheme were assessed in the field by teams of two or more landscape architects. Photographs from key viewpoints representing the views of different visual receptors (although appearing in the landscape effects section) provided the base for wireframe images and photomontages of the proposed

development. The sensitivity of different visual receptors to changes in their views was evaluated based on (1) the nature and context of the viewpoint; (2) the expectations of users/receptors; and (3) the importance and value of the view to the receptor.

The changes in views as a result of the proposal were identified and classified as positive, negative, or neutral. Most visual effects were considered to be adverse, but the presence of the Main Crossing was assessed as neutral because of the aesthetic qualities of the bridge structure and the likelihood that there would be both positive and negative opinions of its merits. The significance of the change to views resulting from the Main Crossing was still noted. The magnitude of visual change affecting receptors was assessed by considering the scale of change in the view due to the addition or loss of features, change in character, and the amount/extent of the view affected, and also by considering:

- The extent of the receptor's available view affected by the development, including the distance from the proposed scheme,
- The angle of view relative to the main activity of the receptor.
- The level of integration or contrast created by the crossing or road and the associated elements within the view.

The overall significance of the visual effects was judged by combining the sensitivity of the receptor and the magnitude of the effect using a cross-classification matrix.

It was noted that this matrix represents thresholds on a continuum. It provides an initial guide, but the significance assigned may be adjusted using professional judgment. Impacts assessed as being of moderate or greater significance were considered to represent clearly perceptible changes to views, and where practicable, mitigation was taken into account. It was also noted that mitigation of adverse landscape and visual impacts are closely related and inter-dependent, thus, mitigation of visual impacts will generally be incorporated in the specific landscape mitigation measures, which have been developed in consultation with other disciplines as part of the iterative approach to the design of the proposed scheme. The assessment noted several landscape mitigation measures that will also mitigate visual effects, including:

- Application of a high standard of aesthetics for the proposed scheme, particularly the sensitive design of the Main Crossing to avoid visual confusion and complement views of the Forth Road Bridge and Forth Rail Bridge.
- Integration of the alignment and earthworks with the surrounding topography.
- Formation of new rock cuttings to achieve a natural appearance.
- Provision of false cuttings and noise barriers to screen or restrict views of the road. (False cutting is a means of screening the road from properties in the surrounding landscape. It is particularly appropriate in gently undulating ground where a natural cutting cannot be achieved. It has the added benefit of reducing the impact of noise. See www.dft.gov.uk/ha/standards/dmrb/vol10/section1/ha5592.pdf.)
- Provision of stone walls, hedges and standard trees to provide screening and reinstate field boundaries.
- Planting mixed or scrub woodland to screen views, integrate new cuttings and embankments and reflect the character of the existing landscape.

The summary of visual effects concludes that open views across the Firth of Forth are currently dominated by the existing Forth Road Bridge and Forth Bridge, which are visible from a wide area, including many of the small coastal settlements along the Firth of Forth and from more distant viewpoints. The Main Crossing will also be the most visually prominent element of the proposed scheme and will feature as an additional structure in both local and distant views.

The Main Crossing has been designed to be an aesthetically pleasing structure, sympathetic to the visual character of the area. The simple, elegant design of the bridge is intended to complement the existing views, including those where the Main Crossing would be viewed directly in front of or beyond the Forth Road Bridge and Forth Bridge. The measures described in the landscape section will also help to reduce the visual impacts of the scheme. For the majority of receptors, views toward the Main Crossing will not be significantly changed. Significant (moderate or greater) neutral impacts are predicted for 217 properties and 23 outdoor receptors. Adverse visual impacts will be significant for properties located in close proximity to the Main Crossing, while the transfer of traffic from the Forth Road Bridge to the Main Crossing will result in beneficial impacts for properties in South Queensferry.

Evaluation Criteria

Objective. The FRC LVIA work is objective in so far as it follows standard and widely agreed procedures set down in a variety of guidance documents. In common with the great majority of UK work, it does not use quantitative methods at all. The use of existing LCAs supplemented by refinement of them is good practice, as is the comprehensive analysis of ZTVs based on a variety of scenarios. The treatment of views and viewpoints as representative of visual receptors is not so clear, but detailed and lengthy appendices describe this work. The LVIA largely avoids very subjective judgments about aesthetic matters related to the value or quality of the landscape, although the supplementary LCA does record condition

and scenic quality of the landscape at the local level, without explicitly using this in the assessment. The assessment of sensitivity otherwise relies on existing landscape designations, and the visual effects assessment uses reasonably well-accepted criteria for judging the importance/value of views and visual receptors. As with most methods, both landscape and visual effects assessments rely wholly on professional judgment in judging the sensitivity of landscape and visual receptors to change, the magnitude of the different effects, and the combination of these to indicate the overall significance of the different effects. The reasoning behind some of the judgments is not always explicit and the relationship of each step in the procedure is not always clearly tied to the overall purpose of the LVIA. Overall, the LVIA as applied to the FRC seems to be of medium objectivity.

Valid. The separation of effects on landscape as a resource from effects on views and visual amenity in the UK LVIA method is commonly accepted but still evolving. The FRC report fuses the two together to some extent, so that visual simulations of change appear under landscape effects whereas current practice is usually to place them in the discussion of visual effects. This feature of the study does not invalidate them, but may lead to a degree of confusion in interpreting the implications of the assessments. However, the overall adherence to generally agreed methods, both for LVIA in general and for transport-related LVIA in particular, adds to the validity of the method, as does the discussion of the method with Scottish Natural Heritage, who are the government advisors on landscape matters and agree with the method. The fact that fieldwork was conducted by more than one professional means that the judgments were not made by one person. However, there is still no actual engagement of the public in any of the assessments, other than through the normal consultation and public review procedures for the environmental impact assessment (EIA) as a whole. There is no benchmarking of the judgments against public opinion, although consultation will presumably have illuminated any major differences of opinion. The professional view is therefore taken as a surrogate for what viewer groups might think of the visual effects. In general, the work has high validity, in so far as it represents the common approach used throughout the UK in relation to highway proposals. Nonetheless, it does not benchmark visual impacts to public opinion, and slightly confuses the distinction between landscape and visual effects.

