HABITAT CONNECTIVITY AND RURAL CONTEXT SENSITIVE DESIGN: *A SYNTHESIS OF PRACTICE*

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THE STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION

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THE U.S. DEPARTMENT OF TRANSPORTATION
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February 2007

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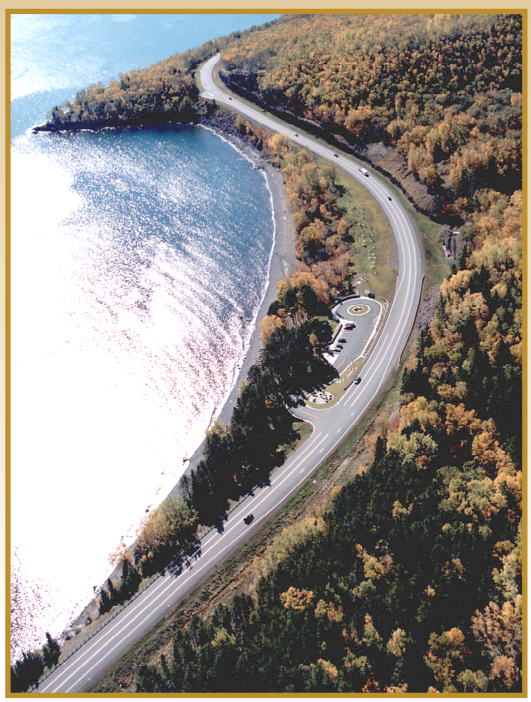

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16. Abstract
This report looks at context sensitive design/context sensitive solutions (CSD/CSS) in a rural setting relating to habitat connectivity, roadside aesthetics, and land use planning. It investigates programmatic procedures used by selected states in implementing and guiding CSD/CSS. Specifically, how can states prioritize design options in a CSD/CSS context so as to maximize the return (e.g., CSD/CSS benefits) on the limited funding for construction and maintenance? It also provides some examples of CSD/CSS design elements and specific case studies.

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TABLE OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

The terms context sensitive design (CSD) and context sensitive solutions (CSS) have been in use for a number of years. However, the national effort really came together in 1998 when the Federal Highway Administration (FHWA) sponsored a conference titled "Thinking Beyond the Pavement." Since then, a number of national guidelines and best practices have been published, and numerous states have formally adopted a CSD/CSS process.

Context Sensitive Design (CSD) and Context Sensitive Solutions (CSS), in the author's opinion, represent a new way of prioritizing design options where the old method can be defined as follows:

> Old School: Consider the three primary criteria of (1) minimizing cost; (2) maximizing throughput, or meeting anticipated demand; and (3) maximizing safety. The designer chooses a design that optimally balances the three primary criteria while meeting the minimum criteria for historical structures, aesthetics, environmental impacts, and community values. These minimum criteria may be in the form of statewide guidelines, state and federal laws, or the result of lawsuits.

Standardized practices have developed for converting the three primary criteria to a dollar value (e.g., total hours of delay for #2, and societal costs of crashes for #3). These practices simplified comparison of design alternatives, because trade-offs between costs, capacity and safety could be compared monetarily. Context sensitive design attempts to raise other criteria (historical, aesthetics, environmental impacts, and community values) to the primary level, so they can be optimized along with safety, throughput and cost:

> New School: Consider the following eight (or more) criteria (1) minimize cost, (2) maximize throughput, (3) maximize safety, (4) protect and preserve historic elements, (5) maximize visual aesthetics, (6) minimize environmental impacts, (7) maximize positive benefit on local and regional economy, and (8) incorporate local community values. The designer must choose a design that optimally balances all these criteria.

Obviously, this is an oversimplified view. Designers over the past century have on some level internalized these "secondary" criteria beyond just trying to meet the absolute minimum. However, the above framework highlights one of the challenges of CSD/CSS: since there are obviously trade-offs between these criteria (or at least between each criteria and cost), how can all these criteria be compared alongside the traditional three so that each one is considered with equal (or at least appropriate) weight?

One way to incorporate CSD/CSS into transportation planning and design is to invest more effort in public outreach and incorporate stakeholder input into design decisions. Project teams can be formed that include key stakeholders. These teams will rank the design alternatives with all criteria in mind. If the project committee can agree on rankings (say an arbitrary 1-5 value), then the relative importance of all criteria can be incorporated into the design decision without converting them to estimated dollar benefits. Incorporating stakeholders and public has been the focus of most CSD/CSS efforts, but in some cases has led to more expensive projects as different priorities are incorporated. Some state departments of transportation (DOTs) are beginning to feel the strain as project costs continue to climb, and the "minimum design" becomes more robust. In some cases, when a CSS feature is included on one project, the public expects it to become a minimum standard and be included on all future projects.

Even for the "minimum design," costs are skyrocketing. American Association of State Highway and Transportation Officials (AASHTO 2006) recently reported that in the last two years (2004-2005), overall construction costs have increased 21%. Meanwhile the growth in federal expenditures under SAFETEA-LU is 0.3% annually. MDT's internal tracking shows that it already spends 5% of its total construction costs on CSD/CSS (Straehl 2006). As MDT attempts to maintain and improve the transportation network with continued decreases in purchasing power, CSD/CSS cannot be successful unless it can be shown to have significant measurable benefits, cost sharing by other partners, and/or cost savings.

This report attempts to investigate how other states have incorporated CSD/CSS into their planning and design, including specific innovative examples of CSD/CSS, and statewide guidelines or standards that are used to prioritize and optimize habitat connectivity, roadside aesthetics and land use planning.

2 METHODOLOGY

In an effort to narrow the rather large topic, the Technical Advisory Committee (TAC) set the focus. The TAC recommended that the primary focus of the case studies and examples should be on habitat connectivity, roadside aesthetics and land use planning. Secondarily, the effort was to focus on rural highways and interstates.

To gather information for this synthesis project, WTI researchers conducted a literature review and stakeholder interviews. National literature on the topic was reviewed and if appropriate summarized in this report. Additionally, interviews were conducted. A survey tool was developed to ensure the interviews captured information that was important to the project Technical Advisory Committee (Appendix A).

The survey tool was used to guide phone interviews with selected individuals. Individuals were identified in the literature and by reputation as having been involved in CSD/CSS projects. An attempt was made to include people from the fields of environmental, public outreach, and design. In some cases the interviews started with a cold call to a DOT division chief (typically environmental or highway design). State guidelines and supporting documents were also collected from the interviewees.

3 WHAT IS CSD/CSS: BACKGROUND FROM NATIONAL LITERATURE

This section attempts to define CSD/CSS and provides a summary of the CSD/CSS process.

3.1 What is CSD/CSS?

There are many definitions of CSD/CSS. Generally they refer to a process of incorporating scenic, historic, cultural and environmental criteria into the planning and design process. A National Cooperative Highway Research Program (NCHRP) report titled "Performance Measures for Context Sensitive Solutions – A Guidebook for State DOT's" defines CSS as follows:

> A transportation project that is designed collaboratively by an interdisciplinary team, which includes community and regulatory agency stakeholders and fits its physical setting by supporting community values and preserving scenic, aesthetic, historic, and environmental resources, while maintaining safety and mobility is a Context Sensitive Solution. (Transtech et al. 2004)

In 1998, the University of Maryland, Maryland State Highway Administration, ASSHTO, and FHWA sponsored a national conference called "Thinking Beyond the Pavement." The proceedings of this conference provide the following definition for context sensitive design:

> Context sensitive design asks questions first about the need and purpose of the transportation project, and then equally addresses safety, mobility and preservation of scenic, aesthetic, historic, environmental, and other community values. Context sensitive design involves a collaborative, interdisciplinary approach in which citizens are part of the design team. (Maryland State Highway Administration 1998)

Context sensitive design (CSD) and context sensitive solution (CSS) are used somewhat interchangeably. The term "CSD" appears to have been used first, and was applied specifically to the design process. CSS is now more commonly used, representing design and strategies outside of design. NCHRP 480, "A Guide to Best Practices for Achieving Context Sensitive Solutions," differentiates CSS from CSD, stating that "CSS integrates all key functions of an agency" and includes "operational solutions" (Neuman, T. et al. 2002). When talking about the concept in general terms, however, the NCHRP 480 report uses "CSD/CSS." Other terms such as "thinking beyond the pavement" (TBTP) and "green highways" have similar connotations.