Reliable. The work was undertaken by a joint-venture consulting firm engaged by Transport Scotland to design, develop, and project-manage the FRC project. Although there is no specific reference to the fact, it is assumed that the assessment was undertaken by landscape architects. This in itself does not mean that those concerned were necessarily trained in the specific LVIA procedures used in the UK, since not all landscape architecture courses include such material. Some practitioners rely on experience gained on the job, drawing on the experience of senior staff and on the available guidance documents. It is therefore not clear whether other professionals might have reached the same conclusions or different conclusions. However, reliance on the national Landscape Character Assessment inventory and the use of more than one professional to conduct detailed fieldwork generally increases reliability. The possibility of differing opinions on aesthetic matters is recognized by the treatment of the effects of the main bridge crossing as neutral, rather than as either positive or negative, thus avoiding the need for the landscape architect to reach a conclusion on its aesthetic merits. The judgments on the sensitivity of receptors, especially the visual receptors, are not fully transparent in that the general reasoning is explained but not the application of the reasoning to the individual receptors. The scale of the scheme and the number of receptors may explain this, but it does raise questions about reliability.

Precise. The project covers an extensive area—the maximum ZTV for the bridge towers is judged to be at a radius of 35 km—and identifies all the visual receptors in this area. At the same time, the landscape effects assessment uses existing LCAs that cover the whole of the substantial Fife and Lothians area, but refines this with new survey work to give a greater level of detail suited to assessing the more local effects of the proposals. Overall, the LVIA is both sufficiently broad ranging and sufficiently precise to cover the range of possible effects. The documenting of landscape effects and visual effects is thorough and painstaking, including lengthy appendices of tables detailing assessments of all the receptors. While commendable, this can also make some of the material rather inaccessible and dense, which may be the price to be paid for precision. The level of precision is appropriate.

Versatile. The procedure is versatile and is designed to be applicable to all types of settings and all types of viewers. The FRC study demonstrates this and covers a very wide range of types of landscape and a wide range of visual receptors within the same basic procedure and evaluation framework. The procedure has been shown to be versatile over a wide range of projects.

Pragmatic. The procedure can be used easily and efficiently by someone with the right skills and experience. Having a national LCA to use as a baseline framework for the impact assessment enhances the pragmatism of the method, but applying it at the scale of this project inevitably poses problems. The ZTV work alone is quite demanding of resources of data, time, skill, and computer processing power, and may

be beyond the resources of an individual or a small practice. Add to that the scale of the fieldwork needed to cover a very substantial study area and the difficulties and resource implications are clear. The emphasis in developing the guidance on these procedures nationally is therefore on ensuring that the work is realistic and proportional to the nature of the project, and is agreed in advance with the decision-making competent authority. If that can be achieved, then it is fair to describe the procedure as highly pragmatic.

Understood Easily. The method used for the FRC study is readily available to stakeholders through the published documents, which are fully available on-line. As required by the European EIA Directive and associated country regulations, a non-technical summary of the whole EIA, including the work on landscape and visual effects, must be widely available for public consumption. This LVIA is clearly articulated for a professional audience, but it is debatable whether the method is sufficiently clearly articulated, either in national guidance or in the project outputs, to be understood easily. The principles are relatively clear, but whether or not their application is sufficiently transparent is perhaps debatable. However, the non-technical summary of the project is relatively accessible as a basic statement of the issues, including the landscape and visual matters. The visual simulations are relatively comprehensive and help understanding of what is proposed.

Useful. Not only is the assessment useful, it is required by law under obligations relating to the European Directive. LVIA is increasingly recognized as a key part of an integrated design process with landscape and visual issues contributing to different stages of the process, in considering alternatives, in scoping, in scheme design, and in successive inclusion of mitigation measures. These steps are demonstrated by the FRC project, although much of this relates to the whole of the EIA rather than specifically to the landscape and visual aspects. It is however clear that landscape mitigation measures have played a significant part in scheme design.

Implemented Consistently. This project follows the accepted UK method for LVIA and the specific interpretation of this for highway schemes.

Legitimate. As summarized in the literature review, in the UK the legal requirement for EIA comes from European Law. The EC Directive and associated UK regulations establish a requirement for description of the aspects of the environment likely to be significantly affected by the development, including landscape (see Chapter 2 for details).

It is therefore apparent that, unlike NEPA, with its specific references to aesthetics, the European legislation refers to "landscape" and does not mention the terms "visual" or "aesthetics." The current methods of LVIA in the UK have developed from this starting point, from the particular interpretation of landscape in the UK, and from the procedures that have emerged for addressing landscape and visual effects and which have been described in two previous editions of guidance, with a third edition in preparation. Debates remain about details of the procedure and especially the assessment of the significance of the effects, required by law, but the procedure as a whole is widely used and an accepted part of landscape practice.

Table 6.5. Evaluation criteria ratings for the Forth Replacement Crossing Report.

Criteria	Rating
Objective	√√
Valid	√√√
Reliable	√√
Precise	√√√
Versatile	√√√
Pragmatic	√√√
Understood Easily	√√
Useful	√√
Implemented consistently	√√√
Legitimate	√√√

Note: The more check marks given a particular criterion, the more that criterion is realized in the VIA examined.

Summary

The LVIA component of the FRC EIA, as expressed in the project's Environmental Statement, is a good example of the overall UK approach to LVIA applied to a very substantial project which has potentially far-reaching effects. Its failings are failings of the overall procedure rather than specifically of this project, and relate mainly to the reliance on professional judgments about the key components of judgments of significance, namely sensitivity of landscape and visual receptors and magnitude of the landscape and visual effects, and the lack of real input from the public to verify the validity of these judgments. Table 6.5 presents the evaluation criteria ratings for the FRC report.

6.3 Lessons Learned

6.3.1 Colorado

The VIA of the I–70 Mountain Corridor produced by the Colorado DOT provides selected insights into the development of a set of best practices for assessing the visual impacts of highway projects. Although the context of the assessment was essentially a managed wilderness and the process used

was biased toward scenic attributes, it had several redeeming procedural features, including the use of VQM and the concept of contrast ratings.