3.2 CSD/CSS is Flexibility in Design

Many practitioners think of CSD/CSS as flexibility in design. Many design standards are geared toward optimizing capacity, safety and cost. By allowing exceptions to these design standards, other criteria can be considered. The AASHTO "Guide for Achieving Flexibility in Highway Design" describes CSD/CSS as follows:

> Encourages highway designers to expand their consideration in applying the Green Book criteria. It shows that having a process that is open, includes good public involvement, and fosters creative thinking is an essential part of achieving good design. (AASHTO 2004a)

The AASHTO "Green Book" (AASHTO 2004b) is a primary source of national design guidelines (although states typically have their own guidelines that supplement the Green Book). However, the Green Book itself states the importance of flexibility in design:

> The intent of this policy is to provide guidance to the designer by referencing a recommended range of values for critical dimensions. It is not intended to be a detailed design manual that could supersede the need for the application of sound principles by the knowledgeable design professional. Sufficient flexibility is permitted to encourage independent designs tailored to particular situations. (AASHTO 2004b)

Although CSS discussions commonly involve design exceptions, this is not the only option. Many of the case studies in NCHRP Report 480 on CSS best practices (Neuman et al. 2002) avoided design exceptions by lowering the design speed. Also, many CSD/CSS have nothing to do with design exceptions, but relate to mitigating for wildlife, aesthetics and other issues.

As the "Guide to Flexibility in Highway Design" (AASHTO 2004a) points out, if a design exception is made, it is crucially important to document the decision in order to protect the agency from liability. Documentation should include:

- a description of existing conditions and proposed improvement,
- a description of non-traditional features,
- crash data,
- costs and adverse impacts resulting from meeting design criteria,
- safety enhancements that will be made to mitigate the effects of the nontraditional feature, and
- compatibility with adjacent roadway segments.

For further information on the design exemption process, refer to:

- AASHTO Guide to Flexibility in Highway Design (AASHTO 2004a), or
- FHWA Flexibility in Highway Design (USDOT 1997)

3.3 The CSD/CSS Process

As mentioned previously, CSD/CSS is primarily a process for including stakeholder and public input in design. This may include a planning process, a design process, or even a process for evaluating the overall program of a State DOT. A summary of the typical CSD/CSS process elements and important considerations is listed below:

- Establish clearly defined purpose and need for project in concept definition.
- Develop a decision process (e.g., one stakeholder gets one vote).
  - Develop evaluation criteria.
  - Define major decision points.
- Identify issues and constraints that need to be addressed in design of projects (i.e., safety, geometric, level of service, etc.).
  - Designer needs to communicate cost, capacity and safety requirements along with purpose and need of project.
- Involve Stakeholders.
  - Identify all stakeholders.
  - Do not forget about the general traveler. Project guiding committees should include one or more general public members.
  - Maintain timely and coordinated stakeholder input.
  - Commit to an open creative approach to problem solving.
  - Train and educate stakeholders.
- Involve public throughout each stage.
  - Develop a public involvement plan.
  - Conduct effective public meetings.
  - Have effective public notification.
- Develop safe, effective, creative alternatives.
  - The designer must bring technical expertise to the decision process without injecting or promoting personal bias in the process.
  - Incorporate public input with environmental documents.
  - Document project decisions.
  - Assure community issues are addressed in design and upheld through construction.
  - Present alternatives in understandable format (e.g., incorporate visual representation).
  - Engage stakeholders in identifying alternatives.
  - Identify opportunities to enhance resources.
  - Identify mitigation.
- Select alternatives.
  - Try to compare “apples to apples”.
  - Adjust levels of detail of analysis depending on issues of importance.
  - Document decisions and reasoning.
- Continue CSD/CSS during construction.
  - Maintain communication with stakeholders.
- Conduct continued research to determine what is acceptable (e.g., design standards and exceptions) and how that is measured.

Much work has already been completed on how to implement the CSD/CSS process on a project or agency level. The summary above is intended as a brief overview. For more information on the overall process, refer to the following reports:

- NCHRP 480 A Guide to Best Practices for Achieving Context Sensitive Solutions (Neuman, T. et al. 2002);
- AASHTO Guide for Achieving Flexibility in Highway Design (AASHTO 2004a); and
- NCHRP Report 69; Performance Measures for Context Sensitive Solutions- A Guidebook for State DOTs. (Transtech et al. 2006). Note that this report details how to develop a CSD/CSS program and track performance with surveys. Although there is some discussion on developing performance criteria (at the project and programmatic level), specific measures are not discussed as the title may imply.

4 PROGRAMMATIC GUIDELINES AND EVALUATION CRITERIA FOR CSD/CSS

This section provides programmatic processes and guidelines that relate to CSD/CSS. This summary does not include standard processes that all states use, but those that appear to be unique and related to the topic.

4.1 General Guidelines

Delivering transportation projects in Oregon means addressing complex stakeholder issues related to habitat connectivity, aesthetics, mobility, economic stimulus, and many other CSD/CSS criteria. ODOT recognized that in order to incorporate CSD/CSS into all projects delivered in the state, it would need to develop a pilot version to test the principles and develop tools.

In 2003, the Oregon State Legislature approved the Oregon Transportation Investment Act III, or OTIA III, which included a $1.3 billion funding package to repair and replace hundreds of aging bridges throughout the state. Key directives to ODOT connected with this legislation required the agency to consider not only the outcome but also the process by which the bridges are delivered. In response to the state legislation, ODOT set five goals for the bridge program:

- Stimulate Oregon's economy,
- Employ efficient and cost-effective delivery practices,
- Maintain freight mobility/keep traffic moving,
- Build projects sensitive to their communities and landscape, and
- Capitalize on funding opportunities.

Another key directive from the Legislature was that ODOT contract services to oversee the delivery of the OTIA III State Bridge Delivery Program. In April 2004, ODOT hired the Oregon Bridge Delivery Partners (OBDP), a joint venture of HDR and Fluor Enterprises, to manage the program and provide design and construction oversight.

To incorporate CSD/CSS into bridge projects, ODOT added the concept of sustainability to develop its Context Sensitive and Sustainable Solutions, or CS^3, approach. The CS^3 approach applies to all phases of project delivery, from planning to design to construction, and measures results at both the project and program levels. Bridge projects must follow a CS^3 approach for either design-bid-build or design-build. Although ODOT anticipates a similar program for general highway design, currently it only applies to bridge projects.

In addition to habitat connectivity, aesthetic considerations, and economic stimulus activities, there are significant challenges to program coordination and project delivery. Key among these are elements concerning environmental permitting, traffic management and control, geotechnical surveys, and securing right-of-way. To capture efficiencies in a program of this size and ensure consistency, ODOT created several unique tools and streamlined processes. The processes for implementing a CS^3 approach are described in detail in the CS^3 guidebook (ODOT 2006). The following summarizes aspects that may be of interest to MDT.

During a project's design phase, there are two key tools used by engineers: the CS^3 Plan and the CS^3 Decision Matrix. The CS^3 Plan requires the design consultant to consider the context and implications of the project before engaging in the technical development of the design. It produces a further refinement of scope based on the CS^3 Key Areas of Economic Stimulus, Diversity, Cost-effectiveness, Mobility, Public Involvement, Environmental Justice, Environmental Program Management, and Sustainability. At key milestones throughout their contract, designers report on the status of their plan, including any success or challenges faced in implementing it.

The second tool valuable to the design process is the CS^3 Decision Matrix. This automated spreadsheet is a modified version of a traditional alternatives analysis that expands the five program goals into specific criteria. The project team uses a scoring sheet to select relative benefits and costs of the criteria based on a scale of 1 to 7 depending on the location and circumstances of the specific project. The criteria are tied together in a matrix according to program goal. Weight is assigned to each criterion based on its significance to the Program and project. The matrix allows for an overall Best Value score for each project based on a comparison of the total number of points to cost of proposed alternative.

The CS^3 Plan template and the CS^3 Decision Matrix are available to consultants and the public on the Oregon Bridge Delivery Partners web site at www.obdp.org/partner/cs3/.

To help evaluate performance at the program and project level, evaluation criteria and metrics are spelled out in the Draft Performance Measures Framework (ODOT 2005a). The framework identifies a mix of quantitative and qualitative metrics organized by program goal and CS^3 key area. An important feature of this document is that the measures are continually monitored and the document updated on a regular basis. Some of the more applicable metrics (note that these are a mix of program and project measurements) include:

- Percent of contract value awarded to disadvantaged businesses,
- Jobs created and/or sustained,
- Total travel time through corridor,
- Work zone restrictions,
- Average response time to address comments and complaints,
- Percent of projects using programmatic permits (discussed below),
- Percent recycled material used, and
- Total volume/weight of waste.

The Environmental Performance Standards (ODOT 2005b) allow for programmatic permits. ODOT expects 85 percent of the bridges to be built with programmatic permits. More information on the bridge program environmental process and other aspects of the program is available at www.obdp.org/partner/environmental/.