The primary procedural feature worth incorporating into a set of best practices was the use of a set of segment-specific VQM goals. These goals had been previously established by the governmental authority responsible for managing the property adjacent to the highway. With regard to undeveloped segments of the roadway, that governmental authority frequently was a federal land management agency, such as USFS or the BLM. In already-developed areas, such as towns, the Colorado DOT identified those local ordinances and practices that defined a desired visual character. This thorough examination and identification of aesthetic goals was used to evaluate if the proposed project would contribute to or detract from the visual aspirations of the community.

This approach is a significant departure from the usual approach of trying to determine if a highway adversely impacts the existing scene. By adopting this method, the Colorado DOT strongly suggests that the real issue is not if the existing scene is adversely or beneficially impacted, but rather if the proposed project advances or abandons the aspirations the community has established for the visual quality of its surroundings. This approach seems to be even more in keeping with the overarching mandate of NEPA than a simple evaluation of how a highway project may affect the existing landscape and viewers.

By using VIA procedures from USFS and BLM, the Colorado DOT inadvertently focused its attention on scenic values and the tourists who travel to this corridor for its setting and the recreational opportunities the setting's landscape provides. The Colorado DOT justified this emphasis by claiming that it was only being responsive to those viewers who would be most sensitive to changes that a highway might bring to this landscape. Subsequently, they overlooked the needs of neighbors, commuters, and others not in the corridor as recreationists. Although local ordinances, municipal administrators, and even the public (through a series of public meetings) were consulted about visual issues, actual location, design, and mitigation decisions appear to have been little affected by the visual needs and aspirations of the permanent local population.

The Colorado DOT seems to have relied primarily on the expert opinion of one professional who assembled the project's VIA. The documentation did not specify that other parties contributed to the VIA or to the discussion of visual issues in the subsequent environmental documents, although given the complexity and size of the project other professionals may have been not only involved but substantially involved. The BLM VIA process would have required at least three professionals evaluating visual impacts to ensure validity.

The use of contrast ratings to define the extent and nature of visual impacts is a process, although used to define impacts to scenery in this example, is a concept that could readily be applied to other settings, including the urban and agricultural settings where most roads are constructed. The description of visual impacts as categorical levels of contrast between what will exist if the project is not constructed and what will exist if the proposed project is constructed appears to be particularly useful.

6.3.2 Minnesota

The Minnesota Department of Transportation (Minnesota DOT) has developed its own unique VIA process. Unlike most other VIA processes used in the United States, it is based on the transactional process of perception. As such, it conforms nicely with the science of environmental psychology which suggests that human perception of visual quality is an interaction between the environment and viewers and not an intrinsic quality of the landscape or simply a fabrication of the human mind. This is a fundamental strength of the Minnesota DOT process worth emulating.

In an effort to streamline documentation, however, the Minnesota DOT process does not require that all steps that an author of a VIA takes be recorded. This lack of evidence may hinder the ability of reviewers to check the accuracy of the assessment and develop an appreciation of what has contributed to the assessment's findings.

The Minnesota DOT VIA process divides the physical environment into three categories: natural, cultural, and highway. Having separate categories is a somewhat unique approach to conducting an inventory and analyzing impacts yet it assures that these elements are thoroughly examined. This gives the author of a Minnesota DOT VIA a reminder to thoroughly identify both natural and cultural features. Similarly by having a separate category for the highway environment, the contribution of the highway to visual quality is better defined than is typical of other VIA processes.

Although Minnesota DOT uses a narrative approach in determining visual quality and visual impacts, it augments the discussion with maps, illustrations, and photographs adding robustness and a better understanding of visual issues by using visual media.

Minnesota DOT is working on how to incorporate the concept of viewers into its VIA process. It acknowledges the arbitrariness and artificiality of the viewer groups it uses but makes a limited attempt at incorporating actual people in its assessment, relying solely on expert opinion to assess visual quality and visual impacts.

Minnesota DOT has conducted parallel research for establishing viewer preferences. By incorporating that process (which was conducted by one of the authors of this paper,

Joan Nassauer), this issue may be overcome if viewer preference is to be used to establish a set of VQM goals for a particular segment of roadway similar to the reviewed work by the Colorado and Washington DOTs.

6.3.3 Vermont

Vermont's environmental review law, Act 250, requires evaluation of scenic impacts for commercial or industrial construction on more than 10 acres of land (1 acre in towns with appropriate subdivision and zoning laws), subdivisions with 10 or more residential units, or roads that are 800 feet long or provide access to 5 or more lots. The courts have established a series of questions that frame what has become known as a Quechee Analysis, named after the court case that established the precedent. It consists of two parts: (1) the determination of whether a scenic effect is adverse, and (2) if the effect is adverse, the determination of whether the adverse effect is "undue."

Under the Quechee Test, adverse effects are assessed by considering the harmony and fit of a project with its surroundings. If a project fits in its context, it will not have an adverse effect. In Vermont, the five criteria considered in the determination of whether an effect is adverse are: the context of the surrounding landscape; the project design; color and materials; project visibility; and effects on open space. If a project is determined to be adverse, three questions must be answered affirmatively for the adverse effect to be considered undue. The three questions are:

1. Does the project violate a clear, written community standard intended to preserve the aesthetics or scenic natural beauty of the area?
2. Does the project offend the sensibilities of the average person . . . when viewed as a whole is (it) offensive or shocking, because it is out of character with its surroundings, or significantly diminishes the scenic qualities of the area?
3. Has the applicant failed to take generally available mitigating steps which a reasonable person would take to improve the harmony of the proposed project with its surroundings (Vermont ANR 2007)?

The Quechee Analysis approach could be a significant contribution in how to conduct VIAs. In particular, the method does not require sophisticated quantitative measurements or analysis; rather it may be based on a largely qualitative response to the Quechee criteria. This results in a VIA that is particularly easy to understand by the public and is widely accepted as legitimate. In practice, the rigor and depth of a Quechee Analysis is easily scaled to the magnitude and significance of the potential scenic impacts, making it very pragmatic and versatile. However, the analysis does not include an established set of measurements or procedures, and it is normally based on the observations of a single landscape architect; both conditions reduce its objectivity, reliability and the consistency of implementation. Nonetheless, within the state there appears to be a wide consensus that the analysis is valid and legitimate.