4.2 Habitat Connectivity

There are no specific regulations regarding mitigation of transportation infrastructure impacts on wildlife habitat loss and fragmentation, barrier effects to wildlife movements, and animal-vehicle collisions. Yet stakeholders are consistently asking that these issues be considered in transportation projects. When concerns about wildlife mitigation emerge, transportation agencies typically respond by addressing habitat connectivity and wildlife movement needs on a project-by-project basis, stretching budgets and timelines beyond original expectations. A state-wide or regional plan or programmatic guidance on how to most effectively and efficiently assess the need for and apply wildlife mitigation measures would help transportation agencies proactively plan for these issues, while improving relationships with stakeholders and potentially decreasing regulatory approval timeframes.

Using a variety of resources and techniques to synthesize information, DOTs or their consultants can prioritize where wildlife mitigation measures can be most effectively applied to protect drivers from animal-vehicle collisions and to maintain habitat connectivity and wildlife movements across landscapes. The list of examples is extensive and growing; rather than attempt to describe in detail or exhaustively inventory such efforts, an overview of select case studies and syntheses on this topic is offered below.

The University of Alaska Anchorage produced a "toolbox" for the Alaska Department of Transportation & Public Facilities (ADOT&PF) to assess how Alaskan roads affect habitat quality and connectivity (DiBari et al. 2004). The project specifically addressed the use of Geographic Information Systems (GIS) to assist transportation planners with project development. Recommendations and suggestions are listed below:

- ADOT&PF should organize all data about existing and proposed roads in GIS databases. Analysis of these data sets should focus on:
    - assessment of direct and indirect impacts of roads on species of concern,
    - effectiveness of restoration demonstration projects, and
    - changes in ecological processes that occur as a result of roads and their related activities.
- ADOT&PF should employ the literature identified in this project to better inform future decision-making with regard to:
    - road design and placement; and
    - potential effects to species of concern, including species of commercial, wildlife viewing, hunting, fishing, and other values.
- ADOT&PF should prepare a "manual" to assist transportation planners with road design and project development.
- ADOT&PF should contact interested parties when planning future projects.
- ADOT&PF should develop a database of local and traditional knowledge.

The research team also created a project website (http://www.akhcp.org) including a project summary, documents, workshop summaries, project-team contact information, and searchable databases including relevant literature and GIS data sets. With access to this comprehensive resource, planners and engineers can efficiently deliver road projects while minimizing the negative effects of roads on habitat quality and connectivity.

The University of Massachusetts – Amherst has created a computer software program called the Conservation Assessment and Prioritization System (CAPS) (http://www.umass.edu/landeco/research/caps/caps.html) to help assess ecological integrity and biodiversity value to prioritize conservation efforts. This program was applied to assess impacts of the Route 11 extension in southeastern Connecticut on habitat and biodiversity (Compton et al 2004). The CAPS system provided a quantitative assessment of ecological values that could be applied in test scenarios, to evaluate and compare impacts of development, transportation and land management projects as well as the potential value of ecological restoration efforts.

The Florida Department of Transportation has created a program to identify and prioritize zones of ecological concern that intersect with highways (Smith 1999). The purpose of this program is to consider underpasses or culverts on a statewide level in order to restore habitat connectivity and ecological processes. This method uses a rule-based GIS model to assimilate multiple factors such as road kill hot spots, riparian areas, greenways, protected conservation lands and known wildlife movement routes.

The Idaho Transportation Department identified wildlife connectivity areas using an approach that integrated GIS spatial data, GIS linkage model analysis and expert workshops to identify areas of interest for mitigation consideration in the southeast corner of the state. Geodata (2005) provides an overview of the methods and results of this approach.

White and Ernst (2003) generally describe a range of strategies to incorporate ecological considerations into transportation projects, summarizing their recommendations as follows:

- Integrate conservation planning into transportation planning.
- Use conservation banking in concert with large-scale conservation plans to mitigate unavoidable impacts of transportation.
- Coordinate with resource agencies early, substantively and continuously throughout transportation planning and project development.
- Build wildlife crossings where necessary to repair ecological damage and restore habitat connectivity.
- Provide alternative transportation and maintain roads on public lands in a manner consistent with surrounding natural resources.
- Use only native species in roadside vegetation management.

Finally, a new interagency federal effort entitled, "Eco-Logical" has been released recently (Brown 2006). Eco-Logical promotes an ecosystem approach to "comprehensively manage land, water, biotic and abiotic resources to equitably promote conservation and sustainable use." Eco-Logical encourages agencies to use flexibility in regulatory processes to plan "ecosystem-based mitigation." Ecosystem-based mitigation is defined as "the process of restoring, creating, enhancing, and preserving habitat and other ecosystem features in conjunction with or in advance of projects in areas where environmental needs and the potential environmental contributions have been determined to be greatest."

When ecosystem-based mitigation is accomplished in advance of infrastructure projects (Eco-Logical targets all infrastructure sectors, not just transportation), agencies capitalize on meaningful conservation priorities and opportunities that may be vanishing or becoming prohibitively expensive over time, increasing the cost-effectiveness of the mitigation. Simultaneously, advanced mitigation should be targeted to fulfill regulatory requirements early on in the development of these projects, ensuring efficient project delivery by avoiding costly delays that can sometimes occur with permitting processes.

The goals of the Eco-Logical's ecosystem approach to developing infrastructure follow:

- ***Conservation:*** Protection of larger scale, multi-resource ecosystems;
- ***Connectivity:*** Reduced habitat fragmentation;
- ***Predictability:*** Knowledge that commitments made by all agencies will be honored – that the planning and conservation agreements, results, and outcomes will occur as negotiated; and
- ***Transparency:*** Better public and stakeholder involvement at all key stages in order to establish credibility, build trust, and streamline infrastructure planning and development.

To implement an ecosystem approach, Eco-Logical outlines three components that iteratively build upon each other through an adaptive feedback loop that accommodates changing priorities, opportunities and threats over time and across landscapes. Starting with an eight-step integrated planning process, conservation priorities are established and used to determine mitigation options, and then as mitigation commitments are planned and executed, the effectiveness of the process and outcomes are assessed; this information influences the next cycle of the process.

There are numerous other examples of how DOTs are incorporating habitat connectivity considerations into projects. Many components such as the use of GIS to analyze spatial data are common, but each situation is uniquely applied to fit the region and stakeholders involved. Programmatic approaches are beginning to be applied more extensively; as DOTs and regulatory agencies work proactively together, it is hoped that these approaches lead to streamlining of project delivery and better environmental stewardship.

4.3 Roadside Aesthetics

The AASHTO "Guide for Transportation Landscape and Environmental Design" (AASHTO 1991) provides a good summary of legislative requirements that specify the need for preserving roadside aesthetics (note that this guide book is currently under revision under NCHRP project 15-33). The main items in that summary include:

- US Code Title 23: Highways and related executive orders: includes requirements for planting wildflowers (at least 0.25% of funds expended for landscaping projects be used for planting wildflowers) and mentions maintaining aesthetic quality in several different contexts including interstate maintenance activities, utilities placed in right-of-way, natural beauty of floodplains, protection and enhancement of rural character on federal lands highways, noise barriers, and wetlands;
- National Environmental Policy Act 1969, designed to "assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings";
- Farmland Protection Policy Act of 1981;
- National Historic Preservation Act 1966;

- Act for the Preservation of American Antiquities;
- Archeological Resources Protection Act;
- Wilderness Act;
- Wild and Scenic River Act;
- Land and Water Conservation Fund Act;
- National Trails Systems Act; and
- Scenic Byways.

A visual assessment process allows transportation agencies to assess public and stakeholder views on visual impacts. To rank alternatives using a visual assessment process, it is best to utilize computer generated views of design alternatives. The FHWA Visual Impact Assessment for Highway Projects (USDOT 1981) is out of print. However, Minnesota has a process that seems patterned after this document that defines visual quality, provides the legal basis, and provides guidelines and methods relating to visual impact analysis (http://www.dot.state.mn.us/tecsup/xyz/plu/hpdp/book2sg/visual/).

Benefits of aesthetic improvements are difficult to measure. They increase the quality of life and enjoyment of motorists using the transportation facility, but the level of benefit is difficult to quantify. To deal with this many agencies put a cap on the percentage of construction costs that can go toward aesthetic treatments. Nevada regulations state: "As a general rule, 3% of total project construction costs on new construction and capacity improvements can be allocated to landscape and aesthetic treatments. Nevada DOT will pay consultant costs for landscape and aesthetic design" (Nevada DOT 2002). North Carolina limits landscaping to 1% of interstate projects, 0.75% for urban projects, and 0.5% for rural (Tennessee and North Carolina DOT 2003).

Denmark's Ministry of Transportation has developed "Beautiful Roads; A Handbook of Road Architecture" (Juels 2002). The handbook does not specify design requirements, but is more of a checklist of things to consider such as:

- for alignment, consider the vantage point from the roadway;
- gentle rounded slopes instead of straight cuts;
- consider the "character of place";
- consider the perspective of bicycle travel;
- suggestions on pavement;
- suggestions on lighting; and
- suggestions on planning.

The Minnesota Department of Transportation (MnDOT) has a policy of cost sharing that impacts CSD/CSS. For example, locally initiated projects require local cost share minimums of 10% for populations less than 5000, and 40% for larger jurisdictions. The policy also includes guidance on aesthetic projects. Generally, local cost sharing for additional aesthetic treatments is 5 to 15% for bridge projects; 1 to 10% for retaining wall and noise barrier projects; and 0 to 5% for other corridor project costs for aesthetic elements. It is important to qualify that MnDOT defines aesthetic elements for the purposes of applying cost participation policy. Items that are considered necessary for a project or required as project mitigation (and not chosen strictly for aesthetic purposes) are not defined as aesthetic elements. Basic aesthetic treatments and features, normally included as standard elements (standard surface rustications and treatments on walls, barriers, abutments, etc.), are not considered as aesthetic elements nor are landscape treatments for specific required functions (e.g., living snow fences, or National Pollutant Discharge Elimination System). Cost sharing also does not apply to MnDOT independently programmed aesthetic, landscape, and site development projects that compete on their own merits with other transportation purposes and needs. In regard to CSS (aside from aesthetics), MnDOT has a design policy memo that states it will incorporate CSS into its design, but that it must also follow cost sharing policies (MnDOT 2004).

For other resources on including roadside aesthetics in projects refer to:

- FHWA Visual Impact Assessment for Highway Projects 1981 (USDOT 1981), and
- “Beautiful Roads; A Handbook of Road Architecture” (Juels 2002).

4.4 Land Use Planning

In Oregon, implementation of CSS standards by ODOT is driven in large part by state comprehensive land use planning laws. The Land Conservation and Development Commission (LCDC) and the Oregon planning program were created in 1973 by Senate Bill 100, with support from both parties and Republican Governor Tom McCall. The law created LCDC and directed it to adopt statewide planning goals, which addressed a range of topics specified by the legislature. Goal twelve of that law specifically addresses transportation issues. As a result, CSS is relatively easy to integrate into transportation projects as part of the initial design.

Although ODOT case studies are used in this report, implementation may not be as straightforward in Montana. However, Oregon is emblematic of the possibilities for coordination between land use issues and transportation planning. For example, while Oregon has enacted comprehensive land use planning laws, the state, like Montana, also enjoys “home rule” status, meaning that local governments have greater flexibility to enhance the existing regulations in place at the state level (NACo 2004). For a definition of home rule see footnote 1.

Including CSS as part of transportation projects may benefit local economies beyond the direct economic impact of construction. The literature on amenity migration to rural communities in the Rocky Mountain West is mature and the message is clear - quality of life, defined many different ways, acts as a pull factor for would-be residents. An increasing number of people want to live in areas rich in recreation and natural resource amenities, and are willing to sacrifice in terms of wages and better job opportunities in order to do so. Examples include a move to a small town, in part, because of the scenic beauty of the area, low crime rate, a desirable climate, recreation

[1] Two types of administrative power exist for local governments. Following the decision Atkins v Kansas, (1903), the so-called “Dillon's Rule" states that local governments are subordinate to the dictates of state legislature. Other states, including Oregon and Montana, are described as "Home Rule" states, with fewer local constraints and therefore greater autonomy with respect to administrative rulemaking.

opportunity, or to be close to family and friends. CSS transportation considerations can play a significant role in helping communities capitalize on and preserve unique amenities. Case Study 2 (Chapter 8) highlights the significance of river access for residents and the local business community in Milwaukie, Oregon. In Big Fork, Montana, a historic bridge was preserved as part of the reengineering of the East Shore Road. Noise mitigation, scenic turnouts, wildlife corridors, and speed controls may also be part of the mix communities seek to preserve as part of their amenity package.

Consideration by the transportation community of inherent local amenities will inevitably attract local support for changes to local transportation infrastructure. Consideration coupled with an active and well-implemented public meeting/education plan will further enhance local support, and the exchange of ideas will often improve the project.

5 DESIGN ELEMENTS AND PROJECT EXAMPLES OF CSS

Specific, detailed examples of CSD/CSS projects are summarized in the section on case studies. Design elements that are common to many CSD/CSS projects are summarized here as well.

5.1 General and Design Examples

There are numerous design examples that have been summarized in various documents. Some of the more common are reduced design speed, interpretive signing, bicycle and pedestrian facilities, and landscaping. For general resources on CSD/CSS as well as specific examples, refer to the following websites.

- www.fhwa.dot.gov/csd
- www.contextsensitivesolutions.org

5.2 Habitat Connectivity

For protecting habitat connectivity, probably the most commonly cited CSD/CSS design element is wildlife crossing structures. These can be overpasses or underpasses that allow both large and small animals to cross the road safely and are included in projects with wildlife fencing so as to funnel the animals to the crossings. For specific examples of wildlife crossing structures refer to the wildlife crossing structures toolkit (www.wildlifecrossings.info). For guidelines on wildlife sensitive fencing refer to "Fencing with Wildlife in Mind" (Colorado Department of Natural Resources 2006).

Many think of habitat connectivity in regard to large animals only, but habitat for small animals can be improved as well. For many small species a road can become a complete barrier to movement. Specially designed culverts can be used to connect habitats and allow for safe movement. For further information on these types of treatments, refer to: www.fhwa.dot.gov/environment/wildlifecrossings/.

Habitat is not limited to terrestrial animals. Culverts can also become a barrier to movement of fish under roadways without appropriate design of the culvert and culvert outlet. Typical treatments include preventing wash-outs and providing resting spots within the culvert. Possibly the best design guidelines for fish passage currently available are from Washington DOT (Bates 2003). Refer to http://wdfw.wa.gov/hab/engineer/cm/culvert_manual_final.pdf.

5.3 Roadside Aesthetics

Roadside aesthetics encompass a myriad of design options. One of the national guideline documents, "A Guide for Transportation Landscape and Environmental Design" (AASHTO 1991) is currently being updated through NCHRP Project 15-33.

One design treatment is changing the alignment of the roadway to improve the number of scenic vistas, reduce large cuts and fills, and fit with the natural landscape. Spiral or transition curves (as opposed to straight lines and circles) not only allow for smoother vehicle operation, but provide a more sweeping natural visual effect. Roads at the toe of a slope can limit the view and make the driver feel closed in. Flatter cut slopes are more pleasing and make the roadway feel more open.

In mountainous areas where rock has to be blasted, the resulting cuts can be carved and painted to look more naturally created. I-70 through Glenwood Canyon in Colorado used this technique so that newly blasted rock faces look almost identical to naturally eroded ones.

Bridges, overpasses and other structures can be uniquely designed to fit with a visual theme for the area. This type of design can be accomplished with artwork, colored and textured concrete, and similar techniques.

Landscaping is a common CSD/CSS element. For rural highways, it entails primarily roadside vegetation. There are several widely used rules of thumb, such as the use of native vegetation, consideration of maintenance costs such as mowing, and consideration of sight distance. However, as the problem statement for a current NCHRP Project (#14-16 Guidelines for Vegetation Management) states, "there are no comprehensive Guidelines that all AASHTO member agencies can use to plan and implement vegetation management programs." Look for a final report from this project in April 2008. However, the NCHRP Synthesis on Integrated Roadside Vegetation Management (Berger 2005) provides a good summary of various state guidelines and best practices. The AASHTO (1991) "Guide for Transportation Landscape and Environmental Design" is currently being updated.

Other commonly considered roadside aesthetics include interpretive signing at roadside pullouts, billboard minimization along scenic highways and special landscaping. For specific examples and design guidelines on roadside aesthetics, refer to the following:

- Scenic Solutions CD-ROM (Scenic America and USDA Natural Resources Conservation Service 2002);
- Beautiful Roads; A Handbook of Road Architectures (Juels 2002);
- Pattern and Palette of Place: A Landscape and Aesthetics Master Plan for the Nevada State Highway System (Nevada DOT 2002); and
- NCHRP synthesis on Integrated Roadside Vegetation Management (Berger 2005).

5.4 Land Use Planning

Land use planning is typically considered in the planning phase and does not usually apply to the design of a specific highway. However, the long term effectiveness of design elements directed toward habitat connectivity need to be protected by ensuring that adjoining land development and any wildlife corridors are protected from development. The design team should consider adjoining land use and anticipated development when considering alternatives, but to actually protect the adjacent land from development requires partnership and support from other agencies and organizations. Huge investments can be made in wildlife crossing structures only to see wildlife driven out of the area by surrounding development. It is not the direct responsibility of the state DOT to maintain habitat corridors; however, by coordinating with resource agencies and local land trusts, habitat connectivity can be maintained beyond the roadway. A team is attempting to do this for I-90 on Bozeman Pass. The partnership includes MDT, Gallatin Valley Land Trust, Forest Service, Montana Rail Link, American Wildlands, and others (contact Josh Burnim, American Wildlands 406-586-8175 for more information).