6.3.4 Washington State

The completeness of the Washington State DOT's approach to visual issues is edifying. It supplies practitioners with several on-line sources of policy and procedural guidance. This includes a step-by-step outline of its VIA process and several instructive examples of well-constructed VIA documents. It is, however, the on-line access to its *Roadside Classification Plan* that sets the Washington State DOT apart from nearly every other state transportation agency. By this document, the Washington State DOT establishes visual quality goals for every segment of every state-managed transportation project, including highway projects. This effort provides the basis for evaluating potential impacts to visual quality that could be caused by a highway project, regardless of location, type, or scale.

Essentially, the Washington State DOT evaluates visual impacts from two baseline conditions: (1) existing visual quality and (2) the visual quality goals for the highway corridor. Visual impacts are determined not only by changes in the landscape but also as a measurement of how close the proposed project will be to helping the State of Washington achieve the level of visual quality that the corridor has been assigned as a preferred future condition. In its establishment of an aesthetic goal for every highway segment, the Washington State DOT has acknowledged that visual quality is an important component of the state's economic and social systems and that it is the responsibility of the state's transportation department to retain the recorded landscape character.

The Roadside Classification Plan would be a stronger document had it been produced in consultation with the public. Internal professional staff were consulted in the development of the document, but there is no evidence that it was ever reviewed by the public. An opportunity was lost to involve the public in identifying landscape character and establishing visual quality goals for every segment of state highway.

In defining existing visual quality and determining impacts to it, the Washington State DOT uses two approaches: (1) a descriptive narrative and (2) numerical ratings of visual quality before the project and as proposed after the project. The numerical ratings potentially add confusion in that the labels can appear to incorporate quantitative measurements when the numbers are not actual measurements of any physical attribute. Rather, they are substitutes indicating rankings within a narrative value. (The numbers 1 through 7 are cor-

related to a narrative description of existing and proposed visual quality, usually stated as being from very low to very high.) The use of formulas that combine, average, and compare the assigned numerical labels magnifies the risk of confusion, because the resulting sums and averages do not follow the constraints conventionally placed on numbers that are used as labels rather than as measurements. Reliance on a narrative approach would have resulted in a sufficiently accurate and more robust document.

Regardless of these shortcomings, the Washington State DOT uses a project's VIA to affect decision-making, particularly with regard to decisions related to design, and mitigation. For the Washington State DOT, a VIA is an extremely practical and useful tool. In the example studied, the Washington State DOT used the results of the VIA to evaluate alternatives and used visual impacts as the primary selection criteria for determining mitigation strategies.

To ensure compliance with its VIA procedures, the Washington State DOT employs a checklist for the author to review the VIA for thoroughness and completeness. Other states (notably California) have a similar checklist and use standard reviewers, but most do not. By having these tools and procedures built into the process, reviews and reviewers can provide excellent quality assurance and quality control. The consistency with which the Washington State DOT has produced its VIAs can be credited to the state DOT's well-articulated procedures and effective quality control methodology, as well as to its consistent use of the same personnel to author and review many of its VIA documents for decades.

Interestingly, the Washington State DOT downplays what is usually considered a fundamental component of a VIA—the determination of viewsheds. Rather than use viewsheds, the Washington State DOT focuses its attention on landscape types, grouping its inventory and analysis around the character of the landscape rather than its spatial dimensions. This is a provocative approach and worth examining as a basis for defining the landscape units that form the basis for conducting any VIA.

The use of maps, photographs, and simulations was superlative and consistent in all of the examined VIAs produced by the Washington State DOT. The effective use of these types of illustrations, coupled with an explanatory narrative to communicate visual issues and potential impacts and mitigation, provides proof for how these items are essential for providing decision makers with useful and succinct information.

6.3.5 Scotland

Perhaps the most defining characteristic of the approach to VIA in the UK is the division of impacts into two major categories—landscape effects and visual effects—each with a distinct inventory and analysis. These dual paths for evaluating what in the United States is referred to singly as "visual impacts," provides a more responsive way of incorporating the transactional approach to perception that environmental psychology suggests is the basis of how humans perceive visual quality and visual impacts. The UK methodology divides the world into two realms—a realm of change to the physical environment or landscape; and the realm of human experience.

To determine effects on the landscape, Transport Scotland (Scotland's DOT) and their consultants determined the existing condition of the landscape using a national (Scottish) database of LCAs, which divides the landscape into landscape character types and/or areas. This database is augmented by additional field studies that make the inventory more exact and the fine-grain peculiarities of the landscape better understood. The additional detailed information could be valuable in judging alternatives and developing mitigation strategies.

The analysis of impacts to the landscape compares changes with and without the proposed project in the future. The UK VIA process avoids the mistake of comparing future impacts with existing conditions.

A major addition to the concept of determining impacts to the physical environment before determining impacts to the experience of perceiving visual quality is the final aspect of the landscape assessment, the determination of if impacts are significant, essentially a determination of the scale of the impact to the physical environment. This is similar to the Minnesota DOT process of inventorying the environment and determining the scale of the impact during the subsequent analysis of impacts.

The assessment of visual effects is premised on human experience. In addition to the physical characteristics of the landscape, it is the experience people have with their environment that matters to Transport Scotland. The visual effects portion of their VIA evaluates the visual experience of viewers, especially what do they consider in the view they see?

For Transport Scotland, determining where views are located and what a viewer experiences in that location is critical in determining the visual impacts of a proposed project. In assessing the significance of these visual effects, the sensitivity of viewers to the magnitude of the physical change is judged. Viewer sensitivity is determined by a model of the viewer, similar to the model used by Minnesota DOT, where the expectations of viewers are paramount in determining existing visual quality and impacts to it. Like Minnesota DOT, these judgments are typically made by professionals without direct input from the people who actually experience the views. For a UK VIA, what people actually value is key to determining visual impacts.

The geographic scope of visual impacts is determined by viewshed (there called Zone of Theoretical Visibility, or ZTV). Identification of key views, the use of photographs to document existing conditions, and the use of simulations are typical.