6 SCANNING TOUR

The Technical Advisory Committee requested that this report recommend a potential scanning tour. This is not meant to imply that a scanning tour is required or worth the expenditure. The authors propose a tour in Oregon, because the state is home to a number of national experts and implementation examples of CSD/CSS in the three main focus areas of this report. Potential scanning tour ideas and contacts are summarized below. However, note that Oregon has a different legislative and political atmosphere than Montana (see Section 4.4), so the TAC may want to consider alternative locations. Contacts from Minnesota, Arizona and other states that have implemented innovative programmatic agreements, design guidelines and case studies are provided throughout this report. These contacts can be used to develop alternative scanning tour options.

A scanning tour could provide both site visits to specific projects, as well as meetings with various staff to provide input and insight on programmatic developments. Some potential components of a scanning tour in Oregon are discussed below (with locations displayed in Figure 1):

- **Fish Passage:** This would include a meeting with select DOT and FWP staff including Greg Apke (ODOT, greg.d.apke@odot.state.or.us, 503-986-3518). DOT and FWP staff could provide an overview of fish passage issues, design guidelines, prioritized drainages, etc. The afternoon would include a tour of selected areas.
- **CS^3 and OTIA Bridge Program:** Presentations could be made by ODOT Bridge design, Oregon Bridge Deliver Partners, Forest Service and others about unique bridge design, CSD/CSS elements and the programmatic processes discussed in this report. A field trip could be made to selected bridges. Contact Lea Ann Hart-Chambers (Lea.Ann.HART-CHAMBERS@odot.state.or.us, 503-986-3798).
- **Land Use Planning:** A presentation could be made by 1000 Friends of Oregon (Bob Stacy or Rob Zako 503-497-1000) regarding Oregon land use planning laws, their background, and how public agencies incorporate these laws into their efforts. The case study discussed later (OR Highway 99E: Kellog Creek to SE Harrison St.) could be a good example of suburban land use planning. A presentation from ODOT by any of the contacts listed in this case study on how ODOT incorporates land use planning could also be beneficial.
- **Environmental Streamlining and Habitat Prioritization:** Representatives from ODOT, DEQ, Northwest Habitat Institute, could provide an overview on their Comprehensive Mitigation Conservation Management program. This program includes streamlining, investigation of mitigation banking for habitat, prioritization of habitat areas, design standards, etc. Contact Chris Maguire (christine.c.maguire@odot.state.or.us, 503-986-3385).

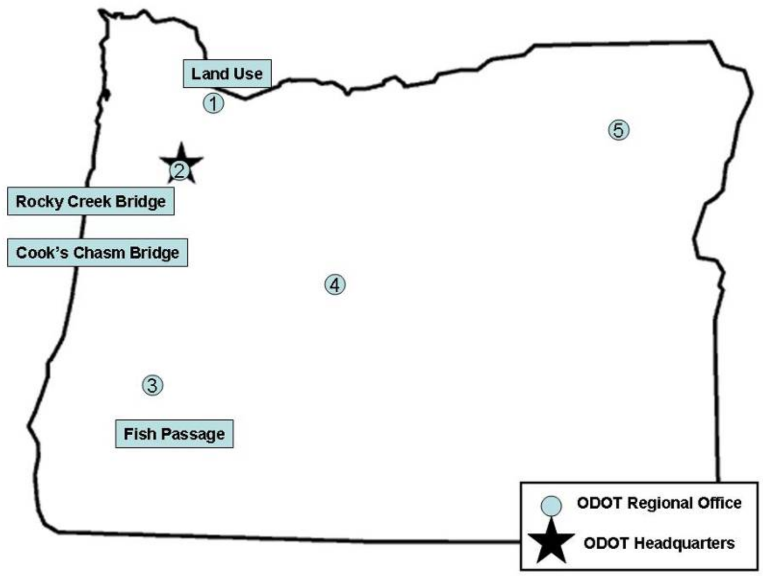

Figure 1: Approximate Locations of Potential Meetings and Field Visits.

7 CASE STUDY 1: TWO BRIDGES ON US 101 (OR)

This study includes two separate bridge projects on US 101 in Oregon. Both examples used CSD/CSS approaches in dealing with aesthetics, historic structures, interpretive signing, access to trail systems (including ADA requirements), and some wildlife passage. These bridges were designed prior to the CS^3 process described in section 4.1 and thus were not part of the programmatic agreements under this program.

7.1 Detailed Description

The Rocky Creek and Cooks Chasm bridges are along the Oregon coast, a particularly scenic highway (The Oregon Coast Highway is a designated National Scenic Byway – All American Road). The Rock Creek (Ben Jones) bridge was fully rehabilitated and the Cooks Chasm bridge was replaced for structural reasons as part of the state's bridge program.

Figure 2: Rocky Creek Bridge. Source: Lea Ann Hart-Chambers, ODOT.

The **Rocky Creek (Ben Jones) Bridge** on US 101 at milepost 130.03 completed rehabilitation in 2002 (Figure 2). This historic structure was designed by Conde B. McCullough, ODOT's first bridge engineer. The bridge was completed in 1927 with an original cost of $45,000. This bridge was originally on US 101. Due to realignment of US 101, the bridge is no longer on the main route but is still a National Highway System bridge structure. The bridge is a reinforced concrete deck arch bridge with a span of 367 feet.

Many bridges designed by Conde McCullough included wayside features (i.e., pullouts), but this one did not. Many people liked to pull off the highway to enjoy the view of the bridge and the ocean, but there was no formal pullout or parking. Another issue was that this area had limited staging space. An area to the south of structure was the only place to do staging. There was an adjacent piece of property available that was owned by State Parks and Recreation, which was donated to allow for a small wayside pullout. ODOT designed the construction so the contractor could stage in this area, and then convert the staging area into a pullout with interpretative signing. The interpretative signing includes three panels about Conde McCullough, Ben Jones and the rehabilitation process. The final design fits with the period and influences of other pullouts in area. A piece of the original railing is used in the interpretive pull out. The designer also worked with the community and county historical society to make the pullout fit with the area (the bridge serves a small community prone to landslides).

Overhead utility lines existed on both sides of the roadway. This project combed overhead utilities to the east and also included an utility conduit on the bridge for future relocation. This project included cathodic protection of the restored structure.

The **Cooks Chasm Bridge** (Figure 3) is located south of the town of Yachats. This bridge was also in a location without much room for construction staging. For reconstruction, there was no dedicated right of way, and an easement was required from the USDA Forest Service. This bridge is on a steep bluff and the Forest Service has a trail system in the area. The existing bridge was built in the mid to late 1930's and was not very attractive. The new design is an aesthetically pleasing concrete arch structure and complements the scenic highway. An ADA trail leads across the new bridge's sidewalk to an overlook with interpretive signing. The overlook was not constructed from scratch, rather it was part of the detour constructed for this project. The supporting embankment walls were architecturally treated.

Figure 3: The Cooks Chasm Bridge. Source: Lea Ann Hart-Chambers, ODOT.

7.2 Partners and Costs

Partners for this project included ODOT, US Forest Service, Lincoln County Chamber of Commerce, Oregon Parks and Recreation, the local community, county commissioners, Lincoln County Historical Society, and FHWA.

Forest Service enhancement funds were used for the Cooks Chasm Bridge to connect to the walking trails in the area.

The Rocky Creek (Ben Jones) Bridge restoration was bid at $3,859,000 and completed in November 2002 for a cost of $3,771,104 (not including planning, design, and inspection). Costs for some of the CSS elements include:

- architecturally treated concrete wall $60,375;
- concrete bridge rail salvage $8,000 (used in interpretive Area);
- asphalt pavement $9,600;
- curbs $950;
- sidewalk $7,200; and
- an additional $10,000 for the interpretive panels (development, frames, installation, etc.) that was funded in a separate contract.

The Cooks Chasm Bridge cost $3,436,000 for construction (not including planning, design, and inspection). The project was awarded October 2001 and completed May 2003. USDA Forest Service enhancement funded portion was $285,000. The following CSD/CSS item costs that could be found include:

- bridge architectural treatment $16,200;
- bridge hand rail $20,000;
- wall architectural treatment $71,600;
- wall hand rail $5,655;
- ornamental rail $92,760;
- wall architectural treatment $31,000;
- wall hand rail $8,905;
- ornamental rail $7,380;
- credit for form liners $(10,500);
- rail reinforcement change $621;
- planter box & soil $3,498; and
- design, fabrication and installation of interpretive signing $45,000.

Planning and design for both projects totaled to roughly 10% of overall cost.

7.3 Goals, Measures of Effectiveness and Impetus

The primary goals of this project were to restore and maintain traffic. The CSD/CSS elements were primarily initiated internally within ODOT. CSD/CSS was included very early in the planning/design process.

7.4 Standards Used or Developed

The cathodic protection design was a copy from other projects. The pullout and interpretive signing followed an existing interpretive standard developed for all US 101 projects in Oregon. No standards were developed, but some new methods were used. The form liner developed for Rocky Creek (Ben Jones) bridge was somewhat unique. This same approach was used and improved upon for the Cook's Chasm Bridge. The railing design for Cook's Chasm was a unique design that was developed from community input on aesthetics.

7.5 Ranking Measures, and Benefits and Reasons

For Cooks Bridge a true cost benefit analysis for the aesthetics was not done; however, when it became clear that the cost was going to be significant, the project team pursued Forest Service funds. In addition, many elderly residents live in the area, therefore, ADA became a clear need.

For all bridges, ODOT is incorporating CS^3 which stands for context sensitive and sustainable solutions. For more information on CS^3 and associated ranking measures, refer to Section 4.1.

7.6 Contacts

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8 CASE STUDY 2: OREGON HIGHWAY 99E: KELLOGG CREEK TO SE HARRISON ST. (MILWAUKIE) SECTION, OREGON

This case study describes a realignment of a portion of Oregon Highway 99E in order to provide enhanced access to the Willamette River, pedestrian amenities, and better business access through town. It also provided an opportunity to reengineer some access approaches to support the efficient operation of the highway for through traffic.

The Oregon land use decision process and Oregon DOT (ODOT) do not incorporate CSS specifically into all ODOT highway projects. ODOT decision making is subject to the rigorous Oregon land use planning legislation that requires that all agencies incorporate many steps and processes analogous to the CSS process. ODOT provides CSS training to its engineering staff, focusing on a logical and effective approach to integrating physical, social and environmental concerns in project development. Oregon DOT applies "Context Sensitive and Sustainable Solutions" or CS^3 objectives to major bridge repair and replacement programs and is currently integrating it into all highway projects.

The 1999 Oregon Highway Plan establishes "highway segment designations" that encourage local governments to work with ODOT to agree upon an appropriate context in three types of urban environments: Downtown areas where a highway is the Main Street (Special Transportation Areas or STAs); Urban Business Areas (UBAs) and Commercial Centers. The most popular designation is the STA, which has established agreements between ODOT and approximately 145 communities that future highway projects will respect local vision in traditional and developing downtown business districts. This project is a STA.

8.1 Detailed Description

Milwaukie is a formerly rural town rapidly redeveloping as a rural suburb of the Portland, Oregon Metro area. It is located between Oregon City to the south and Portland to the north, on Highways 99E and 224 in Clackamas County. Oregon Highway 99E lies one block west of Main Street and the old downtown. The highway is between the downtown area and the Willamette River. There is access to the river from the highway at this location. The older downtown is redeveloping, and local plans call for increased pedestrian convenience and safety at the project site and the development of open space and active recreation along the riverside. The City and ODOT agreed to a Special Transportation Area designation to establish a context for the highway area that is consistent with local plans and vision. Project construction started on August 11, 2005 and was substantially completed on July 26, 2006.

The project included a number of access management measures, including realignment of the access road to the river access, medians to replace two-way left turn lanes, closure of some approaches, and conversion of some full-access approaches to right-in-right-out, which supports the efficient operation of the highway for thru-traffic. The lower number of driveway approaches and the restrictions on turn movements make the area safer and more efficient for pedestrians. The project also includes pedestrian amenities such as refuges in the medians, wide sidewalks, landscaped separation from traffic, and clearly delineated crosswalks at signalized intersections. A third signal was added to the project highway segment to facilitate pedestrian access from downtown Milwaukie to the city's Willamette Riverfront Park area. The project also accommodated through bicycle traffic with 5-foot bike lanes in each travel direction and included substantial landscaping.

The project was initiated in the local/regional Statewide Transportation Improvement Program (STIP) development process, identified in the local downtown redevelopment plan and transportation system plan and also implemented the Metro Boulevard planning direction (City of Portland).

8.2 Partners and Costs

The approximate budget of the project was:

- Planning Design $752,000 (actual);
- Right-of-Way $1,150,000 (estimate); and
- Construction $2,845,000 (estimate).

CSS features accounted for approximately $15,000 of the total cost of the project. Other partners included Metro project selection by FHWA ($1,900,000), ODOT ($2,375,000), City of Milwaukie ($472,000). The ODOT project was primarily a resurfacing (preservation) project, but efforts were made to include urban level refinements including changes to striping, sidewalks, storm drainage and bike paths where existing conditions were below urban standards and sufficient funding could be identified. Where project funds were not available for amenities, especially those beyond the vehicle travel surfaces, such as colored or textured crosswalks, period lighting fixtures, and landscaping, the local government contributed more than the required match to get the features they wanted. Oregon Economic Revitalization teams assisted local government to secure additional funding such as block grants to allow full realization of the local plan.

8.3 Goals, Measures of Effectiveness and Impetus

The goals and objectives were to:

- reinforce the connection between the traditional downtown and the waterfront;
- calm traffic while maintaining efficient flow through the area; and
- support and encourage investment in the downtown area.

Legislative justification included:

- City of Milwaukie Downtown and Riverfront Plan, comprehensive plan and transportation system plan;
- Metro (MPO) Boulevard Policy (Portland); and
- State Highway Plan (1999 OHP) classification priorities for District Highways, Land Use and Transportation Policy (designation of Special Transportation Areas), ODOT 4R/New Urban Design Standards for STAs, section 8.4.2 of the Highway Design Manual, and other HDM standards for District Highways as applicable.

8.4 Standards Used or Developed

From ODOT's point of view, the access management plan commitment to reducing conflicts on the mainline was a considerable accomplishment. The Access Management Plan was a condition of granting STA status to Milwaukie. The Access Management Plan was documented in an intergovernmental agreement between ODOT and the City of Milwaukie. A project specific Access Management Strategy was developed for the project incorporating STA access guidelines. The result was the review and documentation of highway accesses within the project limits, and resulted in the closure of some, and modification or relocation of other accesses all in the context of property owner or business use and need.

From the local point of view, the design of the project included a package of pedestrian protections including a design exception approved to optimize the main connection to the riverside area, which required a design exception due to a less than optimal turn refuge area approaching that intersection. It was felt that access to the riverside justified the exception. In addition, the decision was made to add a third signal to the project segment to enhance pedestrian connectivity from the downtown Milwaukie area to the city's Riverfront Park area.

The City of Milwaukie developed an extensive public involvement effort including a Project Advisory Committee to provide technical support for city government, business interests, and other affected stakeholders. The city also conducted general public meetings to distribute project information and solicit public comment.

8.5 Ranking Measures, and Benefits and Reasons

For this to be a successful project, the conceptual plan identified the needs of both the DOT and the local government, before design and NEPA work were done. Concerns related to highway access by the business community were considered during project development when all highway accesses within the project limits were reviewed. Those concerns were resolved before construction began.

The business community was actively involved with project development via interviews and representative participation on the Project Advisory Committee. The early CSS design was retained throughout the later stage of the project. The primary CSS element was related to traffic design and involved the addition of a third signalized intersection on the project segment.

This project was designed specifically to address a land use planning issue through the following:

- preserving recreational opportunity;
- shaping/influencing general land use patterns; and
- reinforcing existing land use patterns.

Reinforcing the connection to the riverside park supports more extensive use of the park by all citizens. The design both supports the traditional downtown form and was intended to encourage adaptive redevelopment.

This project is unique for an STA, because there is urban development maintained only on one side of the highway, with open space on the other side. However, Oregon has considerable experience redeveloping urban highways compatible with traditional downtown areas.

Considerable public input was obtained by surveys, as well as written comments from attendees of public meetings. Respondents felt that the design elements adequately addressed the goals of the project. Construction of a third signal enhancing pedestrian riverfront access was key as were wider sidewalks and landscape buffers from vehicular traffic. The project satisfied best practices standards from both the engineering point of view and Oregon law.

8.6 Contacts

Ross Kevlin, Planner, ODOT Region 1 (503) 731-8232

Tom Weatherford, ODOT Construction Project Manager Region 1 Project Delivery Unit (503) 731-8238

Nancy Murphy: ODOT Senior Transportation Planner, Transportation Development (503) 986-4128

Tracy White: ODOT Access Management Unit (503) 986-4372

Sue Geniesse: ODOT TGM Contract Manager (503) 986-4442

9 CASE STUDY 3: MINNESOTA TRUNK HIGHWAY 61

This case study involves a reconstruction project of US 61 in Minnesota. One segment (Good Harbor Bay) of this project was also a case study in NCHRP Report 480, but is still contained in this report because of extra information collected that is not included in the 480 report. This project used a CSD/CSS approach to evaluate flexibility of design speed standards, roadside aesthetics, cultural and historic issues.