Several aspects to the visual assessment are unique to the UK approach. For example, impacts for each alternative are determined for summer and winter and for day and night—a much more thorough approach than the typical "nice summer day" analysis done in the United States. Another difference is that key views are consciously sought, not only from the outside, but also from the insides of buildings. In an approach similar to that used by the Minnesota DOT, impacts are identified and classified into three categories: positive, negative, or neutral.

The striking similarities between the Minnesota DOT process and the process used in the UK are perhaps not unexpected, since both are premised on the transactional approach to perception and both prefer a narrative explanation over a numerical one. One major difference between the two processes is that the UK VIA process requires that a final analysis be done on the effectiveness of mitigation and to determine the extent to which the mitigation was successful or even if it will result in an enhanced visual experience.

CHAPTER 7

Study Findings and Implementation Plan

This chapter provides a set of summary findings based on the work presented in the previous six chapters of *NCHRP Report 741* and a set of implementation strategies for distributing these findings to state transportation agencies, professional practitioners who conduct visual impact assessments (VIAs), and academic researchers who can continue the explorations outlined in this study.

The findings presented in this chapter should be considered recommendations that require further research and testing to ensure their scientific defensibility and administrative practicality. These recommendation are, nonetheless, based directly on a review of existing research (as documented in Chapter 2) and a review of existing practices (as documented in Chapters 3 through 6), and they can be utilized as a working paradigm for improving the VIA of highway projects.

7.1 Study Findings

There are three sets of recommendations: a set of six governing directives; a set of four foundational concepts; and a set of twelve best practices. The governing directives provide a standard structure for conducting and documenting VIAs. The foundational concepts provide the intellectual basis and scientific rigor for VIAs. Finally, the best practices provide a thorough, methodical approach for conducting VIAs.

To ensure that an effective, administratively practical, and scientifically defensible process is used to assess the visual impacts caused by highway projects, it is suggested that all of the governing directives, foundational concepts, and best practices should be woven into a state's VIA policies and methodologies.

7.1.1 Governing Directives

The six governing directives are a set of protocols that provide a standard structure for conducting and documenting VIAs.

1. Document compliance with federal and state regulations which require that a VIA be conducted for transportation projects.

As prescribed by the National Environmental Policy Act of 1969 (NEPA), it is the "continuous responsibility" of federal and state governments to "assure all Americans" an environment that is composed of "aesthetically pleasing surroundings." No subsequent legislation or executive action has altered or voided this mandate.

The United States Department of Transportation (U.S. DOT) and subsequently FHWA have interpreted this mandate as a responsibility to assess the visual impacts that transportation projects, particularly highway projects, have on the landscape and the perceptions of these visual impacts by people. Although a focus on visual impacts is only one dimension of aesthetics and human perception, the decision to focus primarily on visual issues is supported by scientific findings that demonstrate that for most human beings, sight dominates all other senses. This has been shown to be particularly true of how human beings perceive landscape changes caused by large-scale human activities, such as the construction of highways.

For state transportation authorities to adequately fulfill NEPA's requirements for assuring an aesthetically pleasing environment, conducting a VIA should be considered a requirement for all federally funded or federally permitted highway-related projects. Additional legislation, executive orders, and court decisions have reinforced the NEPA aesthetic directive. Some of these directives pre-date NEPA, others have been promulgated in the years after its enactment. If any of these federal, state, and local directives apply to a particular project, they should be identified and documented in the VIA.

2. Document how the VIA contributed to location, design, or mitigation decisions in the VIA or in a project's environmental review documents.

A VIA is typically conducted as part of a project's evaluation of social, economic, and environmental impacts. As one

topic in a series of studies conducted to assist decision makers in determining appropriate government actions, a VIA must be directed to providing information that will potentially affect location, design, and mitigation decisions for highway projects. Extraneous information that does not pertain to decision making need not and should not be included in the assessment. This should not be construed, however, to mean that only the findings of a VIA need to be documented. It is critical that the information gathered by following the twelve best practices all be documented in the VIA. It may not be necessary to repeat a full description of all twelve best practices in the project's environmental document, where it may be appropriate to report only the findings of the VIA; but it is still necessary that the environmental document be able to refer to a complete VIA that incorporates complete information based on all twelve best practices.

3. *Conduct and document VIAs in an administratively practical and scientifically defensible manner.*

The courts have emphasized that any VIA must be conducted in accordance with a prescribed method, preferably one vetted by a peer-review process and based on a scientific understanding of the issue. Specifically, a VIA procedure based on scientific understanding will incorporate the generally accepted research findings about human visual perception of landscapes and landscape change, as well as research on methods relevant to VIA procedures (e.g., visual simulation and viewshed mapping methods). A significant opportunity exists to merge the scientific findings about landscape perception and the perception of landscape change with research into identifying the best methods for assessing visual impacts. It is suggested that any new approach to conducting a VIA incorporate existing scientific knowledge and include a method for regularly integrating new scientific knowledge into the procedure in a way that supports the practical necessities of planning and design.

4. *Identify the VIA process that was employed in conducting the assessment and document how rigorously the process was followed.*

Most practitioners who conduct VIAs follow a particular, usually published, process. Identifying the process and providing a citation for regulatory authorities and other readers of the VIA will provide a necessary reference for readers to understand the selected VIA process and to ascertain if it was rigorously followed. For readers who may be unfamiliar with the selected VIA process, it is especially useful to provide a summary or overview of the selected VIA process within the VIA document and in the project's environmental review document. If the practitioner conducting the VIA purposefully modifies a particular VIA process, a justification for each modification needs to be articulated in the VIA. This is especially important so that local, state, and national reviewers understand the adjustments and do not consider any anomalies as evidence of incompleteness.

In the project's environmental review documents, it is similarly essential that the VIA process be identified and a citation to its published guidance be included in the discussion of visual impacts.

5. *Identify who conducted the VIA, their experience, professional credentials, and authority.*

Identifying the author of the VIA and others who may have managed or otherwise contributed to the VIA assigns professional responsibility and provides regulatory reviewers and others with necessary contact information. Listing a person's experience and the number of years they have conducted VIAs provides assurance that the VIA was conducted by someone thoroughly familiar with VIA procedures and with a proven history of performance. Noting the profession and position the author has within the sponsoring agency provides a better understanding of the author's credentials and authority.

6. *Report accurately the findings of the VIA in a project's environmental review documents.*

Frequently, the author of a project's environmental document is a generalist who is synthesizing special studies on individual topics into a single document. Typically, a project's environmental documents only provide a summary of the findings of a VIA. It is important that the author of the VIA concur with how information from the VIA is being presented in the project's environmental documentation. To ensure that the environmental documents accurately depict the VIA, it is necessary for the author of the VIA to review and consent to the depiction of the VIA in the project's environmental documents. It is necessary for this approval process to be formal and documented. If the author of the VIA is compelled to disavow the presentation of the VIA in the project's environmental documents, the reason for rejecting the presentation can be submitted to the authors of environmental documents, noting the changes that are required to bring the document into conformance with the VIA.

7.1.2 Foundational Concepts

The study identified four foundational concepts that provide the intellectual basis for scientifically rigorous VIAs.

1. *Perception of visual quality is an interaction between people and their environment.*

The scientific literature on landscape perception repeatedly concludes that human perception of the landscape, including visual quality and visual impacts, is a *transactional process.* That is, perceived visual quality is the result of interaction between the landscape and people. Visual quality is the product of a relationship between the environment and viewers. Understanding both the affected landscape and the affected population of viewers is necessary for determining visual quality and visual impacts. Conclusions from the abundant research on landscape perception should be employed as a basis for building necessary understanding and for framing appropriate questions about particular characteristics of landscapes and viewers that are specific to a VIA.

One key to a rigorous and scientifically defensible approach to evaluating visual quality (and consequently visual impacts) is to recognize that visual quality cannot be isolated in the landscape or in the viewer. Aesthetic qualities are not intrinsic in the landscape, and beauty is not merely in the eye of the beholder; rather, the landscape and viewers operate within a *system* to generate perceptions of visual quality. The landscape is but one component of that visual system that also includes people.

2. *It is important that the public be directly involved in defining existing visual quality and visual quality management goals, and in determining visual impacts.*

Visual quality is, as previously stated, a transactional process—an interplay between the landscape and the human beings viewing it. Visual impacts are the changes to that relationship between landscape and viewer that will be caused by constructing a highway project. To predict those impacts it is necessary to determine existing visual quality and the visual quality of a future state with the proposed project and without the proposed project. The impact is the difference between the two predicted future states.

Traditionally, professional evaluators—frequently, but not exclusively, landscape architects—have completed the evaluation of existing and future visual quality and the determination of visual impacts. Occasionally, and in some states frequently, historians or planners conducted the evaluation. Rarely have professional engineers or architects conducted the evaluation for highway projects. Regardless of professional background, each type of evaluator has brought a distinct professional bias to the evaluation of visual quality and determination of visual impacts. As documented in Chapter 2, research suggests that professionals, regardless of training or profession, do not adequately represent the visual interests of the public for whom the VIA is theoretically being done.

The differences between what professionals value and what the public values is profound. This is not to say that professionals are incapable of making aesthetically pleasing highways. They can and do, but what they tend to consider as being vitally visually important is frequently undetected by people uninitiated in artistic, picturesque, or ecological theories. Therefore, having only professional input into the VIA process yields unsatisfactory results. It is essential that the public be involved in identifying the character of the existing landscape, particularly what is visually valuable, and in determining visual impacts and the appropriate level of mitigation.

Perhaps the best opportunity for the public to become involved in the VIA process is at its earliest stages—the development and establishment of visual management goals for a highway corridor. Existing scientific research about landscape perception supports the concept that, by having the public define what is visually important in a particular highway segment, professional judgment can be kept at bay and the results of an assessment, even if completed by a professional, will be premised on those visual issues with which actual viewers are concerned.

3. *Highway projects have the capacity to affect the landscape and viewers, and to alter visual quality.*

Highway projects can result in minor or major changes in the landscape and in how the landscape is perceived by viewers. Consequently, highway projects can result in minor or major changes in visual quality. Regardless of the scale of the changes, the capacity for a highway project to alter the landscape and its perception by viewers is fundamental and needs to be evaluated for each project. Documentation for minor impacts may be perfunctory and documentation for major impacts may be exhaustive, but all twelve aspects of what are considered to be best methodological practices should be followed, regardless of the anticipated level or types of impacts. Following all twelve best practices provides a complete assessment of visual impacts and potential mitigation measures.

4. *Responding to the visual impacts caused by a highway project requires the prior establishment of corridor-specific visual quality management goals.*

The determination of impacts without an understanding of what viewers anticipate viewing may direct unwarranted or even undesired mitigation strategies to be implemented. To determine if a proposed highway project will cause adverse, beneficial, or neutral impacts, it is first necessary to establish a visual quality management (VQM) goal for the corridor,

preferably by viewshed or other visual management unit. A highway project can only cause adverse impacts if its impacts denigrate visual quality, as determined by a VQM goal for that segment of the project corridor. Similarly, the project can only benefit the corridor if its impacts improve existing visual quality as determined by the VQM goal.

VQM goals identify specific landscape features or particular views for specific viewers that need to be attained or maintained. If a proposed project assists in attaining or maintaining the goal, it is considered beneficial to visual quality. If the project hinders, reduces, or impairs attaining or maintaining the corridor's visual quality goals, the project has an adverse impact on visual quality. If the project refrains from altering the status of the corridor's existing visual quality, the proposed project is simply neutral in attaining or maintaining visual quality goals.

7.1.3 Best Methodological Practices

This study identified twelve interrelated best practices that provide an administratively practical and scientifically defensible, methodical approach for conducting VIAs. The study found no existing VIA process that includes all twelve best practices. In other words, all current VIA methodologies could be improved by incorporating one or more of these best practices. The twelve best practices could provide, therefore, a set of necessary minimum requirements for improving existing VIA methodologies as they apply to highway development and environmental review documentation.