9.1 Detailed Description

North shore highway (Figure 4) runs 150 miles along Lake Superior and borders several state parks. Three segments (Silver Cliff, Schroeder, Gooseberry Falls) received FHWA 2002 Biennial Excellence in Highway Design Awards. One primary result of CSD/CSS was the selection of a lower design speed (55mph) than typical for this type of facility at Good Harbor Bay and Cut Face Creek. A typical design speed for this type of facility is 60mph or higher. It should be noted that this is not an exception to the standard, but selection of the lowest value on the available scale. The lower design speed significantly reduced the amount of right-of-way, rock blasting, and earthwork needed for a higher design speed because the lower design speed enabled the flexibility of the road to follow the natural contour of the terrain, not only reducing cost, but producing a more aesthetically pleasing roadway. The lower design speed alignment also made it easier to stabilize erosion problems at Cut Face Creek.

Figure 4: North Shore Highway 61 in Minnesota. Source: Scott Bradley, MnDOT.

US 61 is a two-lane highway with 10' paved shoulders. Several high crash locations were given special treatments. One such location is near Cross River in Schroeder. The challenge stems from increased pedestrian and parking use and high speeds as the highway transitions from a rural to urban area. Traffic calming measures were used to alert drivers and slow them down in this transition.

At Silver Creek Cliff a tunnel was constructed. MnDOT was able to use the existing highway as a bypass during tunnel construction, which they would not have been able to do if a typical cut would have been used. This resulted in cost savings of earthwork (to remove the cliff top which was estimated to be a million cubic yards) and no need for construction of a bypass (estimated at $2 million due to the terrain restrictions). Additionally, this design alternative was much more environmentally sensitive and aesthetically pleasing. The tunnel was constructed using the new Australian Tunneling Method.

One project included the replacement of the Gooseberry River Bridge. This project included joint funding from Minnesota Department of Natural Resources to construct a rest area, visitor's center and Gooseberry State Park access. There is a pedestrian crossing under the bridge, trailhead access (including handicapped access), and preservation of a historic overlook.

9.2 Partners and Costs

Several construction phases totaled more than $25 million, and partners included North Shore Management Board (NSMB), Arrowhead Regional Development Commission (ARDC), tribal representatives, and state parks. Internally, the MnDOT project team was unusually multi-disciplinary with landscape architects, foresters, wildlife biologists, aquatic biologists, botanists, hydrologists, cultural and archeological resource specialists, pollution control specialists, pedestrian and bicycle mode specialists, architects, bridge architecture specialists, computer visualization specialists and graphic artists.

9.3 Goals, Measures of Effectiveness and Impetus

Visual Quality Management process was used as well as Transportation Action Model to incorporate public involvement.

MnDOT has the six principles/goals relating to CSD/CSS:

1. Balance safety, mobility, community, and environmental goals in all projects.
2. Involve the public and affected agencies early and continuously.
3. Address all modes of travel.
4. Use an interdisciplinary team tailored to project needs.
5. Apply flexibility inherent in design standards.
6. Incorporate aesthetics as an integral part of good design.

Through public outreach and stakeholder involvement, the following needs identified included:

- transportation needs such as;
  - improve roadway safety, traffic flow and pavement quality,
  - meet current and future transportation demands,
  - improve rest area facility,
  - avoid unnecessary R/W impacts and construction costs, and
  - provide for the mix of motorists and modes - recreational, tourist, commercial, local and interregional;
- stakeholder issues such as;
  - consistency with North Shore Corridor Vision and Goals,
  - preserve traditional views and vistas,
  - enhance scenic and visual qualities,
  - preserve and enhance public access to lakeshore,
  - reduce and prevent erosion problems,
  - avoid impacts to residential and commercial property owners, and
  - avoid impacts to state park land and the environment.

9.4 Contacts

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10 CASE STUDY 4: ARIZONA STATE ROUTE 179

This reconstruction project includes a rural/suburban highway that has challenges related to bicycle/pedestrian needs, scenic viewpoints, and air quality. This project was included as an example of how measurable criteria can be developed.

10.1 Detailed Descriptions

The Arizona State Route 179 project consists of an approximately 10 mile reconstruction of a highway that is very scenic, has high tourist traffic, and is a major inter-city connector. The project ends just south of the Village of Oak Creek on the south side, passes through a national forest, and ends on the north side in the City of Sedona. The project is in the final design stage.

10.2 Partners and Costs

Partners included Big Park Regional Coordinating Council (BPRCC), Yavapai County, Coconino National Forest (CNF), Federal Highway Administration (FHWA), City of Sedona, and Coconino County.

10.3 Goals, Measures of Effectiveness and Impetus

The main needs identified by stakeholders and the public for this project included:

- safety for travelers in the SR 179 corridor;
- efficient traffic movement;
- review of the number of lanes;
- traffic intersection movement and needs;
- sensitivity to the environment;
- right-of-way acquisition;
- community values and quality of life;
- community plan layout and visions;
- land acquisition and development along the corridor;
- pedestrian movement, bicycle movement and public transit needs;
- scenic corridor values;
- economic impacts;
- tourism;
- access; and
- public safety, including emergency service needs.

From this, 17 evaluation criteria were developed to guide design and assist with ranking design alternatives. Examples of criteria included:

- retain and enhance the natural appearance of the landscape and the ability to enjoy scenic views from the corridor;
- provide safe bicycle crossings and circulation;
- minimize air quality impacts; and
- constructability.

Sixty one evaluation measures were mapped to these criteria. Some of these were qualitative, but an effort was made for each criteria to develop a quantitative measure. Some examples of these measures include:

- number of scenic vistas;
- opportunities for bicycle amenities and enhancements;
- average intersection delay (in seconds) per vehicle using the corridor in 2025; and
- impact to construction schedule.

Each measure was converted to a rating from 1 to 5 for each project alternative. There were four stages in the design as some criteria required modeling or extensive analysis that was not appropriate until later stages of design.

10.4 Standards Used or Developed

The Needs Based Implementation Plan is a term used, it appears, for the first time by Arizona on the design of this project. It is really CSD/CSS. It involves large public outreach efforts through web pages, public outreach meetings, local forums, and project newsletters. The public helped drive the list of needs, which then drove the design process. The three phases in Needs Based Implementation Plan are:

- process definition;
- corridor wide design framework; and
- segment concept design.

For this particular project there were four segments, generally (1) in Oak Creek Village, (2) in Coconino National Forest, (3) in City of Sedona, and (4) North of Sedona.

10.5 Contacts

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11 CONCLUSIONS AND RECOMMENDATIONS

This report summarized the effort to review literature and interview other state DOTs to collect information on the state of the practice for CSD/CSS, specifically in regard to rural highways in the areas of habitat connectivity, land use planning, and roadside aesthetics.

During interviews and discussions, the authors heard similar sentiments repeated with comments like "CSD/CSS is just part of the cost of doing business," or "[this state DOT] is committed to CSD/CSS even if it increases the project costs." This approach can work well when goals and criteria are clearly defined, weighted, measured and used to guide design decisions. If not, one can run the risk of an individual or group forcing their priorities on the project without properly balancing all other needs.

Many state DOTs have a policy or position statement on CSD/CSS. These range from a memo from the director to a CSS guidebook. None of these appear to contradict or change fundamental design procedures within the state DOT (beyond encouraging public involvement, and a purpose/vision statement early in the design process). These position/policy statements typically include:

- a definition of CSD/CSS;
- a set of generalized guiding principles (e.g., balance safety, mobility, environment and community);
- a statement that the state DOT is committed to using CSD/CSS; and
- public/stakeholder involvement guidelines.

CSD/CSS is clearly being implemented on many projects across the nation. However, there is not a uniform guideline on how to implement CSD/CSS. Two obvious steps are (1) a clear purpose and need statement early in the project design, and (2) public/stakeholder involvement throughout the design process. In regard to selecting the best design alternative considering a holistic CSD/CSS approach, the most common method is a ranking of opinions by a project stakeholder committee. The Arizona case study, however, shows an example of how actual measurable criteria can be used for comparing design alternatives with respect to benefits that are difficult to measure such as aesthetics, multi-modal use, land development impacts, and tourism and economics. Some State DOTs have implemented cost sharing policies (such as MnDOT) or maximum cost guidelines (such as Nevada DOT) in relation to aesthetics and certain other CSD/CSS elements. This seems a good method for incorporating CSD/CSS benefits that are typically difficult to measure, while still providing for other priorities.

There appeared to be little evidence of follow up and monitoring to see if the original goals and expected benefits were achieved after construction.

Cost sharing was a common occurrence on most CSD/CSS projects especially for aesthetics (e.g., Forest Service funds used to help with pullouts, trailheads, aesthetics, etc.; and local community funds to cover aesthetic treatments).

Implementing and managing CSD/CSS can be an ominous, ambiguous task. The authors propose the following actions that might help MDT to further implement CSD/CSS in a manner that has a positive impact.