1. Establish the geographic scope of the VIA.

The geographic scope of a VIA is defined by a project's viewshed. All of the VIA processes examined in the research for this report began their assessment of impacts by conducting an inventory of the existing landscape. This inventory was usually restricted to an area that would be visible to or from the proposed project—what is referred to as a project's viewshed. Determining a project's viewshed is problematic and has typically been done using a terrain model without considering the potential screening effect of trees and structures. Generally, such viewsheds define a larger area of potential impact than is likely to occur in reality.

The *perception* of a viewshed differs for different types of viewers. For clarity in defining the geographic dimensions of a viewshed, however, a simple definition of static intervisibility is sufficient and removes complicating qualifiers. If any specific portion of the road can be seen by a viewer in any particular location in the landscape, it is by this definition in the project's viewshed. Since intervening vegetation and structures could be considered ephemeral (at least more readily subject to change than landform) it is reasonable to construct a viewshed using only terrain models. Other obstacles that modify intervisibility can be added as necessary on a project by project basis.

2. Inventory relevant physical attributes of the existing landscape.

An understanding of physical attributes of the landscape and their relationships with each other in forming a composition valued by human beings is essential for representing existing landscape character and for describing visual impacts of possible landscape changes. In particular, research suggests that the following physical attributes are consistently related to visual quality, depending upon context: (1) landform relief; (2) vegetation, particularly woodland presence, area, and configuration; (3) presence and configuration of water bodies; and (4) apparent naturalism of land use or character of the built environment; (5) length or area of view; (6) visibly flowering plants; and (7) apparent maintenance, as shown by a neat landscape.

Understanding what physical attributes contribute to a viewshed's baseline condition is critical to later evaluation of visual impacts. Measurement of these attributes may be quantitative (and most defensible in the U.S. legal system), but recent developments in the European Union (EU) suggest that VIA processes that use a narrative description of existing conditions may offer a more useful understanding of the character of the landscape. In addition, traditional aesthetic definitions derived from an artistic vocabulary (using such terms as line, shape, texture, or color) or a picturesque tradition (using such terms as scale, diversity, continuity, or dominance) that are frequently employed in the United States have not been found to be most useful in the EU.

3. Identify whose views will be affected by the proposed project.

Almost all of the VIA processes studied suggest that understanding who will be affected, how they are affected, and to what degree they will be affected, is crucial for determining visual impacts. Most VIA processes for highway projects tend to examine at least two major classes of viewers—people who are on property adjacent to the road and people on the road. The first group, commonly referred to as "neighbors," have views *to* the road. The second group commonly referred to as "travelers," have views *from* the road.

To better understand the proclivities of viewers, both neighbors and travelers are frequently further divided into finer viewer groups. Neighbors are frequently divided by land use. Travelers have been subdivided by mode of travel (e.g., car, truck, bicycle, or pedestrian); or by their primary reason for travel (e.g., commuting, hauling, or recreation).

The assumption that underlies creating these subcategories is that different people value different attributes about their environment and have different levels of exposure and sensitivity. Consequently, it is assumed that why and how these viewers are impacted can be defined by who they are and what they are doing in a certain location, taking in particular views. Although in theory this may be a good analytical tool, it fails to be a practical way to ascertain actual impacts as felt by real people. Determining who in reality is actually impacted has proved difficult to ascertain. The division between neighbors and travelers is artificial; it is frequently acknowledged that a traveler may become a neighbor upon reaching their destination, for example. To compensate, other VIA procedures suggest interviewing actual viewers, but such an approach is fraught with sampling and analytical weighting issues.

A narrative approach to defining who is likely to be part of the affected population is adequate for establishing whose views would be affected by the proposed project. Similar to the approach used to define the affected environment, the affected population can be discerned by who is occupying the project's viewshed, regardless of exposure and sensitivity. Identifying who these people are and their exposure and sensitivity as a narrative, without resorting to quantifying subcategories of different viewer groups, is a sufficiently robust way of identifying the affected population.

4. Establish what affected viewers value in the existing landscape.

Although identifying who is part of the affected population is difficult, determining what viewers value is even more challenging. A promising approach for incorporating the value that viewers place on visual quality into the VIA process is offered by several federal land management agencies that use a public process to determine general visual management goals for the lands they manage. This approach could be transferred to highway corridors. Combining results from existing research on landscape perception with input from a sample of affected viewers, it would be possible to establish scientifically defensible, publicly defined goals for visual quality for any highway corridor. These goals can be established as part of the VIA process or prior to a project being proposed.

This approach, called visual quality management (VQM), is emerging within a few state DOTs as a way to establish corridor-wide visual quality goals, potentially allowing for even a quantitative analysis if the goals are properly articulated. However, it is likely that goals will remain more at a policy level and function more as a narrative directive than a quantitative measure. Regardless, a narrative approach to establishing VQM goals, matching a narrative approach to defining the affected environment, the affected population, and the impacts to visual quality, will be acceptable if rigorously applied.

5. Identify key views that will be used to analyze visual quality and visual impacts.

Assessing visual impacts along the complete length of a highway corridor has been shown to be unnecessary by the methods typically used to evaluate visual impacts. What has been proven effective is to select a series of key views from which to do an analysis of visual impacts.

The rationale and process used to select key views is critical to the validity of the VIA process and must be documented as part of the VIA. Typically, views are selected because they are either iconic or representative. It would be advantageous to have the viewing public assist (at a minimum) in the selection of these key views. This could be done as part of the development of a VQM plan for the corridor that establishes overarching visual quality goals. Key views can be taken from the road (representing what would be seen by a traveler) as well as from adjacent property (representing what would be seen by a neighbor).

Some states do not allow key views to include views from private property. These states have a history of limiting the analysis of visual impacts to a discussion of impacts to public property from public roads. Although this policy has the practical benefit of reducing the scope of the analysis, the concept that evaluating impacts to private interests caused by an action taken by a public agency is outside the limits of how environmental impacts are evaluated does not seem justified. To limit the evaluation of impacts to those that affect the public domain seems to run counter to the intent of NEPA and other laws that seek to balance public and private good. Key views, therefore, should be considered for both the public realm and, as appropriate, the private realm.