- MDT should continue to monitor efforts nationally and in other states in order to incorporate best management practices. Most importantly, when innovative approaches are used in Montana, monitor results after construction and document findings.
- As MDT continues to implement CSD/CSS, it is clear that consistent prioritization processes should be in place for selection of design alternatives. Research projects and workshops could be implemented with the purpose of creating a "measure of effectiveness guidebook." This guidebook would include what measures are acceptable to use, how they should be measured, potential data sources, and what measures are acceptable to convert to cost/benefit ratios.
- MDT might consider a position statement or guideline on CSD/CSS.
- A useful exercise may be one or more corridor case studies. Aesthetic and biological elements and issues could be investigated. Locations could be prioritized. The resulting product would be a corridor plan that gives guidelines on what to include in projects developed along the corridor. This will help early project cost estimation. The plan would also delineate financial responsibility for elements described in the plan as well as those that may arise during design that are above and beyond those described in the plan.
- A statewide CSD/CSS workshop could be implemented. This workshop could be used to educate staff from MDT and other agencies and stakeholder groups. However, this should go beyond education (such as the previous CSD workshop in Missoula, MT on September 5-7, 2001). Working groups could be formed at the workshop to develop draft cost sharing guidelines, prioritize habitat linkage zones, and develop measures of effectiveness/design alternative ranking guidelines.
- This report had a specific focus within CSD/CSS. Although this included policies and guidelines that are generally applicable to all areas of CSD/CSS, there was not specific treatment of other focuses outside of habitat connectivity, roadside aesthetics, and land use planning. Case studies and guidelines could be collected about other areas. For example when rural highways that pass through small communities are upgraded, the local communities' values, traffic calming, bicycle and pedestrian use, often come to the forefront.

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APPENDIX A

Structured Phone Interview for Context Sensitive Design

Hello, my name is Patrick McGowen with the Western Transportation Institute at Montana State University. We are conducting a survey for the Montana Department of Transportation on how your agency incorporates context sensitive design elements into transportation projects. This survey is investigating specific examples of innovative context sensitive solutions as well as how they are prioritized and planned for on a regional or statewide level. Generally we are more concerned with rural higher speed travel corridors outside of municipal boundaries. I will be asking you questions in one or more of the following areas depending on your expertise (Habitat Connectivity, Land Use Planning, and Roadside Aesthetics).

Contact Name

Contact Title/Org

Contact Division

Contact Org.

Contact Phone

Contact email

0) What studies, research, projects has your agency completed on the subject of context sensitive design or context sensitive solutions? Are there any activities currently under way on these topics?

1) Have you been involved in any project that used CSS specifically in the areas of Habitat Connectivity, Land Use Planning, or Roadside Aesthetics?

►If no, then skip to Question 40)

If yes, then continue:

Project Name ______________________________

Project Website ____

Focus area(s) for which this project is a case study

☐ Habitat Connectivity ☐ Roadside Aesthetics ☐ Land Use Planning

2) Can you provide a summary of the project (location, construction date, description, etc.)?

3) Why was this project initiated? (person or resource agency request, event, programmatic initiative or policy, etc)

4) What was/is the approximate budget and duration of the project?

$_____________ Planning Design (☐ Budget Estimate ☐ Actual Cost)

$_____________ Construction (☐ Budget Estimate ☐ Actual Cost)

$_____________ Maintenance and Operations (☐ Budget Estimate ☐ Actual Cost)

$_____________ Evaluation and Monitoring (☐ Budget Estimate ☐ Actual Cost)

What portion is dedicated to CSS features?

Did other agencies participate financially?

5) What are the stated goals/objectives of the project? How were they determined (policy or programmatic standards, project specific requests)?

6) Please give me a description of the most important CSS design elements in this project and how they were initiated (short narrative).

For each CSS design element of the project please answer the following questions:

7) How much was the CSS design element considered during the early project planning or early design stage (i.e. before NEPA review or public participation phase)?

   ☐Not at all ☐Some consideration ☐Very much part of the early design

   Please explain:

   Did it streamline the NEPA process, the permitting process and/or overall project delivery?

8) To what extent did the early CSS design change at the later stage in the project (i.e. after NEPA review or public participation phase)?

   ☐Very little ☐Somewhat ☐A great deal

Please explain:

9) Was the CSS feature initiated because it is in an area prioritized by a previous planning effort?

   ☐Yes ☐No

   If yes:

   A. Which previous planning efforts was that?

   B. Are there any specific modeling procedures or software tools used for prioritizing locations?

C. What databases are utilized and what additional data is collected?

D. Can you please provide documentation of the prioritization process?

10) Was the CSS feature requested by resource agency during environmental review?

☐Yes ☐No

If yes:

Please explain:

Did including the CSS feature help secure regulatory permits?

11) Was the CSS feature requested by public or special interest group during public outreach?

☐Yes ☐No

If yes:

Please explain:

12) Was the CSS feature part of the standard design?

☐Yes ☐No

Please provide any documentation on standard specifications or design drawings.

13) Was the CSS feature initiated by other means? Please specify.

Specific questions will be asked depending on the focus area of this respondent. If the project/respondent covers more than one focus area, ask questions for both:

►For Habitat Connectivity go to question 14)

►For Roadside Aesthetics go to question 25)

►For Land Use Planning go to question 30)

Focus Area Questions: Habitat Connectivity

14) Which of the following best describes the goals of the project?
   A. The connectivity issues were secondary to the stated goals of the project.
   B. This project was designed to specifically to address a habitat connectivity issue.

15) What species of animals are the primary targets for this project?

16) Are specific habitat linkage zones mapped in your state? Yes No

   If yes, are they prioritized statewide? Yes No

   Describe how

17) Are animal vehicle crash hot spots prioritized statewide? Yes No

   Describe how

With respect to habitat connectivity:

18) Is there a permitting or credit/debit incentive in place?

19) What agencies or other entities are involved and what is their role?

20) What programmatic agreements are in place?

21) Are agency best management practices or programmatic approaches related to the permitting or credit/debit process?

22) Was this project based on a previous or existing experience or project?

23) To what degree was this project collaborative with: (who, why, how)

A. Other agencies

B. Other entities or stakeholders

C. The public

24) Can you please provide documentation on any programmatic agreements or processes mentioned?

►**Go to question 25) for Roadside Aesthetics**

►**Go to question 30) for Land Use Planning, or**

►**Go to conclusion starting at 34)**

Focus Area Questions: Aesthetics

25) Which of the following best describes the goals of the project?

A. The aesthetic values of the project were secondary to the stated goals of the project.

B. This project was designed to specifically to address the preservation of the rural character or quality of the setting for the project.

26) How important was the use of the following features of aesthetic design to the project?

	Not at all Important	Somewhat Important	Neither Important nor Unimportant	Somewhat Important	Very Important	Not Applicable
Style of fencing						
Landscaped vegetation						
Sign placement						
Contouring slopes						
Lighting						
Integration with site-specific geology						
Bicycle or pedestrian facilities						
Aesthetic treatments for structures						

Comments?

27) Was this project based on a previous or existing experience or project?

28) What specific character attributes or qualities are being protected?

29) To what degree was this project collaborative with: (who, why, how)

A. Other agencies

B. Other entities or stakeholders

C. The public

►**Go to question 30) for Land Use Planning, or**

►**Go to conclusion starting at 34)**

Focus Area Questions: Land Use

30) Which of the following best describes the goals of the project?

A. The land use planning issues were secondary to the stated goals of the project.
B. This project was designed to specifically to address a land use planning issue.

31) Which of the specific efforts of land use planning were addressed within the context of this project?

A. Preservation of habitat linkage zones
B. Creation of habitat linkage zones

A. Preservation of recreational opportunity
B. Creation of recreational opportunity

A. To shape/influence general land use patterns
B. To reinforce existing land use patterns

Please explain:

32) Was this project based on a previous or existing experience or project?

33) To what degree was this project collaborative with: (who, why, how)

A. Other agencies

B. Other entities or stakeholders

C. The public

Do you have any data on the mitigation costs, can you provide any reports / studies??

►**Go to conclusion starting at 34)**

Concluding Questions

34) Did the design elements adequately address the goals of the project?

Why or why not

35) If not, what other options might exist to achieve the goals, describe?

36) Is this project replicable elsewhere? What are the limitations/possibilities?

37) Was this project part of a:

A. Statewide/regional programmatic policy
B. Locally initiated transportation project
C. Federal mandated policy

38) What quantitative data were collected and used to evaluate the project?

A. Cost/benefit
B. Public input / Surveys
C. Satisfied best practices standards

D. Field Monitoring
E. Other

Please provide any cost benefit assessment for the project

39) What qualitative data were collected and used to evaluate the project (include durations before and after project construction)? Please describe:

40) Can you suggest any other contacts that may be able to provide additional information on this topic?

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