In addition to selecting the locations of key views, further advantage would be gained by determining the preferred season and time of day for employing the key view. The primary use of a key view is to generate "before" and "after" images. How and why the key view was selected and the season and time of the photograph should be documented in the VIA. Two simulations using the photograph could be created to show how the key view will appear in the future, one with and one without the proposed project. These two simulations should be completed for each alternative and used to evaluate impacts to visual quality.

6. Determine the status of existing visual quality.

Visual impacts are determined by evaluating the differences between two future states—one with the proposed project and one without. To be able to determine what those two states would look like, and what would happen to the landscape and the people that view it, it is necessary to first define existing visual quality.

Existing visual quality is the value placed on the existing landscape by those people who currently have views of the environment. Although many VIA methods used in the United States have historically relied on determining visual quality using artistic attributes or picturesque theory, not all methods have followed that course. A few methods have been more in alignment with the transactional process of visual perception, which documents the visual experience people have when perceiving the landscape. This approach includes a descriptive methodology used by the EU to evaluate existing visual quality and describe impacts caused by proposed projects.

7. *Determine what will be the "no-build" visual quality for a selected future date.*

Many but not all of the currently used VIA processes evaluate only the differences between the existing situation and the future with the proposed project. But comparing a future with the construction of the proposed project to the present situation—a practice now followed by most state DOTs—does not adequately analyze the visual impacts that a proposed project is capable of generating. For a true assessment of the status of future visual quality, the future needs to be considered at least twice: once with the proposed project constructed and once without it being constructed. Other changes to the existing landscape are likely to occur even if the project is not constructed. To the extent that these changes can be identified, the future states must be compared.

8. *Document, by alternative, how the proposed project will alter the affected environment.*

Visual impacts to the landscape need to be evaluated as the result of the physical changes that the proposed project will cause to the future "no-build" landscape. Changes to landform, vegetation, water bodies, and cultural features need to be identified for each alternative. A narrative approach is an effective method for recording these impacts when supplemented with maps, illustrations, and photographs that document the identified changes. The impact analysis should avoid straying into a discussion of the value people will ascribe to these changes. Simply documenting the changes in the physical environment is what is required initially. The determination of the value of the changes must occur separately, as impacts to visual quality.

9. *Document, by alternative, how the proposed project will alter the affected population.*

The proposed project will affect viewers. It will change the access some viewers will have to particular views. It may even displace some existing viewers, particularly neighbors. It may bring others into closer proximity to particular scenes, especially scenes with increased views of a modern highway facility. Identifying who will be impacted and providing a narrative description of their exposure and sensitivity to impacts by alternative must be documented as part of the VIA.

10. *Document, by alternative, how the proposed project will change visual quality.*

Understanding the changes the proposed project will cause to the affected environment and the affected population—the two components of a transactional approach to ascertaining visual quality and visual impacts—results in an understanding of how the proposed project will change visual quality. The VIA must simply merge descriptions of the changes to the landscape and the changes to viewers into a discussion of the changes viewers will perceive to the values they place on the environment. Impacts to visual quality need to be defined as being adverse, beneficial, or neutral.

An analysis of impacts to visual quality must begin with an understanding of what those people whose views will be affected by the project value in the existing landscape, how they have chosen to perpetuate those values, and the preferred aesthetics of that landscape. These values should have been articulated already in a VQM plan for the corridor. If they have not, a VQM plan needs to be developed using direct input from the affected population before conducting the VIA.

11. *Compare impacts to visual quality by alternative.*

Typically, a project has more than one alternative; by default, it has at least two—one build alternative and one no-build alternative. Once the changes to the affected environment, the affected population, and visual quality have been determined for each alternative, it is critical to prepare a comparative summary of impacts for use by decision makers in selecting a preferred alternative. Understanding what will physically change in the landscape, how the perception of the landscape will change for viewers, and the impacts the proposed project will have on visual quality is essential for allowing visual quality to be adequately incorporated into location, design, and mitigation decisions.

12. *Identify mitigative strategies to avoid, reduce, minimize, or compensate for adverse impacts to existing visual quality.*

In the event that the preferred alternative has generated adverse impacts to visual quality, it is necessary to determine how those impacts have altered either the status of the

landscape or the perceptions or status of viewers. Adverse impacts are to be avoided, reduced, or minimized. Strategies should be implemented that first avoid, then reduce, and finally minimize impacts. It may be necessary to compensate for adverse impacts that cannot be adequately avoided, reduced, or minimized. Compensation adds an element to the project that represents an effort to offset an unmitigated adverse impact.

Mitigative strategies should be implemented in accordance with the prerogatives established by the VQM program previously adopted for the corridor with the goal of attaining or maintaining the established visual quality goal. It must be recognized that mitigation is not limited to avoiding, reducing, minimizing, or compensating for adverse impacts to the landscape. These strategies also can be applied directly to viewers, for example, by providing better access to desirable views, screening them from undesirable views, or compensating them for views not otherwise mitigated.

In addition to mitigation, the opportunity for enhancing visual quality should also be considered when evaluating the impacts a proposed project has on the VQM goals of the corridor. Some states limit the opportunities for a project to enhance visual quality as a fiscal constraint. Other states do not. Regardless of state policy, it may be possible to select an alternative that improves existing visual quality without spending additional money to do so. Certain location, design, and mitigation decisions may result in an enhancement of visual quality as defined by the corridor's VQM plan without increasing project costs. A VIA process that identifies such opportunities enables NEPA's aesthetic mandate to be met through a simple program of effective location, design, and mitigation decisions.

7.1.4 Conclusion

Agencies wanting to change their existing VIA process could incorporate all twelve best methodological practices, all four governing concepts, and the six procedural directives into any new methodology they create to assess visual impacts. By utilizing these suggestions, a more robust, more scientifically defensible, more administratively practical, and more professionally useful VIA process can be created.

7.2 Implementation

Three sectors of practitioners may find this research useful:

1. People who oversee environmental compliance policy and procedures within the U.S.DOT and state DOTs.
2. Professional practitioners in public sector agencies and private consulting firms who produce or oversee the production of VIAs for highway projects.
3. Academic researchers and instructors and the students they serve, for whom *NCHRP Report 741* may provide the basis for additional examination of the study's findings or other research related to VIAs.

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Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation