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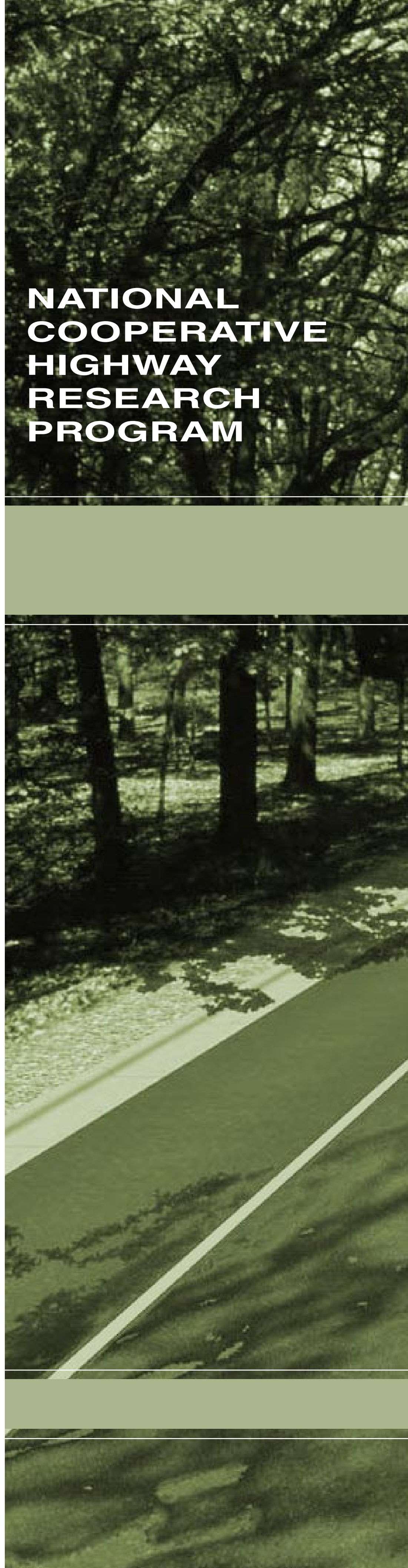

A Guide to Best Practices for Achieving Context Sensitive Solutions

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP REPORT 480

A Guide to Best Practices for Achieving Context Sensitive Solutions

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SUBJECT AREAS
Highway and Facility Design

Research Sponsored by the American Association of State Highway and Transportation Officials
in Cooperation with the Federal Highway Administration

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2002
www.TRB.org

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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NCHRP REPORT 480

Project C15-19 FY'2000

ISSN 0077-5614

ISBN 0-309-06770-7

Library of Congress Control Number 2002113180

Price $21.00

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Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Transportation Research Board
Business Office
500 Fifth Street, NW
Washington, DC 20001

and can be ordered through the Internet at:

http://www.national-academies.org/trb/bookstore

Printed in the United States of America

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FOREWORD

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This guide demonstrates how state departments of transportation (DOTs) and other transportation agencies can incorporate context sensitivity into their transportation project development work. The guide is applicable to a wide variety of projects that transportation agencies routinely encounter. While the guide is primarily written for transportation agency personnel who develop transportation projects, other stakeholders may find it useful in better understanding the project development process. Example project documents are included on the accompanying CD-ROM (*CRP-CD-23*).

Seven qualities of excellence in transportation design and eight characteristics of the process that would yield excellence were identified during the seminal "Thinking Beyond the Pavement: A National Workshop on Integrating Highway Development with Communities and the Environment," held in May 1998. These qualities and characteristics were termed principles of "context sensitive design." Many barriers to context sensitive design were identified during the workshop, including rigid segmentation of responsibility during project development, failure to consider the full range of design alternatives, and lack of clear communication between the stakeholders and the transportation agency.

In September 1998, a National Training Steering Committee was created to oversee pilot efforts to institutionalize context sensitive design principles in five state DOTs: Connecticut, Kentucky, Maryland, Minnesota, and Utah. It was agreed that each of these states would proceed with a policy review and a training program tailored to its individual institutional needs, but that the five states would benefit from frequent exchange of information about the design and progress of these pilot efforts and that all 50 states would then benefit from understanding the experiences of these five states.

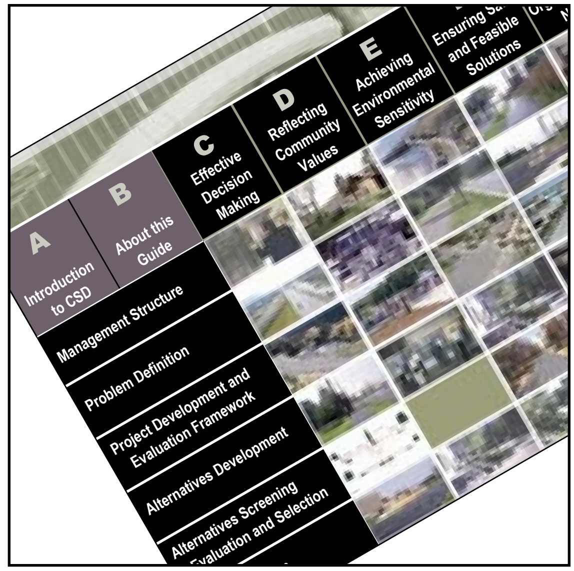
Under NCHRP Project 15-19, CH2M Hill identified approaches for adopting context sensitive design principles, barriers to adoption in a transportation agency, and ways to overcome those barriers. They met with each of the five pilot states and other transportation agencies to learn how each is integrating context sensitive design into its existing project development processes. The information gathered was condensed into an easy-to-read guide that highlights the advantages of context sensitive design, identifies potential disadvantages, describes a range of approaches for adopting and applying context sensitive design principles in the project development process, documents how barriers to context sensitive design are being overcome within state DOTs, and illustrates context sensitive design through case studies.

The CD-ROM included with this printed report *(CRP-CD-23)* reorganizes the material into a matrix of project development process steps and issues related to context sensitivity. It also includes significant background material drawn from actual projects (e.g., evaluation criteria, public involvement plans, aesthetic design guidelines, and animated views of design alternatives) that provide concrete examples of context sensitive solutions.

CONTENTS

A. INTRODUCTION

For many years, planning, design, and construction of highways and streets has been left mostly to the "professionals" – highway and traffic engineers. Selection of routes, the design of the alignment, location of intersections, and the roadway features were based primarily on engineering considerations, with the objective being to provide the highest quality service at the lowest construction cost. Solutions to mobility and safety problems have been infrastructure-oriented, reflecting the training and background of those responsible for solving the problems. Substantive decisions regarding the design of a road itself were left to professional engineers and planners with limited input from the public and external agencies.



As the nation moved into the latter part of the 20th century, the automobile emerged as the predominant mode of travel for both persons and goods. With growth in both the population and national economy, demand for travel increased, resulting in more autos and more and larger trucks using the highway system.

The nation's engineers, through state and federal transportation agencies, responded to the increase in demand for travel and to public policy directives to promote highway travel with more and "better" roads, i.e., roads that enabled traffic to move faster and safer to the travelers' destinations. Their efforts, foremost among them being the 42,000-mile interstate system, have done much to shape the landscape of America. And, despite the significant increase in travel, highway travel has become increasingly safer, with fatalities decreasing significantly over the past 20 years.

Beginning in the 1960s, strong cultural trends emerged. The general public began to have concern and interest in the adverse environmental impacts of man's intrusions on the landscape (including, but certainly not limited to road building). Such interest culminated in the passing of what was among the most important pieces of legislation of the latter 20th century, the National Environmental Policy Act (NEPA) in 1969. From this point forward, roadway design and construction, and indeed, all public works, became more than a matter of building the most economic, shortest, widest, or fastest facility. Rather, engineers and planners are now required to consider features and effects such as wetlands, threatened and endangered species, adverse noise, and other environmental considerations.

The public also has begun to generate a renewed interest and concern with the cultural, historic, and other values that define a community. Americans have become more aware of their sense of place and history, both locally and regionally. Any changes to a community, whether to develop open space, tear down a long-standing building with unique architecture, or build a new road are now increasingly viewed as potential threats to that sense of place and the cultural fabric of the community.

The above trends have produced what in retrospect seems an inevitable result. Departments of Transportation (DOTs) and professional engineers trained to provide a certain quality of design using traditional approaches began to run into resistance from the public and community interests, when highway projects were perceived as having clear, measurable adverse impacts on the communities through which they passed. No longer are the benefits of these "improvements" (faster travel times, greater safety, less delay) widely accepted or perceived as worth the costs in terms of right-of-way, community disruption, etc. No longer does the public unquestioningly accept the proposals of engineering professionals, regardless of how well thought-out they are. Roads, along with other major infrastructure projects, despite being recognized as necessary to the public health and economic well-being of a community, are now increasingly viewed as permanent intrusions on the landscape.

Context Sensitive Design (CSD) is among the most significant concepts to emerge in highway project planning, design, and construction in recent years. Also referred to as "Thinking Beyond the Pavement," CSD reflects the increasingly urgent need for DOTs to consider highway projects as more than transportation. CSD recognizes that a highway or road itself, by the way it is integrated within the community, can have far-reaching impacts (positive and negative) beyond its traffic or transportation function. The term CSD refers to as much an approach or process as it does to an actual outcome.

> *"Context sensitive design asks questions first about the need and purpose of the transportation project, and then equally addresses safety, mobility, and the 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."*
>
> **Thinking Beyond the Pavement, Maryland State Highway Administration Workshop, 1998**

LEGISLATIVE BACKGROUND ON CONTEXT SENSITIVE DESIGN

Beginning in 1969, NEPA required that agencies performing federally funded projects undergo a thorough analysis of their impacts to both natural and human environmental resources. Since that time, the U.S. Congress passed a series of policy acts and regulations to strengthen and increase the commitment to environmental quality. In 1991, Congress emphasized the federal commitment to preserve historic, scenic, and cultural resources as part of the Intermodal Surface Transportation Efficiency Act. Section 1016(a) of that Act provides approval for transportation projects that affect historic facilities or are located in areas of historic or scenic value only if projects are designed to appropriate standards or if mitigation measures allow for the preservation of these resources.

In 1995, Congress passed the National Highway System Designation Act, emphasizing, among other things, flexibility in highway design to further promote preservation of historic, scenic, and aesthetic resources. This act provided funding capabilities for transportation enhancements and supported applications to modify design standards for the purpose of preserving important historic and scenic resources. Most importantly, the Act extended these considerations to federally funded transportation projects not on the National Highway System.

Thirty years of history in national environmental policy making has demonstrated a response to increasing public interest and concern about transportation projects' impacts. The public and local officials have begun to question not only the design or physical features of projects, but also the basic premise or assumptions behind them as put forth by the many agencies. Evidence of this trend is the great number of major projects around the country that have been significantly delayed or stopped, not for lack of funding or even demonstrated transportation need, but for lack of satisfaction that the proposed solution met community and other non-transportation needs.

RECENT ACTIVITIES IN CONTEXT SENSITIVE DESIGN

By the mid 1990s a clear consensus emerged that new approaches to solving traditional highway projects were needed. The recent laws and statements of public policy required those charged with the planning, design, and construction of highways to adopt a new direction. In response, the Federal Highway Administration (FHWA) and other agencies committed to develop a program to change the way highway projects are performed.

The following activities have framed where the transportation profession stands with CSD:

- The FHWA partnered with AASHTO, Bicycle Federation of America, National Trust for Historic Preservation, and Scenic America to produce a landmark publication, *Flexibility in Highway Design.* This design guide illustrates how it is possible to make highway improvements while preserving and enhancing the adjacent land or community. *Flexibility in Highway Design* urges highway designers to explore beyond the most conservative use of *A Policy on the Geometric Design of Highways and Streets* (AASHTO Green Book). Within an open, interdisciplinary framework, project teams should develop roadway designs that fully consider the aesthetic, historic, and scenic values along with considerations of safety and mobility—the essence of CSD.
- An invitation-only conference, "Thinking Beyond the Pavement: A National Workshop on Integrating Highway Development with Communities and the Environment" was held in May 1998. This conference, co-sponsored by the Maryland State Highway Administration, FHWA, and AASHTO, was targeted at state DOTs *and* environmental and community stakeholder groups.

- Five pilot state DOTs (Connecticut, Kentucky, Maryland, Minnesota, and Utah) were selected to work with FHWA in defining and institutionalizing CSD principles and practices. Policy reviews, training, and other activities have been conducted, with the results shared with other AASHTO members at national conferences and meetings.
- A second conference, co-sponsored by FHWA and the American Society of Civil Engineers (ASCE), was held in Reston, Virginia, in June 1999. This conference, "Flexibility in Highway Design," was targeted at highway design professionals. It introduced the concepts of CSD, presented case studies, and produced findings regarding design professional needs to meet CSD demands.
- Following the success of *Flexibility in Highway Design*, AASHTO embarked on developing their own publication to provide further guidance on how designers can develop flexible highway designs. NCHRP Project 20-7 (Task 114) was commissioned to prepare a companion document (referred to as a "bridging document") to *Flexibility in Highway Design* based on the work of four AASHTO Task Forces.
- An FHWA/AASHTO International Scanning Tour was conducted in 2000 to visit European countries and uncover their CSD problems, practices, and solutions.

This report summarizes findings from National Cooperative Highway Research Project 15-19, *Application of Context Sensitive Design Best Practices.* The research was performed to summarize activities in the CSD field, and to provide transportation planning and design practitioners and their organizations with a guide for implementing CSD at both the organizational and project level.

Research tasks performed to support the findings in this report are summarized below:

- Literature on environmental process, highway safety and design, community and public involvement, and related subjects was reviewed.
- Telephone interviews were conducted with agency staff in DOTs and other transportation agencies to gain perspective on the extent and commonalities of CSD problems and solutions.
- Visits were made to the five pilot states and to the Eastern Federal Lands (FHWA) offices to interview staff working on CSD initiatives, review projects, and collect materials from these agencies.
- National and regional conferences in Connecticut and Montana on CSD were attended and further information and insights gained on national activities.

TERMINOLOGY

The principles and concepts behind CSD have many advocates. Different organizations have coined their own terminology to express CSD. In Maryland, the first state DOT to embrace and institutionalize CSD, the term "Thinking Beyond the Pavement" (TBTP) was adopted to express the viewpoint that a highway project in many perspectives extends beyond just the highway itself. Scenic America refers to "place sensitive design," focusing on the topographic, visual, and community surroundings.

Many agencies, including most notably the Utah DOT, are concerned with outcomes rather than just process. Successful transportation projects include not only a "design" process or task, but also construction, maintenance, and operations. A successful project is sustainable in the sense that promises and commitments are maintained past any construction. Thus, a context sensitive solution (CSS) integrates all key functions of an agency.

Another view of context sensitivity emphasizes the broad nature of potential solutions. Not every context sensitive project includes a design component. Operational "solutions" may be appropriate.

For many, the term "Context Sensitive Solutions" (rather than design) better captures the overall intent and philosophy of the movement.

While no firm consensus on one set of terms has emerged, the terms context sensitive design and context sensitive solutions are well understood. In this document the acronym CSD/CSS will be used to express the concept.

THE CSD/CSS VISION

The seminal national workshop held in Maryland in 1998 developed a strong vision for the CSD/CSS movement. The vision developed by the workshop participants addressed both the outcome (qualities of the project) and the process (characteristics):

A vision for excellence in transportation design includes these qualities:

- The project satisfies the purpose and needs as agreed to by a full range of stakeholders. This agreement is forged in the earliest phase of the project and amended as warranted as the project develops.
- The project is a safe facility both for the user and the community.
- The project is in harmony with the community and preserves environmental, scenic, aesthetic, historic, and natural resource values of the area.

- The project exceeds the expectations of both designers and stakeholders and achieves a level of excellence in people's minds.
- The project involves efficient and effective use of resources (time, budget, community) of all involved parties.
- The project is designed and built with minimal disruption to the community.
- The project is seen as having added lasting value to the community.

A vision of the process which would yield excellence includes these characteristics:

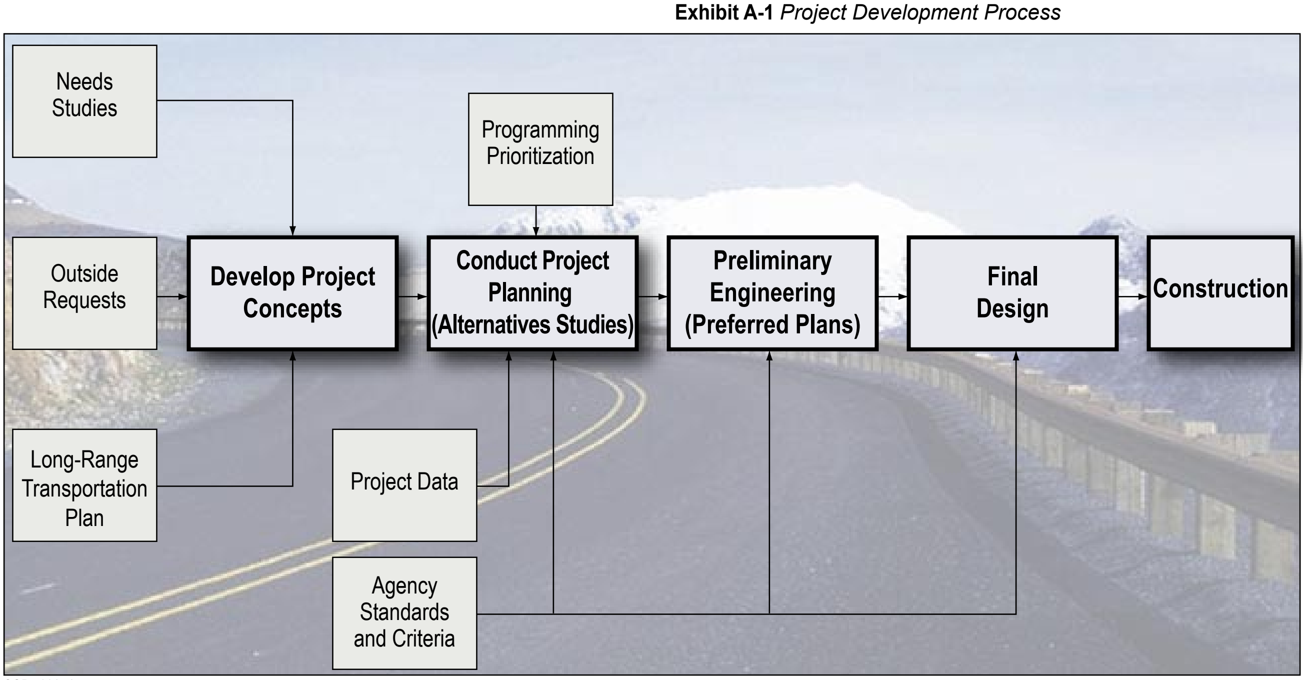
- Communicate with all stakeholders in a manner that is open and honest, early and continuous.
- Tailor the highway development process to the circumstances. Employ a process that examines multiple alternatives and that will result in consensus on approaches.
- Establish a multi-disciplinary team early with disciplines based on the needs of the specific project and include the public.
- Seek to understand the landscape, the community, and valued resources before beginning engineering design.
- Involve a full range of stakeholders with transportation officials in the scoping phase. Clearly define the purposes of the project and forge consensus on the scope before proceeding.
- Tailor the public involvement process to the project. Include informal meetings.
- Use a full range of tools for communication about project alternatives (e.g. visualization).
- Secure commitment to the process from top agency officials and local leaders.

INSIGHTS ON CSD/CSS

As expressed by the vision statement above, the terms *Context Sensitive Design* and *Context Sensitive Solutions* refer to an approach or process as much as it they do an outcome. What is unique and "groundbreaking" is that CSD/CSS recognizes that road and highway projects are not just the responsibility or concern of engineers and constructors, or for that matter only the responsibility of the DOT or transportation agency. Instead, CSD/CSS calls for the interdisciplinary collaboration of technical professionals, local community interest groups, landowners, facility users, the general public, and essentially any and all stakeholders who will live and work near or use the road. It is through this process and team approach that the owning agency gains an understanding and appreciation of community values and strives to incorporate or address these in the evolution of the project.

CSD/CSS is first and foremost about a transportation agency carrying out its mission–providing for the safety and mobility of the public. CSD/CSS is thus all about *completing projects*, whether it's freeway reconstruction, major arterial widening, local street improvements, or bicycle path construction. The principles of CSD/CSS, shown in Exhibit A-1, apply essentially to any transportation project, with the main aim being to assure that the full range of stakeholder values is brought to the table and actively incorporated into the design process and final result (as the project needs are defined).

Exhibit A-1 *Project Development Process*



CSD_162_2

CSD/CSS begins early, and continues throughout the entire project development process (from project concepts through alternative studies to construction), and indeed, to beyond project completion. CSD/CSS means maintaining commitments to communities.

Much literature, including most notably the publication *Flexibility in Highway Design*, stresses the importance of being "context sensitive" where a highway runs through or adjacent to parklands, scenic areas, or special environmental areas or viewsheds. While such facilities are clearly of special interest, the notion of context sensitivity extends beyond these "special" projects.

CSD/CSS applies essentially anywhere and everywhere. That is, every project has a context as defined by the terrain and topography, the community, users, and the surrounding land use. The CSD/CSS approach applies to urban streets, suburban arterials, rural highways, low volume local roads, and high traffic volume freeways. The particular CSS (solution) would depend on the context. Exhibit A-2 provides examples of the diversity of roads and contexts for which CSD/CSS applies.

CSD/CSS FRAMEWORK

A consensus of the research and practitioners, and review of pilot state activities and projects confirms that there are four essential aspects to achieving a successful CSD/CSS project. These include *effective decision making and implementation,* outcomes that *reflect community values* and are *sensitive to environmental resources,* and ultimately, project solutions that are *safe and financially feasible.* CSS savvy teams and organizations responsible for project development employ specific processes and tools to achieve success in each of these areas.

In terms of the project development process, there are six key steps that define complex projects and that must be considered with care. The overall *management structure,* including organization and project management issues, is clearly of vital importance. *Problem definition* – defining the nature, scope, and severity of the transportation problem being solved is a key early step in the process. Referring to Exhibit A-1 above, project proposals resulting from identification of a problem or need can come from many sources (outside requests, safety, or asset needs study, long range plan implementation).

The development of a solution involves a series of key steps that take place during the project planning and study phases. *Project development framework, alternatives development,* and *alternatives screening, evaluation, and selection* are all key phases of any project. These phases are where active engagement of stakeholders, open discussion, creativity, and weighing of choices are accomplished. Finally, *implementation* of a selected solution translates the hard planning work to a constructed or completed project

Exhibit A-2 *Diversity of Project Contexts*

that will yield real benefits. It also includes activities and actions of the agency after construction, including maintenance, operation, and monitoring of the performance of the implemented project solution.

ORGANIZATION OF THIS GUIDE

The above discussion suggests a two-dimensional framework for describing CSD/CSS. This framework is used to organize and present recommendations and findings in the following manner. The document has been prepared to be interactive in a CD-ROM format.

Following brief introductory comments in Sections A and B, the material on CSD/CSS is presented in the following six sections :

- Effective Decision Making (Section C)
- Reflecting Community Values (Section D)
- Achieving Environmental Sensitivity (Section E)
- Ensuring Safe and Feasible Solutions (Section F)
- Organizational Needs (Section G)
- Case Studies in CSD/CSS (Section H)

The first four sections (C through F) are project-focused. The text focuses on best practice discussions, with “box” inserts integrated to highlight particular lessons learned from projects around the country. Section G, Organizational Needs, addresses management issues and lessons learned from those transportation agencies that have institutionalized CSD/CSS. Section H presents a series of case studies.

Each section is organized around the six key steps in the project development process outlined above. For example, in Section E, the body of knowledge related to Environmental Sensitivity is organized around the process from beginning (problem definition) to end (implementation). Each chapter includes a bibliography of resources related to its topic. These are combined into a master bibliography in Appendix A/B. In the interest of keeping the presentation as brief as possible and to minimize resources needed to produce this document, additional examples and other supporting materials are assembled in the Appendices located on the accompanying CD.

B. ABOUT THIS GUIDE – THE MULTI-DISCIPLINARY APPROACH TO CSD/CSS

The key strength of the CSD/CSS concept and methodology is its applicability to all of the agency participants in the transportation development process. Because of this flexibility, CSD/CSS can be applied from numerous perspectives and, in doing so, bridge differing points of view to successfully implement projects. For example:

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- **Project managers** must balance a wide range of budget and resource prioritization issues and determine how to efficiently deliver the right resources at the right times during the project.

- The **highway engineer's** perspective focuses on the development and application of critical design criteria, and on providing the intended performance, including safety and operational efficiency. In the CSD/CSS environment, highway and traffic engineers are concerned with how to develop creative, affordable design solutions that are consistent with good engineering practice and principles.

- E**nvironmental managers,** whose staffs are responsible for assessing the impacts of project alternatives, providing documentation, and proposing mitigation, will be concerned with interacting effectively with highway engineers, resource agency representatives, and the public as part of the project team.

- **Public involvement specialists** are concerned with identifying who should be involved in the project, how best to seek their input, and how to integrate that input so that it provides meaningful information to project technical staff.

- **Senior managers** and transportation **agency administrators** are ultimately responsible for meeting the needs of their customers and seeing that the project is delivered on time and within budget.

All of these roles are critical to the success of transportation improvements – and CSD/CSS is an approach that enables disciplines to effectively accommodate what otherwise might be competing interests. The interaction among these professional disciplines is complex. The management and integration of staff resources represents perhaps the greatest challenge in effective project development for an agency, because project success will be achieved not by individual "pockets" of professionals working independently, but by forming teams and integrating activities.

The sections in this document are designed to reflect these different perspectives, as described below.

CSD/CSS FOR PROJECT MANAGERS

Every decision maker is confronted with balancing numerous options, stakeholders, and professional disciplines while delivering transportation projects. Often, this balance is achieved through the day-to-day management of resources and staff; in the end, effective projects are designed and built. As programs become more complex and stakeholders more interested in influencing how projects impact their communities, delivering successful projects becomes much more complex. Additional requirements come from the environmental process and the formal public input process required by NEPA.

Singly, each of the disciplines and stakeholders that must be included in the development of a project is manageable. As input from multiple sources is required, the risk of miscommunication, of improper analysis or technical omission, or of alienating a key constituent grows dramatically. A worst case scenario: a needed project is derailed because a critical point of view was left unconsidered; a significant environmental impact was not recognized; or constituency rallies a community against the project.

CSD/CSS is a formalized process for significantly reducing the risk that a project gets derailed. The worst case scenarios listed above are generally avoidable – had there been the one public meeting to capture a previously unknown stakeholder's point of view or better communication among designers and environmental experts, the project may have been completed without a problem.

Using CSD/CSS processes effectively takes some effort and resources, but these are generally well worth the benefits gained from ensuring that all disciplines are working together; that they have a process for identifying and resolving differences; and that decisions are documented and defensible.

Although project managers will generally not be expert in all technical disciplines, they should have an appreciation of the duties and challenges of each discipline and the ways each discipline can contribute to the project. For that reason, project managers will likely be interested in all content in this guide. Specifically, project managers may want to focus on the portions of each chapter related to management structure and specifically to Section C, Effective Decision Making. CSD/CSS is all about completing projects, which can be seen as completing a series of processes, tasks, and work efforts, each of which involves one or more key decisions.

CSD/CSS FOR THE TRANSPORTATION AND HIGHWAY DESIGN PROFESSIONALS

CSD/CSS presents significant challenges – and opportunities – for engineers and other design professionals responsible for implementing transportation projects. From this perspective, CSD/CSS focuses on identifying problems in functional or performance terms, and arriving at solutions that address them. In developing those solutions, the design process is presented as a series of choices, with the designer's task being to make effective choices that balance the often competing interests of operational efficiency, cost, serving multiple users, and achieving environmental sensitivity.

Of course, designers will be concerned with how to effectively employ the proven design criteria and policies published by AASHTO and their respective agency, without increasing the risk to their agency. Section F, Ensuring Safe and Feasible Solutions, addresses these primary concerns. In particular, the Problem Definition and Alternatives Development sub-sections present non-traditional approaches that may be of special interest.

Many designers will also be concerned with how they can effectively present or communicate ideas to non-technical stakeholders, how they should interact with other fellow professionals such as environmental specialists, and how they can play an appropriate role in the overall decision process. CSD/CSS provides a methodology for designers to present the rationale for guidelines and criteria and a working environment to determine which guidelines might be adjusted while maintaining safety. While CSD/CSS may result in more effort than simply "going by the book," it is unlikely that today's community stakeholders will allow untenable projects to proceed. Since successful projects will require a level of compromise and trade-off, CSD/CSS is an excellent tool for providing structure to the process. In the end, key decisions will be documented, absolutely necessary design requirements will be met, and guidelines that can be adjusted for the betterment of other factors will be modified in a reasonable, defensible manner. Thus, individual areas of other chapters in the guide will be valuable and of interest to highway designers as well.

Finally, designers should be interested in how the concepts, research, and ideas are translated into real project solutions. Section H, Case Studies, provides a wide range of CSD/CSS creative design solutions and applications of the concepts to illustrate in real terms what CSD/CSS is all about.

CSD/CSS FOR THE ENVIRONMENTAL MANAGERS

Since the enactment of NEPA, recognizing the importance of natural and human environmental issues has become a key component of most infrastructure projects. Obtaining public input and understanding community needs is a key benefit of the environmental process that is now making its way into all aspects of project evaluation, development, and implementation. CSD/CSS is a key tool for extending the benefits of an inclusive project development approach and as such, should be most familiar to environmentally focused disciplines.

CSD/CDD offers additional opportunity beyond addressing environmental issues. It allows all points of view, including community concerns, questions about design standards, and project delivery and management issues, to be addressed in a structured, iterative process. This allows those responsible for the environmental process to gain an understanding of engineering issues that might affect a project's safety or constructibility. This process also provides a forum for resolving conflicts in the early phases of a project, as part of initial alternative development, thereby reducing the likelihood that they will become larger project risks or fatal flaws during the formal environmental review. Section E, Achieving Environmental Sensitivity, was prepared to provide an overview of CSD/CSS from the perspective of the environmental process. Of course, environmental planners should also be interested in issues addressed in other sections of the guide, including alternative development, screening, and decision making.

CSD/CSS FOR PUBLIC INVOLVEMENT SPECIALISTS

Public involvement has become a key recognized component of most successful transportation projects. Starting with the environmental process, stakeholder input is an essential part of an overall project development effort. Many transportation agencies gather and use community input very effectively throughout the lives of projects – and CSD/CSS recognizes and documents programs that have turned out to be most effective. CSD/CSS integrates the best aspects of a robust community involvement and public information program throughout the project development process and across all of its technical disciplines. In addition to public, jurisdiction, and resource agency stakeholders, highway designers, environmental professionals, and project managers within the sponsoring agency are viewed as necessary stakeholders. CSD/CSS builds on what has worked, and expands the concept to a new audience. Section D, Reflecting Community Values, captures the body of knowledge and experience to date from agencies that have successfully incorporated public involvement into their transportation projects.

Public involvement specialists may wish to consider making this manual available to the public-at-large. Community stakeholders will benefit from an awareness that a process such as CSD/CSS exists and is available for their participation. For the involved stakeholder, an in-depth understanding of CSD/CSS will be of considerable benefit, especially when it comes to appreciating and understanding the roles and responsibilities of the various participants described here.

CSD/CSS FOR SENIOR MANAGERS AND ADMINISTRATORS OF TRANSPORTATION AGENCIES

Senior managers of transportation agencies are concerned with the overall performance and effectiveness of their agency in meeting the needs of their customers. Completing projects that stakeholders support, that are on time and within budget, and that deliver value to customers are key objectives. Minimizing the potential for adverse outcomes from lawsuits is also a concern. While CSD/CSS offers significant opportunities to achieve these goals, its implementation may require management and cultural changes, or may call for investments in reorganization, retraining, and new skill development. Such implementation measures may present serious challenges to budget-strapped public transportation agencies.

Section G, Organizational Needs, addresses how some senior managers have transformed their agencies to be context sensitive in everything they do. Section G also addresses the benefits of organizational change. In addition, the management structure portions of all the guide chapters should be of interest to administrators and senior managers.

HOW TO USE THIS DOCUMENT

The CSD/CSS process is aimed at capturing all necessary interactions among the various professional activities. This is often a non-linear, iterative process, ideally communicated through Web technology that can present information in a non-linear, interactive format. For that reason, a key component of this report is the accompanying electronic version, the home page of which is shown in Exhibit B-1 (following page). This "e-deliverable" allows users to access each report element in whatever order he or she chooses. The e-deliverable also contains cross-reference links throughout the document, including links to appendices, related sections, and all of the exhibits.

The material contained in this report is designed for numerous audiences, each with a different set of expectations and responsibilities for transportation project development. A reader may read the document cover to cover or, more likely, focus on those elements most useful for the challenge at hand. The printed version is designed to facilitate navigation as much as possible—the electronic version is ideal for a focused approach.

The Home Page represents the matrix shown at the beginning of each chapter in this document:

Exhibit B-1 *E-Deliverable A Guide to Best Practices for Achieving Context Sensitive Solutions*

The interactive version of this manual allows users to access material in a non-linear fashion. Readers may select sections in any order, select topics that appear in each section, or select any intersection of document sections and sub-topics. This e-deliverable contains all of the material contain in the printed report, as well as the associated appendices for each section.

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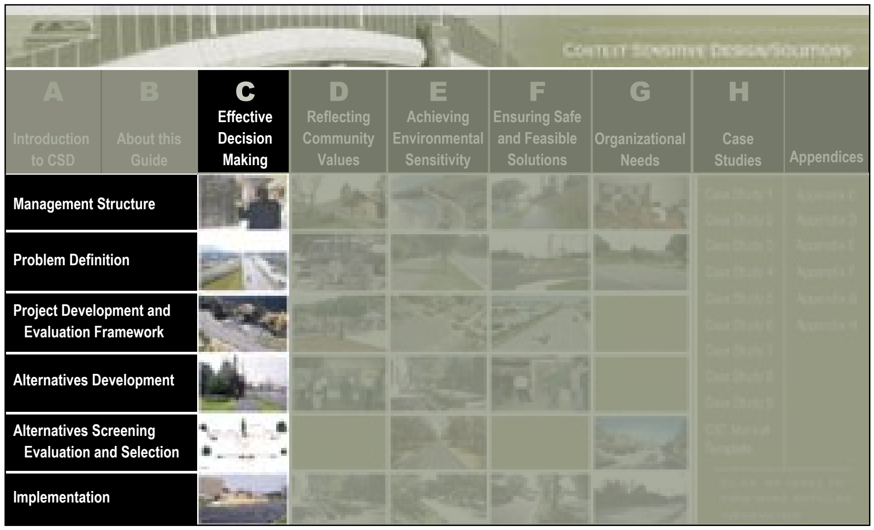
- The **major topics** running across the top represent the major sections of the document, starting with Section C, Effective Decision Making, through Section G, Organizational Needs (and followed by Case Studies and Appendices). To read the document cover-to-cover in a linear fashion, each of these sections may be read in order. To read the major topics that are of priority to you, the title of each section may be selected for direct access.
- The **sub-topics** running down the left side of the matrix represent the sub-sections consistently addressed throughout the document. For most of the major sections noted above, these sub-sections are repeated and contain detail relevant to the specific section topic. For example, a discussion of Management Structure is contained in each section of this manual, each tailored for the section's specific issues and audience. To focus on each sub-topic, the sub-topic title may be selected to take the reader to its first occurrence. Subsequently, navigation is provided to the next occurrence of the same sub-topic through the rest of the document.
- Where the major sections and the sub-topic intersect, a **matrix** is created that illustrates the interrelationship between these key CSD/CSS concepts. In the electronic version, the reader may access these intersections of major topics and sub-topics directly, going immediately to the specific information of interest.

Other features of the electronic version of the manual include:

- **Exhibits.** All Exhibits contained in the published version or linked within the electronic document and are viewable (and printable) using the freely available Adobe Acrobat Reader.
- **Case Studies and Appendices.** Each case study is included along with accompanying exhibits.
- **Appendices.** To reduce the paper requirements in the presentation of this material, all appendices are included on the CD deliverable accompanying this guide. Materials are viewable and printable using Adobe Acrobat Reader.
- **Search Engine.** The electronic document is fully searchable, including all document text and text contained in Acrobat versions of the Exhibits and Appendices.
- **Cross-links.** Cross-references throughout the electronic document are linked, allowing the reader to jump quickly to topics of interest.
- **Bibliographic Links.** Citations to websites are linked and may be accessed directly from any computer with Internet access.
- **Added Material.** The electronic document contains simulation examples that cannot be shown in the hard copy.

C. EFFECTIVE DECISION MAKING



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CSD/CSS implements solutions obtained from multiple alternatives and actions, each requiring one or more decisions. The management and execution of a CSD/CSS project should provide focus to and support decision making and implementation.

CSD/CSS projects are a series of tasks, each of which may involve a series of decisions that result in a final project decision outlining the ultimate action to take. Clearly, a critical success factor for any project is establishing and communicating *at the project outset* how the project will proceed, what decisions will be made and by whom, and what analyses, processes, and documents will be produced to support important decisions. It is thus appropriate to begin the discussion of CSD/CSS and project development with *Effective Decision Making*.

MANAGEMENT STRUCTURE

Whether a project is small or large, simple or complex, efficiency and assurance that the decision is a good one requires a process. Elements of managing an effective decision making process are discussed in the following sections.

DEVELOP DECISION PROCESS

The purpose of developing a decision process is to ensure complete and accurate identification of the problem, selection of the best alternative, enhancement of agency credibility, and efficient use of resources—in short, to ensure that good transportation investment decisions are made. A decision process incorporates the following elements:

- The decision points in the process
- Who will make each decision
- Who will make recommendations for each decision
- Who will be consulted on each decision
- How recommendations and comments will be transmitted to decision makers

Decision Points

The CSD/CSS Project Development Process includes a recommended set of decision points. These basic steps will support almost any planning process, but may need to be refined to suit a particular project. The particulars of the decision process should reflect the type of environmental review process required under NEPA for federally funded projects, and any other relevant state or local environmental regulatory processes. Specifics will differ in some respects for projects requiring an Environmental Impact Statement (EIS) vs. an Environmental Assessment (EA) vs. a Categorical Exclusion (CE). The meshing of state or local environmental requirements with those at the federal level will require special attention in the design of a project's decision process.

The focus of a decision process is often mistakenly placed on only the final decision, overlooking the many intermediate decisions along the way. For example, in an alternative selection process, the alternative development and screening occurs prior to detailed alternative evaluation. Whether it is explicitly stated or not, the early steps involve decisions on compiling the list of potential alternatives, the manner and level of detail to which they will be outlined or described, the feasibility criteria to be used, and the list of feasible alternatives to be considered further. Specification of each decision step in this way highlights the importance of individual decisions. For example, if it is made clear that only alternatives emerging from an early screening process will be considered during the evaluation phase, the importance of active participation by staff, stakeholders, and decision makers in the early screening process will be heightened.

Breaking down larger decisions into their component pieces also helps to identify the differences in needed stakeholder involvement at various points in the process. It may be important for different stakeholders to be involved at various decision points, or for different parties to make various decisions. For example, some decisions require very specific technical expertise (for example, what are appropriate or feasible ways of mitigating traffic noise, and what are their costs and other attributes). Others require broader participation and perhaps less technically oriented input (for example, community inputs on the aesthetics of special bridge designs, or on the incorporation of public art as enhancements to a project).

The nature of decisions within the process often requires clarification as well. For example, are particular decisions binding or can they be revisited later in the process, and if so, under what conditions? Is the decision dependent on data or conclusions provided from another source outside the current project process? Can the decision be revised or reversed as part of a concurrent or future planning activity? Will it be used as the basis for another upcoming planning or programming activity? Knowing the answers to these questions at the outset of the project supports the credibility of the process and increases the likelihood that the resulting decisions will "stick."

A diagram representing the decision process can be a very helpful management tool throughout the project. It can be used to clarify the relationship between past, current, and future activities and to show progress. Examples of decision process diagrams are included in Exhibits C-1 and C-2.

Participants in the Decision Process

Acknowledging who has the authority for each decision ensures that expectations are consistent with reality. An advisory committee may make initial recommendations in the process, but elected officials or agency staff may make final decisions. Stakeholders may have only an indirect communication link to decision makers, and should know in what form their recommendations or comments will be transmitted to decision makers, and how their input will be weighed or used.

In many cases identification of decision makers is obvious—they are the regional or district managers, department heads, or management teams of the transportation agency; or in some cases elected public officials. But sometimes it isn't clear who will make a particular decision. Will this decision be made by the district or headquarters staff? Will it be made by the city manager, a special task force, or the city council? Will it be made by a group of mid-level managers or the senior manager? Establishing who specifically or what level of an agency will make decisions is important because the context for the decision is governed by who makes the decision.

Just as the regulatory processes that govern the project affect the decision process, they will also affect the choice of decision makers. For example, by statute, the lead and cooperating agencies in a NEPA process will have decision making authority for determining that the alternative evaluation is complete and accurate, and for selecting a preferred alternative.

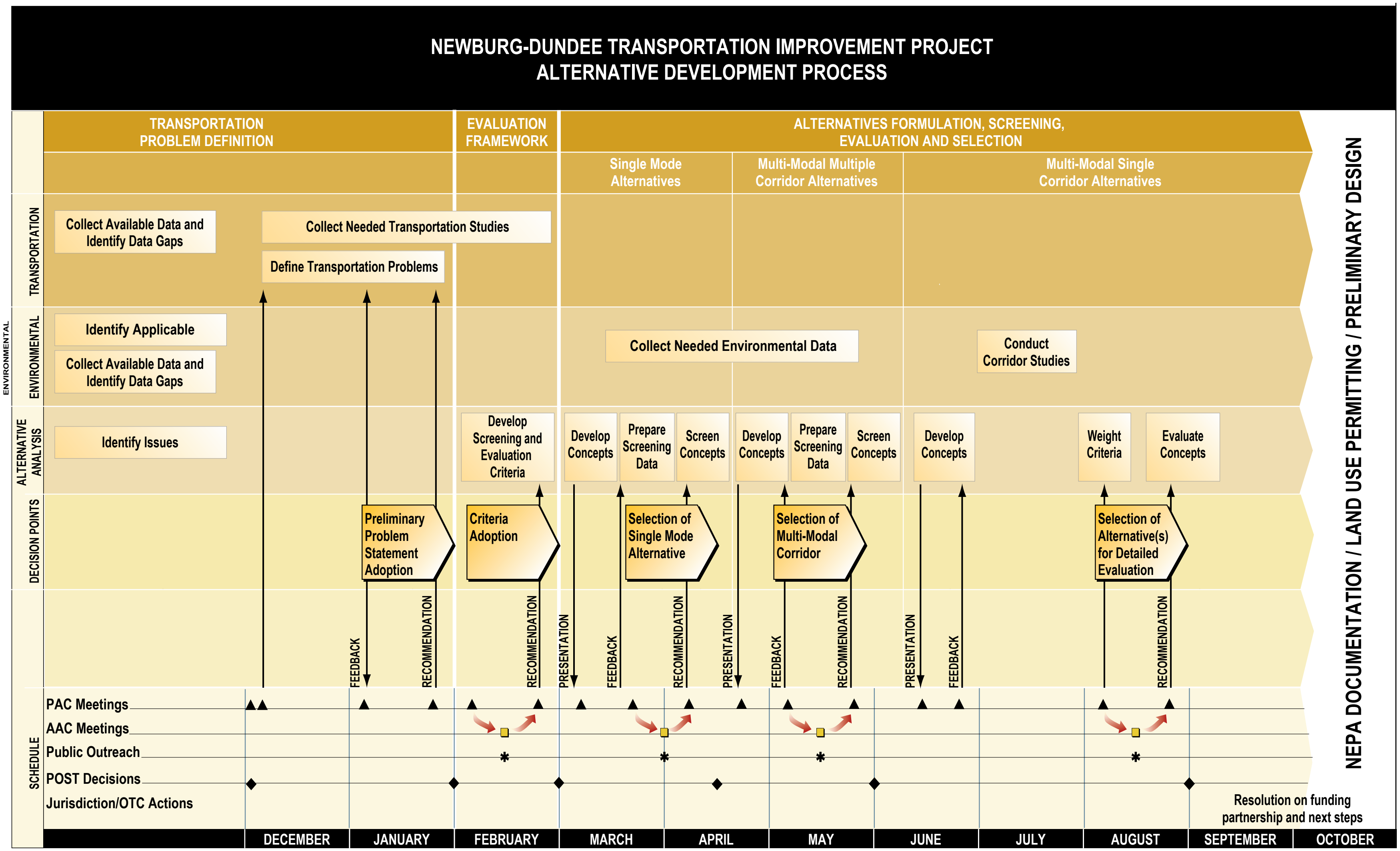
It is often useful to represent the groups involved in the decision process in a diagram that can be used to explain the management structure. This helps to clarify the roles and responsibilities of the various groups and the connections between them. Some examples of management structure diagrams are included in Appendix C.

Agency "Buy-In"

The adoption of the decision process is a decision in itself, and is one that mandates buy-in at all levels of the organizations involved in the decision, prior to presentation to stakeholders for review. Agreement about the decision steps at the outset of the project development process improves the agency's ability to determine where public input can be incorporated into decisions and where public input will not be sought. Agency review and buy-in to the decision process are also useful in uncovering any major internal disagreements about how decisions should be made, and can prevent costly and time-consuming controversies about methodology or level of public participation that often arise later in the process.

Thoughtfulness in developing a decision process and careful implementation of that process facilitates cost-effective project delivery. If each step in the process is completed in a thorough manner and leads logically to the next step, it is easier to resist the inevitable requests to go back to the beginning, to reconsider previous steps, to commit ever greater levels of staff and resources. Milestones can be established as freeze points that will not be revisited, and momentum and adherence to schedule can therefore be maintained. This is particularly important for larger,

Exhibit C-1 *Decision Process – Example 1*



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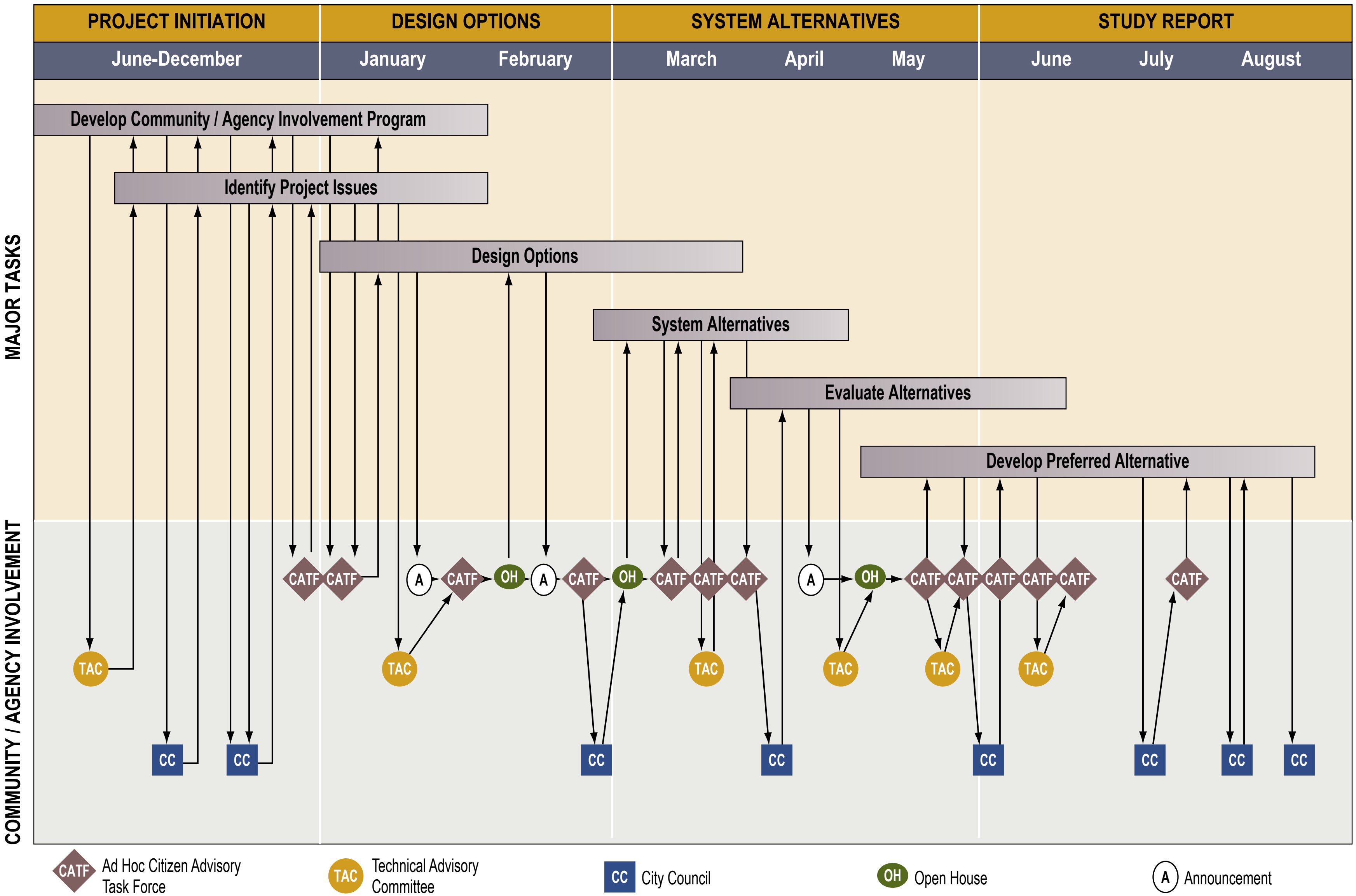
SOURCE: Oregon Department of Transportation

Exhibit C-2 *Decision Process – Example 2*



SOURCE: City of Shoreline, Washington, Aurora Multi-Modal Pre-Design Study

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complex projects that may take a year or more to complete the planning and decision making. A risk inherent to such projects is changes in staff, elected officials, or other key stakeholders during the project. Lacking a firmly documented decision process and background, the tendency is often for new participants to want to revisit decisions or actions previously completed by their predecessors.

FORM, RESOURCE, AND CHARTER PROJECT TEAM

Forming an appropriate project team, ensuring it has the needed budget and staff resources, and chartering the project team members are key elements of success in achieving CSD/CSS. The literature on project delivery suggests that the most effective project teams include representatives of all the parts of an organization with responsibility for ultimate implementation of the project. Project teams should remain intact and engaged throughout the project.

This highlights the importance for transportation projects of building multi-discipline teams with members experienced in such areas as geometric design, traffic engineering, maintenance and operations, environmental impact analysis, landscape architecture, urban design, and public involvement. Organization of such teams may run counter to typical agency organizational structures, which are discussed in the chapter on Organizational Needs, Section G.

Project teams can be quite large to encompass all of the needed expertise, or they can be comprised of a core group supported by a pool of broader resources. These teams can incorporate consultants and other outside assistance (from other agencies and organizations), or can be comprised solely of agency staff, with outside support called upon as needed. In either case, it is critical for the team members to understand they are collectively responsible for delivering a successful project, and to have the resources necessary to get the job done. Having a realistic sense of the available project development resources at the start helps to craft appropriate methodologies for data collection, alternative development and evaluation, public outreach, and so on. It is less likely that promises will be made that cannot be kept due to budget and staffing constraints.

Team chartering is a focused way to guide the project team through the process of defining itself—its purpose, scope, goals, behaviors, responsibilities, and other elements that provide the clarity of purpose essential for high quality performance. Chartering sessions in which external facilitators are generally used enable all of the team members to participate fully. Chartering sessions can be used to generate a common vision of the project—what objectives should be achieved, what outcomes are desired, how the project should be viewed by the community. Chartering is also an excellent way to establish ground rules for how the team will operate and make decisions, communicate internally and externally, document its activities, and so on. Chartering of the project team with advisory groups, decision makers, and other groups key to project implementation can also be very helpful in successful project execution.

Best practices for chartering involve the holding of workshops (which can be anywhere from a half-day to two days depending on the size and complexity of the project) at which all key stakeholders, both internal and external, involved in decision making, are invited. Chartering document examples are provided in Appendix C.

PROBLEM DEFINITION

DEVELOP AND DOCUMENT UNDERSTANDING OF THE PROBLEM

Initial project decisions begin with development of a list of the transportation problems to be addressed. These problems are generally described in quantitative measures of accident rates, travel delays, or geometric deficiencies in relation to applicable decision standards or averages. Many projects initiate from a need to reconstruct aging or deteriorating infrastructure. Some problems may be noted as the absence or lack of a transportation service, such as sidewalks. (See Section F for more detail on quantitatively defining transportation problems.)

The list of problems can then be transformed into a comprehensive need statement. It is critical for this statement to reflect the full range of public values identified through the public involvement process, and to legitimize all of the affected interests without appearing to favor one particular solution. For example, a problem definition should likely be stated as "provide for efficient movement of people and goods from Area A to Area B" rather than "widen Highway X from four to six lanes between Point A and Point B." The broader statement allows for consideration of transportation system management and transportation demand management strategies, and/or promotion of alternate modes, as well as a variety of highway solutions. It also clearly highlights early on the nature and types of decisions that will need to be made.

Successful execution of this problem definition step requires testing the need for the project as it has been defined by the agency, often through extensive stakeholder communication. It results in a common understanding and public acceptance of the defined need. If a NEPA process is involved, this dialogue represents the beginning of project scoping (see Section E). The end result becomes the basis for the statement of purpose and need, although the problem definition may incorporate non-transportation elements that would not necessarily be part of the NEPA statement of purpose and need. Examples of problem definitions are provided in Appendix C.

PROJECT DEVELOPMENT AND EVALUATION FRAMEWORK

After the transportation problem and need has been defined, it is possible to develop a framework for evaluating alternatives. This step in the process establishes criteria for measuring effectiveness of alternatives in meeting the identified need, defines data needs, and focuses the study effort. It also determines how the evaluation will be conducted.

It is critical to develop the evaluation framework before alternatives have been formulated. Otherwise, stakeholders may attempt to structure criteria to lead to selection of their preferred alternative rather than to focus on the outcomes they believe to be most important.

Evaluation criteria can be quantitative or qualitative, depending on the complexity of the problem, the expected level of controversy, the structure and scope of the public involvement process, and the preference of decision makers. For the most part, projects involving difficult trade-offs and high degrees of controversy benefit from the use of quantitative measures. They can help to objectify the discussion and move stakeholders from strongly held positions to consideration of specific outcomes from various alternatives. They can also provide decision makers with a definitive rationale for trade-off decisions and alternative selection. However, the use of quantitative criteria requires technical experience in quantitative evaluation methodology, careful work with a dedicated and balanced group of stakeholders, and strong support from decision makers.

Whether the criteria are qualitative or quantitative, they help to focus the data collection and the discussion on the relative merits of the alternatives in relation to critical issues, and on factors that distinguish among the alternatives.

DEVELOP EVALUATION CRITERIA

Different types of criteria can be used at different points in an alternative screening and evaluation process, to determine if alternatives are feasible, to reduce the number of feasible alternatives that will be evaluated in detail, or to select a preferred alternative from the reduced universe.

Feasibility criteria are used to ensure that the alternatives meet minimum performance levels, are constructible, and are reasonable. Reasonability criteria can be difficult to formulate, but can relate to such items as proven technologies and cost. Note that cost is generally not permitted to be a sole criterion for eliminating alternatives from a NEPA process.

Evaluation criteria are used to evaluate the performance of alternatives that emerge from the feasibility screening against desired project characteristics. These characteristics represent the full range of stakeholder values and provide the "context" for CSD/CSS. In a NEPA process, it is helpful if these criteria incorporate the elements evaluated under NEPA. Within the broad NEPA elements, specific criteria can be developed to highlight items likely to differentiate among alternatives and issues of particular importance to stakeholders. For example, criteria can define what specific impacts would adversely affect neighborhood cohesion. Is it roadways bisecting the neighborhood, diversion of traffic through the neighborhood, or removal of neighborhood institutions? With respect to effects on existing businesses, do critical items relate to changes in traffic circulation, consolidation of access points, or removal of parking? With respect to visual resources, is tree removal, provision of landscaping, or roadway elevation important? Example evaluation criteria are provided in Appendix C.

DEVELOP EVALUATION PROCESS

The evaluation process can be conducted simply or in an elaborate or formalized manner depending on the needs of the project. For example:

- Staff can rate the alternatives against the criteria and provide that information for review and comment in the public involvement process. Staff ratings and public comments can be provided to decision makers.
- Stakeholder group(s) can review information provided by staff and rate the alternatives. Staff and stakeholder group ratings can be provided to decision makers.
- Ratings by various stakeholder groups can be combined by staff into an overall rating summary for consideration by decision makers.

- Staff can rate the alternatives and stakeholders can establish criteria weights to distinguish the relative importance of one criteria over another. Quantitative rates and weights can be combined into an alternative ranking. The use of multiattribute utility analyses techniques for comparison of rankings of disparate attributes is used by some agencies for assisting in decisions among significantly different alternatives. Ranking information and stakeholder recommendations can be used to inform decision makers of preferences. A hypothetical case study illustrating this process is included in Appendix C. Also included is an example decision model from a project in Illinois and Iowa.

The criteria and the method in which they will be used to evaluate the alternatives is documented in the evaluation framework, which should reflect the results of information exchange with project stakeholders and broad public outreach.

ALTERNATIVES DEVELOPMENT

DEVELOP AND DOCUMENT FULL RANGE OF ALTERNATIVE SOLUTIONS

As in the developing problem definition, it is critical to ensure that the full range of stakeholder values is reflected in the universe of alternative solutions considered at the outset. This avoids the all too common problem of suggestions for viable alternatives being raised near the end of the process, resulting in a "back to square one" loop of activities.

Each proposed solution should be formulated to its best advantage, to be as robust an alternative as possible. "Strawmen" are not conducive to building credibility or trust with stakeholders. Ideas from stakeholders that are not initially feasible as presented can be modified in a collaborative process to make them more viable rather than rejected out of hand. The aim is to emerge from this step with a group of alternatives—any one of which could be approved for implementation. Stakeholders should be provided a complete explanation of why unfeasible alternatives are eliminated, to maintain their trust and minimize the chances of such alternatives resurfacing.

In the case of the Newberg Dundee Management Information System (MIS) in Oregon, alternatives were developed as multi-modal packages, each including highway, bicycle, pedestrian, public transit, and land use elements. Some alternatives were focused on major highway improvements with support from the other modal elements; some featured light rail and interurban rail as the featured components. This set of alternatives reflected public concerns and Oregon DOT's commitment to thorough consideration of non-auto transportation elements as part of the total solution set. An example description of a multi-modal alternative from the Oregon DOT is included in Appendix C.

ENSURE EDUCATION OF ALL PARTIES ON INNOVATIVE SOLUTIONS

Often stakeholders, including staff from the sponsoring agency, enter the project development process with a set of fixed ideas about the best solution. Such ideas often vary widely from one group to another. In some cases, potential solutions are not even considered because they fall outside the ideas initially brought to the table. CSD/CSS "best practices" suggest seeking outside known channels for potential solutions. This requires a willingness of all parties to become educated on a broad range of solution sets. Of course, just because a concept works in one place does not automatically make it appropriate for another. The project team should work collaboratively with stakeholders to ensure mutual understanding of potential solutions and their applicability to the identified problems. Examples of concepts that may work some places but not others include strategies such as high occupancy vehicle lanes, traffic calming, and unique interchange forms such as single point diamonds. In some cases, travel patterns or local preferences work against such solutions; in other cases, the topography or climate (snow and ice conditions) may preclude certain design solutions that work well in the sun belt.

PORTRAY ALTERNATIVES IN AN UNDERSTANDABLE FORMAT

Experience across the country suggests that engineering plan view drawings of arterial, highway, and freeway improvements are not understandable to non-engineer stakeholder groups. For this reason, it is important to place emphasis on preparation of understandable presentation formats to ensure a high quality of information exchange during the development of alternatives between the agency and stakeholders.

Photo-simulation and three-dimensional animation or simulation of alternatives represent the most effective form of presentation. Note, however, that they are often too costly to undertake early in the development process when many alternatives are still being considered. Less costly approaches for presenting alternatives in an understandable way include:

- Overlaying plan drawings onto aerial photography at a large scale so that landmarks and major impacts can be identified
- Eliminating unnecessary engineering detail from plan drawings so that key features of the alternatives are recognizable
- Providing schematics showing the direction of traffic flow for projects with complex circulation patterns
- Developing clear naming/numbering conventions that help to group “families” of alternatives and facilitate tracking of alternatives through the entire project development process

Where a new (to an area or community) concept is proposed, such as traffic calming, or a roundabout, it can be useful to show photos or videos from existing applications elsewhere.

Types of drawings, use of color, appropriate scales and detail, and use of topographic mapping or aerial photography are all factors in creating good presentation graphics.

Examples of display graphics for presentation of alternatives are shown in Exhibit C-3 (following page).

In addition to clarity of presentation, it is also important to present all the alternatives in a common format for easy and honest comparison. Alternatives prepared to differing levels of detail or sophistication may present an appearance of bias, whether intended or not. Common scales, quality of drawings, use of common coloring schemes, and presentation of supporting information should be consistent among alternatives that are developed and presented.

ALTERNATIVES SCREENING, EVALUATION, AND SELECTION

PROVIDE “APPLES-TO-APPLES” COMPARISON OF ALTERNATIVES

A key aspect of alternatives evaluation is highlighting the trade-offs among the various alternatives—here’s what you get in this one, here’s what you don’t get—relating back to the criteria identified earlier in the process. The focus is on distinguishing among the alternatives in an “apples-to-apples” comparison of impacts or outcomes of importance to the public and decision makers.

TAILOR LEVEL OF ANALYSIS TO ISSUE AND PROJECT

Depending on the nature of the project, the steps in the decision process may be repeated several times—first for developing conceptual alternatives for a TIP or STIP, second for developing and narrowing down the list of alternatives to be considered in an EA or EIS, and third for evaluating those alternatives in technical reports and the EA or EIS. During each of these processes, the level of analysis required to make a decision is different, as are the techniques for stakeholder involvement. As a project moves through these phases, alternatives are refined and their impacts can be identified with greater precision. Early evaluations may include qualitative measures, and later evaluations more quantitative. The evaluation criteria and methodology should vary accordingly, with lesser degrees of specificity at the early stages.

Stakeholders generally demand high levels of detail for their areas of concern, regardless of the project development stage. Agencies can work collaboratively with key stakeholder groups (resource agency staffs, potentially affected property owners) to understand and accept the different levels of detail appropriate for the different stages of the project. Many of the sponsoring agency’s own technical staff also desire highly detailed information, even at early stages of project development. Developing protocols for various types of analyses suited to the particular stages of project development is a useful approach for matching resource requirements to project needs.

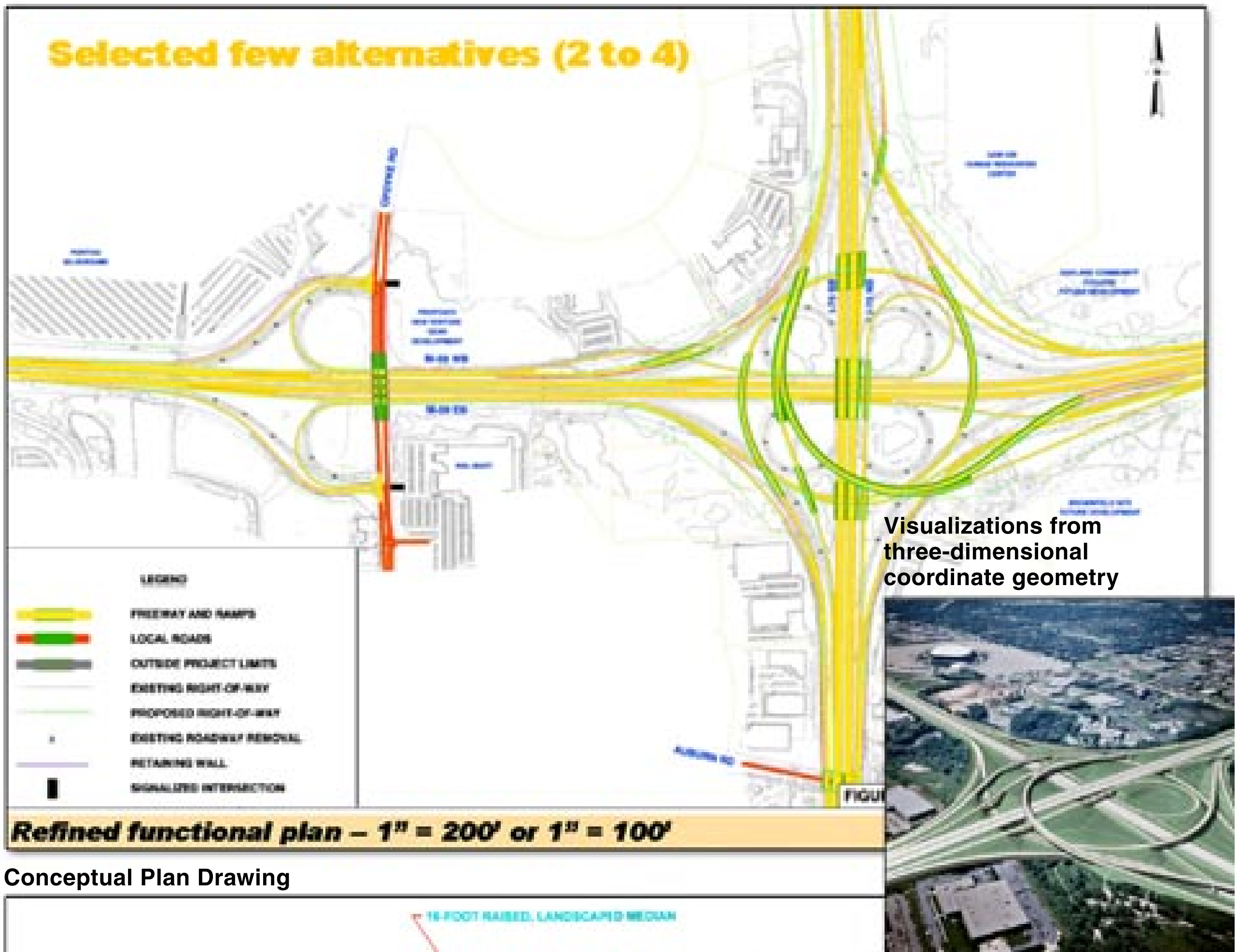
DOCUMENT ALTERNATIVE EVALUATION AND SELECTION

Documentation of the alternatives development process is critical for establishing the credibility of the alternatives analysis process. Establishing naming conventions at the outset of the process assists in clear tracking of alternatives and their variations. Keeping careful notes of each meeting at which alternatives are discussed, and recording specific reasons why each alternative was either forwarded for further evaluation or rejected, provides the backbone of this documentation.

For projects requiring NEPA compliance, this material is included in an EA or EIS to document alternatives considered but rejected. In these projects, the alternative evaluation and selection process ends with selection of a preferred alternative as documented in a Finding of No Significant Impact (FONSI) for an EA, or a Record of Decision (ROD) for an EIS. Detailed documentation of the evaluation process is provided in technical reports, the Draft EA or EIS, and the Final EA or EIS.

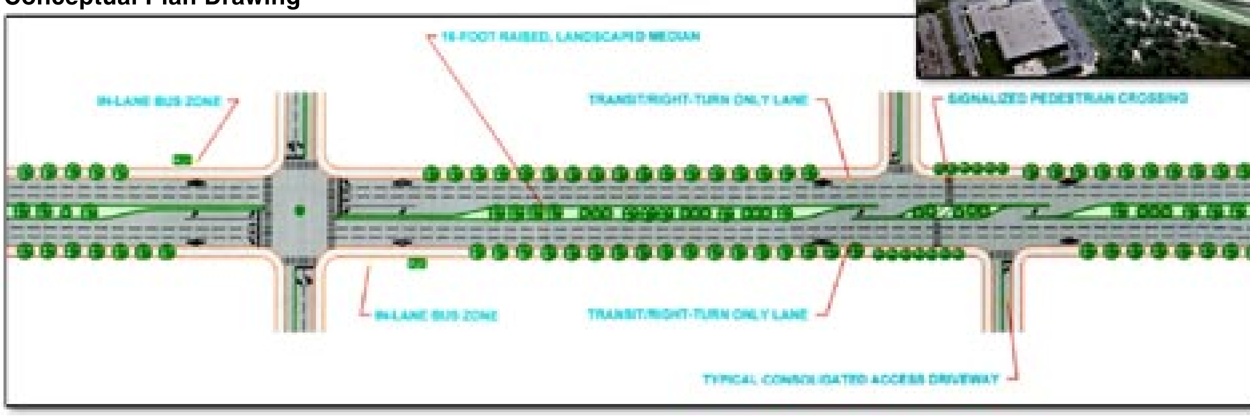
Exhibit C-3 *Presentation of Alternatives for Understanding and Effective Input from the Public and Non-technical Stakeholders*

An effective alternatives development process employs appropriate scales and detail

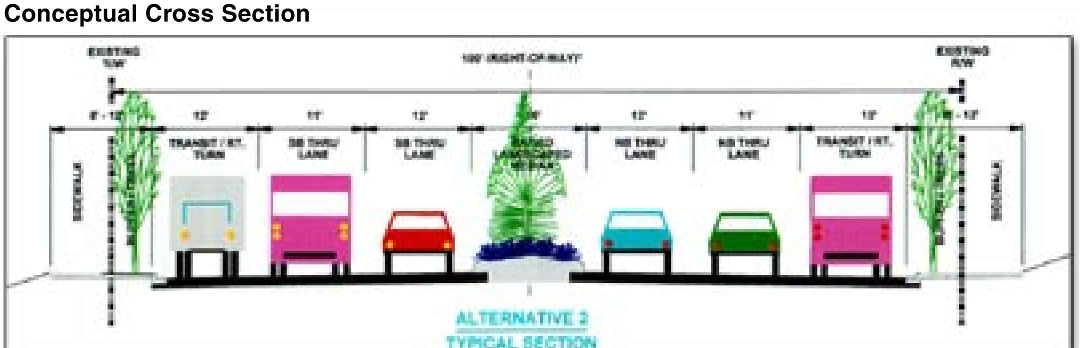


Visualizations from three-dimensional coordinate geometry

Conceptual Plan Drawing



Conceptual Cross Section



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DECISION MAKING AUTHORITY

Stakeholders, as individuals or members of advisory committees, should have meaningful input to the decisions made during a project. Acceptance of a CSD/CSS process does not mean relinquishing the authority and responsibility for the owning agency. Stakeholders are owed an open and honest process, and a well-documented and communicated decision. Final decisions on the preferred solution remain the responsibility of the owning agency.

IMPLEMENTATION

DEVELOP PROJECT FUNDING PLAN

A critical part of the decision-making process is the funding plan. Most agencies are resource constrained. Stakeholders should know or be informed of what the budget constraints are and what sources of funds are available, as well as any schedule or other “strings” attached to funding. This includes not only initial construction, but also maintenance and preservation or other funding to operate the solution as needed.

Development of a reasonable funding plan and continual reference to it during the project can assure that project alternatives remain financially feasible. This issue is discussed further in Section F, Ensuring Safe and Feasible Solutions.

MONITOR CHANGES IN DESIGN AND MITIGATION

A key part of the decision process that is often overlooked involves decisions made following completion of project planning. For example, in projects requiring NEPA compliance, formal decision tracking is often considered complete when the FONSI or ROD is issued. However, as a project proceeds through final design and construction, many variations in design and mitigation can occur. Stakeholders are often surprised by these changes because they assume the project will proceed on the assumptions included in the environmental review process documents. Maintaining clear records of these changes, the rationale, and the resulting impacts can add to the credibility of the overall process with stakeholder groups, especially resource agencies and affected property owners.

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D. REFLECTING COMMUNITY VALUES

Federal legislation (ISTEA and TEA-21) established broad principles of public involvement to be employed in transportation decision making. The pilot states and other "context sensitive" agencies involved with CSD/CSS characterize effective public involvement as:

CSD_100D_1

- Proactive
- Tailored to local needs and conditions
- Frequent and ongoing
- Inclusive
- Innovative, using a combination of techniques
- Educational on issues and technical matters
- Supported by strong leadership and institutional support
- Intended to affect the results of the planning process

These characteristics clearly differentiate between *public relations* (selling a fait accompli) or *public information* (telling how, when, and why a project will be built) and *public involvement* (providing meaningful participation in the evolution of the project and the decision process). Effective or meaningful public involvement clearly represents more than regulatory guidance. It serves as an important underpinning for achievement of CSD/CSS, relevant during each step in the CSD/CSS process.

MANAGEMENT STRUCTURE

DEVELOPING A PUBLIC INVOLVEMENT PLAN

Following development of a decision process (as described in Section C, Effective Decision Making) it is possible to develop a public involvement plan. All pilot states focus much attention on internal management processes, tools, and techniques aimed at development of a public involvement plan. To be effective, the plan must be integrated with the decision process and it must be strategic. The aim of a plan is to describe the affected publics, what information they need in order to have meaningful input at each decision point, what information is needed from them for the agency to do its work at each decision point, what techniques will be used to achieve the required information exchange, and what staff and budget resources are needed to accomplish these activities.

The latter point is particularly significant. Public involvement, like any other project activity such as survey, traffic data collection, and design, requires identification and scheduling of specific resources and skills tied to other project activities. For some projects or at certain points of a project, public involvement activities and outcomes will be on a project's critical path.

Developing a public involvement plan generally involves four steps:

1. Identifying stakeholders
2. Interviewing stakeholders
3. Selecting public involvement techniques
4. Planning for implementation

An example of a Public Involvement Planning Form is included in Appendix D.

Identifying Stakeholders

A first step in achieving meaningful public involvement in project development involves identifying the individuals and groups likely to be affected by the project, those who have a "stake" in its outcome. While this stakeholder group includes owners of property adjacent to the various alignments, it also includes users of the facility, representatives of jurisdictions in which the alternatives are located, transportation service providers in the area, and a wide range of interest groups.

Stakeholders are people likely to support the project as well as those likely to oppose it. Representatives of the sponsoring agency are also considered stakeholders—they definitely have a stake in its outcome! A typical list of stakeholders might include:

- Adjacent property owners (residential, commercial, industrial, institutional—education, religious, government, non-profit)
- Adjacent property renters (residential, commercial, industrial, institutional)
- Facility users (commuters, truckers, business customers, major regional employers)
- Local jurisdiction elected and appointed officials (city council, county commissions, township boards, planning commissions)
- Local jurisdiction transportation or technical professionals (public works directors, traffic engineers, planning directors)
- Regional transportation professionals (Metropolitan Planning Organization transportation planners, Council of Government planners)
- State transportation professionals (State DOT highway designers, traffic engineers, environmental planners)
- Federal transportation professionals (Federal Highway Administration, Federal Transit Administration)
- Transportation service providers (transit agencies, airports, marine ports)
- Neighborhood organizations
- Business organizations (local and regional Chambers of Commerce, economic development agencies, industry associations)
- Transportation interest groups (transit, bicycle, pedestrian, highway)
- Environmental interest groups
- Historic preservation and scenic conservation groups
- Growth management interest groups
- Good government interest groups

To identify potential project stakeholders it is useful to gather together people within the sponsoring agency familiar with the project area and with the transportation needs. They can identify potential issues that could be raised by a project in the area, the groups likely to be affected by those issues, key people in each group, the type of impacts that might be expected, and the significance of that impact on the group. Exhibit D-1 displays an example of a stakeholder identification table. Blank stakeholder identification forms are provided in Appendix D.

Identifying stakeholders is sometimes difficult. Knowledge of local customs and local "powers" can sometimes be critical. Strong or influential community leaders may not always be elected or appointed officials. A lesson learned by staff with Connecticut DOT on one project was that the local elected official (town selectman), presumed to be the key local individual, was in actuality not the most influential or important community member to include. Clearly, knowledge and understanding of the local community is a critical success factor in identifying stakeholders.

Exhibit D-1 *Example of Stakeholder Identification Table*

Issue	Stakeholder Group	Key People	Type of Impact	Significance of Outcome to Group
Increase traffic, noise, light pollution, and degraded desert views	Public Stakeholders - Sierra Vista Neighborhood Association	Joan Sanchez, President Michael Alder, Vice President	Noise; aesthetics/visual; light/glare	Potential for increase traffic noise, light pollution, and impacts to south-facing homeowner's views
Potential drainage issues due to increased impervious surface/ runoff. Residents may experience visual and construction impacts. Railroad Pass Interchange currently has limited sight distance and a high fatality rate	Government - City of Henderson	Melissa Moran, City Engineer	Drainage; aesthetic/visual; safety	May experience drainage problems/impacts during construction. Railroad Pass Interchange improvements would increase driver safety
Lose summer recreation traffic. However, summertime traffic gridlock must be addressed.	Business - Boulder City Rotary Club	Enrique Trejo, Coordinator	Negative business impacts; traffic	The solution to traffic gridlock may result in negative business impacts.

SOURCE: Nevada Department of Transportation

Interviewing Stakeholders

The next step is to conduct one-on-one interviews with a selected set of potential stakeholders. Telephone or in-person formats can be used. The necessary number of interviews will vary widely by project. Narrow down the list of potential stakeholders derived from the exercise above, making sure to include a full range of those affected. This will not only include likely opposition, but potential supporters, facility users, and so on. Project sponsors often think they know all the positive aspects of a project, but it is easy to miss a particular stakeholder perspective. It is just as important to learn why people may favor a proposed action as why they may oppose it.

Interviews generally begin with a brief overview of the transportation need that is prompting the project development activity, and proceed to questions concerning perceived issues and concerns, level of interest, ways the individual or group want to be included in the process, appropriate techniques for information exchange, key sources used for obtaining information about community activities, and other individuals or groups who may be interested in the project. Example questions are included in Appendix D.

These interviews result in an improved understanding of stakeholder issues and characteristics, provide ideas for appropriate public involvement techniques, and build agency credibility. People love to be listened to, and respect the agency for taking the time and trouble to do so. The point here is to base public involvement planning on actual consultation with stakeholders, not to speculate on their attitudes.

Personal interviews also have the advantage of placing staff locally in the project area, giving them an opportunity to get a sense of place and how the community functions at the project outset. One engineer from Connecticut DOT expressed it best – "*In an ideal world, an engineer should have to live in a community for at least one week before working on a project there.*"

Selecting Public Involvement Techniques

The third step is selecting tools and techniques to use at particular points in the decision process, to flesh out how the information exchange processes will be conducted. Matching information needs with public involvement techniques is an opportunity for creativity. Many excellent resources are available to provide ideas for appropriate approaches to accomplish particular objectives (see the reference list at the end of the chapter). Appendix D provides the table of contents from several publications on selecting public involvement techniques.

No two projects are exactly alike, and public involvement tools and techniques should be tailored to reflect the particular character of each project—its group of stakeholders, its geographic location, the successes and failures of previous public outreach programs, the level of complexity and controversy, and so on. Even cultural differences in stakeholder groups will be of importance in identifying effective techniques. For example, reliance on websites or e-mail lists for disseminating project information may not be effective ways to reach lower income groups or certain segments of the population. Agencies working in Alaska have noted that some native tribes prefer and react better to formal presentations from government officials over open house formats. The key, of course, is to understand the local groups and differences and tailor an approach that works for the stakeholders, not one that is more convenient for the agency.

Techniques are also likely to differ from one decision point to another within any project because the nature of the required information exchange is different. At the beginning of the process, for example, the agency usually seeks to discover community issues and validate its understanding of the project need, but may have relatively little detailed or substantive information to share with the community. Later in the process, the

Guidebook for Creating a Scenic Byway Corridor Management Plan

This guidebook was prepared by the States of California, Oregon, and Washington and relates their experiences with the Pacific Coast Scenic Byway (U.S. 101). Drawing from this experience, state transportation officials and consultants outlined the basic steps in the planning process with examples of successful approaches, lessons learned, and potential pitfalls. It is intended for use by communities and agencies who are preparing corridor management plans under the National Scenic Byways Program, and can also be used more generally by any group wanting to have increased involvement in how public roads and highways integrate into their neighborhoods, communities, and regions. One lesson learned related to the structure for public involvement in one of the states. The original assumption was that input from advisory groups at the local level would feed into an oversight advisory group covering the entire corridor. In actual application, the oversight advisory group did not have enough familiarity with local conditions to create a meaningful plan. In response, the structure was changed so that all the planning was done at the local level and summed by segments to create a corridor-long plan. This ability to exert "local control" over key elements of the plan increased the interest and involvement of local community citizens and elected officials and was key to generating an implementable plan.

agency is seeking feedback on particular alternatives and may need opportunities to present a large amount of detailed information.

The tendency in planning for public involvement is to schedule project-specific events and encourage stakeholders to participate in them. Experience on many projects has shown that while it may be a bit less efficient, project team participation in community- and stakeholder-sponsored activities may yield much more satisfactory results. In many cases, taking the project to the stakeholders, rather than the reverse, increases the likelihood of successful information exchange.

It is important to recognize that no matter how thorough a stakeholder identification activity is conducted at the outset of the project, the list of stakeholders will change as the project progresses. As more detailed information is available, members of the general public who were previously uninterested in the project will become stakeholders. The earlier all of the interested parties can be identified the better. For that reason, it is a good practice to include mechanisms for outreach to the general public, in addition to known stakeholders, as a continuing element of the overall public involvement plan.

The pilot states have all focused on development of materials to aid in planning for public involvement. Minnesota DOT has developed a guide to public involvement entitled *Hear Every Voice.* Chapter 5 of the guide includes descriptions of public involvement techniques as well as evaluations of how they have worked within the context of a plan or project. Appendix D includes excerpts from the document to illustrate the types of techniques discussed and the evaluation template. Appendix D also contains example public involvement plans and options for assembling stakeholder advisory groups.

Minnesota DOT Public Involvement Guidelines

Minnesota DOT developed the following public involvement guidelines to assist its personnel in implementing public involvement plans and activities. They reflect the mandates of ISTEA, reinforced by TEA-21, as well as public agency best practices.

- For all Mn/DOT plans and projects, public involvement plans should be developed and tailored to the complexities of the project.
- Solicit public involvement as early as possible.
- When possible and appropriate, Mn/DOT employees will plan for smaller, more informal group meetings and discussion.
- Mailing lists, including known neighborhood associations, civic and cultural groups, environmental organizations, citizen advisory committees, and organizations and associations with low income, minority , elderly, and disabled constituents will be kept up-to-date as appropriate.
- Mn/DOT employees will make an effort to go where the people are.
- Communication must be two-way, continuing, and consistent.
- Mn/DOT is committed to being clear about the process of public involvement and how it ties to decision making.
- Varying types of incentives may be necessary given the type of project, or plan, and the people who are invited to the meeting.

Each of these guidelines is discussed in Chapter 2 of *Hear Every Voice* (Minnesota Department of Transportation. *Hear Every Voice, A Guide to Public Involvement at Mn/DOT*. June 1999).

Planning for Implementation

Implementation planning involves integrating the selected public involvement activities into the total project scope, schedule, and budget, and obtaining final buy-in from management. Some agencies less experienced in CSD/CSS do not yet treat public involvement as a task that must be planned and budgeted. "You never know how many meetings you are going to have to hold" is sometimes heard. Of course, one of the points of up-front stakeholder identification and rigorous planning is to find out what the needs are. The issue is no different than, for example, not performing traffic counts and then asserting "you don't know how much traffic you need to design for." Clearly, part of being successful is understanding the requirements ahead of time and knowing where to get needed resources, inside the agency or elsewhere.

While it is often stated that good public involvement is expensive, and poor public involvement is even more expensive, budgets for public involvement must be realistic. There are many ways to leverage resources; additional resources and references are presented at the end of this chapter.

Finally, a public involvement plan is a useful tool, a key element of the project implementation strategy. But, it is only a road map, and will likely require modifications as the project proceeds. For that reason, it should not be viewed as a sacred document, set in stone. Of course, it should also not be set on the shelf as an interesting but irrelevant document.

PROBLEM DEFINITION

IDENTIFYING COMMUNITY ISSUES AND CONSTRAINTS

Stakeholder interviews conducted as part of public involvement plan development should provide a set of community issues, values, and constraints concerning the project. Results from such interviews may not necessarily provide a complete picture of all community values and interests. Most good public involvement plans call for broad community outreach at an early point in the project to ensure mutual understanding between the agency and the stakeholders of the full set of concerns associated with the project. Upon further examination, it may be determined that some of the identified issues cannot be dealt with in the current project development process; they may need to be referred to other agencies that can take appropriate action, shifted to another planning or project development process better suited to address them, or postponed for consideration at a later stage of project development. Those identified issues that do pertain to the project at hand should be incorporated into the problem definition and documented as input to the evaluation framework in the next step.

Outreach should be focused on understanding community attitudes about the nature of transportation problems or issues associated with the identified project. Specific concerns about safety or mobility, about land use or land development are of interest. Outreach should also focus on finding out the specific values associated with the local context. Importance of adverse effects (noise, cut-through traffic, speed of traffic, on-street parking, circulation, access to parks, schools, businesses) should be expressed. Individuals or groups may note a concern or issue that might seem irrelevant to the project, but agency staff should strive to maintain an open mind and to listen to what is being said. Often the issue will surface at some point in the project if left unaddressed.

Typical techniques for broad outreach to the public for the purpose of issue identification include newsletters with response forms, websites with electronic comment options, information telephone lines, surveys, elected official briefings, open houses, and advisory groups.

CONFIRMING AND REFINING PROBLEM DEFINITION

A problem definition can be crafted from the issues identified by the agency and the community through similar techniques as described for issue identification. The point of this outreach is to assure congruence between the agency's view of the problems to be addressed and those recognized by the community. If these views are different (and they often are!), it is very difficult for affected property owners and stakeholders to consent to trade-offs that adversely affect their interests later in project development. The absence of general endorsement of the problem definition is a strong signal that the project is not ready to proceed to the next step.

The Pennsylvania DOT uses a four-stage project development process as part of their environmental streamlining efforts. As discussed in Exhibit D-2 (following page), the Visioning Stage, a Development Stage, a Refinement Stage, and a Final Comparison Stage are all intended to gain understanding of community values and interests as they pertain to the project and its effects on the community and environment.

PROJECT DEVELOPMENT AND EVALUATION FRAMEWORK

INVOLVING STAKEHOLDERS IN FRAMEWORK DEVELOPMENT

Agencies are usually comfortable with evaluating alternatives based on quantitative measures of capacity, safety, design standard compliance, plan compliance, and minimization of direct impacts to known natural resources. However, they are generally less comfortable with attempts to measure the effects of alternatives on issues such as "quality of life" or "community cohesion." These are often viewed as intangible and, therefore, unmeasurable. However, if these are important issues to the stakeholders, they must be tackled head-on. Ignoring these just

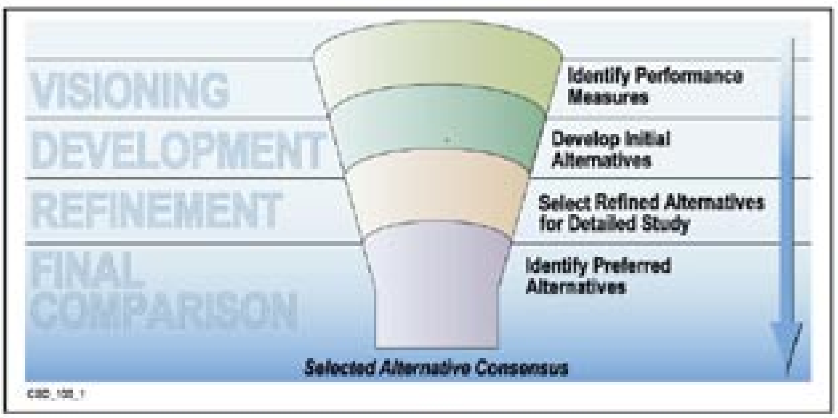
Interstate 83 Community Design Center

As part of identifying alternatives for improvements to an aging and unsafe segment of Interstate 83 near York, Pennsylvania, Pennsylvania DOT conducted an extensive collaborative process with community stakeholders. In addition to creating a community advisory committee, project website, toll-free number, e-mail address, and newsletters, the core of the effort involved a week-long "community design center" process. Participants could recommend possible roadway alignments and other solutions and see them drawn on a large-screen CAD system while they watched. During the design sessions, project staff also presented background information on the environmental process and on traffic modeling, helping participants develop the same understanding as the project planners and designers. Eight alternatives resulted from the collaborative process. In a subsequent design center session, the alternatives were evaluated against engineering constraints, cost, the project needs statement, and environmental constraints using a GIS database, again allowing the participants to understand and participate in the alternative design and selection process.

because they seem difficult to measure sends the wrong message to stakeholders that they are unimportant. In any event, there have been many successes in working with stakeholders to develop quantifiable evaluation criteria for such categories. When properly prompted, individuals with knowledge of the project area and pressing concerns about future development can usually pinpoint specific, measurable items that capture their concerns. Examples of evaluation criteria are presented in Appendix C.

Exhibit D-2 *Pennsylvania DOT – Four-Stage Development Process*

The PennDOT uses a new, four-stage Project Development Process as Pennsylvania's model for Environmental Streamlining. The new process, shown in the diagram below, will include a Visioning Stage, a Development Stage, a Refinement State, and a Final Comparison Stage.



The Visioning Stage will be used at project initiation to help communities gain a better understanding of the changes that a new highway may or may not bring to their areas. This stage includes a series of public meetings throughout the study area to begin the two-way communication process between PennDOT and the community at-large. The visioning meetings provide the public with an opportunity to identify what is important to the area (jobs, traffic, environmental quality, etc.) and to help in the identification of areas for growth or protection. Information generated at the public meetings will be used in the development of performance measures for advancement of the project.

The Visioning Stage includes the collection of background environmental data as the beginning of the mapping process. That background includes natural resources (wetlands, watersheds, wildlife areas), community resources (land uses, proposed developments, farmlands, community facilities), historic sites, parks, and recreational areas. This information will be collected through a review of state and federal environmental agency files, a review of aerial mapping, interviews with local officials and residents, and field interviews.

Although the time required to develop a project may seem extensive before plans for a groundbreaking can ever be anticipated, time can be an ally in preparing local communities to anticipate pending changes well before they ever occur. Toward that end, PennDOT will conduct an extensive outreach campaign with the multiple purpose of educating and informing the public through involvement with the project. In addition to public meetings and public hearings that will be held as the project progresses through the engineering phase, a host of public outreach activities will be conducted to provide open access to the project.

SOURCE: Pennsylvania Department of Transportation

While broad outreach techniques such as those mentioned above can be used to "reality-test" a set of evaluation criteria, small groups representing a cross section of stakeholder interests are best suited for initial development of the evaluation framework and specific criteria. Consultation could be conducted with an advisory group established for the project, an existing advisory group, or a series of special interest groups consulted on criteria associated with their particular issues of concern.

ALTERNATIVE DEVELOPMENT

ENGAGING STAKEHOLDERS IN IDENTIFICATION OF ALTERNATIVES

CSD/CSS processes can vary in how this step in the process is approached. In one approach, the agency can propose a set of alternatives that meet identified needs and take into account identified concerns. These alternatives are then reviewed in a public outreach process, and new alternatives or variations suggested during the outreach activities are incorporated into the process.

In another approach, alternatives are generated in various events involving stakeholders such as resource agency or advisory group workshops, and public design charrettes. Ideas generated in this fashion are refined by agency technical staff and disseminated broadly for public review and comment.

Discussions with staff from the pilot states indicated a preference in many cases from their customers to be involved at the beginning. Project successes were attributed to the DOT "starting with a blank sheet of paper." (An interesting sidelight of this is where pilot state staff set an expectation in their customers' minds from previous projects in which they had started the public process with a plan to "sell." In taking the "blank sheet of paper" approach for the first time, staff had to overcome skepticism that they didn't have a hidden plan already developed. Once they achieved credibility, though, the working relationship and alternative process moved ahead.)

Many hybrids of these approaches have also been successful. Key elements of success are related to sincere consideration of ideas proffered by stakeholders and conscientious work with stakeholders to convert their ideas into technically feasible alternatives. Throughout the process of alternative development, agency staff must maintain an open mind, holding conventional notions about the "right answer" in abeyance. In many cases cited by the pilot states, collaboration between agency staff and stakeholders has resulted in better solutions than any individual group had conceived on its own.

IDENTIFYING OPPORTUNITIES FOR ENHANCING RESOURCES

Agency/stakeholder collaboration and consultation involved in alternative development will likely uncover opportunities for enhancing resources. These might include such items as extending bicycle, pedestrian, or wildlife corridors; providing economic development opportunities; creating a community gateway; improving the appearance of a corridor; enhancing the setting of a valued community resource; improving the connectivity of one area to another; constructing curb extensions to improve bus operation efficiency; and so on. One case study in particular, the TH 61 project in Minnesota, represents an excellent example of taking advantage of enhancement opportunities.

In states such as Maryland and Connecticut, historic resources such as churches, cemeteries, and stone fences along the right-of-way are integral to the sense of place. To the extent possible, these elements should be incorporated into the project. For example, in Kentucky and Connecticut, the DOT has committed to employing special stonemasons to build or re-build historic stone fences. In another example in Maryland, the DOT uncovered an over 100-year-old, unique drainage structure during investigations for a resurfacing project. Their redesign incorporated this feature, thereby preserving it and indeed uncovering it for all to observe.

In Utah and Arizona, local artists have been engaged to incorporate art that evokes memories of Native Americans from the region. Interchange structures and retaining walls have been transformed to local sources of pride. See Exhibit D-3 (following page) for examples of such enhancements from the City of Phoenix.

Roberts Parkway Overpass, Burke, Virginia

In 1997, preliminary engineering drawings for a four-lane, median-separated overpass were prepared to eliminate an at-grade railroad crossing in a residential area of Burke. Virginia Department of Transportation (VDOT) hosted an open house for interested citizens in the area to view the plans and provide comments. Concerned citizens did not like the proposed bridge, a bare-bones concrete and chain-link design. A citizen's task force was formed to provide input to VDOT and help to design a bridge that has several aesthetic amenities such as iron rail fencing, decorative paving stones, and enhanced facades along the sides of the bridge. VDOT learned a key lesson on this project: early citizen involvement and local political leadership can intervene in transportation design to produce a more satisfying end result that enhances the local community.

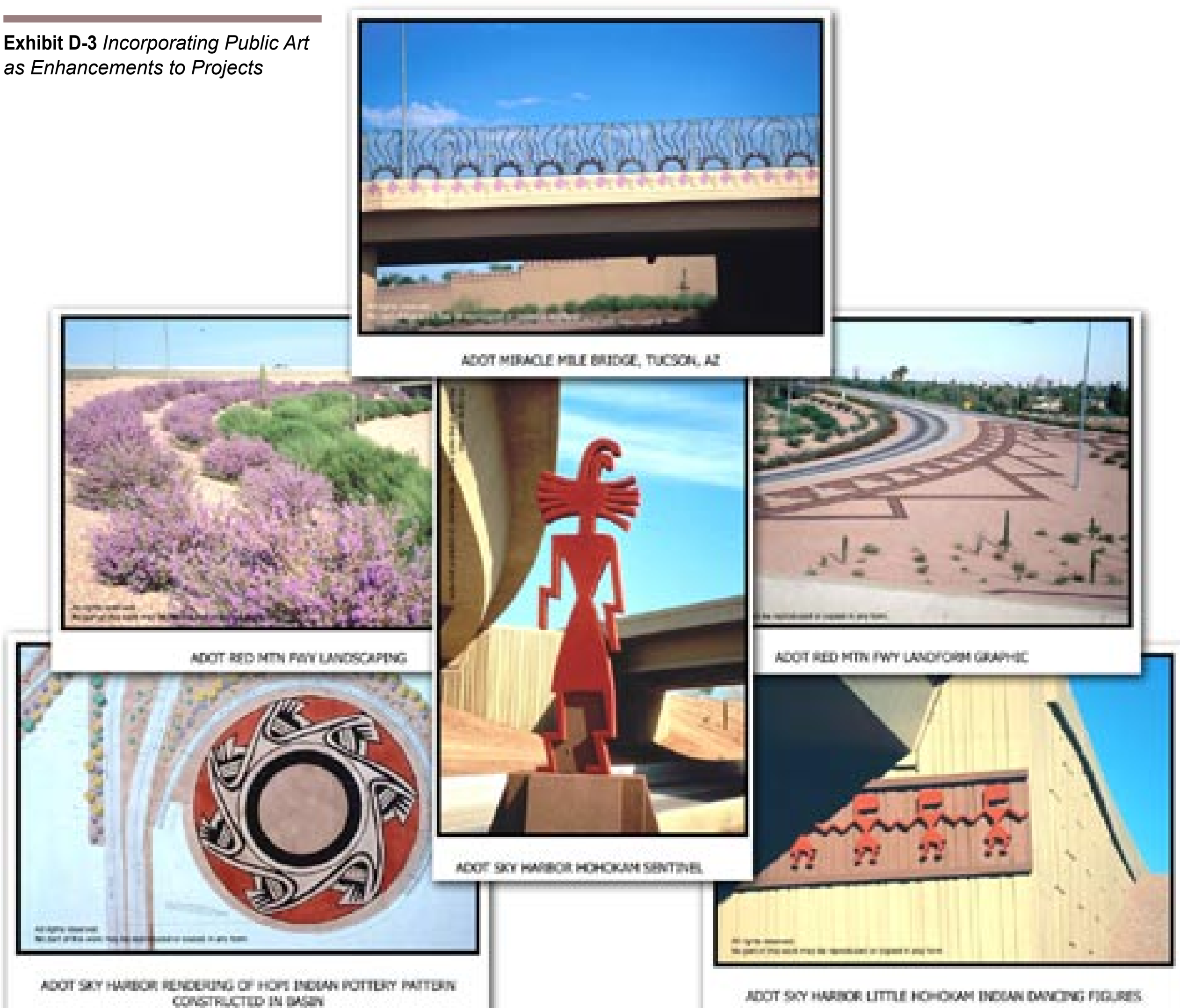
A final example is given in Section H, Case Studies, for a project in Maryland. There, a large, significant oak tree was preserved in the median of a six-lane arterial. Profile and alignment adjustments and construction of a special irrigation system preserved the tree and enhanced the project.

There are, of course, funding issues associated with enhancement activities. These are discussed in more detail in Section F, Ensuring Safe and Feasible Solutions. From the perspective of stakeholder and public involvement activities, though, there is clearly a role for them to investigate and secure alternative funds to support enhancement activities that fall outside the policies of the transportation agency. Agencies make a serious mistake when they reject out of hand an enhancement opportunity because "we don't pay for that." Being open and honest with stakeholders means acknowledging what the financial and policy constraints are, and then beginning a dialogue with the stakeholders to figure out how to accomplish the enhancement opportunity. Developing this type of partnership for project implementation increases the likelihood that the project will move forward. Responsible stakeholder groups will see it as their job to help secure funding, make their own trade-offs, and otherwise work with the agency staff. At a minimum, the project agency should strive to accommodate or at least not preclude later incorporation of the enhancement feature as a separate project once specific funding for it is obtained.

IDENTIFYING OPPORTUNITIES FOR AVOIDING/ MINIMIZING ADVERSE EFFECTS

Information exchange with stakeholder groups during alternative development will also provide ideas for ways to avoid or minimize adverse effects of the project. Examples include substituting retaining walls for fills to reduce the project footprint, constructing noise walls to reduce impacts to adjacent residents, using decorative surfaces

Exhibit D-3 *Incorporating Public Art as Enhancements to Projects*



SOURCE: Arizona Department of Transportation on project structures to better fit the project into its setting, adding landscaping and other streetscape elements to enhance the connection of the facility to adjacent land uses, and so on.

Often the way to mitigate adverse effects is merely to "re-engineer" the corridor. Connecticut DOT engineers speak of literally walking a project alignment, noting the terrain, proximity of buildings, tress, etc., and adjusting the centerline as they proceed. They consider this good design practice – paying attention to details, and designing the alignment almost foot by foot.

The Federal Lands design philosophy is strongly in this camp. Clients of theirs include the National Park Service. Federal Lands staff understand that first and foremost the alignment and cross section must be placed in a manner that "lies lightly on the land," in other words, that looks as if it belongs.

IDENTIFYING MITIGATION FOR UNAVOIDABLE ADVERSE EFFECTS

If adverse effects cannot be avoided, a collaborative alternative development process can help identify opportunities for mitigation. Key environmental technical staff are consulted to develop mitigation plans.

ENGAGING STAKEHOLDERS IN ALTERNATIVE EVALUATION

As discussed in Section C, Effective Decision Making, stakeholders can be involved in the screening and evaluation of alternatives in a variety of ways. The level and type of involvement should be determined in the Evaluation Framework document. Staff analysis results can be shared broadly with stakeholders for review and comment through newsletters with response forms, websites with electronic comment options, information telephone lines, surveys, elected official briefings, open houses, community workshops, and radio and television talk shows. Town meetings, using electronic voting or more conventional methods, can be used to elicit stakeholder preferences.

Stakeholders can also be involved in conducting the screening and evaluation. For example, alternative rating and criteria weighting workshops can be designed for advisory groups, other types of stakeholder groups, or large public gatherings.

In projects for which NEPA documents are being prepared, it is often useful to share initial results from technical reports with stakeholders to ensure the analysis is accurate and complete. Although accuracy and completeness are ultimately addressed during public review of Draft EAs and EISs, agency credibility can be enhanced by selective outreach earlier in the process. In this way, agencies can be assured that the draft documents do not contain easily avoidable errors or omissions. This review can be accomplished through presentations to advisory groups or special interest groups.

Public hearings provide the public with a last chance for direct input into the NEPA alternative selection process. Research indicates that "open" public hearings, which are conducted like open houses and allow participants to provide testimony at private court reporter stations rather than in a large public forum, are preferred by most state DOTs because they increase active public input.

By the time of the public hearing, though, a well-executed project should not encounter any new or previously unexpressed views or inputs on the project or the alternatives. One good measure of the success of a public involvement program is "no surprises" at the public hearing.

IMPLEMENTATION

MAINTAINING COMMUNICATION THROUGH CONSTRUCTION

Many public involvement processes conclude at the end of the alternative selection process. This ignores the continuing interest many stakeholders have in the details of final design and construction. It also ignores importance to maintaining agency credibility for communicating any changes in the project that occur during these post-planning activities. Staff from some of the pilot states indicate this is a painful lesson learned – that hard work to achieve credibility and buy-in can be erased by ignoring stakeholder concerns or important project activities after a decision is reached.

Any number of events can have an unforeseen effect on the project or individuals. Changes to the plan, schedule delays, changes to construction detours, etc., all present risks if not communicated to stakeholders.

An extension of existing newsletters and websites can be used to update stakeholders, and occasional meetings with existing advisory groups and elected officials can be scheduled at key milestones (Exhibit D-4, following page). A more extensive outreach program may be needed during construction to provide traveler information about revised routing and adjacent property owner/renter information about planned construction activities.

Exhibit D-4 *Example Newsletter for a Construction Project*

EVALUATING THE PUBLIC INVOLVEMENT PROGRAM

Following the completion of the project development process is an excellent time to conduct an evaluation of the public involvement program. In addition to providing insights into the particular project for which it is conducted, the evaluation can provide meaningful lessons that can be incorporated into future project development processes and agency communication programs. The evaluation can be approached from the perspective of the public involvement practitioners who implemented the public involvement program, other agency staff, and/or the stakeholders. A combination of these perspectives can also be incorporated into the evaluation. While there is a diversity of opinion concerning appropriate factors to consider in such an evaluation, the factors should reflect the agency's particular goals in conducting public involvement. Some factors to consider in structuring an evaluation include:

- Accessibility to the decision making process
- Diversity of views represented
- Opportunities for participation
- Integration of concerns
- Information exchange
- Project/decision acceptability
- Direct and indirect cost to the agency
- Direct and indirect costs to stakeholders
- Agency cost avoidance

Response forms and other comments from stakeholders received throughout the process can provide input to the evaluation. If additional stakeholder input is desired, process participants can be surveyed by mail or telephone. Different questions can be directed toward participants who participated in different ways—those who served on an advisory committee, those who attended a meeting, those who were on the mailing list or visited the website, and so on. Some evaluations also include a random survey of the general public to ascertain the broad public perspective on the quality of the project development process.

Rural Roadway Expansion Projects Incorporates Community Values

The Wisconsin Department of Transportation pursued the expansion of 42-mile segment of Highway 12 in south-central Wisconsin from a two-lane to a four-lane highway citing safety as the primary concern. Opponents of the project organized as the Safe Highway 12 Coalition and asserted that WisDOT could improve safety on the two-lane roadway at a fraction of the cost of the expansion. The Coalition hired a consultant to develop an alternative plan. Based on the more complete set of alternatives, negotiations for a final compromise were conducted. The final decision supported the four-lane roadway expansion but also included funding for protection of the Baraboo Range National Natural Landmark, funding to assist Sauk and Dane Counties plan for highway-related growth, and sponsorship of studies to evaluate a commuter rail line for the area. Public involvement resulted in a project that provided a safer roadway and recognized community values.

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E. ACHIEVING ENVIRONMENTAL SENSITIVITY

James Codell, Secretary of the Kentucky Transportation Cabinet, expresses the vision of Kentucky and provides direction to his staff who work on projects for Kentucky residents. *"You should act as if the project is going through your own back yard."* Achieving environmental sensitivity is much more than completing technical analyses or submitting mandated forms or documents. It is a commitment to, in the view of Federal Lands Division philosophy, assure that a project "lays lightly on the land." Context sensitive professionals and organizations see themselves as environmental stewards, not just transportation providers. This attitude and approach to their work represents a significant difference from the old way of doing business.

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MANAGEMENT STRUCTURE

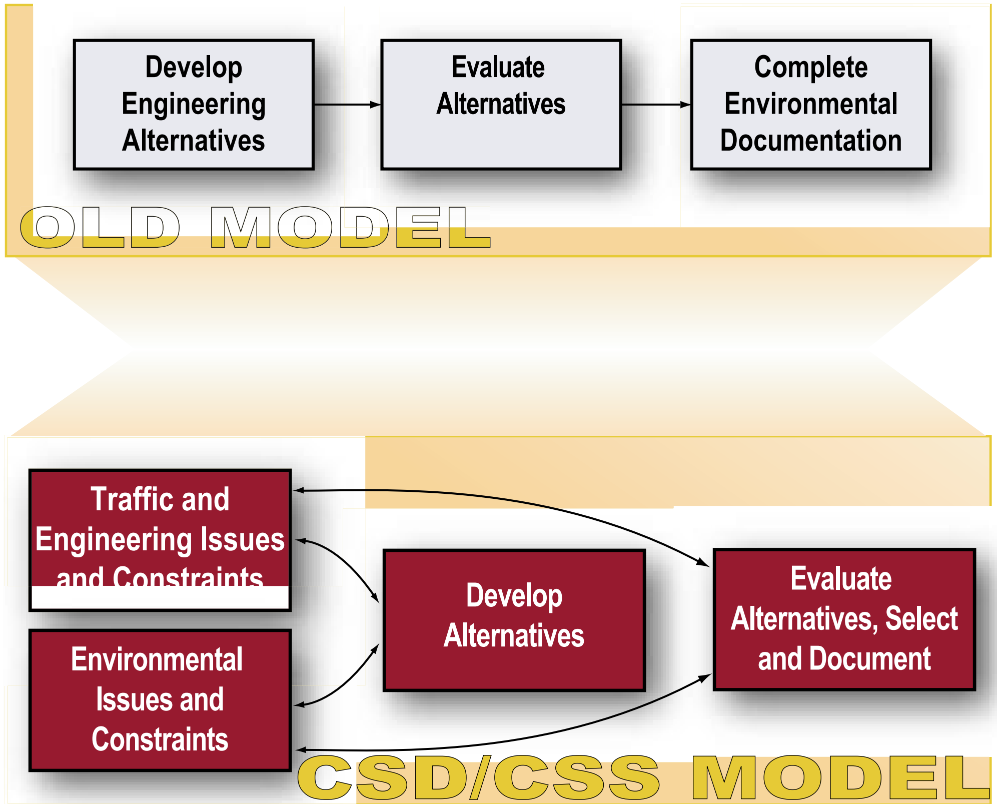
CSD/CSS means involving social, economic, and environmental considerations as a meaningful part of the solutions generating process, not as add-ons or after-the-fact steps. In the remainder of this section, a reference to environmental considerations is assumed to mean the broad spectrum of SEE (social, economic, and environmental) effects. This CSD/CSS approach helps build consensus for the eventual decision and saves costs by incorporating such considerations from the beginning when it is easier to accommodate change. Environmental sensitivity means incorporating consideration of SEE effects within the alternatives development process. This is an advance over outdated agency processes in which engineers determine an alignment or plan, and then "after-the-fact" evaluate the plan for adverse environmental consequences. Exhibit E-1 (following page) shows a comparison of the old model versus the new model.

ESTABLISH ENVIRONMENTAL REVIEW PROCESS

Perhaps the key management issue is determining if the project will be conducted under NEPA. There may be confusion about the relationship of NEPA and CSD/CSS, but steps in the two processes are nearly identical, and the two can fit together very easily. The processes are overlayed and integrated, not run consecutively. Both aim at selecting the best alternative, both are intended to provide timely information for effective decision making, and both provide the interdisciplinary framework for considering the positive and negative impacts of the proposed action.

Because NEPA is a national law that applies to all federal agency actions, it is almost always implemented through a series of regulations promulgated by each federal agency and in many cases each state DOT. Despite this national law, and the common aim to provide the agency with a defensible decision process, each of these agency regulations is different from the others in its particulars. In all NEPA projects, though, it is necessary to identify the lead and cooperating agencies as well as the type of review required. It may not be possible to determine if an EIS, EA, or CE is appropriate during the first step of the process, although in many cases the lead agencies are able to make the decision even at this early point. The earlier the determination can be made, the better, because it affects the design of the public and agency outreach programs as well as a variety of data gathering efforts.

Exhibit E-1 *Context Sensitive Approach – Integrating Concurrent Engineering and Environmental Analysis*



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If the project does not require either federal funding, a federal agency permit, or other approval action, and is therefore not subject to NEPA regulations, the environmental review process will likely be guided by local, regional, or state environmental regulations as well as response to stakeholder issues and concerns. Some agencies choose to follow NEPA even if it is not required to ensure that if conditions change, and a federal action is later triggered by the project, there is no need for "back tracking" to accommodate federal requirements.

In addition to understanding the relationship of the project to NEPA, it is also important to determine the applicability of other regulations that can affect the development, evaluation, and selection of alternatives, and the ultimate implementability of the project. Such regulations might include local, regional, or state laws that control land use; restrain urban growth; protect against adverse impacts to specific lands, species, or other resources; require a public vote to approve certain types of projects; or require a public vote to approve funding for particular projects.

Knowledge of the regulatory framework in which the project will be developed at the outset of project development helps to avoid surprises that cause delays and rework at later stages of the process. The NEPA process is clearly intended to operate as an umbrella approach so that all related environmental laws, regulations, and policies are considered in a coordinated fashion during decision making.

DEVELOP AGENCY OUTREACH PLAN

The "Reflecting Community Values" section of the report described the development of a public involvement plan (Section D). The development of a plan for involving resource, regulatory, and other agencies is similar, and is often included as part of the public involvement plan. Organizations typically consulted include federal transportation agencies (Federal Highway Administration, Federal Transit Administration); state DOTs; local transportation and land use agencies (cities, counties, MPOs); Native American tribal organizations; federal resource agencies (Environmental Protection Agency, U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Forest Service, U.S. Parks Department); and other state natural resource/environmental protection/land use agencies such as Departments of Natural Resources and State Historic Preservation Offices.

Like other stakeholders, resource and regulatory agency staff have particular perspectives and specific constraints relating to their availability for involvement in the project. In planning for the participation of federal resource agencies, for example, it is important to remember that their operating procedures often make it very difficult for staff to participate in activities not directly connected to an ongoing NEPA process or permit action. Moreover, in most regulatory agencies staff is often spread very thin and forced to prioritize among many important projects and concurrent activities. Limited availability of agency staff often requires scheduling of special activities for them at selected project milestones rather than assuming they can participate as regular members of broad-based project advisory groups that will meet often during the development process. Field trips, special resource agency advisory groups that meet only several times during project development, and focused resource agency workshops are proven effective approaches for achieving agency involvement.

Pilot states working with agency stakeholders have attempted to maintain an environmental stewardship focus and at the same time improve efficiencies. The Connecticut DOT is working with the FHWA Division Office and Connecticut State Historic Preservation Office (SHPO) to develop programmatic agreements covering minor projects and even minor work efforts on the Merritt Parkway, which is listed on the National Register of Historic Places. Other agreements involve continual coordination at every stage of an archaeological investigation. In Kentucky, as part of a section 106 Programmatic agreement, a consultation procedure is being established between the State and Native Americans, even though there are no federally recognized tribes in the state.

North Carolina DOT is acting as an environmental streamlining laboratory. The vision of NCDOT is to engage all stakeholders in a shared, efficient, and balanced process that advances environmental streamlining while maintaining environmental stewardship.

Despite budget and time constraints, it is critical to the success of the CSD/CSS (and NEPA) process to obtain information from the appropriate resource and regulatory agencies concerning problem definition, evaluation criteria, alternatives development, alternatives evaluation, and the identification of a preferred alternative.

PROVIDE STAFFING SUPPORT

Achieving environmental sensitivity and maintaining control over a project's schedule and budget requires commitment of resources at the project level. In Kentucky, the Transportation Cabinet created 12 staff positions to monitor all environmental activities at the District level. The Maryland SHA has undertaken similar action. Kentucky also has established an Environmental Advisory Team, consisting of KTC staff, FHWA staff, and consultants to track environmental commitments and look for opportunities to streamline and improve the process.

Agencies new to CSD/CSS may find it necessary to increase the level of staff support or retain consulting services for environmental coordination and project development activities.

PROBLEM DEFINITION

DEVELOP PROBLEM STATEMENT

An early step in both the CSD/CSS and NEPA processes is the identification of the problems to be solved and the development of a problem statement. It is critical that the statement be useful for development and evaluation of potential solutions. Problems must be stated in terms of underlying causes. For example, congestion, in itself, may not a problem, but rather a symptom of a problem. If, instead, the problem is defined as travel demand that exceeds capacity, the problem has been framed in a way that can lead to a solution—it is either possible to attack the problem from the demand side or the capacity side, or a combination of the two.

Similarly, problem statements should avoid being mode specific. Thus, for example, a problem is not the lack of light rail transit lines from point A to point B. Rather, there may be a lack of transportation options within a particular corridor where only auto transportation options exist. Solutions could include expanding opportunities for bike, pedestrian, light rail, bus, and other public transportation.

In some cases, a problem could relate to a particular type of vehicle. For example, roadway geometry that makes it difficult for emergency vehicles or particular types of trucks to gain access or to complete specific turning movements could be a significant problem in a corridor used heavily for freight movement.

Problem statements generally define the current conditions as well as conditions at the end of the forecast year, generally accepted as a 20-year planning period. Even though transportation performance may not be a problem now, future conditions may not meet local or state performance guidelines of a road segment or intersection. Projecting traffic demand 20 years in the future can be very controversial. Making sure there is agreement concerning the modeling assumptions involved in these projections is critical to the success of most urban projects because it goes directly to the heart of gaining agreement on the problems to be addressed.

While traditional problem statements focus on transportation performance issues, it is possible for them to also incorporate broader community issues such as economic development, visual identity, community character, and livability. In fact, this provides a much stronger problem statement and will more than likely help to differentiate among possible alternative solutions.

Staff from all pilot states are unanimous in their view that well thought-out, clearly communicated, and commonly understood problem statements go a long way to achieving both environmental sensitivity and project success.

CONDUCT SCOPING TO CONFIRM AND REFINE PROBLEM STATEMENT

Recreation and Natural Resource Enhancements Provided at Low Cost

With the replacement of the Flansburg/Nobleboro Bridges in Herkimer County, New York, the New York State DOT established a scenic West Canada Creek overlook, recreational crossings, and 1.5 acres of restored wetlands at minimal cost by including these features into project staging and excavation. External agency coordination was conducted with the Adirondack Park Agency; U.S. Fish and Wildlife Service, Environmental Protection Agency, and Park Service; the Town of Ohio; and the Ridge Runners Snowmobile Club.

The context of the proposed project is defined through *scoping*, a collaborative process with resource and regulatory agencies. This is one of the first opportunities to gather information about the environmental issues and constraints, about the natural and community resources that could be affected by the project. Scoping can also serve to help define the range of solutions or alternatives considered feasible. Most importantly, it provides agencies an opportunity to help separate issues of significance from those of less importance with the intent of being able to focus resources appropriately. It parallels the identification of issues and constraints described in Section D, Reflecting Community Values, in which public outreach is used to identify issues from a citizen perspective.

Scoping is an excellent opportunity to make sure that environmental considerations are not an after-thought in developing and evaluating alternatives, and to ensure that all of the relevant information is on the table early in the project so all of the trade-offs can be considered. This is the right time to gather ideas on what features could make the project better, more implementable, and more worthy of celebration. While scoping is often focused on discovery of natural resource issues and constraints, it is important to also incorporate examination of the social and economic (human environment) context as well.

If the project is being conducted under NEPA, scoping is required as part of the preparation of an EIS, and is often conducted during preparation of an EA. However, even if the project is not following a formal NEPA process, this collaborative data gathering activity is considered an essential part of the CSD/CSS process.

PROJECT DEVELOPMENT AND EVALUATION FRAMEWORK

INVOLVE STAKEHOLDERS IN FRAMEWORK DEVELOPMENT

Establishing criteria to be used in screening and evaluating project alternatives early in the process is absolutely critical to the defense of the eventual solution. Criteria can be derived from information gathered through the scoping process. Endorsement from the resource and regulatory agencies can then be sought prior to formal adoption of the evaluation framework. Some states, such as Pennsylvania, Oregon, and Washington, have processes in place to formalize agency review and endorsement of evaluation criteria, but informal review processes can be used to achieve alignment. Examples of evaluation criteria are included in Appendix D.

DEVELOP PURPOSE AND NEED

The Project Purpose and Need is a formal element of NEPA documentation. As such, it is technically not required for non-NEPA projects, but is strongly recommended because it firmly establishes the beginning framework for evaluating alternatives. The first question one must ask of any alternative is, “Does it meet the Purpose and Need?” The Purpose and Need must be derived from the problem statement, but it is limited to a discussion of transportation issues. It represents the reason the federal agency is contemplating taking action. While the USDOT may recognize the importance of achieving community livability, it is not authorized to invest in the transportation infrastructure solely for that reason.

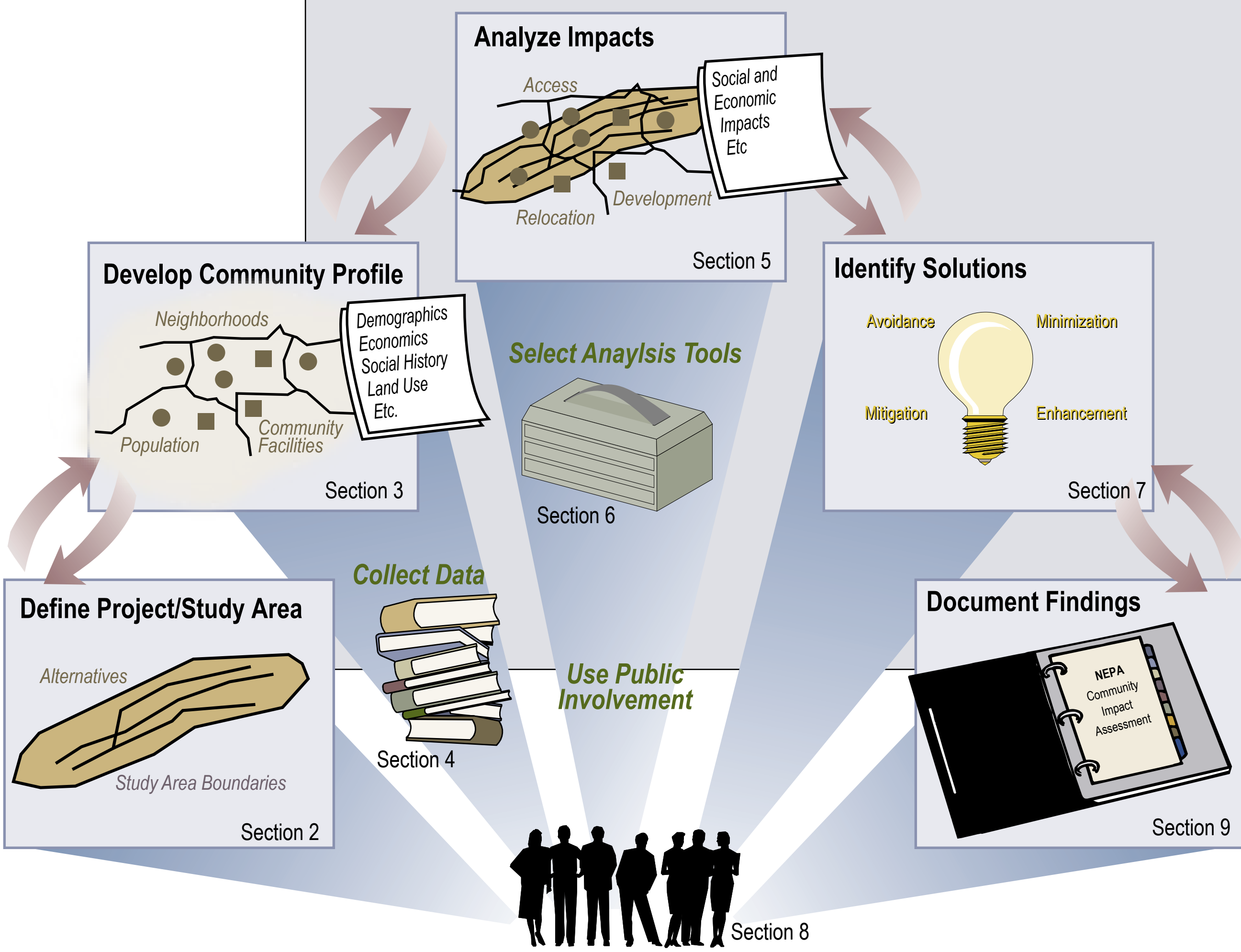
Information provided in a Purpose and Need typically includes:

- Brief project history
- Transportation system linkage
- Capacity issues

Community Impact Assessment Process

In 1966, FHWA prepared a primer on Community Impact Assessment to address the impacts of proposed transportation actions on communities, neighborhoods, and people. The document suggests that when assessing community impacts, the analyst must be aware of the basic logic behind the process. The assessment diagram shown here provides the fundamental tasks in the process. The assessment process has the following components:

- Define the project and study area – Develop various project alternatives which satisfy the project purpose and need and identify potential impacts.
- Develop a community profile – Define the affected area, including neighborhood boundaries, locations of residences and businesses, economic and demographic data, history of the community, and land use plans.
- Analyze impacts – Assess the impacts to the community of the proposed action versus no action. Investigate consequences of the action.
- Identify solutions – Identify potential solutions to address adverse impacts.
- Use public involvement – Involve the public in developing project alternatives. This step is integral to all the above steps.
- Document findings – Provide oral presentations and a written report documenting findings for distribution to interested parties and support decisions.



Community Impact Assessment Process

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- Transportation demand
- Legislative mandate
- Moral relationships
- Safety issues
- Rendering deficiencies

Preparation of the project Purpose and Need requires care because it, like the problem statement, must not imply a specific solution, but must be stated in terms of underlying causes. Yet, it cannot be so broad as to invite investigation of alternatives outside a reasonable spectrum of options. Again, asking that first question can help narrow the range of alternatives and facilitate spending resources on only examining reasonable potential solutions.

In many cases, a great deal of problem analysis may already have been completed as part of the agency's prior planning process. This prior planning work can provide data that can be used to narrow down the Purpose and Need. For example, the corridor in questions may have been evaluated and rejected as a new transit corridor, indicating it is only viable for Transportation System Management, Transportation Demand Management, auto, bicycle, and pedestrian modal solutions. Or, a regional planning study may have evaluated a number of bridge repair and replacement options, indicating that repair is not viable and that a new bridge must be built serving the existing corridor. It is important to take advantage of any previous work in developing a Purpose and Need statement.

ALTERNATIVES DEVELOPMENT

Wildlife Features Add Aesthetic Value

Wildlife plantings and nest boxes for kestrels and wood ducks enhance the aesthetics of the Lake Ontario State Parkway in Monroe and Orleans County, New York, while providing wildlife shelter and food. Habitat is managed by mowing and selective thinning. Volunteer groups maintain the annual nest boxes. Partners in New York DOT project included the Braddock Bay Raptor Research Center; the New York State Office of Parks, Recreation, and Historic Preservation; the Nature Conservancy; and the Boy Scouts of America.

ENGAGE STAKEHOLDERS IN ALTERNATIVE IDENTIFICATION

This is the most creative part of the project development process, in which sets of solutions are crafted in response to the problem statement and the evaluation criteria. Alternatives are generally developed through iterative processes, including public, agency, and project team input.

It is important that resource and regulatory agencies as well as the general public have a meaningful opportunity to contribute ideas for solutions to the defined problem, and that the range of alternatives considered reflects the full range of ideas expressed. Documenting alternatives suggested through outreach activities, even though many will be screened out in the next step of the process, adds to the credibility of the process. It should be straightforward to understand why the establishment of evaluation criteria early in the process provides an excellent framework for quickly narrowing the alternatives receiving full consideration.

IDENTIFY OPPORTUNITIES FOR REDUCING ADVERSE ENVIRONMENTAL IMPACTS

A key concept in both CSD/CSS and NEPA is the notion that consideration of approaches for reducing adverse environmental impacts is required in the course of developing alternatives. The first aim is to avoid impacts entirely. Avoidance not only is best environmentally, but is generally the least expensive option. One pilot state, the Minnesota DOT, illustrates the value of focusing agency resources on avoidance. Mn/DOT's investment in MnModel (see Appendix E) was intended to provide their staff with the means to avoid archaeological sites during highway route location studies throughout the state.

If avoidance is not possible or impractical, the second aim is to minimize adverse impacts to the extent possible. Then, and only then, is mitigation considered. In other words, providing brick facing on sound walls to improve their visual appearance is a mitigation measure—completely avoiding the need for sound walls, or greatly reducing the linear feet of needed sound walls are both preferable choices.

In recent years, the concept of environmental stewardship has increasingly gained acceptance. Environmental stewardship is the practice of not only protecting, but enhancing the environment as a routine part of project development. While quite different from the formal Transportation Enhancements Program and dedicated funding created under ISTEA and maintained under TEA-21, it takes the familiar "avoid, minimize, mitigate" approach one step further. Environmental stewardship aims to leave environmental conditions better than they were before the project and encourages consideration of activities that are modest, natural extensions of project activities. For example, adding a fish ladder to a culvert that is included in a project is an enhancement that requires a bit more investment but adds an important benefit. This approach builds credibility and trust between transportation and resource agency staff, and with the public. This broad concept of not only protecting, but enhancing the environment, is gaining acceptance and is commonly referred to as "environmental stewardship."

Many agencies, including a number of the pilot states, have formalized processes for enhancing projects. Examples of landscaping and aesthetic design guidance documents are provided in Appendix E.

The cultural attitudes of professional design staff can also play a significant role in achieving environmental sensitivity and minimizing adverse impacts. Skilled highway designers take pride in minimizing construction cost or maximizing operational effectiveness of a highway. Designers that are environmental stewards can be just as effective. For example, the Maryland Route 355 project (see Section H, Case Studies) includes a unique design solution that retained a prominent, beautiful oak tree as part of a project to widen from two to six lanes. The solution, which involved plan, profile, and special irrigation systems, was identified not by local or environmental stakeholders, but by highway design staff who were also environmental stewards.

Geographic Data Library Provides Information for Environmental Planning

The Florida Department of Transportation teamed with the Florida Department of Environmental Protection to fund the University of Florida GeoPlan Center's efforts to consolidate, house, and maintain Florida's publicly-funded GIS data in a digital "library" (FGDL). Data and images were gathered from numerous state and federal agencies, nonprofit organizations, and private agencies. The data was converted into uniform file formats and projections, subjected to quality control, documented, and organized into a series of CD-ROMs. The library provides uniform data, allowing professionals as well as less technically proficient people to use land use, roads, soils, hydrology, cultural features, habitat, aerial photography, and other data. Applications of the data are being used to plan Florida's Statewide Greenways System and for the Wetlands Rapid Assessment Procedure Application that assists in evaluating wetlands. A new application being developed is the Environmental Screening Analysis tools that will help screen projects with significant secondary and cumulative impacts early in the planning process.

ALTERNATIVES SCREENING, EVALUATION, AND SELECTION

TAILOR LEVEL OF ANALYSIS

The level of environmental analysis varies dramatically depending on the type of study and the nature of the decision being made. For example, an environmental analysis of a variety of transportation improvements in a 60-mile corridor will be conducted at a much more general level of analysis than the improvements to a specific interchange. In the first case, the analysis is generally made from existing secondary source information and policy-level issues; the second requires comparisons of specific project footprint impacts.

In all cases, it is critical to obtain agreement from participating agencies (and oftentimes from resource and regulatory agencies) about the appropriate level of detail for the environmental analysis. The CSD/CSS process is likely to increase the amount of up front data gathering needed. It requires careful thinking about the types of information needed to consider all of the issues raised by stakeholders and embodied in the evaluation framework. If the cost of data collection is too high to be acceptable, additional work with stakeholders may be needed to modify data requirements to a more reasonable level. Existing data can be used in place of original data development. Keep in mind that the early consideration of this information is always with the goal that more options exist early in the process before there is an over-commitment of resources.

Successful and efficient project development and delivery almost always requires synchronicity between the level of detail in the engineering and environmental analysis. Failure can be expected when the level of engineering greatly exceeds the level of environmental analysis or vice versa. For example, not having enough information about the affected environment while advancing a design concept can lead to the discovery of a deal-breaker late in the process and the need to go back and search for another alternative. Conversely, having adequate information about the surrounding environment, but failing to consider the feasibility of tying in an interchange to a freeway corridor can also lead to backing up and looking for another alternative. It is also critical that construction feasibility be kept in mind as attempts to avoid, minimize, or mitigate environmental issues are pursued.

ENGAGE STAKEHOLDERS IN ALTERNATIVE EVALUATION

As discussed in Section C, Effective Decision Making, and Section D, Reflecting Community Values, there are many effective ways for involving stakeholders in the alternatives screening, evaluation, and selection process. This alternatives evaluation is central to CSD/CSS and is also the heart of the NEPA process. It is the primary method of balancing impacts and benefits while satisfying the underlying purpose and need for the project.

Screening processes for eliminating alternatives with fatal flaws are generally employed. The aim is to eliminate infeasible concepts, ones that do not address the identified problems (that do not demonstrate a fit with the purpose and need), that cannot be reasonably engineered, that rely on untested technologies, and that are inconsistent with agency plans or policies. Cost alone cannot be used as the criterion for eliminating alternatives from consideration on projects following the NEPA process. There may be some circumstances, such as situations in which project funding is provided by a local ballot measure with a funding cap, where cost may be an acceptable screening criterion. Another example is when competing alternatives have similar benefits and impacts, but very different costs - eliminating the higher cost alternatives would be acceptable. Environmental impacts are also not generally used as screening criteria because there is no absolute standard for unacceptable levels of impact, or there are potential ways to mitigate the adverse effect. There always must be a trade-off analysis of the various benefits and impacts associated with the reasonable alternatives.

REFINE AND COMMIT TO MITIGATION STRATEGIES

Following selection of the preferred alternative, the CSD/CSS process encourages refinement of mitigation actions to be incorporated into the project, and formal commitment of resources to implement them. This allows for development of more accurate project cost estimates and easy tracking of commitments through the following phases of the project.

REFINING AND COMMITTING TO MITIGATION STRATEGIES

Public and agency comments on Draft EAs and EISs provide a basis for refinement of proposed mitigation strategies in NEPA processes. Final commitments are made through agency approvals of FONSIs and RODs. In projects not involving the NEPA process, or to cover agreements made between various state and local agencies that are not signatories to the FONSI or ROD, an interagency agreement or Memorandum of Understandings can be used to document agreements made by various project partners. Examples of such agreements are provided in Appendix E.

New York Route 110 Intermodal Transportation and Land Use Study

The primary goal of this study for the New York DOT was to identify options to reduce personal vehicle use in the Route 110 Corridor in the middle of Long Island. The study examined both transportation and land use practices using a three-dimensional computer-based simulation. A preliminary visualization tool—a video-based simulation of a significant intersection in the corridor—was used to inform the towns of Huntington and Babylon about the uses of visual simulation as a land use and transportation planning tool. Realistic traffic flow was correlated with the visual scene and presented in a live interactive session. This application also sets the stage for four-dimensional master planning—that is, including the element of time in simulated integrated transportation and land use planning.

IMPLEMENTATION

MONITOR CHANGES IN DESIGN AND MITIGATION

One likely result of CSD/CSS is improvement in the level of trust between transportation and resource agencies. Considering effects on environmental resources as an integral part of alternatives development, rather than an after thought following selection of the preferred alternative, will address many resource agency and public criticisms of transportation decision making processes. However, this trust can easily be broken if commitments made during the project development process are not honored during the final design and construction phases of the project. CSD/CSS calls for monitoring the project design and construction processes to identify changes that could affect implementation of agreed upon environmental impact avoidance, reduction, and mitigation measures. Continued consultation with resource and regulatory agencies throughout these processes is needed to ensure that inevitable changes do not increase impacts to unacceptable levels.

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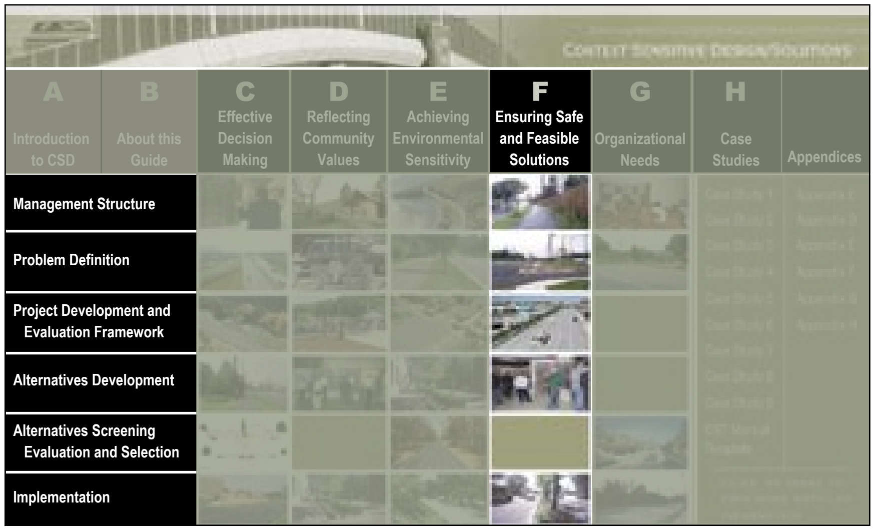
F. ENSURING SAFE AND FEASIBLE SOLUTIONS

Successful CSD produces transportation solutions that are both safe and feasible. Above all else, the public values safety and expects that transportation agencies will only implement solutions that provide an acceptable level of safety. With respect to feasibility, solutions must also meet constructibility and financial thresholds.

Ensuring safe and feasible solutions requires agencies to apply both management techniques and technical skills within a well-defined process. The section outlines lessons learned from the pilot states and other agencies who have successfully implemented safe and feasible solutions to difficult CSD projects.



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MANAGEMENT STRUCTURE

Addressing the feasibility of solutions involves the following key management issues applied on a project-specific basis:

- Establishing and/or applying appropriate design criteria, policies, and procedures for design decision making, and assuring that technical staff have the appropriate background and knowledge in their use
- Employing risk management practices to minimize the chances of a tort lawsuit resulting in a successful claim against the agency in the future as a result of a project decision or action
- Securing project funding, and applying programs and policies related to all aspects of the project, including resolution of what is expected of all parties involved in terms of the funding of the project

Staff from the pilot states confirm the importance of clearly defining and adhering to established design procedures and policies in both safety and feasibility. The benefits of addressing these management concerns include overall risk management (related to tort liability claims resulting from design decisions), and consistency and fairness in dealing with stakeholder groups.

ESTABLISHING DESIGN CRITERIA – THE AASHTO POLICY ON GEOMETRIC DESIGN

The foundation for highway design in the United States is the technical background and recommendation design values published in the AASHTO *Policy on Geometric Design for Highways and Streets* (referred to as the "Green Book"). The five pilot states, and indeed, with very few exceptions, most state DOTs refer to the AASHTO Green Book for technical guidance in their work.

The design concepts and values found in the AASHTO Green Book are based on established practice and research. AASHTO's objectives have been to assure highway safety by providing uniform and cost-effective roadway features for motorists. The AASHTO Green Book has been developed and refined over the years through the cooperative efforts of the 50 states, the Federal Highway Administration (FHWA), and numerous research entities, including the Transportation Research Board (TRB). AASHTO policies are continually refined and revised based on results of research conducted at the state and national level. Beginning with "A Policy on Highway Classification" published in 1938, AASHTO has published numerous policies covering all aspects of highway design over the 60+ years since the original policy, with the most recently issued updated policy in 2001. Research continues in anticipation of further updates to Policy as needs change and knowledge increases.

AASHTO has developed the Policy to be flexible, recognizing the importance of its applicability across a wide range of conditions. AASHTO's Bridging document to FHWA's *Flexibility in Highway Design* discusses at length the flexibility in the Policy and the intent of its use.

A related design policy is the AASHTO *Roadside Design Guide* (RDG). This document addresses design of slopes, clear zones and recovery areas, traffic barriers (guardrail, bridge rail, median barrier), roadside hardware, curbs, and median treatments.

> *"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….Sufficient flexibility is permitted to encourage independent designs tailored to particular situations."*
>
> **Foreword – AASHTO Policy on Geometric Design of Highways and Streets, 2001 edition**

STATE DESIGN MANUALS AND "STANDARDS" RELATED TO THE AASHTO POLICY

Although the AASHTO policy reflects input and a consensus of all states, it is recognized that differences in state needs exist. States are free to adopt their own design policies and guidelines, or to accept the AASHTO Policy as written. Indeed, contrary to the understanding of many, the AASHTO Policy does *not* represent a national standard for design of all roads. The adoption and publication of design standards for highways are the responsibility of each state DOT. While practice varies somewhat, for the most part state DOT design manuals and practices closely follow the guidance in the AASHTO Policy. Some states (Arkansas, for example) adopt the AASHTO policy as written for their practice. Most states develop independent design manuals, design charts, procedures, etc. Note, however, that in most cases the technical content of these manuals is very close to or identical to the AASHTO Policy, particularly for basic geometric design elements of the cross section and horizontal and vertical alignment.

The FHWA is by statute responsible for approving the design of highways on the designated National Highway System. Through rule-making, FHWA has adopted the AASHTO Policy as the applicable set of design values and criteria that apply to such facilities. Finally, it is important to recognize that roads under local jurisdiction (owned and operated by counties, municipalities, or townships) may be designed and maintained to different design criteria, depending on the individual owner. Again, practice varies across the country, but many counties and municipalities follow the design guidelines and practices published by their state DOT.

T*he Manual on Uniform Traffic Control Devices* (MUTCD), published by the FHWA, is also a key reference. The MUTCD describes requirements and recommendations for the application and design of traffic control devices, navigational and warning signing, pavement markings, and work zone traffic control devices. Adherence to the MUTCD is a requirement by law.

DESIGN PHILOSOPHY AND BACKGROUND ON DESIGN CRITERIA (AASHTO)

Geometric design is defined as the design of the visible dimensions of a highway, with the objective being the "forming" of the facility to meet the functional and operational characteristics of drivers, vehicles, pedestrians, and traffic. This is both a science as well as an art. Geometric design deals with features of location, alignment, profile, cross section, and intersections for a range of highway types and classification.

The geometric form and dimensions of the highway should properly reflect driver safety, desires, expectations, comfort, and convenience. It should do so within the context of a host of constraints and considerations, including terrain, land use features, roadside and community effects, and cost considerations.

Central to the geometric design process is the application of design criteria, guidelines, and standards. Such criteria and standards provide acceptable dimensions or values for the purpose of producing a facility of a given quality (operational and safety) in a cost-effective manner. Experience has shown that the use of generally accepted practices and concepts and uniform design values can provide a reasonable degree of safety. A uniform approach to design provides a consistent "expectation" for the user (e.g., red light at the top of a signal indication, exit to the right, appropriate operating speed, etc.). This expectation is particularly important for the inexperienced driver, the older driver, a driver unfamiliar with the road or area, the distracted or inattentive driver, or the impaired driver. A uniform design approach also addresses the safety and other needs of pedestrians and bicyclists.

Most agencies develop and use what are referred to as standard drawings, standard details, and other documents referred to as design standards. Such documents are useful in that they promote design efficiencies (i.e., in most cases it is not necessary and not cost effective to originally design a feature from scratch each time a project is designed) and as such represent good quality control practices.

Designers and the public should not confuse use of design standards with providing a "standard" design. A standard design is not always the "best" design. Site-specific issues that dictate another, more "context-sensitive" solution must often be considered. Merely applying a design that complies with standards or criteria is not always the best solution. Designers are often required to be creative and sensitive in addressing the many facets of design to fit a particular situation. As designers respond to increasing concerns over community values, social, economic, and environmental constraints, the need for flexibility in the design process becomes more significant. Flexibility is best achieved by experienced design professionals in consideration of all known factors and related trade-offs. It should not be viewed as a reduction in geometric criteria. Of course, in the pursuit of flexibility, the expected safety performance of the facility should be consistent with that expected of a "full standard" design.

ALTERNATIVE SOURCES OF DESIGN CRITERIA AND GUIDELINES

AASHTO is not the only source of geometric design criteria. Other agencies have developed alternative design criteria and dimensions to suit their special context and needs. For example, the AASHTO Policy reflects a strong consideration of travel efficiency, and meeting driver desires to minimize travel times. Thus, emphasis is placed on geometric values that enable as high a design speed as is practical for the context. For roads designed for the National Park Service, a different design philosophy applies, with attendant different design values.

FHWA's *Flexibility in Highway Design* suggests the use of special design criteria for special purpose roads such as scenic byways, parkways, etc.

The Institute of Transportation Engineers is another source of design criteria for urban roads and residential streets.

Another case is represented by the Vermont Agency of Transportation. In response to statewide dissatisfaction with the design impacts associated with AASHTO Policy values, the Vermont legislature passed legislation directing the use of alternative design values for Vermont roads. These values represent somewhat lesser dimensions than are suggested by AASHTO Policy, although the differences are in many cases nominal. (These new design standards have been in effect now for about 5 years, with no apparent degradation in safety or loss of design flexibility.)

"Park roads are for leisurely driving only. If you are in a hurry, you might do well to take another route now, and come back when you have more time."

Park Road Standards, National Park Service, 1984

The Florida DOT has developed design values for projects or corridors in urban areas identified as relating to livable community problems. Somewhat different design dimensions apply than other state highway facilities.

Finally, most transportation agencies recognize there is a difference between projects that are newly constructed or completely reconstructed, versus those involving 3R. For the latter projects, it is typical practice to employ different, generally less restrictive design criteria. One source of such criteria that is referenced by many states is *Transportation Research Board Special Report 214*.

Exhibit F-1 (following page) illustrates the range of design values suggested in the AASHTO Policy and the other sources of criteria for both Rural Principal Arterials and Rural Minor Collectors. While there are clearly similarities, also note that, depending on the agency and conditions, all basic cross section dimensions may vary.

TORT LIABILITY, DESIGN EXCEPTIONS, AND RISK MANAGEMENT

Most state DOTs and local agencies must deal with the issue of tort liability. Agencies are faced with defending their actions such as design decisions in the face of lawsuits stemming from traffic crashes on their system. Given that a certain number of crashes is inevitable, and laws permit such suits, the number of lawsuits filed and increasing sizes of awards to plaintiffs are a source of great concern among many personnel of transportation agencies. An agency's management structure and project development processes, including use of design criteria, design decision making, and documentation practices, are all important aspects of good risk management.

Exhibit F-1 *Comparison of Geometric Design Criteria*

Rural Minor Collector

	2001 AASHTO Policy (Green Book)	TRB Special Report 214 (3R Criteria)	NPS Park Road Standards (Connectors, Special Purpose)	Vermont Agency of Transportation (October 1997)
Design Speed (mph)	30-50	—	15-40	25-50
Lane Width (ft)	10-11	10-12[2]	10	9-10[5]
Shoulder Width (ft)	5[1]	2-3[3]	3	2
Minimum Clear Zone (ft)	10	No basis for nationwide standard	No set dimensions	Minimum of 10 ft based on slope and volume
Maximum Grade (%)	7-9	—	9-11[4]	7-10
Comments	[1] May be reduced as long as minimum 30 ft width is maintained	[2] Based on speed and percent trucks [3] Inferred – design values reflect combined lane and shoulder width	[4] Higher maximum associated with lower design speeds	[5] 10-ft for 50 mph; 9-ft for all lessor speeds

Rural Principal Arterial

	2001 AASHTO Policy (Green Book)	TRB Special Report 214 (3R Criteria)	NPS Park Road Standards (Principal Park Road)	Vermont Agency of Transportation (October 1997)
Design Speed (mph)	50-60	—	45-60	35-55
Lane Width (ft)	12	11-12[1]	11-12[3]	11-12[4]
Shoulder Width (ft)	8	5-6[2]	3-8[3]	6-8
Clear Zone (ft)	See Roadside Design Guide for general guidance	No basis for nationwide standards	No set dimensions	Minimum of 12 ft based on slope and volume
Maximum Grade (%)	4-5	—	5-8	5-7
Comments		[1] Greater widths where trucks > 10% [2] Inferred – design values reflect combined lane and shoulder width	[3] Dependent on traffic volume	[4] 11-ft lanes adequate for 45 mph or less

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OVERVIEW OF TORT ISSUES

Technical staff of agencies and consultants responsible for roadway design should understand basic concepts of tort law as they apply to highway planning and design. For the most part, states have similar common law of torts. If there is a legal duty that is breached (negligence), and it caused injury or damages, then the injured party can be compensated by the negligent party through the courts.

The courts do not expect public officials, including staff of the transportation agency, to be perfect, nor to make the best possible decisions. It is simply asked that the decisions made and actions taken be reasonable under the circumstances. In many cases in which a transportation agency is found negligent and the plaintiff receives a large award, it is because either someone in that agency was found to have simply failed to exercise ordinary, reasonable care, or the decision making process was so poorly documented that it could not be shown to be reasonable in court.

When negligence is claimed, there are usually six principle issues that must be resolved in court.

Did damages occur? It must first be proven that the plaintiff suffered damages.

Did a potentially dangerous defect exist? The courts do not expect transportation agencies to guarantee that their roads are absolutely safe under all possible conditions. However, drivers should be able to expect that a highway is reasonably safe for usual and ordinary traffic and road users who are exercising reasonable and prudent care, both in the daytime and at night. “Defects” may be conditions or objects that are extraordinary in nature that drivers cannot see or anticipate or have not been warned about.

Was the defect a “proximate” cause of the damages? The fact that a defective condition existed does not necessarily mean that the governmental agency was negligent. The defect must be found to be a proximate cause of the plaintiff’s damages.

Did the agency have knowledge of the defect? Negligence requires knowledge of a problem. Once a governmental agency has received notice of a defect, a duty may arise to repair the defect or at least to warn drivers until it can be repaired. Simply ignoring a safety problem, or failing to document and study it, does not shield an agency from tort claims.

Was the transportation agency acting in a “discretionary” or “ministerial” role? Discretion means the power and duty to make a choice among alternatives. Agencies exercise discretion through the independent judgment of how to allocate available resources, what impacts to accept, and which priorities to address. Planning, design, policy, and legislative actions are typically considered discretionary. In the absence of obvious defects, some courts may provide protection for discretionary decisions. In other words, a plaintiff may not be able to challenge a decision that was discretionary in nature. The concept is that judges and juries should not substitute their judgment for those of professionals in technical matters.

Ministerial functions are considered distinctly different in some jurisdictions from discretionary functions. These generally involve clearly defined tasks performed with minimal leeway for personal judgment. Roadway maintenance functions (filling potholes, replacing signs, plowing snow) are typically considered to be ministerial in nature.

Did the plaintiff contribute to the crash through negligent behavior? Contributory negligence is considered conduct which falls below the standard of care which individuals must exercise for their own safety and which contributed to the injuries. In most states, the relative negligence of all parties is compared, and any award to the plaintiff may be reduced proportional to the plaintiff’s relative contribution to the crash. The concept of “joint and several liability,” used in many, but not all states, means that all defendants have a joint responsibility to the plaintiff. If one defendant cannot afford to pay their share of the award to the plaintiff, then the other defendants must increase their payments to fully compensate the plaintiff.

As was noted above, roadway planning and design are by their nature discretionary processes, involving professionals assessing trade-offs among operational efficiency, costs, safety, environmental impacts, and community concerns. Such trade-offs are inherent to CSD. In general, many courts will support the role of the designer in making such discretionary decisions. Discretionary decisions can enjoy protection from claims of negligence *as long as the designers can show that, in fact, they exercised this discretion by carefully evaluating alternatives and weighing the important trade-offs*. (Note that in some jurisdictions courts may apply tests of reasonableness to decide whether a design action is discretionary and thus immune from challenge. Adherence to accepted practices (e.g., consistency with the AASHTO policy) may serve as proof of reasonableness.) However, immunity has been held not to apply to decisions made without prior study or conscious deliberation; in other words, when there is a failure to exercise “due care” in the planning and design process. (Note that the ability to prove that “due care” was exercised will more often than not depend on the availability of required documentation.)

In order to be successful in a claim of negligence in the design of a roadway, a plaintiff must show that there was a "defect" in the design and that the defect was a "proximate cause" of the injuries suffered. Further, to overcome "design immunity" the plaintiff may have to show that the transportation agency failed to exercise discretion in the design process by preparing the design without adequate care, by making arbitrary or unreasonable design decisions, or by creating a design that contained an inherently dangerous defect from the beginning of use.

BEST PRACTICES FOR RISK MANAGEMENT

State laws regarding tort suits vary, but certain general best practices apply across most jurisdictions. First, stakeholders should recognize that transportation agencies limit greatly the risk of a successful tort suit involving a design issue by focusing on design solutions that are proven, i.e., that are within current design guidelines and criteria. *Thus providing a nominally safe, i.e., within criteria, design is the first and major step toward minimizing tort risk.*

Occasionally, however, situations arise in which an acceptable design cannot be achieved given the site-specific situation under the design criteria that were selected for the project. The judicious use of *design exceptions* (referred to by some as design deviations) may be acceptable if in the expert opinion of the highway professional the exception will not result in or produce a *substantive safety* problem.

The term *design exception* refers to acceptance of a design value outside that within the range considered acceptable for the conditions. Examples would include a narrower shoulder (say, 4-foot versus 10-foot), narrower lane width, sharper curve for a given design speed, etc.

Exhibit F-2 summarizes the design features considered by the FHWA as requiring a design exception should their design dimension fall outside the normal design range. Individual states may generally follow FHWA practice, but it is common for states to include other design elements as part of their design policy for considering design exceptions. Appendix F also contains the design exception review form from the Federal Highway Administration's Design Standards Information.

A critical aspect of the design process, including design decision making and risk management, is the process of considering and documenting the need for design exceptions. In most cases, key senior staff within an agency such as the Chief Engineer or Roadway Design Engineer must review and approve design exceptions. Documentation of the need for an exception is critical to assure good decision making and as risk management. The design exception request includes the following:

- Description of existing highway conditions and proposed improvement project
- Thorough description of the substandard feature(s), providing specific data identifying the degree of deficiency
- Crash data for at least the latest 3-year period, indicating frequency, rate, and severity of crashes
- Costs and adverse impacts that would result from meeting current design standards
- Safety enhancements that will be made by the project to mitigate the effects of the substandard feature
- Discussion of the compatibility of the proposed improvement with adjacent roadway segments

A well-performed and documented design exception represents the best defense for an agency should a lawsuit occur as a consequence of a crash that occurred within the project at a later date. Appendix F contains examples of design exception reports from two states – two from Connecticut, and one from Iowa. The latter state employs a process in which quantitative safety analyses are part of the process. Designers are expected to estimate the substantive safety performance of the proposed design to support decision making.

Exhibit F-2 *Controlling* Geometric Design Criteria*

**Design elements considered by FHWA to be of sufficient importance to require a Design Exception Request if design criteria are not met.*

Traveled Way Width	Vertical Curvature
Shoulder Width	Vertical Clearance
Normal Cross Slope or Crown	Stopping Sight Distance
Radius of Curve	Bridge Width
Superelevation	Horizontal Clearance
Tangent Grade	Structural Clearance

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PHILOSOPHICAL APPROACH TO DESIGN EXCEPTIONS

Design creativity and design exceptions have been discussed widely within the pilot states and the highway design profession as a whole. There is a general consensus as to their role in the process of arriving at a context sensitive solution.

Design exceptions pre-date CSD/CSS, coming into prominence in the 1970s as states gradually lost their sovereign immunity. *Design* *exceptions are not viewed as essential to successful CSD/CSS.* Creativity or flexibility in design should not be equated with ignoring design criteria or an agency's accepted design practices. Staff from the pilot states confirm that the concept of flexibility in highway design does not translate to operating outside their geometric design policies. In Maryland, staff note that the number of design exceptions has not increased since Thinking Beyond the Pavement/Context Sensitive Design has become the normal course of business. This view is also confirmed by staff in Connecticut. Kentucky's most difficult and landmark CSD/CSS project, reconstruction of the Paris Pike, was completed without any design exceptions.

BEST PRACTICES FOR RISK MANAGEMENT

The minimizing of tort claims and the support of good decisions, should be a concern to all stakeholders. It is in everyone's interest to avoid situations that increase the substantive safety risk to motorists, pedestrians, or others. Tort claims paid by an agency represent taxpayer funds that cannot be used for other public purposes.

Discussions with risk managers for various DOTs, and a review of the literature on tort laws and liability provide a consistent message. Full application of the CSD/CSS design processes discussed here supports risk management, as demonstrated in the following:

***Consider Multiple Alternatives* –** Thorough consideration of multiple alternatives, including explanation for why a full standard design may not be possible or desirable, and what alternatives are, represents good risk management practices. This practice highlights the concept of design as representing discretionary choices.

***Evaluate and Document Design Decisions*—**Design reports should document the expected operational and safety performance of the proposal. Stakeholder engagement, including developing, evaluating, and discussing different alternatives requires documentation. All such documentation can and should be readily available to place in project files for later reference. Special care should be taken where a new or creative concept is proposed such as a roundabout or traffic calming feature. If a design exception is needed, documentation should be complete, including a full description of the need for the exception based on adverse effects on community values, the environment, etc.

***Maintain Control Over Design Decision Making* –** The owning agency must stay in control of decisions regarding basic design features or elements. Active stakeholder involvement and input does not translate to abrogation of the responsibility of the agency to make fundamental design decisions.

***Demonstrate a Commitment to Mitigate Safety Concerns* –** Where a design exception or unusual solution is proposed, plan completion should focus on mitigation. Decisions to maintain trees along the roadside, for example, may be accompanied by special efforts to delineate the edgeline and/or trees, implement shoulder rumble strips, or provide guardrail or other roadside barriers.

***Monitor Design Exceptions to Improve Decision Making* –** A few states make a special effort to keep a record of design exceptions by location, committing to review their safety performance over time. The intent is not to second guess a decision, but to build on and improve a knowledge base for future decisions regarding design exceptions.

Despite the best efforts of designers, crashes occur and tort claims are filed. An overriding concern of design agency staff (designers, quality managers, decision makers, and risk managers) is not necessarily the avoidance of such claims, but rather the defense of a good and appropriate decision should a claim be made. Some risk managers try to encourage their agency's staff to do the right thing, i.e., to perform their job in the best professional manner and not worry about the agency being sued. Following the best practices outlined above is all that can and should be expected of professional staff of an agency.

PROJECT FUNDING, PROGRAMS, AND POLICIES

A financially feasible project is one that can be implemented completely within the normal constraints, priority programs, and agency policies. A context sensitive approach and solution may involve incorporating special design features, enhancements, or other investments that either mitigate an adverse effect or help to achieve acceptance by key stakeholders. Such features may require not only an initial investment, but also an ongoing commitment for maintenance or other resources. The management challenge, of course, is to avoid the Christmas tree effect on every project, and also to make commitments consistently for all stakeholders.

Project staff from Minnesota and Maryland DOTs highlighted the importance of establishing policies regarding what would or could be included as part of any project. Best management practices suggest that policies be established and communicated to stakeholders at the beginning of the project so ground rules are established prior to alternatives development.

Most states have well-defined policies and programs for implementing noise barriers, wetland mitigation sites, and other environmental mitigation. Other issues, however, not specifically mandated by NEPA or other regulation, have become commonplace, particularly with projects in urban areas. The following are areas that pilot states and other DOTs have focused on in development CSD/CSS-related management policies on project funding:

- Undergrounding of utilities (what would be paid for, cost sharing)
- Pedestrian and streetscape amenities (roadside furniture, decorative lighting), including what can be included in a project and what can be paid for by the state
- Landscape maintenance (agreements for local jurisdictional care of median and roadside landscaping; note that such agreements in the case of Maryland influence what the DOT is willing to commit to implementing)
- Policies on funding and/or including artwork
- Policies on funding aesthetic bridge and retaining wall treatments (practice in Minnesota is to commit a fixed percentage of a project based on its estimated construction cost)

Even in cases where state DOT policies preclude direct reimbursement for certain items, best practices as put forth by Maryland, for example, allow for their inclusion in a project, with the DOT reimbursed separately by the local government.

These policies are seen by the pilot states as being essential to striking a balance between adhering to financial controls and limits, and properly dealing with these important issues not as extras but rather as important aspects of each project. At a minimum, they set the ground rules with communities so that an understanding exists at the project outset.

PROBLEM DEFINITION

Every transportation project is intended to address one or more problems. Successful CSD/CSS starts with a clear definition of the transportation problem(s). This includes both technical analysis and communication with stakeholders. Transportation problems can be broadly categorized as:

- Safety driven
- Mobility driven
- Infrastructure replacement or rehabilitation
- Enhancement
- Economic development

The type and nature of the problems being addressed should relate directly to a project's purpose and need (see Section E). While not all projects require a purpose and need statement, all projects are intended to address one or more problems.

Pilot state staff agree that projects that run into difficulties in completion are often those for which the problem is either not well understood, not agreed to by key stakeholders, or not articulated or explained.

HIGHWAY SAFETY PROBLEMS – UNDERSTANDING SUBSTANTIVE AND NOMINAL SAFETY

Not every project is safety driven. However, in the execution of every project, concerns about public safety are almost always evident. The characterization of a highway or alternative as being "safe" or "unsafe" is often at the center of controversy involving a proposal and even in some cases the entire project.

Best practice in engaging stakeholders and making decisions about what is acceptable focuses on two aspects of safety. Hauer refers to the concept of *nominal safety* and *substantive safety*. While this terminology is relatively new, the concepts are not and are reflected in good practices by many of the pilot states.

Nominal safety refers to a design or alternative's adherence to design criteria and/or standards. Designers and agencies responsible for the transportation network have an obligation to provide a design that meets the needs of most drivers, that allows for drivers to operate both legally and safely, and that is consistent with accepted design practices. Design criteria such as are published in the AASHTO policy, and signing and traffic control practices as indicated in the MUTCD represent or define nominal safety for a highway.

Substantive safety refers to the actual performance of a highway or facility as measured by its crash experience (number of crashes per mile per year, consequences of those crashes as specified by injuries, fatalities, or property damage). One would characterize a road or road segment as being substantively safe or unsafe based on its performance relative to expectation.

It is important to note that the two types of safety, while often related, are not the same thing. It is not uncommon to have a road that is nominally safe (i.e., all of its geometric features meet design criteria) but substantively unsafe (i.e., there is a known or demonstrated high crash problem).

Similarly, not all roads that are nominally unsafe (have one or more design features that do not meet current design criteria) are also substantively unsafe.

Both nominal and substantive safety are important to understand, communicate to stakeholders, and include in design deliberations and decision making.

> *"We've got to train our staffs to understand the safety and operational effects of highways."*
>
> **Leon Kenison, Commissioner (retired), New Hampshire DOT, and former Chairman of AASHTO Standing Committee on Safety.**

An explanation for why substantive and nominal safety differ is in part due to the nature of design criteria – their derivation, and actual values as put forth by AASHTO. Many designers believe that there is a direct and consistent relationship between design criteria and substantive safety. A thorough understanding of the assumptions and models employed by AASHTO shows this is not the case.

Exhibit F-3 summarizes the functional basis for the geometric design criteria in the AASHTO Policy. The AASHTO design values for features such as horizontal curvature, grades, and stopping sight distance are based on operational models with assumptions for driver behavior. According to AASHTO, these models apply across a wide range of project contexts (location, functional class, traffic volume). Design of features such as lane and shoulder width, and roadside elements are based in part on research on the observed substantive safety effects of the element. Design values recommended by AASHTO reflect not only safety considerations, but also traffic operational needs, maintenance considerations, constructibility, and other factors.

NOMINAL AND SUBSTANTIVE SAFETY THRESHOLDS

One can readily measure the nominal safety of a road by comparing its design features (lane width, shoulder width, sight distance, curvature, grades, roadside features) to prevailing design criteria. One module of FHWA's Interactive Highway Safety Design Model (IHSDM), a *Policy Review Module,* is intended to do just that. The vision of FHWA is that the IHSDM will become a standard best practice as a design diagnostic and decision making tool. Appendix F provides an overview of FHWA's IHSDM.

Similarly, one can measure or characterize an existing highway's substantive safety (i.e., define the nature and extent of the safety problem) by determining the frequency, type, severity, and other characteristics of crashes, as well as other information (most importantly, its traffic volume). Here, best practices call for comparing the actual performance of a road with some established benchmark or comparison figure.

The expected safety performance of any road is strongly related to its context, defined by the following:

- Traffic volume
- Location (rural, urban, suburban)
- Functional classification (controlled access, arterial, collector, local)
- Facility type (two-lane, multi-lane undivided, multi-lane divided)
- Terrain (mountainous, rolling, level)

Exhibit F-3 *Functional Basis of AASHTO Geometric Design Criteria for Highways*

Functional Basis of AASHTO Criteria

	Safety Criteria	Operational Criteria	Sensitive to Traffic Volume?	Comments/Notes
Cross Section	✔ (rural only)		Yes	Lane and shoulder width values for rural highways from NCHRP Report 362; reflect studies of crashes related to width, but also involve highway capacity and speed effects on width
Roadside Design	✔		Yes	See AASHTO Roadside Design Guide; design values for roadside, slopes, barriers and other devices based on crash studies and other research
Horizontal Alignment		✔	No	AASHTO design procedures based on providing design for driver comfort, with presumed "margin of safety" against loss of control due to skidding at high speeds
Vertical Alignment		✔	No	Values for grades based on providing for drainage (minimum grades) and operational quality / speed behavior (maximum grades)
Stopping Sight Distance		✔	No	Values for stopping sight distance based on providing for drivers to see 2-foot object and come to full stop to avoid hitting the object (operational model of nominally safe behavior)

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- Roadway segment (mid-block or typical section, intersection, including type of intersection traffic control)
- Surrounding land use (number of driveways, commercial versus residential; associated pedestrian activity)

Typical best practices are to compare the safety performance of a particular highway with a relevant statewide average or expected value for that facility type. Thus, a meaningful review of a two-lane rural highway would involve comparing it to other similar two-lane rural highways (not to all highways or other highway types). Most states compile statistics that describe the mean crash rate, characteristics of crashes (multi-vehicle, single vehicle) and their severity (percent resulting in an injury or fatality) to enable judgments about substantive safety. Exhibit F-4 illustrates the range in expected crash rates and severity one should expect for the full range of highway types.

The values in Exhibit F-4 are representative and for general reference only. National statistics for crash rates by different highway types are not available. Care should be taken in comparing statistics from different states, as there may be many differences between states in matters such as reporting levels (minimum crash severity requiring a police report to be filed with the state), data quality, and even definitions of severity, type, or other features. Also, geographic and climate differences can produce differences in overall crash rates between states. Best practices generally call for using a state-specific database or table. Appendix F contains a description of Iowa DOT's "best practice" safety data analysis tool – SAVER: E5, and a discussion of fundamental architecture of the Design Decision Support System from *NCHRP Report 430*. See also *NCHRP Report 430* for more information on crash data quality issues.

Exhibit F-4 *Representative Accident Rates by Highway Types*

Location and Road Type	Fatal Accidents No./MVM*	Injury Accidents No./MVM*	Property Damage Only Accidents No./MVM	Total Accidents No./MVM
Rural				
No Access Control	0.07	0.94	1.39	2.39
2 Lanes	0.05	0.89	1.95	2.89
4 Lanes or More, Undivided				
Partial Access Control				
Divided Espressway	0.04	0.44	0.76	1.24
Freeway	0.03	0.27	0.49	0.79
Suburban				
No Access Control				
2 Lanes	0.05	1.26	2.56	3.88
4 Lanes or More, Undivided	0.04	1.58	3.31	4.93
4 Lanes or More, Divided	0.03	1.10	2.24	3.37
Partial Access Control				
Divided Expressway	0.06	0.82	1.29	2.16
Freeway	0.02	0.32	0.74	1.07
Urban				
No Access Control				
2 Lanes	0.05	1.51	3.38	4.94
4 Lanes or More, Undivided	0.04	2.12	4.49	6.65
4 Lanes or More, Divided	0.03	1.65	3.19	4.86
Partial Access Control				
Divided Expressway	0.02	1.08	2.04	3.14
Freeway	0.01	0.40	1.01	1.43

*MVM – million vehicle miles

Source: AASHTO. Manual on User Benefit Analysis of Highway and Bus Transit Improvements, 1977.

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Exhibit F-5 *Applying Concepts of Safety to Problem Definition and Solutions*

Substantive Safety Criteria	Nominal Safety Criteria: Meets	Nominal Safety Criteria: Does Not Meet
Meets	• Infrastructure improvements only (no need or justification for geometric revisions) based on safety	• 3R criteria may be considered • Incorporate only low cost safety enhancements • "Upgrade" to full standards may not be cost effective (consider design exceptions to avoid costs and impacts)
Does Not Meet	• Targeted safety improvements (low or high cost depending on extent of problem) • Focus on cost-effective solutions to safety problems	• Complete reconstruction to current criteria probably warranted (no or very minimal design exceptions) • Consider special targeted safety enhancements

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Another method for determining the substantive safety of a highway is to compare its performance with accepted crash prediction models. FHWA's Interactive Highway Safety Design Model established models for predicting crashes for two-lane rural highway segments and intersections. Other models published in the technical literature provide insights as to expected performance. They also provide means of testing or describing the expected effects of a different design alternative, and of quantifying safety impacts of a design decision.

Exhibit F-5 illustrates how knowledge of nominal and substantive safety can influence the overall approach to problem definition and solution. Every highway segment or project can be categorized as being nominally safe or unsafe; and as substantively safe or unsafe. A two-by-two framework thus captures all possibilities. Highway or road projects that may be nominally unsafe but substantively safe may be candidates as 3R projects (assuming a significant mobility issue is not present), which implies less stringent design criteria. Or, for such projects the designer may be more willing to accept a design exception if the context warrants this. Projects that involve a road that is known to be substantively unsafe but nominally safe require special targeted effort to deal with the safety problem. For highways or roads that are both nominally and substantively unsafe, reconstruction to full standards and a reluctance to accept a design exception may be appropriate.

Finally, a project involving a proposed new road has by definition no existing substantive safety performance. For such projects a focus on nominal safety – adherence to design criteria is the best approach. Designers should be reluctant to plan and design a road on newly acquired right-of-way with significant geometric design exceptions.

MOBILITY-DRIVEN PROJECTS

In many instances projects involve provision for enhanced mobility. The following are typical mobility-driven projects:

- Two-lane to multi-lane projects
- Intersection improvements
- Construction of new interchange
- New facility (community bypass, for example)
- High Occupancy Vehicle (HOV) facilities
- Pedestrian or bicycle facilities
- Rail or bus transit facilities or improvements

Mobility can be a local issue, but it is often a regional issue. Projects of a regional nature (improvements to arterial corridors, freeway widening) can have substantial adverse impacts to the communities through which the facility passes, but offer few perceived benefits to those affected the most.

For regional mobility projects it is important to identify the stakeholders or beneficiaries of the mobility improvements and engage them throughout the project. In the absence of such stakeholders, advocacy for mobility often falls on the DOT or transportation agency staff. This situation is common across the U.S. Where DOT staff serve as surrogate stakeholders who advocate for mobility or particular solutions to mobility problems, they run the risk of being seen as biased and not impartial facilitators of a context sensitive solution.

ECONOMIC DEVELOPMENT RELATED PROJECTS

Some projects may be intended to facilitate the development or re-development of land, downtown areas, or other transportation facilities. These projects may be directly legislated, or be indirectly linked to development through an area or regional master plan. As with mobility-driven projects, clearly articulating the problem or purpose of the project, and directly involving beneficiaries in project activities is essential to remove agency staff from an advocacy position.

INFRASTRUCTURE PROJECTS

Some projects primarily involve the reconstruction or replacement of aging pavement, bridges, or other infrastructure. While this may be the sole problem, it often occurs in combination with other problems. Thus, a roadway in need of repair may also be one that has insufficient capacity for expected future demand, or may be one that experiences a substantive safety problem.

Where infrastructure is the sole project driver, treating the project as a 3R rather than 4R project may facilitate development of a cost-effective and lower impact solution. Some projects develop unnecessary conflicts among stakeholders when the solution involves upgrading the road to current design criteria. Examples include replacement of older, narrow bridges on local, lower volume county roads. Context sensitive solutions, such as those implemented by Federal Lands staff, examine the substantive safety performance of the bridge, and, if appropriate, construct a new bridge with lesser width dimensions than the current standard, but consistent with the performance and context. It is interesting to note that this approach to infrastructure problems offers tangible cost saving benefits to agencies. Upgrading to full design criteria will almost always be more costly than an alternative 3R solution.

PROJECT DEVELOPMENT AND EVALUATION FRAMEWORK

Context sensitive design; indeed, any highway design, is truly the result of a series of choices designers make, consulting with stakeholders, based on the many factors and inputs. With reference to the agreed upon problems, and to the knowledge base in AASHTO and the agency's design procedures, the task of a CSD/CSS team is to make choices in the development of project-specific design criteria. Best practices suggest that the project development framework be established and discussed with stakeholders early in the project, prior to beginning work on the alternatives.

A key concept expressed by staff from all pilot states is to recognize the functional classification of the road or highway. As shown in Exhibit F-6, different classes of facility serve distinctly different purposes on the highway network. Problems and the approach to solutions must reflect the functional classification. Regional mobility enhancement solutions are appropriate for freeways and principal arterials. Speed consistency and quality of service are paramount for such roads. The function of local roads, on the other hand, is entirely different. These serve as land access, not for through traffic mobility. Speed is less important.

The significant choices that designers make in developing solutions include *design speed, design traffic conditions, and design vehicles.*

SELECTING A DESIGN SPEED

Highway designers select a design speed, which is used to help establish the three-dimensional design features. The 2001 AASHTO Policy highlights the concept of choice through a new definition of design speed:

Selection of an appropriate speed is left to the judgment of the designer, with general guidance provided by AASHTO as noted in Exhibit F-7 (following page). Best practices call for designers to select a design speed that is high enough so that most drivers will travel at or lower than the design speed, but low enough so that the physical effects of the design (alignment, roadside, etc.) will be manageable and acceptable.

> *"Design speed is a selected speed used to determine the various geometric design features of the roadway. The assumed design speed should be a logical one with respect to the topography, the adjacent land use, and the functional classification of highway."*
>
> AASHTO Policy on Geometric Design (2001)

Design speed is the single most important choice designers make. The choice of a design speed should be made carefully, with full recognition of the context of the project. A good illustration of the effect of selecting a reasonable design speed is provided by a project performed by the Connecticut DOT in the town of Brooklyn (see Section H for Case Study). Selection of the initial design speed produced significantly greater requirements for longer vertical curves, and

Exhibit F-6 *A Highway's Functional Classification Defines the Types of Trips it Serves*

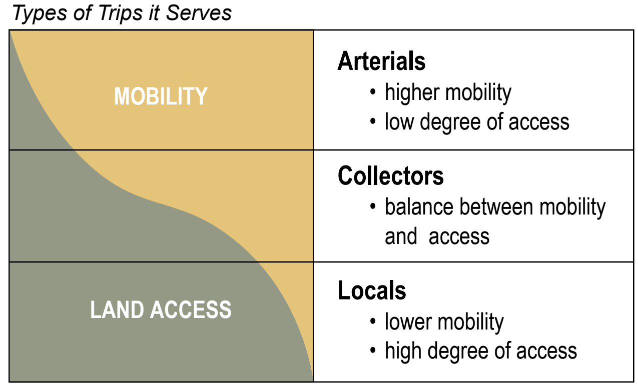

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Exhibit F-7 *Ranges of Design Speed Recommended by AASHTO*

	Terrain	Rural US (mph)	Rural Metric (km/h)	Urban US (MPH)	Urban Metric (km/h)
Freeway	Level	70	110	60 - 70	100-110
	Rolling	70	110	60 - 70	100-110
	Mountainous	50-60	80-110	50 min.	80 min.
Arterial	Level	60-75	100-120	30-60	50-100
	Rolling	50-60	80-100	30-60	50-100
	Mountainous	40-50	60-80	30-60	50-100
Collector	Level	40-60	60-100	30+	50+
	Rolling	30-50	50-80	30+	50+
	Mountainous	20-40	30-60	30+	50+
Local	Level	30-50	50-80	20-30	30-50
	Rolling	20-40	30-60	20-30	30-50
	Mountainous	20-30	30-50	20-30	30-50

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hence greater earthwork and right-of-way impacts. The resulting design was viewed as being overly impacting on the surrounding terrain. Moreover, the existing safety performance of the roadway did not indicate a problem related to the vertical alignment or sight distance. As a result, CTDOT revised the design, selecting a lower design speed, which produced an alignment considered to be substantively safe, with fewer impacts and lesser cost.

Traditional design practices and training of highway designers results in design speed being equated with design quality. In other words, many designers view a 60 mph highway as qualitatively better than a 50 mph highway. This view tends to be more valid in the rural environment, but even so, the substantive safety differences between the two are generally overestimated. It is certainly true that designs that support a higher speed have a greater margin of safety for faster drivers than other designs. Acceptance of a slightly lower design speed (say, from 60 mph to 55 mph) may, in some cases, result in an acceptable plan with no loss of substantive safety. An example of this is given by one of the case studies from Minnesota. Design for a slightly lower design speed than was originally envisioned enabled a suitable realignment of a highway and incorporation of enhancement features, without a serious degradation in the safety of operational efficiency of a highway and incorporation of enhancement features, without a serious degradation in the safety of operational efficiency of the highway (see Section H).

Interestingly, all pilot state staff noted that speed consistency along a highway is as or more critical to good operations than the design speed. FHWA's IHSDM offers a new tool, a *design consistency module,* that allows the evaluation of expected speed behavior along a two-lane rural highway.

A challenge to context sensitive designers in the urban environment is to produce a high quality design where low speeds are considered to be safer. Conflicts with pedestrians, or immovable roadside objects (such as may exist in areas of limited right-of-way) call for lower speeds to achieve substantive safety. Indeed, European Context Sensitive Design practice as uncovered by an FHWA/AASHTO International Scanning Tour focuses on specific design actions intended to produce and maintain lower speeds through towns or developing areas. Referred to as traffic calming, treatments such as speed humps, diverters, chicanes, road narrowing, and other treatments represent best practices for low speed urban conditions where pedestrian safety and mobility is a primary concern (see Exhibit F-8).

Exhibit F-8 *Example of Traffic Calming Treatment (Intersection "Bump-out")*

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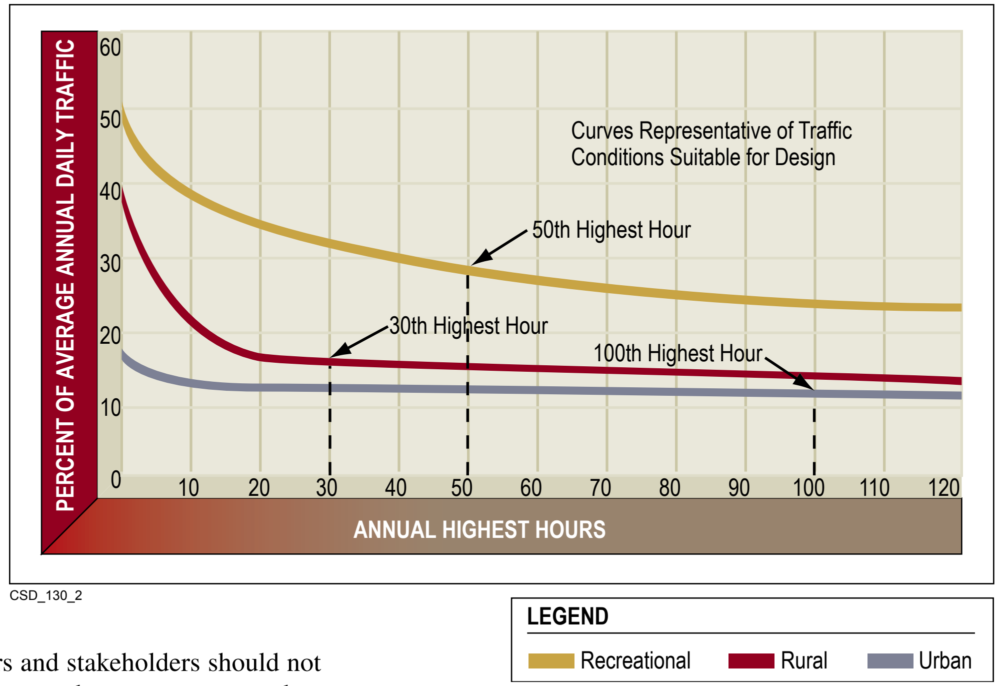
DESIGN TRAFFIC AND LEVEL OF SERVICE

Designers also have a choice for the level of traffic for which they and stakeholders wish to design; and the quality of traffic service to be provided. Design traffic is usually expressed as an hourly volume (referred to as design hour volume or DHV), generally derived from a long range travel forecast for the project.

Exhibit F-9 *Guidelines for Selecting Design Hour Volume*



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The DHV or design year traffic is not often thought of as a choice; indeed, in many cases the traffic forecast or projection is provided to the project team by an outside stakeholder or agency such as an MPO. However, designers and stakeholders should not lose sight of the fact that they can choose to accommodate either many or fewer hours of the year in which the DHV will occur as shown in Exhibit F-9.

A related design choice is the design level of service (LOS). LOS is a qualitative term describing the density of traffic, and relating travel speeds, delays, and other measures to performance. LOS is defined differently for the range of highway types and operating conditions, including freeways (mainline, ramps, and weaving sections), two-lane highways, intersections, arterial highways, transit facilities, and pedestrian facilities. LOS ranges from A to F, with LOS E generally representing operation at the practical capacity of the highway (or highway segment). The Highway Capacity Manual represents best practices in terms of procedures for defining, calculating, and designing for LOS. AASHTO recommended LOS targets are shown in Exhibit F-10.

An early application of the principle of choice in designing for traffic is the reconstruction of the North Central Expressway (U.S. 75) undertaken by the City of Dallas and Texas DOT. Initial planning studies conducted in the mid 1980s concluded that the available right-of-way and overall corridor context would not allow for accommodating the theoretical demand forecast by the MPO. A level of traffic, and implied level of service E was established as the design basis following extensive discussions with stakeholders. This decision greatly shaped the design solution.

Exhibit F-10 *Design Levels of Service Recommended by AASHTO*

	Terrain	Rural	Urban/ Suburban
Freeway	Level	B	C
	Rolling	B	C
	Mountainous	C	C
Arterial	Level	B	C
	Rolling	B	C
	Mountainous	C	C
Collector	Level	C	D
	Rolling	C	D
	Mountainous	D	D
Local	Level	D	D
	Rolling	D	D
	Mountainous	D	D

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Designers have choices regarding the LOS to which a given design should be targeted. The choice should reflect the problem being addressed and the context. AASHTO provides some guidance in this area (see Exhibit F-10), but note that the AASHTO values are considered just guidance, and not mandates, requirements, or a design issue requiring a design exception. Indeed, the AASHTO policy contains considerable discussion on the issue of designing for congestion (which would be LOS E), in recognition that in some cases LOS E is all that is practically feasible. Most states also have specific guidance in their policies and manuals regarding design LOS. As the design LOS applies to the design year traffic, it will generally be as high as is considered practical.

The choice of an appropriate LOS should be based on the project purpose, and on judgements regarding future traffic increases, and the consequences of under-designing. Note that the FHWA does not consider LOS as a design issue requiring a design exception if published guidance is not met.

DESIGN VEHICLE(S)

The design vehicle is also a choice to be made by the designer. In most instances, the design vehicle dimensions and operational characteristics of interest are its physical dimensions and turning characteristics. These influence the intersection geometry (corner radii, channelizing roadways, and islands). Larger and longer vehicles such as semi-trailers produce greater turning paths and require more space.

Selection of an appropriate design vehicle is highly context sensitive. Where the surrounding land use or that served by the road is industrial in nature, it is generally prudent to select a larger vehicle as the design vehicle. For residential streets or neighborhoods, delivery trucks or school buses may be more appropriate.

In the urban context, selection of a design vehicle should consider the needs of pedestrians and activities outside the traveled way. Longer vehicles requiring greater turning radii produce longer intersections, which increase crossing distances for pedestrians and may promote higher turning speeds.

ALTERNATIVES DEVELOPMENT

Every alternative solution should clearly meet the project purpose or address the problem being solved. Safety-driven projects should have components or alternatives that directly address the specific crash types being experienced. Mobility-driven projects should involve solutions that address vehicular movement or pedestrians. These may include addition of lanes, intersection improvements, new facilities, or traffic control improvements; or demand management approaches.

DEVELOP MULTIPLE ALTERNATIVES; START WITH A BLANK SHEET OF PAPER

Staff from the pilot states all echo the view that successful projects incorporate a principle that multiple alternatives should always be considered. Creativity, within the context of good engineering practice and with a focus on solving the identified problem, is central to CSD/CSS. Indeed, the most effective strategy is to initially engage stakeholders prior to developing any concepts or alternatives – to start with a blank sheet of paper.

Stakeholders desire active involvement in the development process. For effective involvement by non-technical stakeholders, it is useful to engage them in a dialogue or educational process about the design or other options, physical requirements and traffic operational characteristics, and wherever possible, show relevant examples of a similar design solution applied elsewhere. Successful techniques include workshops explaining simple concepts of highway design, traffic engineering, access management, etc., related to the project. Creative graphics can illustrate important concepts such as how underground utilities may influence the feasibility of a plan. A challenge to technical staff is to translate an idea or concept proposed by the public or a stakeholder into a technically feasible alternative. The process of doing so can also serve an educational function (for example, explaining the nature of horizontal curve design, sight distance, and effects on right-of-way). One project example from the Colorado DOT involved the development and dissemination of “Fact Sheets” which were designed to illustrate and explain basic engineering concepts to non-technical groups. See Appendix F for these examples.

Stakeholder involvement is essential to uncover aspects of a project about which the design staff may not be sensitive. For example, projects involving corridors in agricultural areas generally must address issues of farm field access, drainage tiles, use of the road by farming equipment, and leasing of parcels (in other words, knowing the ownership of a parcel may not be enough, as the property may be farmed by someone else). Very few highway designers understand all of these issues and needs without working directly with farmers and learning how they do their jobs. In urban commercial areas, stakeholders are interested in on-street parking, in disruptions to their businesses during the construction period, and in access to their properties by both vehicles and pedestrians. Regarding the latter, many highway engineers require help from pedestrians and pedestrian advocacy groups to understand the needs and issues of pedestrian mobility and safety.

"We've come to the realization that the Highway Department doesn't have all the answers."

CHARLES ADAMS,
MARYLAND STATE HIGHWAY ADMINISTRATION

Alternatives development involving stakeholders is often iterative. Successful CSD/CSS staff do not become wedded to a given plan, but are instead flexible, willing to work with individual stakeholders to address a local problem. The success of committing to multiple alternatives and involving stakeholders was highlighted by staff from Kentucky Transportation Cabinet (KYTC). They admitted that being forced to go back and consider a different alignment alternative resulted in a better solution than one originally put forth by KYTC.

DESIGN CHOICES AND THEIR CONSEQUENCES

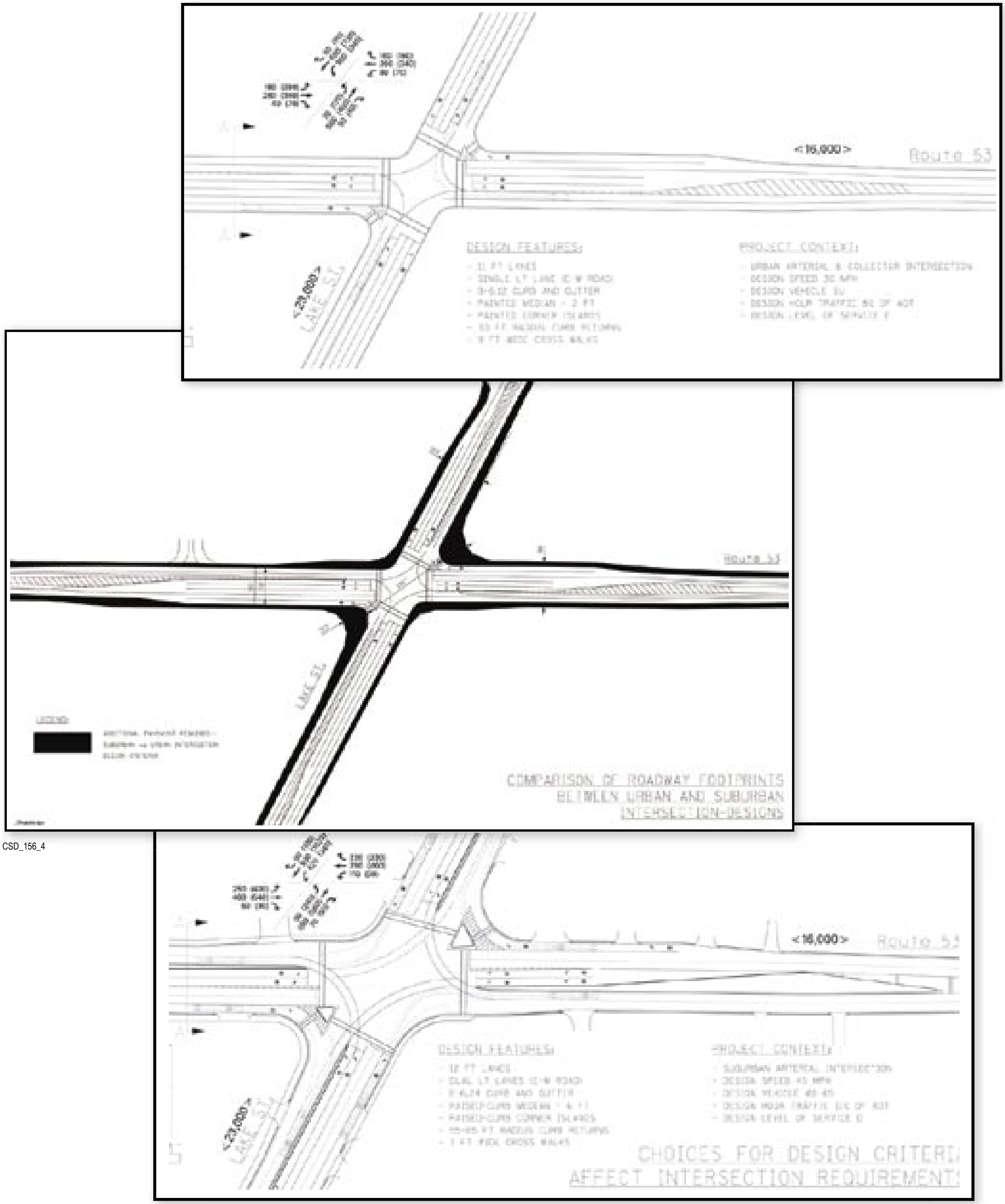
Agency staff will often reference their policies in making choices about LOS, design criteria, etc. While such policies are developed for reasons, and should be respected, stakeholders may challenge the policies or expect their rationale be explained in the context of the particular project. Saying "we need to use a 70 mph design speed because that is what our policy says" begs the question of what the right choice should be for the specific project application, or at least what the functional reason for the policy is.

The choices that designers and stakeholders have should be made with full consideration of the project's context and the problem being addressed. Thus, if a project involves increasing capacity for through traffic, careful consideration of the design traffic and LOS is appropriate. If the project is primarily a rural highway safety-driven project, then selecting a high enough design speed would be paramount, and providing a high quality roadside of great concern.

Designers should not make inappropriate choices just to avoid conflicts or right-of-way acquisition. Designers and stakeholders should recognize that there are relationships between design choices and operational consequences. For example, there is both research and anecdotal evidence of an adverse relationship between substantive safety and congestion; thus, choosing to design for, say, LOS E may in some cases be expected to be accompanied by a less substantively safe facility.

The cumulative effect of the many choices designers make (in consultation with stakeholders) can significantly influence the resulting solution, and its feasibility and/or acceptability. Exhibit F-11 (following page) illustrates two different design solutions for the same basic set of circumstances as defined by average daily traffic and intersection geometry. Depending on the designer choices for design speed, design vehicle, design traffic, and design LOS, completely different design solutions and their related footprints may result. *Note that each solution may be optimal in its proper context*. In one case, design for a suburban intersection of two primary arterial highways may call for somewhat greater speeds, higher LOS, and larger design vehicles. Design features may include double left-turn lanes, 12-foot lane widths for operations, and raised medians for access control. Of course, the right-of-way footprint and overall design would be greater. In the second instance (a central city), the context may call for lower speeds; pedestrians may be relatively more important (and hence minimizing crossing distances and promoting lower speeds more important). There may not be available right-of-way, and the overall location more constrained. Here, use of narrower lane widths, single left-turn lanes, painted medians, and smaller radius turns accommodating a bus or single unit truck may be more appropriate.

Exhibit F-11 *Examples of Intersection Design Representing a Range of Choices in Design Criteria*



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FLEXIBILITY AND CREATIVITY

Translating concepts of flexible design and design creativity into actual solutions is often difficult. In simple terms, the notion of creativity and flexibility often reduces to thinking differently about how to attack the problem. For example, a typical approach to a mobility project may call for a two-lane road to be converted to four lanes. Traditional design execution may result in the road being widened about the existing centerline. A designer striving to be context sensitive, however, will see the following as potential options throughout the project, or at any one location:

- Widen asymmetrically (for example, maintain one right-of-way line and widen all to one side)
- Develop new, independent centerline
- Adjust profile (vertical alignment) to minimize driveway and right-of-way effects
- Adjust and vary width *and* alignment throughout the project
- Consider alternatives to traditional widening (For example, the Iowa DOT is converting many four-lane undivided arterials to two-lane with center turning lanes. This solution addresses both safety and mobility concerns and avoids need for widening.)

Conversion of Four-Lane Undivided Urban Roadways to Three-Lane Facilities

There are creative ways to enhance safety and improve traffic operations without widening a road. Conversion of four-lane undivided urban roads to three-lane designs (referred to by some as a “road diet”) is in extensive use in many locations, and in particular, in Iowa. In a study conducted by Thomas Welch, PE, Iowa DOT, it was found that safety was improved significantly by converting often congested existing four-lane highways to a three-lane highway (one lane each direction of traffic with a median two-way left-turn lane). At first glance, it is difficult for most, including numerous transportation engineers and planners, to accept that, in urban corridors with less than 20,000 vpd, reducing the number of traffic lanes improves traffic safety and maintains an acceptable level of service. The study showed that substantial reduction in accident rates is primarily the result of the reduction in conflict points and improved sight distance for turning and crossing traffic along the corridor. Additionally, fewer decisions and judgments have to be made to enter or cross a three-lane highway resulting in a more “user-friendly” roadway. Based on experience in a number of locations, the study showed using this conversion, it would be reasonable to expect a 20 to 40 percent reduction in crashes. Another attribute of the three-lane facility is the traffic calming affect it has on the traffic flow. Aggressive motorists cannot travel along three-lane corridors at excessive speeds making multiple lane changes. The variability of travel speeds along the three-lane corridor is also reduced which helps reduce possible collisions. This creative “tool” in the traffic engineers safety tool box can be implemented quickly, at a very low cost, and with less right-of-way, environmental impacts, and controversy associated with other improvement alternatives.

Section H shows case studies, many of which demonstrate creative thinking in problem solutions.

ALTERNATIVES SCREENING, EVALUATION, AND SELECTION

Stakeholders can and should be directly involved in the development and refinement of alternatives. Such involvement may be at the broad project level, but also on a site-specific level. Depending on the scope, complexity, and nature of the project, designers should be prepared to generate multiple plans, and to evaluate them equally.

TOOLS AND TECHNIQUES FOR EVALUATING THE SAFETY AND FEASIBILITY OF ALTERNATIVES

Many stakeholders have difficulty reading, interpreting, and understanding traditional design plans. Few stakeholders can grasp concepts of queuing, traffic bottlenecks, and their effects on design features and vice versa.

Best practices in the pilot states and elsewhere take full advantages of advances in computer design technologies. In particular, the use of computer-generated visualizations has become institutionalized in many design agencies as a core tool for explaining and characterizing the visual effects of a design.

VISUALIZATION

Visualization techniques are powerful tools to assist in the decision regarding design choices. For example, the Minnesota DOT utilized visualization in one study of alternative cross section design values for a highway through a sensitive park area. As shown in Exhibits F-12 (following page), the different values for lane and shoulder width, and for type of roadside design (curb and gutter versus open section) produced different visual impacts and effects on number of trees to be removed. The Connecticut DOT employed visualization to demonstrate the visual impacts and enhancement opportunities associated with alignment alternatives for a road through a town. Finally, visualization is even being used in complex interchange projects to demonstrate construction phasing schemes. The Wisconsin DOT, in a project involving reconstruction of a $500 million interchange in Milwaukee, is employing visualization for such purposes.

Visualization techniques can also be used to show the effects of different arterial cross section designs, or to demonstrate a streetscape or roadside treatment proposal. For a project in Denver, Colorado, a hotel owner was concerned about the potential blocking of a view of the Rocky Mountains from guest windows by a proposed ramp overpass. Visualization enabled the Colorado DOT to demonstrate that the design would not create a visual barrier from the windows in question. Exhibit F-13 (following page) shows four design alternatives for an arterial project in Washington state.

There are different types of visualizations, from renderings over photographs to three-dimensional images generated from design files and digital terrain models. The latter require more preparatory work (the proposed functional design must be completed first in both plan and profile), but are visually true to scale. Also, it is possible to readily generate countless images from different angles and eye locations. The former are relatively simple and easy to generate, but care must be taken to represent the true visual character. A rendering would apply to one view from one location. Exhibit F-14 (following page) shows an example rendering from a freeway project in Missouri.

Visualization has become a standard practice for many DOTs. Indeed, public and stakeholder groups once shown visualizations expect them on every project after the first one. Pilot states have recognized the need to have capable staff and the appropriate computer software to incorporate visualizations on their projects.

Exhibits F-12 *Visualization to Review Alternative Solutions for Rural Highway Design Project in Minnesota*

SOURCE: Minnesota Department of Transportation

TRAFFIC OPERATIONAL SIMULATION

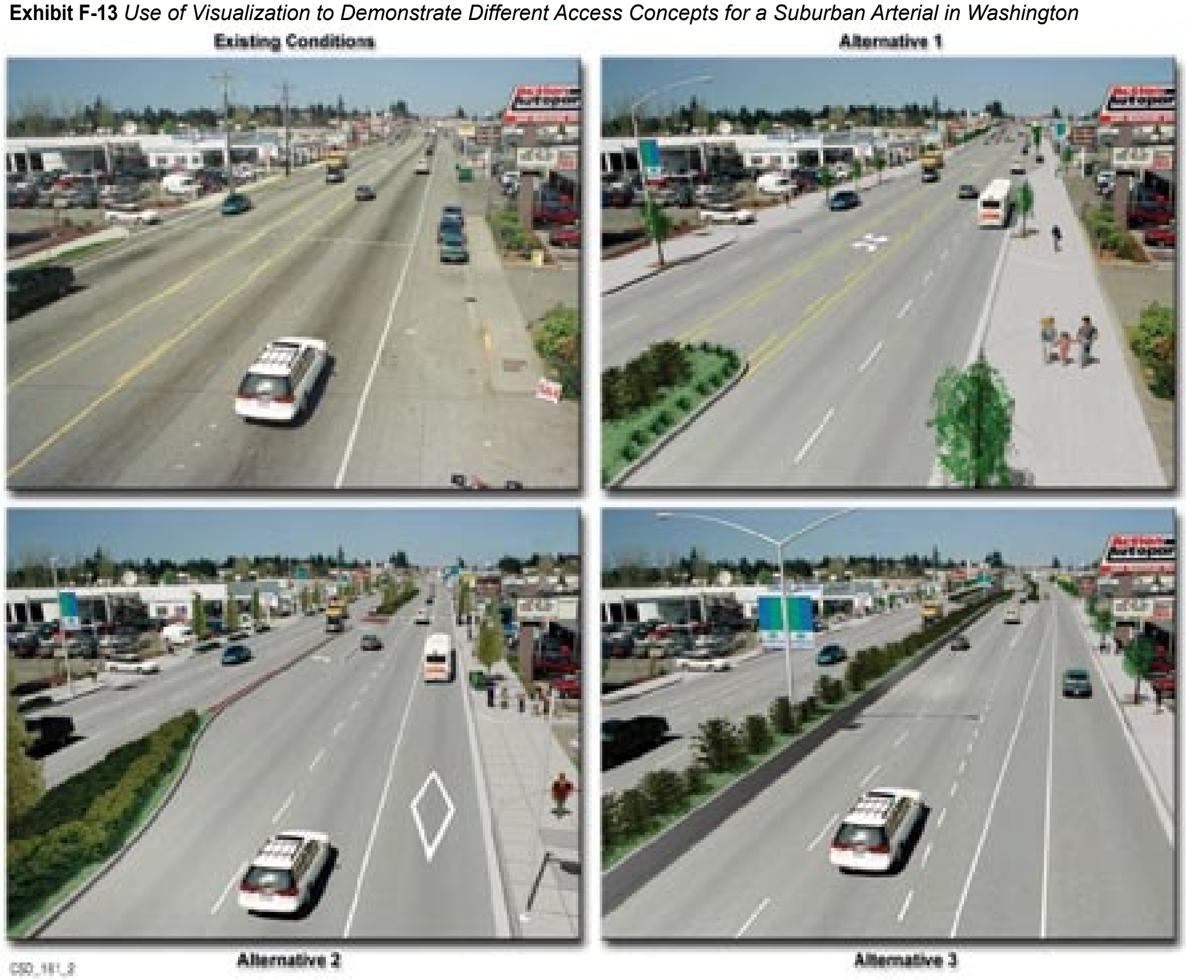
In many cases, traffic operational issues are a concern either to technical stakeholders or the general public. Traffic operational concepts are difficult even for technical professionals to grasp. The effects, for example, of increased traffic on queuing, delay, and operations are not linear, and are often not well understood. Simulations showing the effects, for example, of no action but increases in traffic can be powerful tools for demonstrating the expected need for a mobility solution.

Simulation of vehicles or vehicle streams through complex locations such as closely spaced intersections, or through roundabouts, is a useful tool to demonstrate operations. With respect to new solutions such as roundabouts, some agencies have found it useful to demonstrate their operation where a roundabout is proposed for the first time in an area. The Iowa DOT used a VISSIM simulation of roundabout operations to explain to the public how they worked, and found it to be valuable for a project in Ottumwa, Iowa. The Ottumwa VISSIM, along with examples of additional simulations, are included in Appendix F.

Exhibit F-14 *Photo Rendering of Rural Freeway Project in Missouri*

SOURCE: Missouri Department of Transportation

Exhibit F-13 *Use of Visualization to Demonstrate Different Access Concepts for a Suburban Arterial in Washington*



Best practices include FHWA's CORSIM model (which provides detailed quantitative output and animation of traffic operations through an integrated network comprised of arterial streets and freeways). Other software tools include VISSIM, Paramics, and Synchro. The greatest value can be obtained from simulations where calibration (i.e., replication of operations as they occur and are observable by stakeholders) is possible. Simulation then can be particularly effective in showing, for example, the queuing and resulting other problems that might occur if no action were taken and traffic increased.

QUANTITATIVE SAFETY MODELS AND APPLIED RESEARCH

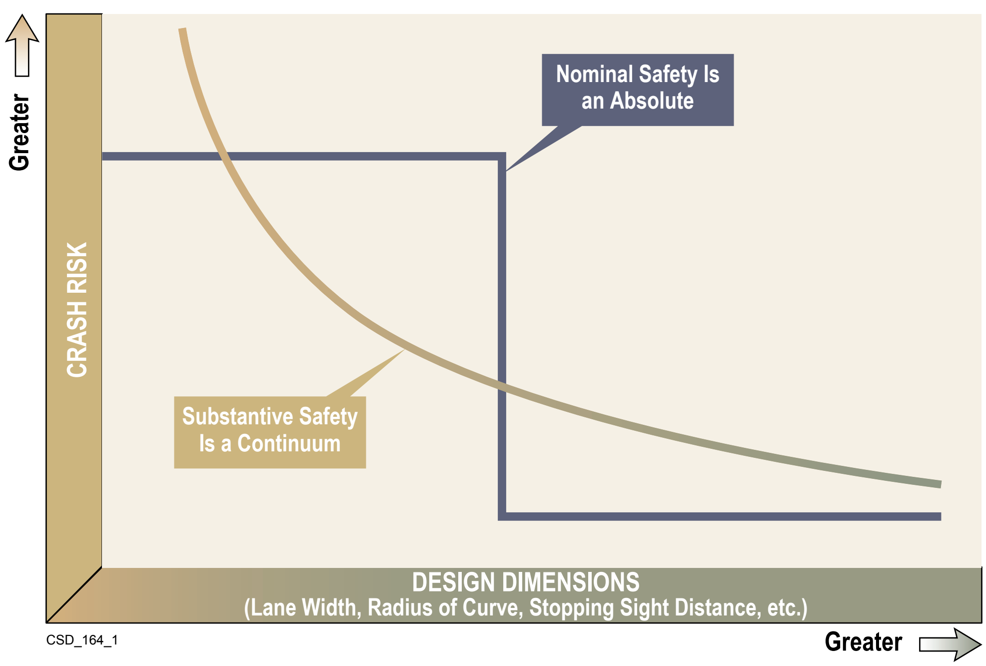
Knowledge of the safety effects of design aids designers and stakeholders in making reasoned decisions and tradeoffs involving safety. One helpful insight by Fambro notes that substantive safety is a continuum, not an absolute. Incremental differences in a design dimension (radius of curve, width of road, offset to roadside object) can be expected to produce an incremental, not absolute change in crash frequency or severity. This differs from the thought process suggesting that a nominally unsafe design will automatically result in a substantive safety problem. Exhibit F-15 illustrates this concept.

Much research has been performed over the past 30 years to uncover substantive safety design relationships. Recent advances in statistical procedures, coupled with improved data collection techniques, have resulted in greatly improved capabilities for modeling the safety effects of design dimensions. The profession now knows more about the substantive effects of design decisions than was known 30 years ago. Appendix F provides a list of key reserved references for determining the substantive safety of geometric highway design alternatives.

Many of the best models are relatively new. Few agencies have well-established procedures for exercising these models. There are examples, however, of recent projects in which the use of crash prediction to differentiate alternatives was successful in helping to arrive at a decision. One notable example, environmental and design studies for reconstruction of U.S. 93 in Montana for the Montana DOT, employed substantive safety analysis to help explain the benefits of converting from a two-lane to four-lane facility in an environmentally sensitive corridor. Kane County in Illinois has used safety models to assist in countywide assessment of safety needs and problems by comparing actual performance of over 300 intersections and highway segments with modeled or predicted performance. Appendix F contains excerpts from the SEMCOG *Traffic Safety Manuel*, Second Edition, September 1997.

The ability to predict or estimate the expected safety performance of an alternative are becoming essential to CSD/CSS projects. Stakeholders no longer accept the characterization of a plan as being "nominally safe" as sufficient to warrant accepting a set of well-defined adverse impacts to cultural resources, wetlands, etc. FHWA's IHSDM and other research efforts now represent best practices to explain the substantive safety effects of lane and shoulder widening, roadside improvements, alignment revisions, and intersection improvements.

Exhibit F-15 *Comparison of Nominal and Substantive Concepts of Safety*



Use of Safety Prediction Models by Montana DOT

The Montana Department of Transportation has used quantitative safety prediction models to evaluate alignment and cross section alternatives studied for corridor improvement projects. A study of a 16-mile segment of Montana Primary State Route 78 from Absorokee to Columbus in Stillwater County included published models from FHWA-sponsored research to investigate trade-offs between safety and environmental impacts.

The project purpose and need statement noted that the crash rate for the route was four times greater than the state average for similar highway types. High crash experience was attributed to outdated geometry (i.e., the route was "nominally unsafe"). Substantive safety effects of 32-foot versus 36-foot and 40-foot cross sections were compared with right-of-way, construction cost, farmland, wetland, and other environmental effects. Models derived from FHWA research by Zegeer, et. al. (Safety Cost-Effectiveness of Incremental Changes in Cross-Section Design, Informational Guide, 1987) on the expected safety effects of various lane and shoulder widths were applied to the route-specific crash and traffic data to compare quantitative measures of cost, acres, and number of relocations.

The draft environmental impact statement (DEIS) noted that reconstruction of the entire alignment was required to meet safety purposes and needs. A 32-foot cross section (including two 12-foot lanes and 4-foot shoulders) would produce a 33 percent reduction in crashes. The DEIS also noted that other alternatives, such as a 36-foot or 40-foot width would produce some additional crash reduction and other transportation benefits over the 32-foot width, *but the additional benefits were not judged to be worth the cumulative impacts and costs*. Consistent with the purpose and need statement, the 32-foot cross section was identified as the preferred alternative for this project.

GIS TECHNOLOGY

Safety and other information that is geo referenced can be powerful tools to answer questions, explain alternatives, and demonstrate site-specific solutions that relate to a problem. The use of GIS systems for cataloging design impacts (right-of-way, wetland parcels, etc.) and for crash analysis represents best practices.

A safety-driven urban freeway project in Minnesota met partial resistance initially from community groups. Success in explaining the need for the improvements was in part attributed to Mn/DOT's ability to show the residences (home locations) of those involved in crashes on the segments in question. Stakeholders were surprised to see how many of their neighbors had been involved in a crash on the freeway in question. A system-wide problem became personalized, and support for the safety improvements was generated by the ability to generate location-specific data.

DEMONSTRATING A COMMITMENT TO MITIGATE SAFETY CONCERNS

In many cases where the context sensitive solution cannot meet normal new-construction design criteria, additional safety enhancement measures can be built into the project to mitigate possible safety concerns. Examples of alternative safety mitigation measures that may be considered in conjunction with a design exception or to address a specific safety problem are shown in Exhibit F-16 (following page).

DECISION MAKING

The weighing of attributes and process for selecting an alternative are discussed in Section E, Achieving Environmental Sensitivity. Involving stakeholders in the entire process, including alternatives development and evaluation and screening, will result in an open and honest decision process. Commitment to CSD/CSS does not translate to abdication of an agency's responsibility to make the final decision. CSD/CSS is not about taking a vote – but rather, about decisions made with all stakeholders involved and given the opportunity to have input.

IMPLEMENTATION

The objective of the CSD/CSS process is implementation, which in many cases means construction. Successfully implementing a solution that was openly arrived at requires great care and a management commitment to follow through. In most agencies, staff assigned to develop the plan are not directly involved in construction. Pilot state staff in many states observed that the hand-off from planning and design staff to construction staff, if not done properly, can result in the negation of carefully developed plans and commitments to stakeholders.

It is common practice in many agencies to perform value engineering (VE) studies prior to construction or bidding. Such practices, although well-intentioned, can lead to unforeseen adverse decisions. In Maryland, it was noted that an unintended result of VE studies was the removal of items from the project that represented commitments to stakeholders in the effort to maintain economy. Best implementation practices incorporate meetings and project plan reviews between design staff, construction engineers, and contractors. Important issues that involve stakeholders include right-of-way commitments (avoidance), trees or other landscaping, avoidance impacts and related roadside design decisions, property access and driveways, detours and other traffic issues during construction, construction schedules (time of day), and noise and dust mitigation.

Exhibit F-16 *Measures for Mitigating the Potential Safety Risk From Design Exceptions*

Design Exception	Alternative Safety Mitigation Measures
Narrow lanes or shoulders	▪ Pavement edge lines ▪ Raised reflective markers ▪ Delineators ▪ Shoulder rumble strips ▪ Centerline rumble strips
Steep sideslopes, roadside obstacles	▪ Roadside object markers ▪ Slope flattening ▪ Rounded ditches ▪ Obstacle removal ▪ Breakaway safety hardware ▪ Guardrail or crash cushions
Narrow bridge	▪ Approach guardrail ▪ Pavement edge lines ▪ Warning signs and/or object markers
Limited sight distance at crest vertical curve	▪ Advance warning signs ▪ Obstacle removal ▪ Shoulder widening ▪ Driveway or intersection relocation
Sharp horizontal curve	▪ Advance warning signs ▪ Shoulder widening and/or paving ▪ Improved superelevation ▪ Transverse rumble strips or pavement markings (reduce speeds) ▪ Slope flattening ▪ Pavement and anti-skid treatment ▪ Obstacle removal ▪ Guardrail or crash cushions
Hazardous intersection	▪ Upgrade intersection traffic control ▪ Warning signs ▪ Street lighting ▪ Pavement anti-skid treatment ▪ Speed Controls ▪ Sight distance improvements

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Lessons learned from the pilot states on construction and related implementation issues are as follows:

- Staff with construction experience should be consulted as alternatives are being refined to avoid constructibility problems, avoid the agency making promises that can't be kept, and to alert stakeholders to issues of concern
- Design staff should fully brief construction staff on key design decisions, and in particular, on resolution of stakeholder-related design issues
- Design staff should maintain contact with the project throughout construction, and should be available to resolve construction issues and problems
- The public and stakeholders expect continual information and updates during construction
- Changes in the field are to an extent inevitable–field changes that affect commitments to stakeholders must be openly and honestly communicated to stakeholders, before the changes are made
- Maintain the openness and trust established by the agency during planning and design
- Retain customer focus during construction, by working with property owners, striving for flexibility, and looking for ways to further enhance the project as it is built

Some states are attempting to assign one project manager to see the project through construction to assure that appropriate coordination occurs.

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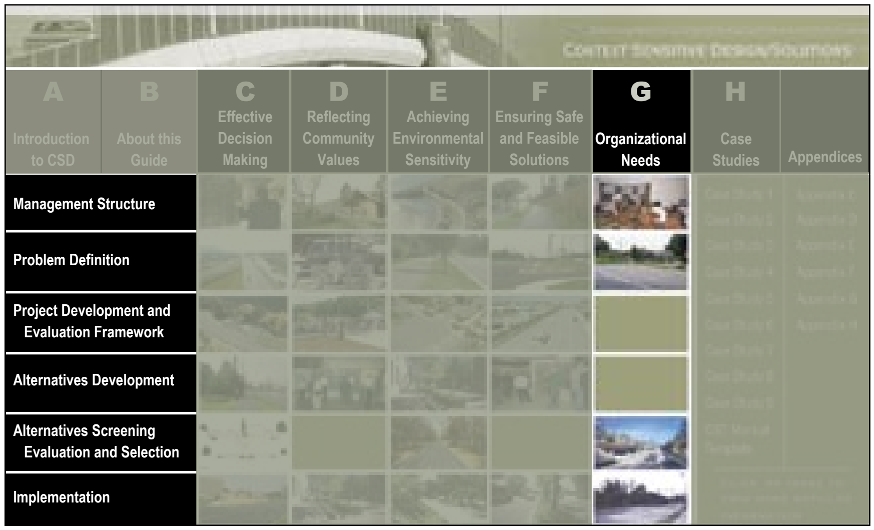
G. ORGANIZATIONAL NEEDS

Organizations intending to implement CSD/CSS will inevitably face the need for changes in their structure, work processes, staff make-up, and above all else, culture. This section addresses organizational needs for agencies interested in embracing CSD/CSS. It is based largely on efforts in the Utah DOT to change their organization, and on the experiences in the other pilot states as they institutionalized CSD/CSS.



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MANAGEMENT STRUCTURE

Broadly speaking, organizations have three assets with which they can affect performance:

- **People**—the collective skills, abilities, availability, and willingness of people in the organization to perform certain tasks or functions.
- **Process**—the formal policies, processes, tools, and procedures, as well as the informal ways that work gets done.
- **Structure**—the formal organizational structure, as well as the way people are organized into teams or units to accomplish work.

From an organizational management perspective, addressing all three areas is necessary to achieve the full benefits and impacts of CSD/CSS.

ADOPTING A CSD/CSS CULTURE

Context sensitive design is a top down initiative. Where it has been successfully implemented throughout an organization, success can be attributed to leadership at the top of the organization. In Maryland, considered the originator of CSD/CSS, cultural change began with the Governor and was transferred to the DOT and State Highway Administration through the Director, Parker Williams. Similarly, in Utah, the Director of UDOT, Tom Warne, and in Kentucky, the Secretary of the Transportation Cabinet, James Codell, shared the vision and were thus able to translate that vision to staff and effect the necessary culture change.

The importance of having a culture conducive to CSD/CSS cannot be overstated. Culture is the sum of how employees in an organization expect to be treated, what they value, and how they conduct their business. Whenever significant change is introduced, one or more of these three elements of culture must change.

Organizational cultures can be supportive and positive, that is, they can help the organization deliver effective, efficient products and services in a manner that also inspires employees. Organizational cultures can also have the opposite characterization and impact. Whether a new process or approach is used depends on whether the existing staff within an agency embraces or rejects the change. *Of all of the elements necessary for successful implementation of CSD/CSS, organizational acceptance and use is the most critical.* This cultural readiness is the extent to which the culture is supportive and positive about the intended change.

Leadership within most organizations will recognize that implementing CSD/CSS requires a change in their organizational culture. This culture change is still aligned with the organizational capacity issues of people, process, and structure, but it applies the adaptation of people to a new way of conducting business. Change will generally need to occur in the following areas:

- Change in thinking
- Change in roles and responsibilities
- Change in work processes (in this case, the project development process)

Ensuring that the organization's culture is conducive to change is a basic requirement to successfully implement CSD/CSS. Among the key attributes of a conducive culture is the organization's focus on efficiently and effectively serving the customer's needs. Additionally, the organization must be driven by leaders who can articulate and inspire the need for excellence and can provide a means of moving toward the desired goal. Finally, the organization must be able to understand and analyze itself well enough to chart a course from its current approach to doing business to the new one.

> "If you are a customer driven organization these concepts are logical."
>
> CONNECTICUT DOT STAFF ENGINEER

A model CSD/CSS culture can be expressed simply as being *customer focused*, and *environmental stewards*, while retaining orientation as the efficient *providers of transportation services*.

Organizational-self-assessment is an important step in identifying how and where change efforts should be focused. Appendix G contains a self-assessment process tool that was used by consultants who worked with the Utah DOT in the CSD/CSS management organization efforts.

DEFINING A PROCESS CHANGE/ IMPLEMENTATION PROCESS

Sustainable performance depends on well-defined processes. Similarly, implementation of CSD/CSS (assuming that it represents major change for the organization) also depends on well-defined change processes. Within this sub-section, there are two separate themes—key functions, and key process steps.

While there are a variety of reengineering processes, the three-step process that follows is a good starting point. Key functions are:

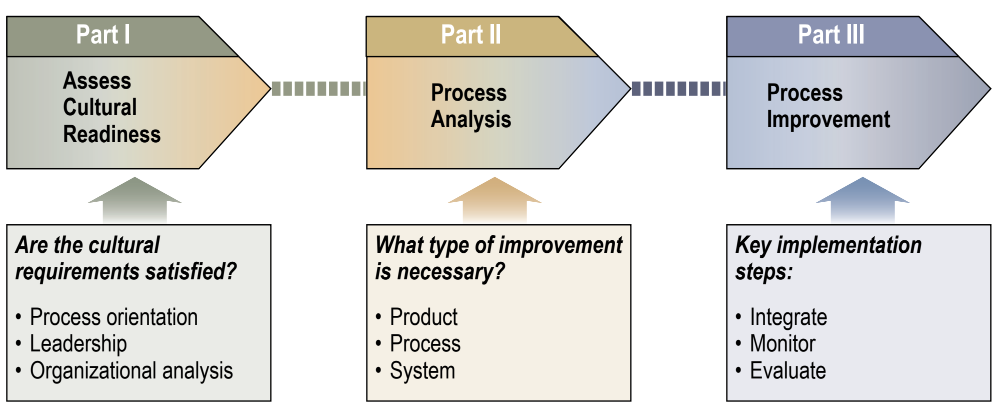
1. Deciding to work differently (***Decide to Change)***
2. Directing resources toward high-value uses ***(Direct Change)***
3. Supporting improvement with the right skills, roles, and responsibilities ***(Support Change)***

As previously stated, CSD/CSS is a top down initiative. This is not to say, however, that the support and vision from middle managers and others within the agency are not important. Indeed, a better approach is to make a decision to implement CSD/CSS based upon a case for action developed by staff within the agency. The case for action should be built upon current performance data so that it demonstrates in a compelling manner that the current way of doing business is no longer acceptable and that a new business approach must be designed and implemented.

The following three-step process was developed by Tenner and DeToro, to respond to what they believe are the three reasons why organizational improvement efforts fail. The first reason is that the organization lacks an internal culture that is supportive to change. The second reason is that the organization fails to plan sufficiently for the change. The third primary cause of failure is a lack of skills or competence in systematically improving the organization. While the process is developed in detail in their book *Process Redesign, The Implementation Guide for Managers*, the key aspects of the process are summarized in Exhibit G-1.

Thorough preparation, planning, and senior management involvement are necessary for successful long-term organizational improvement. Analyzing the performance of key processes is necessary before adequate planning can be completed. Tenner and DeToro recommend using a *process inventory* as the basis of planning for change rather than an organizational chart. A process inventory is a set of maps that span across organizational lines to define

Exhibit G-1 *Organizational Redesign Process*



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SOURCE: Utah Department of Transportation the steps of how things get done. The performance of each process should be measured against two criteria: effectiveness and efficiency. The degree of process effectiveness defines how well the process leads to the right product or level of service. Process efficiency defines in relative terms how much resource (labor hours, materials, dollars) is expended to generate the product or service. The process analysis is used to define the critical gaps between the desired situation and the current situation. This gap can be used to develop a case for action to mobilize the organization into changing.

POLICIES AND PROCEDURES

More often than not, existing policy will be adequate to implement CSD/CSS processes and approaches because the purpose of policy is to set general direction and intent as well as to grant general authority, not to define behavior for each and every activity within an agency. If any changes in written authority are required, it is more likely that operating guidelines or procedures must change.

The states that have fully institutionalized CSD/CSS, such as Maryland, have discovered the need to review certain specific operational policies, articulate new ones, and clarify others. The following is a summary of areas in which pilot states have focused:

- Funding of certain project items (roadside amenities, pedestrian lighting, undergrounding of utilities).
- Development of guidelines for aesthetic design treatments (types, strategies, funding).
- Local maintenance agreements for roadside landscaping and other features.
- Prequalification and/or certification of specialty service providers (example, stone wall construction).

Thinking Beyond the Pavement – A Team Approach

In Maryland, early recognition that a team approach to the Thinking Beyond the Pavement (TBTP) initiative was essential to addressing organizational and process issues. Teams were established and work plans developed for the following specific areas of focus:

Organization and Policy Task Team

- Review current policies and develop policy recommendations addressing pedestrian lighting, right-of-way, utilities, and the funding of certain project items.
- Create internal and external awards recognizing the TBTP approach to project development.
- Review graduate engineer interview criteria for their support of TBTP principles and modify as needed.
- Develop data to better estimate man-hour and consultant requirements for project development while meeting current requirements.
- Include the TBTP approach in Maryland State Highway Administration (MSHA) business plans.
- Develop outcome measures for public and private investments associated with the Neighborhood Conservation Project Development Program.

Project Development Process Team

- Develop a streamlined process for delivering transportation projects that provides continuity between all phases.
- Identify other states that have undertaken similar process reviews and learn from their efforts.
- Identify a pilot project that will use one project manager and/or consultant team in all stages from planning to maintenance.
- Develop guidelines for the preparation of project development plans that address public involvement, schedule, resources, and delivery process strategies.
- Identify the appropriate time and use of independent value engineering and budget for needed time and resources.
- Improve the effectiveness of the preliminary field investigation, final review, and constructibility review meetings and processes.

Community Involvement Team

- Develop MSHA community involvement guidance document.
- Develop community involvement skills training for MSHA staff and consultants.
- Develop a strategy for more intensive use of visualization in project development.
- Include community involvement skills in the consultant selection process.

Project Management and Leadership Development Team

- Develop an orientation course for the MSHA organization and MSHA's project development process
- Develop an Orientation Resource/Reference Guide for project managers.
- Develop introductory- and advanced-level project management courses.
- Develop advanced-level, topic-specific project management courses and a support system for project managers that would include mentors and other resources.

PROJECT MANAGEMENT

One of the most important needs identified by many of the pilot states was the area of project management. Project success or failure, measured by stakeholder acceptance, and schedule and budget adherence, is recognized to be in large part a function of the skills and capabilities of project managers. Pilot states have invested substantially in the development and delivery of project management training courses. A benchmark example is Minnesota DOTs Project Management Academy Course (see Appendix G for course outline).

The skills, approaches, and attributes of good project managers are evolving in the CSD/CSS environment. Traditionally, agencies have selected and promoted experienced highway design staff to project management. The historic Project Manager (PM) model has generally been that the PM is the technical overseer of a project, which consists primarily of a series of technical assignments (survey, geotechnical, roadway design, right-of-way plans, etc.).

Agencies involved with CSD/CSS now recognize that effective project management requires the PM to be:

- Manager of resources of a diverse technical nature, some of which may come from outside the agency
- Manager of the overall schedule
- Facilitator and manager of unforeseen changes in the project
- Facilitator and communicator of both technical and policy information to external stakeholders
- Negotiator and decision maker, empowered to act on the agency's behalf in a constantly evolving project environment

In many cases, the key resource areas and focus are not on traditional highway technical areas but more public involvement activities, or the environmental process. Exhibit G-2 (following pages) provides an example of a checklist for project managers. Appendix G also contains additional information taken from "Thinking Beyond the Pavement."

PROBLEM DEFINITION

From the perspective of the agency, how its staff define problems and approach their solution should reflect a customer focus. This begins with an understanding of the role the agency plays in the evolution and articulation of long-range transportation plans, and proceeds through STIP execution, construction, and even maintenance.

Problem definition and problem solutions are clearly context sensitive at a state and regional level, as well as at a local level. Decisions to invest in highways versus transit, to promote controlled or smart growth, to facilitate economic development of a type or by location, are all made in the political arena, not a purely technical one. Acceptable solutions to mobility issues will reflect not only practical physical or budgetary constraints, but also public policy.

In certain parts of the country, land development patterns and population are stable; community values strongly favor preservation of resources. In these contexts, mobility solutions such as road widening, building bypasses, or other similar infrastructure may run counter to the community values. In other parts of the country, communities may desire new roads to open up land for development, or to compete economically with others. Other examples include the applicability of transit or demand management solutions. These clearly are accepted and effective in some cities, and are ineffective or simply not reasonable in others. Agency staff must understand and adapt to the public values in defining and solving their transportation problems.

THE ROLE OF COMMUNITY VALUES IN DEFINING PROBLEMS

CSD/CSS efforts in Utah directly addressed the issue of problem definition and the mindset to solutions. As part of its pilot state activities, UDOT's senior management held workshops to engage staff in discussions of their approach to their work. During the course of these workshops they proposed a name change to "context sensitive solutions" (CSS) and they developed a concise set of principles with descriptions. Exhibit G-3 summarizes UDOT's adopted process for problem definition and solutions.

The proposed adoption of the term *Context Sensitive Solutions* for Utah is based on the following insights:

- The users of Utah's transportation system aren't interested in design, they're interested in solutions. To them design sounds like a process or a means to an outcome. As transportation users, they are paying for and they expect outcomes.
- By focusing on the intended outcome rather than the process or activity, UDOT can help strengthen its own accountability for performance.
- Not all transportation solutions require a design or physical infrastructure.

The set of recommended principles was established to be few in number so UDOT staff can more easily remember and use them. To make each principle more useable, each has an "evidenced by" and an "achieved by" box that further describes what "success looks like" in practice and how to make it happen.

Exhibit G-2 *Checklist for Project Managers*

1. The project satisfies the purpose and needs as agreed to by a full range of stakeholders. This agreement is forged in the earliest phase of the project and amended as warranted as the project develops. *This quality relates to characteristics #3 and #4. Was the project designed/built to meet the statement of needs, goals, and objectives as articulated in the design program? Were the goals and objectives modified as necessary as the project progressed and was continued support gained from stakeholders?*	☐ **Failed:** The project addresses the identified needs but meets few of the goals and objectives agreed upon or meets some goals and objectives of the project team but few goals and objectives of other stakeholders.
	☐ **Somewhat meets:** The project meets some of the initially identified goals and objectives, but goals and objectives were not modified as the project developed.
	☐ **Meets:** In the opinion of a full range of stakeholders, the project meets the goals and objectives as initially identified and then amended through the project development.
	☐ **Exceeds:** The project not only meets the goals and objectives as initially identified and amended, but meets community or project goals not formally included in the scope of the project.
	☐ **Innovates:** ____________________
2. The project is a safe facility both for the user and the community. *Is the facility viewed as safe by a full range of stakeholders?*	☐ **Failed:** The project has worsened safety.
	☐ **Somewhat meets:** Safety is increased in some areas but other safety problems remain.
	☐ **Meets:** The project team and the community view the project as safe.
	☐ **Exceeds:** Project safety has been accomplished in a manner that also enhances the community's environmental, scenic, aesthetic, historic, and natural resources and uses them as an inspiration for many project design elements.
	☐ **Innovates:** ____________________
3. The project is in harmony with the community and preserves environmental, scenic, aesthetic, historic, and natural resource values of the area, i.e., exhibits context sensitive design. *This quality is the corollary of characteristic #2. Does the project derive some of its qualities from the community's sense of its own identity and the physical attributes of the community, e.g. historic resources or landscape qualities of the community?*	☐ **Failed:** The project ignores the environmental, scenic, aesthetic, historic, and natural resources of the area surrounding the project.
	☐ **Somewhat meets:** The project preserves some resources in the surrounding area.
	☐ **Meets:** The project preserves the community's environmental, scenic, aesthetic, historic, and natural resources and reflects their qualities in some project design elements.
	☐ **Exceeds:** The project both preserves and enhances the community's environmental, scenic, aesthetic, historic, and natural resources and uses them as an inspiration for many project design elements.
	☐ **Innovates:** ____________________

Exhibit G-2 *Checklist for Project Managers*

4. The project involves efficient and effective use of resources (time, budget, community) of all involved parties. *Did the project meet or exceed its budget? Was the project completed within the agreed upon timeframe? Was redesign of part or all of the project required? Was involvement of the public designed in a manner to fit individuals' abilities to offer time.*	☐ **Failed:** The project encountered substantial delays, due either to the late identification of significant resources of the exclusion of certain stakeholder groups from the initial setting of project goals and objectives or for some other reason.
	☐ **Somewhat meets:** The project encountered some delays, due either to the late identification of significant resources or miscommunication with stakeholder groups or for some other reason.
	☐ **Meets:** There was efficient execution of work on time and on budget, with effective participation from stakeholders. The project team worked from the inception toward the generally acceptable solution.
	☐ **Exceeds:** There was quick and efficient execution of work, on time and on budget and with coordinated involvement of all stakeholders from inception through construction.
	☐ **Innovates:** ______________________________
5. The project is designed and built with minimal disruption to the community. *Were the needs of businesses, residents, and the traveling public considered throughout design and construction of the project?*	☐ **Failed:** There was major community disruption during construction.
	☐ **Somewhat meets:** There was some community disruption during construction.
	☐ **Meets:** There was person-by-person coordination with adjoining property owners and coordination with all affected parties to minimize disruption to the community.
	☐ **Exceeds:** In the views of members of the community, construction disruption was avoided to the extent possible and everything reasonable was done to mitigate its effects.
	☐ **Innovates:** ______________________________
6. The project is seen as having added lasting value to the community.	☐ **Failed:** The community is not satisfied with the project.
	☐ **Somewhat meets:** The community is satisfied with some parts of the project but not with others.
	☐ **Meets:** The community is satisfied with all aspects of the project.
	☐ **Exceeds:** The community is pleased with all aspects of the project and describes it to other communities as a model project of its type.
	☐ **Innovates:** ______________________________

Exhibit G-2 *Checklist for Project Managers*

7. The project exceeds the expectations of both designers and stakeholders, and achieves a level of excellence in people's minds. *This quality incorporates all of the other qualities for an overall evaluation of the project. Its measure may be the sense of pride that project team members have in their accomplishments, or the pleasure taken by citizens in the beautification yet functionalism of the project area, or the recognition of the project through awards or citations of its success.*	☐ **Failed:** The project does not meet expectations of either designers or other stakeholders.
	☐ **Somewhat meets:** The project meets expectations of designer and other stakeholders in many areas.
	☐ **Meets:** The project exceeds expectations of both designers and other stakeholders and is cited by both as an example of excellence in your company's work.
	☐ **Exceeds:** The project exceeds expectations of both designers and other stakeholders, is used as a model by you company for future work, and is cited by citizens as an example of the best of your company's work.
	☐ **Innovates:** ____

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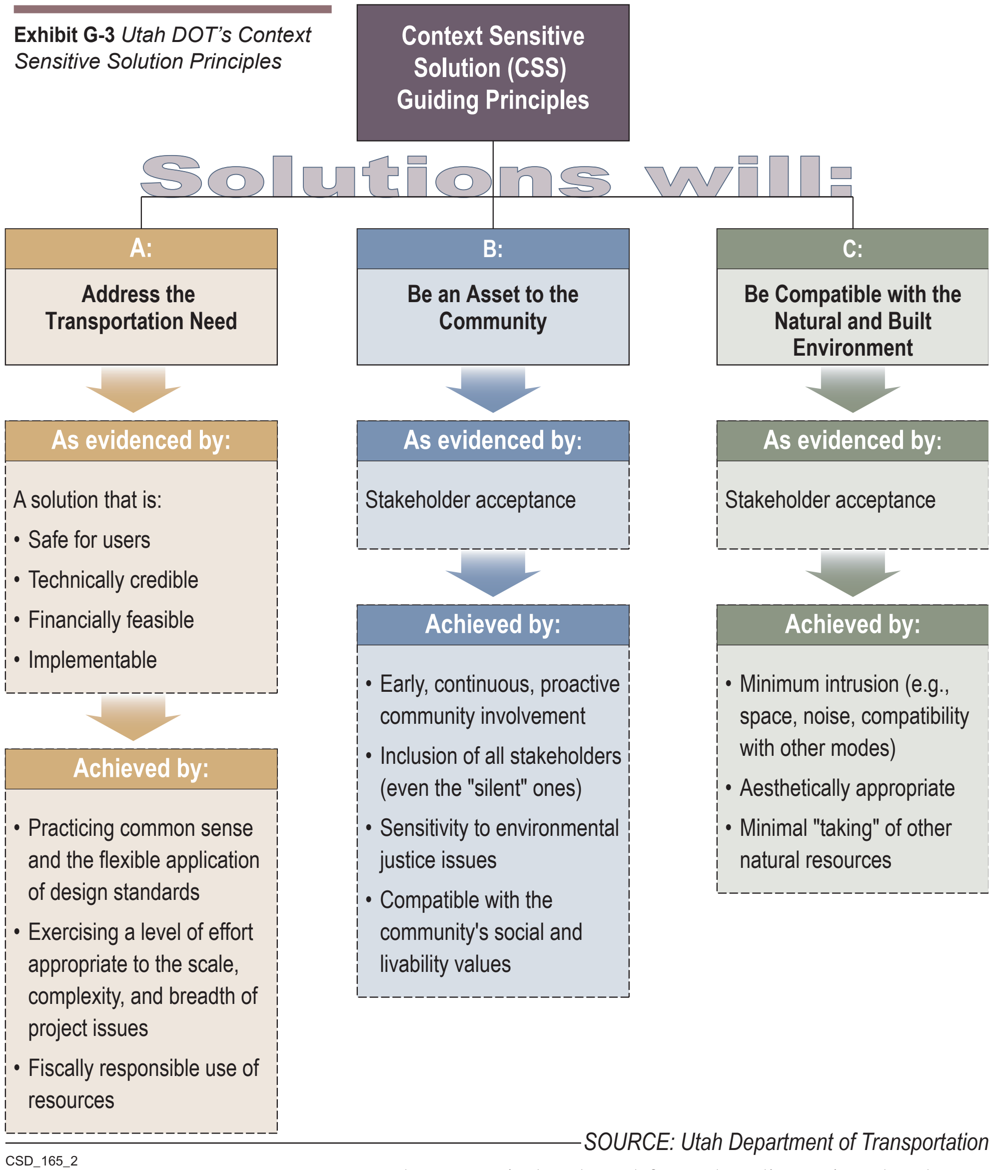
The first principle, *Address the Transportation Need*, is the job of the department. It is why UDOT exists as an agency. The other two principles, *Be an Asset to the Community* and *Be Compatible with the Natural and Built Environment*, describe two ways that UDOT must work if it is to successfully do its job. That is, the principles describe *how* UDOT staff should work with users and other stakeholders as they find solutions for meeting the transportation needs.

Exhibit G-3 *Utah DOT's Context Sensitive Solution Principles*



In practical terms, rarely can all three principles be fully honored on any given project. That is, the specifics of a project often result in competition among them. The challenge for UDOT staff is to balance the demands represented by these principles in a way that represents the best overall solution. From the perspective of UDOT senior management, strengthening the department's public outreach is necessary because effective public involvement is considered the best vehicle to identify and resolve the competing demands of these three principles.

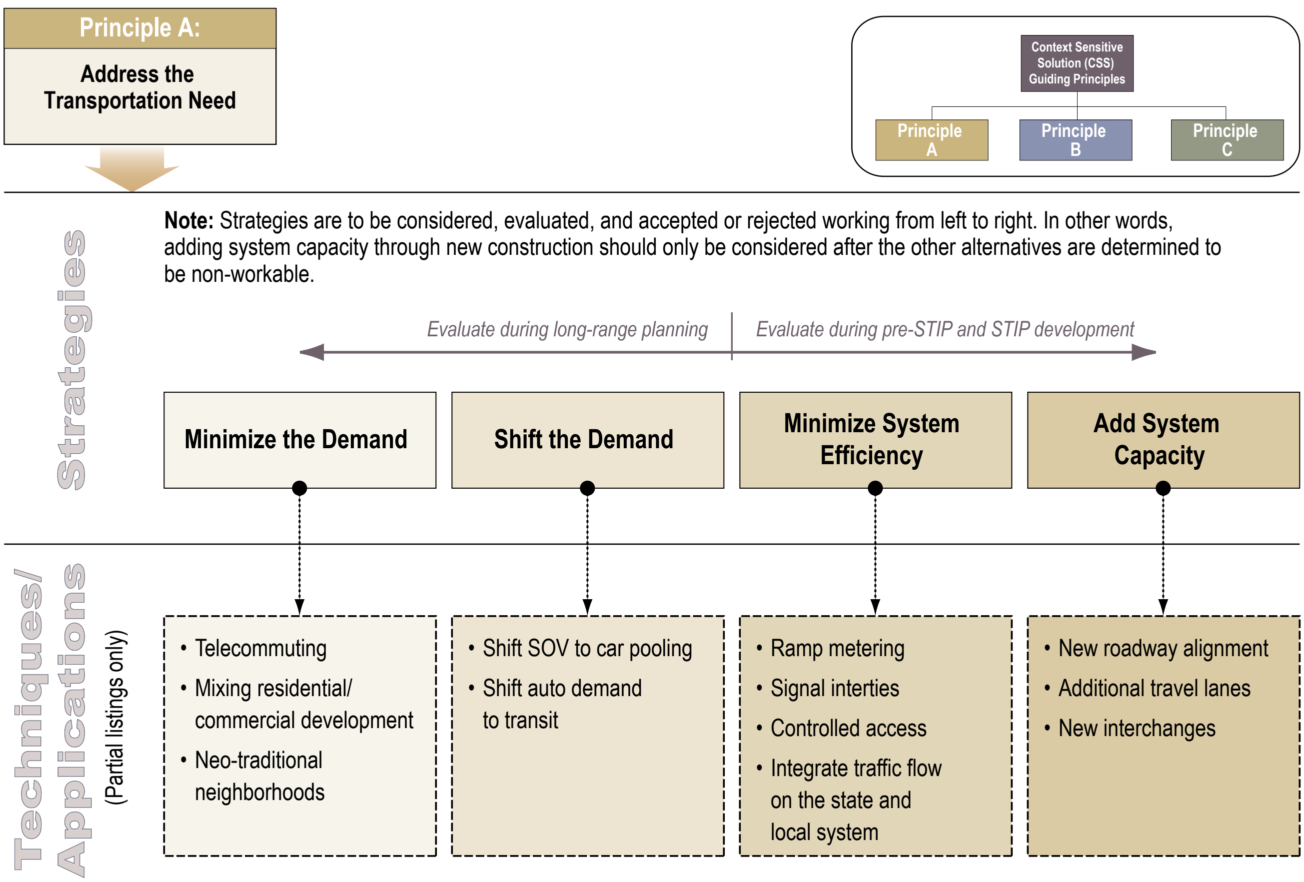
Further definition of UDOT's approach is provided by Exhibits G-4, G-5, and G-6. Note in particular the discussion of strategies under Principle A, *Address the Transportation Need*. The process derived by UDOT *begins* with minimizing demand, and moves only to add system capacity as the last or lowest priority. Assuming that staff follow these strategies as laid out, the types and nature of solutions studied and ultimately implemented should mirror the priorities.

The above is not to suggest that all agencies should adopt UDOTs specific strategic approach to problem definition. Rather, the UDOT model suggests that agency staff can gain value in engaging their customers and stakeholders at the strategic level, and from that discussion develop an approach to problem definition and solution that reflects the desires and wishes of the overall community.

PERFORMANCE-BASED PROBLEM DEFINITIONS

The ways in which agencies define problems; indeed, how agencies measure their success, provide insights to how problems are defined and solutions are proposed. To the extent that programs are developed and projects described in physical terms (we're supposed to be doing a "lane widening" project) versus performance-based terms (we're supposed to reduce delay along the corridor) may suggest to management that the agency may not have the right focus. Some projects are described as involving an upgrade to standards which may imply a wider facility, re-alignment, or other impacting physical improvements.

Exhibit G-4 *Utah DOT's CSS Principle A – Address the Transportation Need.*



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SOURCE: Utah Department of Transportation

For such projects, one may ask what value is obtained by upgrading to standards (making the facility nominally safe). If the answer is safety, then the solution had better make sense relative to the actual performance of the facility (its substantive safety). If in fact there is no substantive safety problem, or if the type of safety problem does not relate to the proposed design solution, stakeholders can rightly question the value of the improvement.

A focus on defining problems and projects in performance-based terms, and stressing performance over physical assets, is suggested as a best practice to be implemented by the management of DOTs and other transportation agencies.

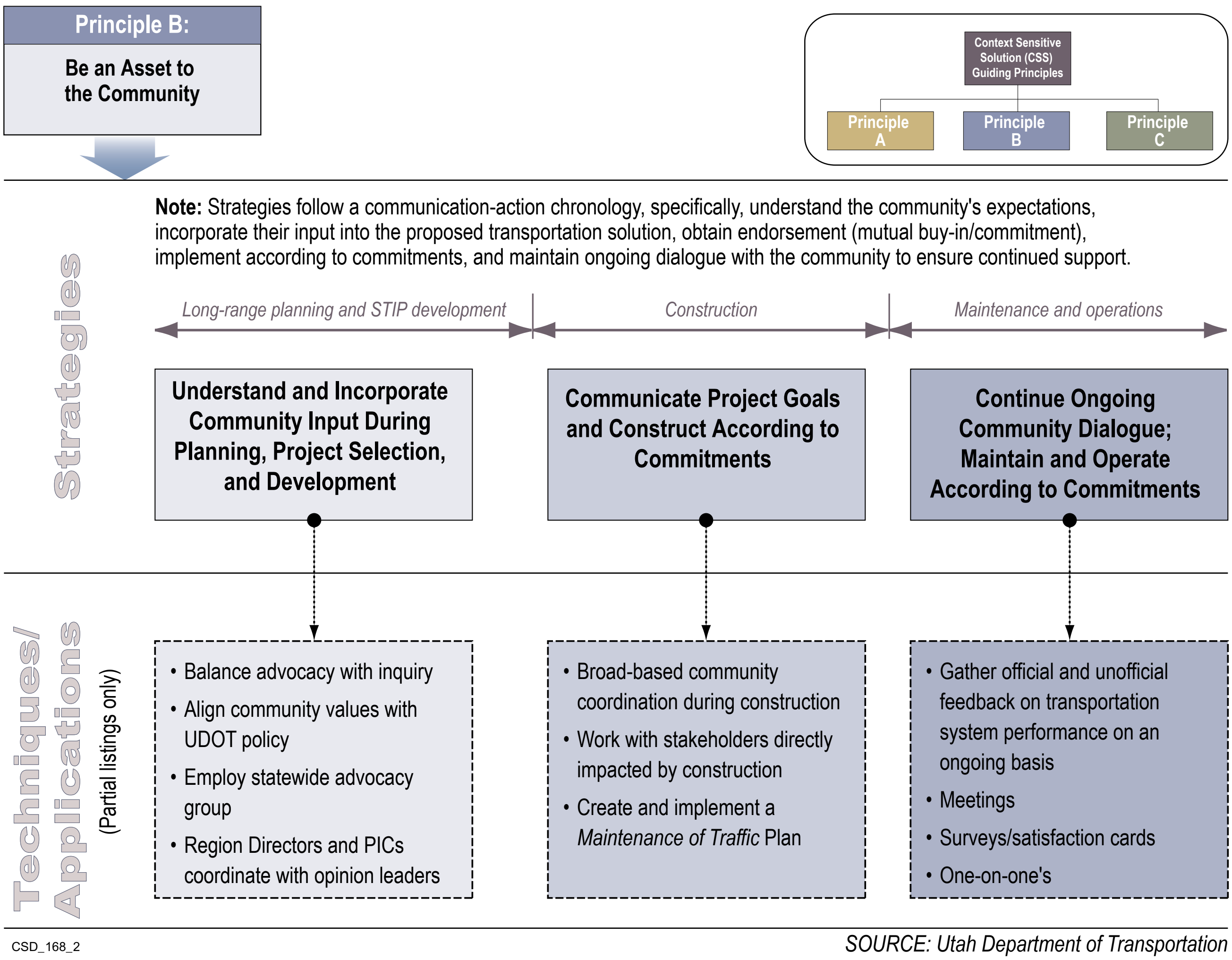
ASSET MANAGEMENT

The importance of being able to clearly define transportation problems at both the program/system level as well as project level is heightened in the CSD/CSS environment. Most state DOTs have implemented management systems that monitor the performance of their primary hard assets – pavement and bridges. Such systems track the conditions and basic characteristics, enabling development of programs to rehabilitate or replace aging infrastructure in the most cost-effective manner.

If there is a single, universal value in transportation, it is safety. Providing for safe facilities was considered a core value from the beginning of CSD/CSS activities in Maryland and elsewhere. Safety is one of AASHTO's top priorities, as evidenced by their commitment to implementing a national Strategic Highway Safety Plan. Market research has confirmed that stakeholders across all spectrums value highway and traffic safety.

In the CSD/CSS environment, then, it would seem that the ability to incorporate and articulate safety in meaningful terms, both in problem definition as well as solutions, should be among the highest DOT management priorities. To date, however, s*afety management* and an agency's

Exhibit G-5 *Utah DOT's CSS Principle B – Be an Asset to the Community.*



SOURCE: Utah Department of Transportation

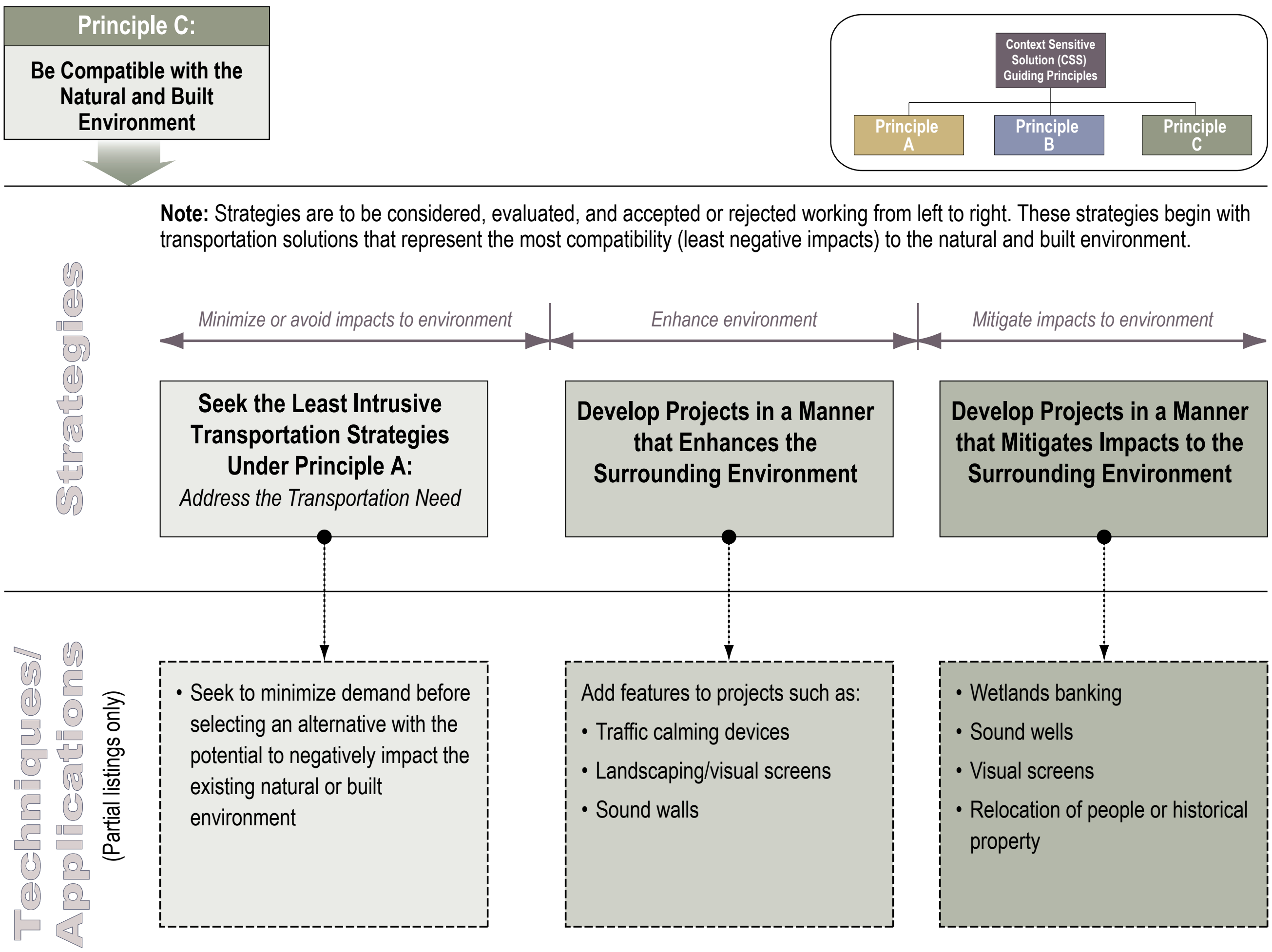
safety performance (as well as its safety assets) are not as universally tracked or maintained to the same level as pavement and bridges or other agency hard assets.

As of 1999, fewer than 40 percent of state DOTs were employing computer-based and advanced technologies covering safety data collection, maintenance, linkages with other data, and decision support. Very few agencies maintain comprehensive inventories of assets such as guardrail or barrier systems, or reference maintenance records as a matter of routine in identifying safety problems. In most states, the currency and depth of understanding of highway safety is limited to few staff. *Arguably one of the most important issues that agencies should address to support CSD/CSS is the development and use of more sophisticated, usable safety management systems.*

The ability to differentiate between substantive and nominal safety (see Section F for more discussion) is critical to successful development of acceptable solutions. Stakeholders no longer accept compliance with design standards as a safety rationale for accepting an adverse impact. DOTs must be able to demonstrate a substantive safety problem exists, and to do so in meaningful terms that can be directly related (by location as well as type) to the proposed solutions. Conversely, agencies should be assured that their limited dollars devoted to safety improvements will be well spent and return measurable benefits. This can only be achieved at the system level through appropriate development and use of safety management systems.

The reader is referred to *NCHRP Report 430, Improved Safety Information to Support Highway Design*. Appendix G contains the executive summary and other material from that report. To summarize here, there are five important

ExhibitG-6 *Utah DOT's CSS Principle C – Be Compatible with the Natural and Built Environment.*



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SOURCE: Utah Department of Transportation

functions that DOTs perform that would be enhanced or made possible through development of what is referred to as a design decision support system (DDSS):

- High-hazard location identification
- Problem identification for a project
- Input to preliminary design for a project
- Analysis of a proposed design exception
- Development or refinement of design standards and criteria

Among the agencies employing such systems, the Iowa DOT is considered a benchmark for effective collection and use of safety management information to support their activities.

ALTERNATIVES DEVELOPMENT–ALTERNATIVES SCREENING, EVALUATION, AND SELECTION

Senior managers of the pilot states recognize that the alternatives development process, including the technical steps of screening, evaluation, and selection, requires different team structures than are currently used, new, or updated technical capabilities and skills, and new approaches to project completion. A key management responsibility is to provide the resources and structure to enable project success at the individual project level.

PROJECT TEAM TECHNICAL STRUCTURE

Most CSD/CSS projects require a full suite of the following expertise or skills:

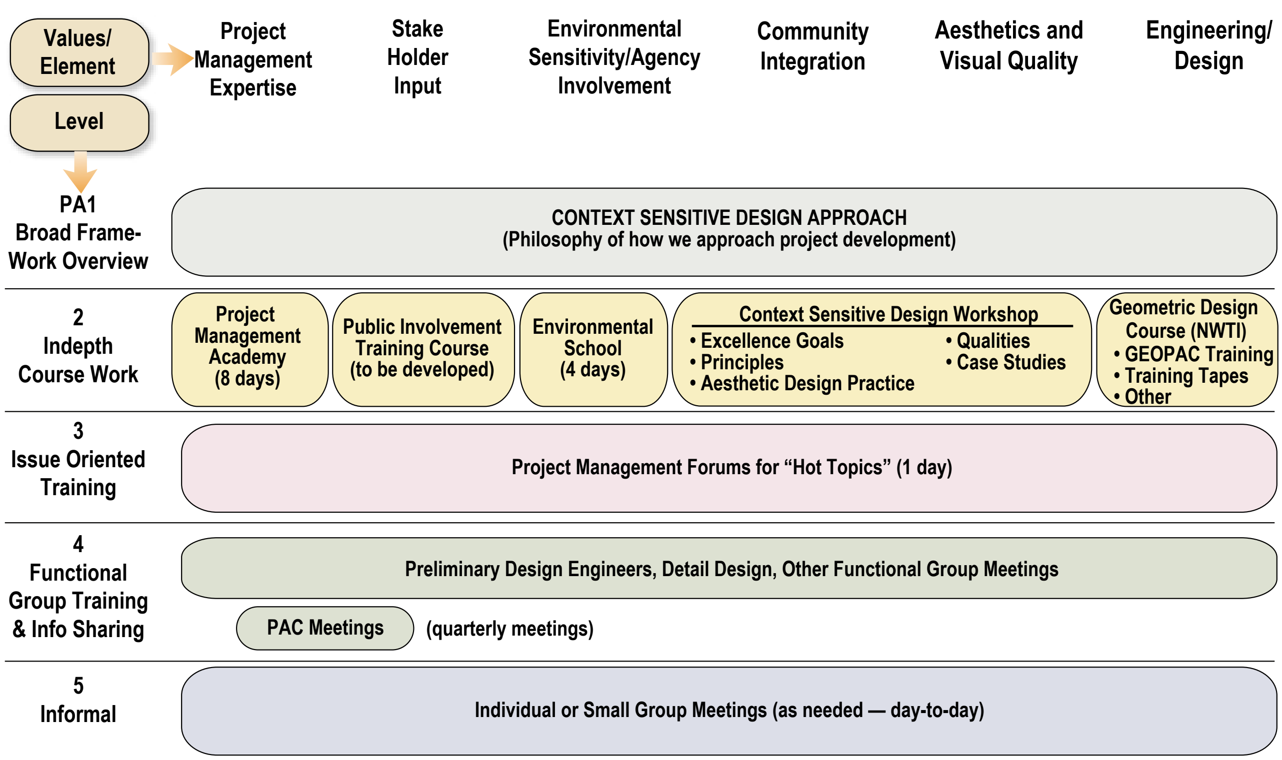
- Project management
- Public involvement planning and implementation
- Environmental process management
- Environmental technical analysis (air quality, cultural resource, biological resource, noise, etc.)
- Transportation planning
- Traffic engineering (including microsimulation)
- Traffic and highway safety
- Highway design
- Structure and retaining wall design
- Landscape architecture
- Construction engineering
- Visualization

SKILL ACQUISITION AND DEVELOPMENT

The range in technical skills implies both a level of investment in personnel training or acquisition, as well as the investment in tools and techniques (e.g., visualization software and hardware). Pilot states and other organizations are recognizing the need to increase investment in technical training, in project management training, and in communications and facilitation expertise. In the case of Maryland, each district has added both an environmental coordinator and a public involvement coordinator to serve as members of project teams.

Discussions with senior managers at the Minnesota DOT reveal that they expect a change in the make-up and skill sets of staff over time. Demand for pure technical skills in traditional design and engineering areas will always be present, but as efficiencies in the CAE process are implemented, less effort relative to other skills is anticipated. Conversely, there is a recognized need to increase the number of staff with communication and facilitation skills. Also, there will clearly need to be a deepening and broadening of the skills and knowledge within an agency of substantive safety related to design or traffic features and conditions. Exhibit G-7 provides the Mn/DOT's Framework for Training.

Exhibit G-7 *Minnesota DOT's Framework for Training*



SOURCE: Minnesota Department of Transportation

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In some cases, agencies are involving certain staff much earlier in the process than before CSD/CSS. The best example of this is the use of landscape architects. These are used by many DOTs relatively late in the process; often only during final design. In Maryland, however, landscape architects are considered core team members and are involved at the beginning of every project, during the scoping and planning activities. Their input is sought throughout alternatives development and plan evolution. This, of course, tends to increase the overall demand for these resources across the organization.

Many organizations offer professional development opportunities in one or more areas noted above. The National Highway Institute, part of FHWA, is one source for adult learning. Other sources include the American Planning Association, and professional organizations such as the Institute of Transportation Engineers and American Society of Civil Engineers.

Some states have developed tailored training programs to address their specific needs. For example, the Maryland State Highway Administration put together a course on environmental awareness and sensitivity for all staff. The Ohio DOT offers an intensive 2-week course in the environmental process as a requirement for any individuals or consulting firms desiring to perform planning work for ODOT.

Specific to CSD/CSS, the University of Kentucky developed a course on CSD for staff in the Kentucky Transportation Cabinet and consultants. This course (Exhibit G-8), developed as part of Kentucky's pilot state activities, is now mandatory for all working in the state. It has been offered to other states interested in CSS. Minnesota DOT has also develop a training course in CSD. Finally, discussions with educators and findings from national conferences indicate a need to incorporate context sensitive design principles and practices in university curriculum.

Exhibit G-9 (following page) contains a listing of organizations offering training related to one or more aspects of transportation project development related to CSD/CSS.

DESIGN STANDARDS AND CRITERIA

AASHTO has emphasized that the *Policy on Geometric Design* is a flexible document. Indeed, a close reading of it reveals that there is significant flexibility in both technical content and recommended usage.

In practical terms, however, most design activities in the U.S. are based directly not on the AASHTO Policy, but on a given agency's design manual. And, most design manuals have evolved over the years to be much more rigid, i.e., to define more narrowly what is "minimum" or acceptable.

The reasons for rigid design criteria are not generally understood by working staff, a situation that inhibits their ability to be flexible or creative. The commonly held view of most design engineers is that a design value published in a manual is there primarily for safety reasons, and that any deviation from that value will result in significant degradation in safety. (This nominal safety thought process is illustrated in Exhibit F-15.)

Rigid design standards in many cases have evolved to serve three purposes – efficiency in design, as a quality control measure, and efficiency in construction. Efficiency in design relates to the time to produce a design drawing. In the CAE environment, there are clearly cost efficiencies associated with ready access to electronic libraries of standard details and drawings. Similarly, from a quality control perspective, the use of standard dimensions, details, etc., assures that at least some minimum design will be provided. Staff less technically knowledgeable can be assigned to design work – "follow the standard" becomes the watchword. The third reason for rigid standards is to avoid confusion or misunderstanding in construction. Local contractors become familiar with the

Exhibit G-8 *Kentucky Training Outline*

SOURCE: University of Kentucky Website

Exhibit G-9 *National Resources for Technical Training in CSD/CSS Disciplines*

	Course Title	Sponsor	Contact Information
Highway Planning & Design	Context Sensitive Solutions Training Course	Project for Public Spaces (PPS) and Federal Highway Administration (FHWA)	Toni Gold 860-232-9018 urbanedge@aol.com
	Roadside Design	American Society of Civil Engineers (ASCE)	John Wyrick ASCE Continuing Education 1801 Alexander Bell Drive Reston, VA 20191-4400 Tel.: 703-295-6184 Fax: 703-295-6144 jwyrick@asce.org
	AASHTO Roadside Design Guide	National Highway Institute (NHI)	Lynn Cadarr 703-235-0528 lynn.cadarr@fhwa.dot.gov
	Design, Construction, and Maintenance of Highway Safety Appurtenances and Features	NHI	See above
	Road Safety Audits and Road Safety Audit Reviews	NHI	See above
	Road Safety Audit Workshop	ITE/FHWA	ITE 1099 14th Street, NW, Ste 300 West Washington, DC 20005- 202-289-0222
	Analysis & Preservation of Historic Bridges	ASCE	See ASCE above
	Safety & Operational Effects of Highway Design Features on Two-lane Rural Highways	FHWA	FHWA Midwest Resource Center Fred Ranck 708-283-3545
	Roundabout Planning and Design	FHWA	FHWA Joe Bared 202-493-3314
Traffic Engineering	Traffic Calming Seminar (materials for course available)	Institute of Transportation Engineers (ITE) and FHWA	See ITE above
	Highway Capacity and Quality of Flow	NHI	Lynn Cadarr 703-235-0528 lynn.cadarr@fhwa.dot.gov
	High Occupancy Vehicle (HOV) Facilities	NHI	See above
	Access Management, Location and Design	NHI	See NHI above
Transportation Planning	Project Management for Planners	American Planning Association (APA)	Marjorie J. Lepley or Stephanie Gordon Cady Strategic Directions 1813 Warren Ave. North Seattle, WA 98109 Tel: 206-284-9037 Fax: 206-362-7385 mlepley@seanet.com

Exhibit G-9 *List of Training Programs (continued)*

	Course Title	Sponsor	Contact Information
Transportation Planning (cont.)	Safety Conscious Planning	ITE/FHWA	See ITE above
	Applications of Geographic Information Systems for Transportation	NHI	See NHI above
	CSS Training - A course for Transportation and Planning Professionals	PPS	Toni Gold 860-232-9018 urbanedge@aol.com
Urban Planning	Introduction to Urban Travel Demand Forecasting	NHI	See NHI above
	Advanced Urban Travel Demand Forecasting	NHI	See NHI above
	Introduction to Metropolitan Planning	NHI	See NHI above
Environmental Process (NEPA)	NEPA and Transportation Decision Making	NHI	See NHI above
	Environmental Training Center (Managing the Environmental Process)	NHI	See NHI above
	Public Involvement in NEPA and the Transportation Decision-Making Process	NHI	See NHI above
Environmental (Technical)	Fundamentals and Abatement of Highway Traffic Noise	NHI	See NHI above
	Functional Assessment of Wetlands	NHI	See above
	Wetlands & 404 Permitting	ASCE	John Wyrick, Manager On-Site Training Worldwide ASCE Continuing Education 1801 Alexander Bell Drive Reston, VA 20191-4400 Tel.: 703-295-6184 Fax: 703-295-6144 jwyrick@asce.org
Communications & Facilitation	Practical Public Relations and Marketing for Planners	APA	Denny Johnson, Public Affairs Coordinator American Planning Association 1776 Massachusetts Ave. NW Suite 400 Washington, DC 20036 Tel: 202-872-0611 Fax: 202-872-0643 djohnson@planning.org
	Highway Program Financing	NHI	See NHI above
	Project Management	ASCE	See ASCE above

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DOT's standard approaches and details, and can bid lower and construct more efficiently knowing them.

What is unfortunate is that the focus on rigid standards has been translated in the minds of working level staff to a belief that standards equals safety, and that no compromises can be accepted. This view holds even with design values that clearly are not related to design exceptions or to substantive safety. Thus, for example, an agency may have in their manual a design drawing showing that a rural frontage road should intersect a crossroad no closer than 300 feet from a freeway ramp terminal intersection. Designers consulting such a drawing and confronted with a situation in which the intersection is 280 feet away will consider this 1) substandard; 2) unsafe; and 3) requiring some sort of design improvement. Note that this type of analysis is often done with no consideration or reference to actual crash records, and often without a site visit. The costs to the agency of this sort of decision process are obvious – unnecessary expenditure in a realignment, unnecessary impact to a landowner, and in many cases, unnecessary conflict with an environmental resource or stakeholder.

> *"The direct application of established design criteria or standards is no assurance that a certain quality of design will be achieved – indicating that such criteria are not sufficient in themselves…The design professional applies the design criteria or standards, chooses minimum, above-minimum or desirable values, and develops the composition of the facility in three dimensions. Thus the attitude and capability of the designer can play a significant role in determining operational efficiency and safety."*
>
> **Jack E. Leisch, Philosophical Considerations in Highway Design, Dynamic Design for Safety, 1974.**

The problem of intelligent use of criteria and technical knowledge is not new. Encouragement for designers to be flexible, use their judgment, and apply design criteria judiciously goes back many years. In the CSD/CSS environment, this approach will become more and more critical to success of an agency.

Empowering staff to be flexible *within design criteria* will mean that 1) staff need to become more knowledgeable in not just the criteria, but the reasons for them (which may include safety, operations, maintenance, constructibility, and other issues); and 2) a commitment to address the rigidity in current criteria and design manuals. With respect to the former point, FHWA has developed a course to educate design staff on the background behind AASHTO design criteria and to highlight the relationship between design features and substantive safety for two-lane roads. See Appendix F for the course outline. With respect to the latter point, management of DOTs should carefully review their design manuals and standard drawings to assure that they are not overly rigid.

PROJECT CONTINUITY

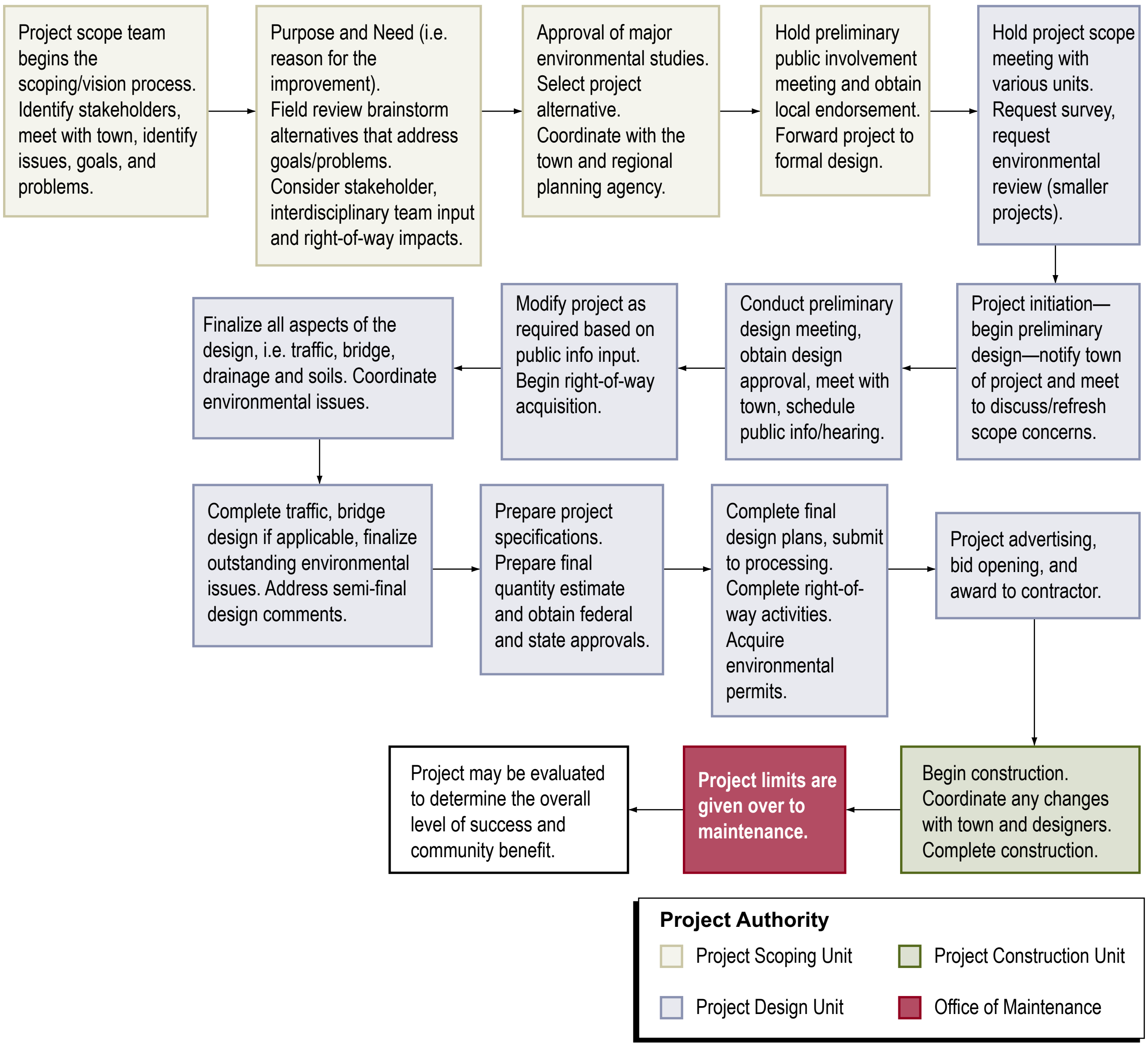
Projects pass through major phases, from planning and environmental studies (culminating in a FONSI or ROD) to preliminary and final engineering, to construction and ultimately maintenance. Typical project delivery involves a hand-off from one part of the organization to another at each of these major phases, and often one project manager to another. Exhibit G-10 (following page) shows a typical project flow chart provided by the Connecticut DOT, which highlights through the use of color the key hand-off phases in the project.

Best management practices, reflective of experience from the pilot states, recognize the hand-off or transition as an area of high risk of failure. From the perspective of external stakeholders, they are dealing with one organization. To the extent that the organization has worked with them, made commitments and promises, and extracted support, the expectation is that the commitments and promises will be kept.

Some of the greatest problems and CSD/CSS failures have occurred in the transition from design to construction. Commitments to save trees, accommodate a driveway or other seemingly minor (from the overall project's perspective) issues can be violated if construction staff are not properly briefed, are not themselves context sensitive, or if the promise could not be kept because of a construction problem that was unforeseen during design.

These performance gaps can be addressed by continuity of staff assignments, and in some cases technical training. Certainly awareness training can help for both design and construction staff. Some states have begun to assign one project manager to follow the project from planning through construction. Where this does not occur, inclusion of construction staff on the project team during the planning and design phases is used to avoid conflicts, followed by a full briefing of construction staff concerning promises that have been made. One of the reasons for inclusion of landscape architects early in Maryland's efforts is to highlight early key maintenance issues and concerns (e.g., who will care for median plantings).

Exhibit G-10 *Connecticut DOT's Project Flow Chart*



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SOURCE: Connecticut Department of Transportation

PROJECT DECISIONS

The organization of an agency and the manner in which it executes projects should support CSD/CSS. Of primary concern here is the ultimate decision reached by the agency. CSD/CSS is not a voting process in which external stakeholders hold veto power over the agency. Ultimately, decisions about what (if anything) to build, and where and how to build it, are the responsibility of the DOT or owning agency.

In most successful CSD/CSS projects, arriving at a solution involves negotiation with stakeholders. Issues can be relatively minor or local (location of a driveway) or can involve substantive design issues (such as width of the roadway, clear zone dimensions, and right-of-way issues). *All CSD/CSS projects are local.* Working the problem and successfully negotiating solutions requires agency staff to be familiar with the local area, the community values, the individual stakeholders–in short, the local context.

Many agencies use technical experts housed at a central location as resources for the entire agency. Examples include bridge design, in some cases traffic engineering, and in many cases geometric design. Project development processes may include review cycles in which such staff review, comment upon and, in many instances, approve or disapprove plans.

Recognizing that agency staff assigned to the project must work locally, it is important for DOTs and other agencies to establish protocols and procedures, and to clarify roles and responsibilities of all internal staff to support the stakeholder working process at the local project level. Local agency staff need full understanding of what is and is not negotiable. They need to have ready access to a resource or individual to answer a question or help develop a solution. Conversely, agencies putting their staff in a position to negotiate and make judgments need to support staff judgments and decisions. Local project staff are less effective and less apt to be creative when they have to "run it by the central office" before they can make a promise or propose an approach.

RISK MANAGEMENT

It is also clear that DOT management needs to assure that their staff understand the applicable tort laws in their jurisdiction, that quality review processes are well established and followed, and that design exception policies and procedures, including documentation are understood and followed. Tort concerns are present, CSD/CSS or not. But tort concerns should not be held as a reason for not endorsing CSD/CSS. More technical background on tort liability and best risk management practices is outlined in Section F, Ensuring Safe and Feasible Solutions.

Information Management Practices

Context sensitive practices (consider alternatives, weigh trade-offs, design using good industry practices, make and explain decisions openly, and document fully all aspects of the project) will build a strong case for an agency's defense of tort claims.

Of course, complete documentation and then document retention and management become key aspects of risk management, as both crashes and tort claims may occur many years after the decisions and construction. In such cases, defense of the agency's actions may be led by professionals who were not directly involved in the actual project execution. It is unfortunately the case that design agencies lose or settle claims not because their staff actions were inappropriate, but because the project files are incomplete or missing key documentation, and staff responsible for the project are no longer available to explain what was done and why.

Information management systems are now being used by some agencies to build and maintain all records or files associated with major projects. To date, these practices are associated with environmentally sensitive projects in which challenges or lawsuits are anticipated. Agencies such as the Iowa DOT and the Illinois State Toll Highway Authority are now proactively employing document management technology for selected projects considered as high risk of future litigation. These technologies include retention, keyword search capabilities and other time and space saving features.

The application of document management technologies and information management infrastructure appears appropriate for managing design exception and design decision files, although no instances of this have been identified.

IMPLEMENTATION

Institutionalization of CSD/CSS requires effort, resources, and some cost. Parker Williams of Maryland inserted the Thinking Beyond the Pavement (TBTP) initiative into the SHA's business plan, in recognition of both the importance and effort needed to accomplish the work. At a minimum, the implementation of CSD/CSS represents real out of pocket costs for an organization. Depending on the extent of the change, the implementation may represent significant costs. These costs can be broken into the following three cost components.

- **Process redesign/training design** - Process design and training design represent explicit costs, including internal staff cost and vendor/consultant costs.
- **Implementation cost** - Implementation costs should include all costs related to making the process changes fully operational. These costs should include team meetings, training, and a post-implementation evaluation.
- **Opportunity costs** - Opportunity costs represent those things that cannot be done because of the current way of doing business. While somewhat difficult to quantify, opportunity costs can be calculated. For example, if a DOT has to delay a project because it didn't respond to community concerns about CSD/CSS issues, the cost of the delay can be calculated.

The use of teams appears to be fundamental to the successful design and implementation of organizational change. The reason behind their effectiveness has to do with the nature of the work required to change. This work deals with complex issues that requires the real time integration of skills, experiences, and perspectives that are unlikely to reside in a single individual. Additionally, the successful implementation and sustained use of a new process depends on its broad-based understanding and acceptance within an organization. The use of teams during the creation and roll out of a process change by their very nature begins to build a broader basis of acceptance.

"...in the kinds of broad-based change that organizations increasingly confront today, teams can help concentrate the direction and quality of top-down leadership, foster new behaviors, and facilitate cross-functional activities. When teams work, they represent the best proven way to convert embryonic visions and values into consistent action patterns because they rely on people working together. They also are the most practical way to develop a shared sense of direction among people through out an organization."

KATZENBACH AND SMITH

THE BUSINESS CASE FOR CSD/CSS

Business organizations, whether they are public or private, for-profit or non-profit, make changes for reasons. The reasons can be to survive in a changing business climate, or to improve their standing and grow. In the case of transportation agencies, the compelling reasons for embracing CSD/CSS may vary depending on how well (or poorly) they are performing their jobs as measured by the following:

- Customer satisfaction (the traveling public, business community, state, and local elected officials)
- Productivity or value produced (number of projects completed, constructed dollar value of projects, fatalities and injuries reduced, number of person trips served on the system, surveys of conditions of the assets of the system components)
- Cost of doing business (total agency costs to deliver all services)

In discussions and interviews with senior and middle management of DOTs, there is a common concern about the organizational implications of CSD/CSS. "CSD sounds expensive" is a theme often heard when discussing how an organization might need to change. A variation of that at the project level is "all that stakeholder and environmental stuff makes sense for complex projects, but we can't afford (or don't need) to do that on the routine projects." This latter point is usually driven home by noting that the current business climate for state DOTs forces them to do more with a smaller and in many cases less experienced work force.

"If we could do everywhere what we did here, we would waste fewer resources."

JIM BYRNES,
COMMISSIONER,
CONNECTICUT DOT

Agencies that have institutionalized CSD/CSS confirm that real, measurable benefits accrue to the agency and ultimately the taxpayers and constituents of their states. The benefits can be broadly categorized as *reducing* agency costs of doing business, as *delivering projects on schedule* (avoiding delays or project halts that were previously common), and as *improving the relationship with their customers*.

Many of the presentations highlighted in the national CSD/CSS conferences feature projects that had been stalled for years (Paris Pike in Kentucky is a notable example). On a lesser scale, every agency has their list of projects that have not been completed, or have been started and stopped multiple times, for any number of reasons. Each such project represents a drain on the staff time and other resources of the DOT. In some notable cases, the cost of planning and environmental studies and re-studies ends up exceeding the construction cost of the project! To the extent that business as usual can be expected to result in a continuation of such project failures, not addressing the underlying reasons (which are invariably related to one or more aspects of CSD/CSS) will result in continued inefficiencies.

Efficiencies and savings are also evident in the development of processes established by context-sensitive organizations. For example, the Minnesota DOT investment in MnModel, a GIS-based tool to help predict or identify potential archaeological sites, has saved millions of dollars by enabling Mn/DOT to find alternatives that avoid conflicts in alignment location studies. This is a considerably less expensive proposition than paying to recover or mitigate sites. As one planner from Minnesota put it in expressing their desire to avoid Native American burial grounds, "*We're not in the archaeology business!*" Another example is the practice of Maryland of negotiating landscape maintenance agreements at the project outset with local units of government, thus avoiding unnecessary investment in expensive planting treatments if the local government is unwilling or unable to maintain them.

Another cost of delays that may not be counted by an agency, but that is surely felt by the state or region in which it works, is the loss of value associated with a project not delivered on time (or at all). Every project is intended to address one or more problems, whether they are related to mobility (hours of delay), safety (lives lost, injuries suffered), or economic development (jobs created, property values enhanced). When investment in a transportation project is halted or delayed, the stream of benefits that completion would have produced is lost forever. This can have tragic consequences in the case of a known substantive safety problem that is left unaddressed for years while stakeholder conflicts are resolved. Final resolution, even involving a highly effective solution, may never recover the lost lives or injuries that were incurred during the years of delays.

Longer term benefits to the entire organization are clearly evident as CSD/CSS is implemented, as projects are completed that are sources of pride, and as stakeholders perceive a positive change in their relationship with the DOT. Pilot state project-level as well as senior management staff observe that, once they "prove themselves" to their customers, projects that follow become less contentious (or at least, the tone and working relationships are better). The benefit of a customer base that is supportive takes many forms. The management of all pilot states assert that DOT staff morale improves as working relationships improve, and as the agency develops a sense of pride in being stewards of CSD/CSS. Local governmental leaders become more supportive, are less inclined to reject proposals out of hand, and are more open to working on issues following a positive experience with the agency.

Regarding the issue of "we can't afford to do this all the time," it would seem that being customer focused is not something one can choose to do or not do depending on the project. Thus, the view that "we can't do this all the time" to an extent misses the point and misunderstands what CSD/CSS is all about. It may be true that an agency can't afford a $200,000 public involvement campaign on every project, but it is also true that one can't afford to *not* make an effort to identify and address community values and stakeholder concerns. As was noted earlier in Section D, an effective "context sensitive" public involvement plan is one that is tailored to the project and stakeholders in form, substance and resources.

> *"Context sensitive design is personal."*
>
> **Connecticut DOT engineer**

As a final note, the marginal costs of CSD/CSS, once institutionalized, may significantly decrease and in fact disappear. Staff well trained in how to manage such projects and who use the proper resources and perform CSD/CSS as a matter of routine will be more productive. They and the agency as a whole will not view the effort as extra work but rather as business as usual. As one engineer from a pilot state put it, *"These concepts (CSD/CSS) are logical and common sense.*"

STRATEGIES FOR IMPLEMENTING CSD/CSS

Management of transportation agencies need not feel as if CSD/CSS requires an all or nothing approach. Of course, the notion of being customer-focused is clearly central to the initiative. To the extent that an agency's self-assessment suggests a lack of customer focus, this arguably may be the top priority. However, in terms of implementing specific management programs, agencies are encouraged to focus on areas where their self-assessment suggests clear improvements are needed. Thus, senior management of some agencies may believe that improving their public involvement programs, capabilities, resources, etc., is the highest priority. Others may believe that technical staff skill development, project management, or development of safety management capabilities has the greatest payback. What is most important is that agencies move forward, as stakeholder and public expectations most certainly are evolving. In the view of many, the CSD/CSS approach is viewed as key to successful project development.

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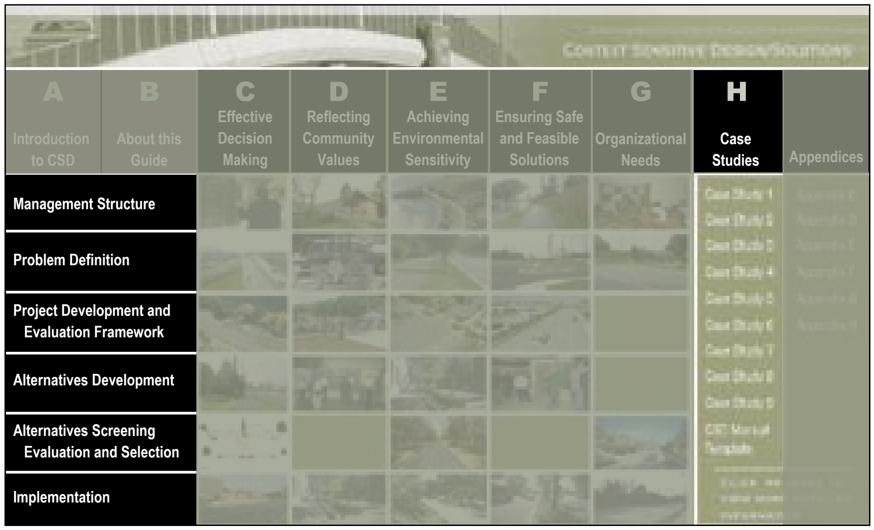
H. CASE STUDIES

The following is a selection of case studies that illustrate application of the principles and thought process behind CSD/CSS. The case studies were assembled from materials and interviews conducted with pilot state representatives, as well as with other agencies contacted during the research project. The case studies are geographically diverse. They illustrate a wide range of project contexts, from rural roads to urban streets. They demonstrate that one can be context sensitive when dealing with a freeway, an arterial, or a local road. In one case, they show that the mission of a transportation agency can and should go beyond providing for safe and efficient transportation. They represent both small projects and substantial efforts.



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Most of all, the case studies show how project success can be achieved by following the framework discussed here, and applying the right resources to solve a problem.

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CASE STUDY NO. 1

MERRITT PARKWAY GATEWAY PROJECT

GREENWICH, CONNECTICUT

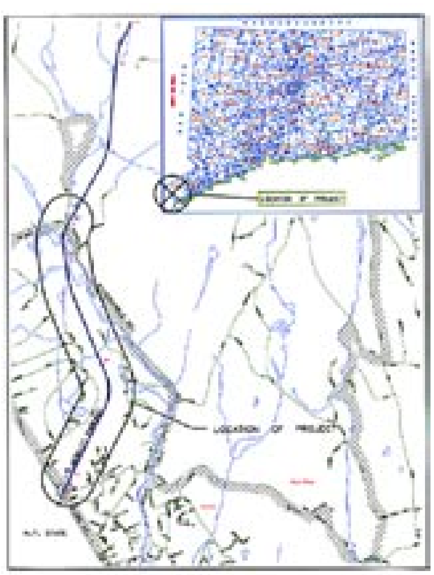
SETTING

The Merritt Parkway (The Parkway) was constructed in the 1930s and opened to traffic in 1940. The facility, a four-lane divided arterial highway, was originally designed and continues to function as an essential component of Connecticut's transportation system.

The Parkway has long been recognized for its unique design features and scenic character. Its park-like setting, majestic bridges, and scenic landscaping make it a distinct and appreciated asset to the state. The bridge architecture utilizes motifs that were popular in the 1930s, including Art Moderne, Art Dec, Classical, Gothic, and Renaissance.

The Parkway was placed on the National Register of Historic Places in 1991, and in 1993, was designated a State Scenic Road. In 1996, it achieved designation as a National Scenic Byway.

When first constructed, the land use through which the Parkway was built was primarily rural, agricultural, and open space uses. Over time, the landscape has matured and changed. Development has occurred in the vicinity of the Parkway, bringing with it both increased traffic and residences near the Parkway.



Both the volume of traffic and its character and operations have changed over time. The Parkway now carries traffic in excess of 50,000 vehicles per day in some segments. Originally designed for speeds prevalent in the 1930s (35 to 40 mph), it now operates at speeds in excess of 60 mph, and with greater density of traffic. The Parkway has evolved into now serving as a commuter route.

Not surprisingly, the substantive safety history of the Parkway has become an increasing concern to the Connecticut DOT. Both the terrain and context, as well as the character of the original design, produce relatively high risk of severe roadside collisions with obstacles such as trees and rock outcropping. Shoulders are typically only 2 feet wide, and clear areas and offsets to fixed objects generally less than 6 feet. The narrow median was not originally designed with a physical barrier. The heavier traffic and speeds greater than the Parkway was designed for are also issues of concern.

From 1986 through 1990, there was one reported crash every 8 hours, one injury every 20 hours, one fatality every 52 days, and a guide rail struck every 36 hours along the 38-mile corridor. This alarming history of both frequent and severe crashes indicated a need for action.

PROBLEMS TO BE SOLVED

The problems to be solved were improving the safety and operational efficiency of the Parkway while maintaining its unique and valued characteristics. Related to these problems were resolving the long-term role of the Parkway relative to development and its attendant pressures, and with respect to other transportation system features in the area.

These problems were articulated in a series of questions and issues developed by a stakeholder working group that was convened by the Connecticut DOT.

- The Parkway's future as it relates to its capacity to carry vehicles cannot be separated from the land uses allowed or encouraged by local zoning entities and towns.

- Pressures for an expanded transportation facility and the desire for increased local development are not separate and unrelated. The future of the Parkway was viewed as being inextricably driven by the land use decisions made by towns and others.
- A fundamental question to be resolved (a choice to be made) was stated simply – Is the Merritt Parkway a major transportation facility or is it simply a beautiful place?

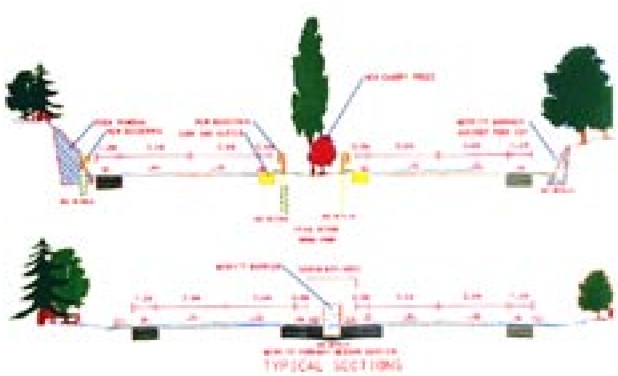
The project in which these issues were addressed involved the development of guidelines for resurfacing, safety improvements, and enhancement projects for the Parkway. These guidelines would in effect provide firm direction for the scope, nature, and types of improvements considered appropriate for the Parkway over the long term.

STAKEHOLDERS

- Connecticut Department of Transportation
- Fairfield County, CT
- Merritt Parkway Working Group (comprised of DOT staff in engineering, traffic, landscape design, maintenance, construction and planning; outside experts in architecture and preservation)
- Local town officials
- General public

CSD/CSS APPROACH

Much work and many meetings were held to wrestle with the conflicting issues of providing for safety (and in particular, roadside safety) and maintaining landscaping and other visual features. Extensive research was conducted, including thorough site reviews and interviews with the original landscape architect, W. Thayer Chase, to fully understand and confirm his philosophies and intentions.



Deliverables to be used by the DOT included 'Merritt Parkway Guidelines' and 'A Landscape Master Plan For the Merritt Parkway.'

DESIGN FLEXIBILITY AND THE APPLICATION OF DESIGN CRITERIA

The Connecticut DOT, through its Merritt Parkway Working Group, in effect established corridor-specific design criteria that reflected the consensus best efforts to balance safety and aesthetic considerations.

- The DOT chose a design speed of 60 mph for the facility, intending to post a 50 mph legal speed limit.
- The DOT chose not to view the Parkway as a route to be used for increasing through regional east-west capacity.
- The DOT chose to address the safety issue by focusing primarily on roadside crash severity. Design solutions (see attached typical sections) incorporated 4-foot shoulders and enhanced crash tested barrier systems that were visually less obtrusive than standard guiderail. Barrier or rail was placed in the median depending on the presence of mature trees, which for the most part were retained. Some rock outcroppings were selectively removed, but the general overall roadside character was retained.

Note that, were this a new freeway or expressway, or a similar route in a different context, the DOT would apply more stringent design criteria for the roadside. The *AASHTO Roadside Design Guide* suggests up to 30 foot clear as a target dimension from the edge of pavement, with mild slopes and free of obstacles. Such a design, or use of continuous barrier, was not considered appropriate for the context of the Parkway.

Part of the design process was the development of a new, aesthetic median barrier. To be acceptable, the barrier needed to pass vehicle crash tests based on criteria established in *NCHRP Report 350*, which specifies speeds, angles of collision, and vehicle types, as well as defines success or failure in the testing. The DOT also selected a steel-back timber guide rail system after researching many other systems. This unique system was also crash tested to assure conformance with *NCHRP Report 350* criteria.

Finally, detailed studies of crash types and locations were performed. Based on these studies, selected high risk trees were removed, or identified for preservation, but with protection afforded them.

As projects have been implemented, the DOT has monitored their performance. A key measure, improvement in safety, has been successfully addressed. Although the frequency of crashes has not decreased, the severity has. In fact, this outcome could have been expected, as the placement of improved barrier systems is intended to address severity and not crash frequency.

STAKEHOLDER INVOLVEMENT

The Working Group recommended establishment of a Merritt Parkway Advisory Committee. This group would review actual design and other plans and assure their conformance with the guidelines and master plan. (It was noted that in some cases direction was vague, and in others contradictory. Location-specific interpretation required some discussion.) Issues of long-term roadside maintenance were reviewed and some changes made as a result.

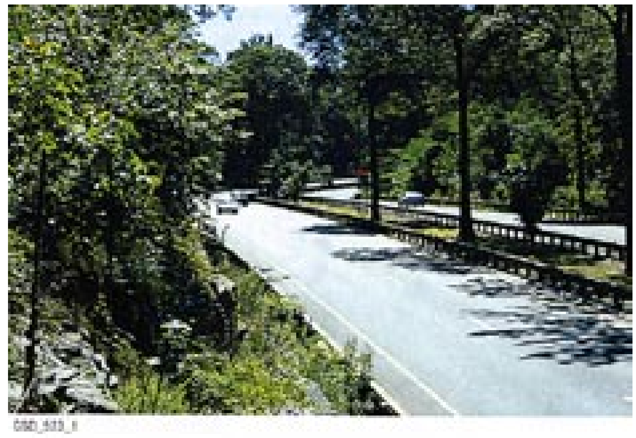
Community involvement was extensive during development of the guidelines and master plan. Elected officials helped identify key stakeholders. Issues of invasive species, noise attenuation, visual effects, and loss of privacy were discussed. Techniques included development of renderings to illustrate design and landscaping concepts.

One group of stakeholders that in retrospect should have been included but was not initially was construction experts. The close working areas and special design features created unforeseen problems when the actual individual projects were implemented. Based on construction experiences, minor changes in design of curbing, rock outcropping removal, and other features were made for future projects.

Public information meetings and workshops were held to explain the vision and the approaches. These served to further highlight the attention of the general public on the Parkway, its future, and the need for improvements.

LESSONS LEARNED

This case study shows the importance of arriving at a vision or framework for problem solving before developing the solution. In the case here, articulating what the Merritt Parkway was (and was not) was necessary before beginning design investigations.



Another lesson learned was the importance of being flexible in the development and use of design criteria. Also, addressing a safety problem with specific actions is illustrated here. The key safety problem, severity of roadside crashes, was directly addressed through a series of treatments. Also note that a realistic view of what could be accomplished (a choice of aesthetics over safety) should be a part of overall thinking and solution development.

A final lesson learned was the importance of involving construction and maintenance staff in the development and evaluation of solutions.

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CASE STUDY NO. 2

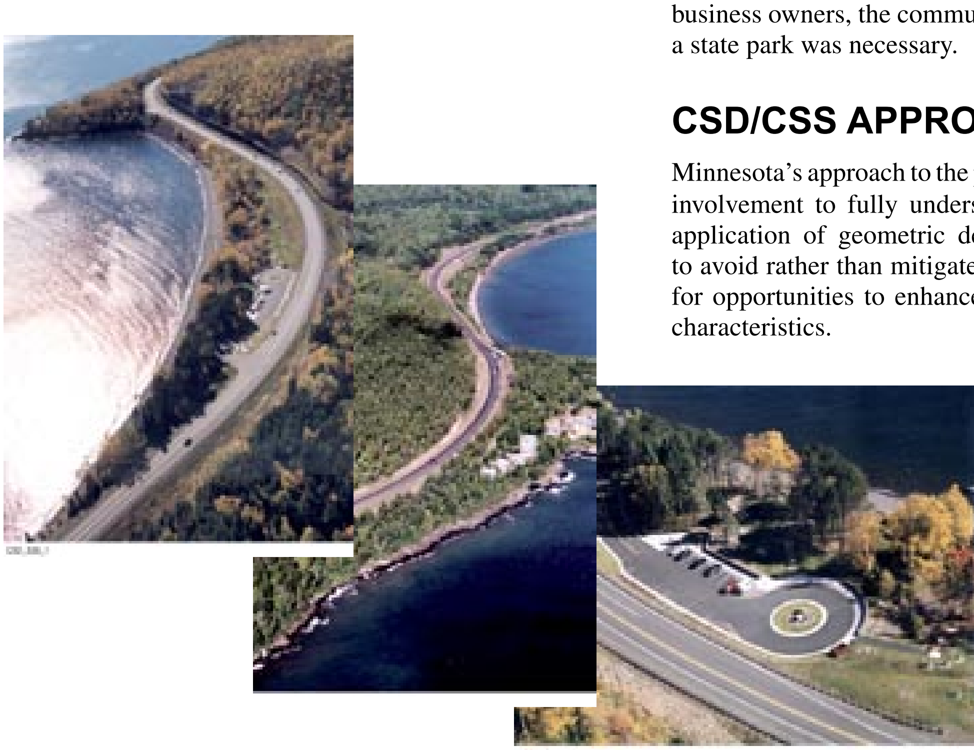
MINNESOTA TH 61

NORTH SHORE SCENIC DRIVE

SETTING

Minnesota's Trunk Highway 61 (TH 61), North Shore Scenic Drive, runs northeasterly along the rocky and heavily forested edge of Lake Superior, for more than 150 miles, from the regional trade center of Duluth to Canada. TH 61 is both a scenic highway and tourist destination, as well as a vital interregional and international trade corridor for northeastern Minnesota. As such, it passes through 19 small communities, large tracts of state and national forest resources and recreation areas, eight state parks, numerous rivers, streams, historic sites, markers and points of interest, many safety rest areas, wayside parks and campgrounds, an Indian reservation, and a national monument.

Visitors who travel along the North Shore Scenic Drive hope to experience the magnificent landscapes, the cascading rivers, the rugged shorelines, and the breathtaking vistas along with the other natural and cultural resources and history that abound along this Lake Superior region. The characteristics that draw visitors to this region are so unique that Minnesota's TH 61 North Shore Scenic Drive was recently designated and distinguished as an "All-American Road" in the National Scenic Byways Program.



PROBLEM TO BE SOLVED

TH 61 required reconstruction to replace the pavement. The basic cross section of two lanes each direction of travel was sufficient, but an effort was made to upgrade the facility to modern design criteria.

The challenge in doing so was to develop an alignment that met the needs of both visitors to the area as well as local residents and business owners. Aside from being a tourist and recreational driving destination, within an environmentally challenging area, the North Shore Scenic Drive must provide adequate safety, mobility, and access for local residents, businesses, recreation areas, and commercial trucking while accommodating bicyclists, pedestrians, and rail crossings. Balancing transportation, community, environmental, and stakeholder needs along this corridor was a tremendous challenge.

STAKEHOLDERS

The overall project required coordination with 19 communities, state and national forests, eight state parks, and an Indian reservation. For this segment of TH 61 North Shore Scenic Drive, coordination with local residents and business owners, the community of Good Harbor Bay, and a state park was necessary.

CSD/CSS APPROACH

Minnesota's approach to the project focused on stakeholder involvement to fully understand all issues, flexibility in application of geometric design criteria, a commitment to avoid rather than mitigate adverse impacts, and to look for opportunities to enhance the project given its unique characteristics.

The Minnesota Department of Transportation's (Mn/DOT's) reconstruction and realignment of TH 61 along Lake Superior's Good Harbor Bay illustrates a context sensitive design approach that balanced transportation, community, and environmental needs without requiring exceptions to geometric design standards. This project also illustrates context sensitive design that did not arise out of contentious public involvement and controversy but rather out of proactive project management and involvement of stakeholders.

Design Flexibility and the Application of Design Criteria

The project designers and stakeholders applied the flexibility already inherent in the AASHTO Green Book by selecting a 55 mile per hour (mph) design speed rather than a 70 mph design speed that was initially selected and used for preliminary alignment investigations. The lower design speed was considered appropriate for the project's unique circumstances (transportation needs, terrain, land uses, valued resources, etc.) and maximized the flexibility to find the best roadway alignment balance point among the corridor's safety, mobility, social, economic, and environmental goals.

Mn/DOT referenced boththe AASTO Green Book and the ITE Traffic Engineering Handbook as technical information supporting their selection of a lower design speed.

"Above minimum design values should be used where feasible, but in view of the numerous constraints often encountered, practical values should be recognized and used."

The specific effects of a lower design speed were to allow the highway alignment to be shifted and design flexibility to be accomplished without the need for exceptions to geometric design standards. Full lane widths and shoulder widths and appropriate roadside design for safety was possible for the alignment based on the lower design speed. Finally, the effect of the lower speed resulted in Mn/DOT saving considerable construction costs by avoiding extensive rock cuts.

Stakeholder Involvement

Mn/DOT's District One staff made key commitments early in the project development process:

- To work closely with local communities and stakeholders to establish a highway corridor vision . . . a safe and aesthetic highway that enhances the local communities through which it passes.
- To make context appropriate design decisions along this corridor.
- To apply design flexibility to preserve historic, natural, and scenic corridor qualities.

Meetings and discussions with the stakeholders resulted in an articulation and common understanding of these transportation, community, and environmental stakeholder objectives:

- Improve roadway safety and traffic flow.
- Meet current and future transportation demands.
- Improve pavement quality.
- Improve an existing limited-use safety rest area facility.
- Minimize right-of-way and construction impacts and costs.
- Remain consistent with north shore corridor visioning and management goals.
- Enhance the scenic and visual qualities of the corridor.
- Preserve historic and traditional views and vistas from the highway.
- Preserve and enhance public access to the lakeshore.
- Avoid adverse impacts to residential and commercial property owners.
- Avoid adverse impacts to the environment and state parkland.
- Reduce erosion along the lakeshore and Cutface Creek.

Design Enhancements – Fitting the Context

The alignment shift enabled the design to avoid conflicts that would have required mitigation. Specifically, impacts to a state park and relatively high cost and visually obtrusive rock cuts were avoided.

Mn/DOT went beyond avoidance, though. Consistent with Mn/DOT's context sensitive commitments and proactive stakeholder involvement, consensus was reached in determining project purpose and need to balance transportation, community, and environmental objectives. Specifically, a consensus was reached that selecting a lower design speed appropriate for the project characteristics would provide the flexibility to shift roadway alignment and balance project objectives without requiring exceptions to geometric design standards. As part of the overall project, given the vision of the stakeholders and importance of the route as a resource, Mn/DOT seized the opportunity to enhance the environment by the following actions:

- Alignment shift provided additional space to enable the expansion and reconstruction of the Cutface Creek Rest Area.
- Mn/DOT undertook the stabilization of a shoreline erosion problem.
- Cutface Creek bank stabilization was accomplished.

LESSONS LEARNED

This project demonstrates the importance of establishing key basic design criteria consistent with the context. It also demonstrates a not well understood principle, that lower design speeds in rural areas need not be considered less safe than higher design speeds.

Other lessons learned include the importance of working closely with stakeholders, and taking the opportunity to not only mitigate or avoid, but to enhance the environment as part of design and construction of a transportation project.

An overriding lesson learned was that proactive project management and stakeholder involvement, in combination with appropriate and context sensitive design flexibility, accomplished project benefits that might otherwise be foregone:

- Geometric standards for the design speed were met without exceptions.
- Safety and mobility improvements were added with the alignment shifts.
- Right-of-way impacts and costs were minimized.
- Unnecessary construction impacts and costs were minimized (rock cuts, disposal, etc.).
- The goals of the scenic north shore corridor vision were met.
- Original and valued vistas of Lake Superior were preserved.
- Public access to the lakeshore was preserved and enhanced.
- Improvements to the limited-use safety rest area were added.
- Eroding areas were stabilized along the alignment shift.
- State park impacts and rock cuts were minimized by the alignment.
- The alignment fit the land forms and context physically and visually.

The application of appropriate and context sensitive design flexibility during project development led to a successful balance of transportation, community, and environmental needs that are served by the constructed project. The constructed project also met four key measures of design excellence: 1) community acceptance, 2) environmental compatibility, 3) engineering and functional credibility, and 4) financial feasibility.

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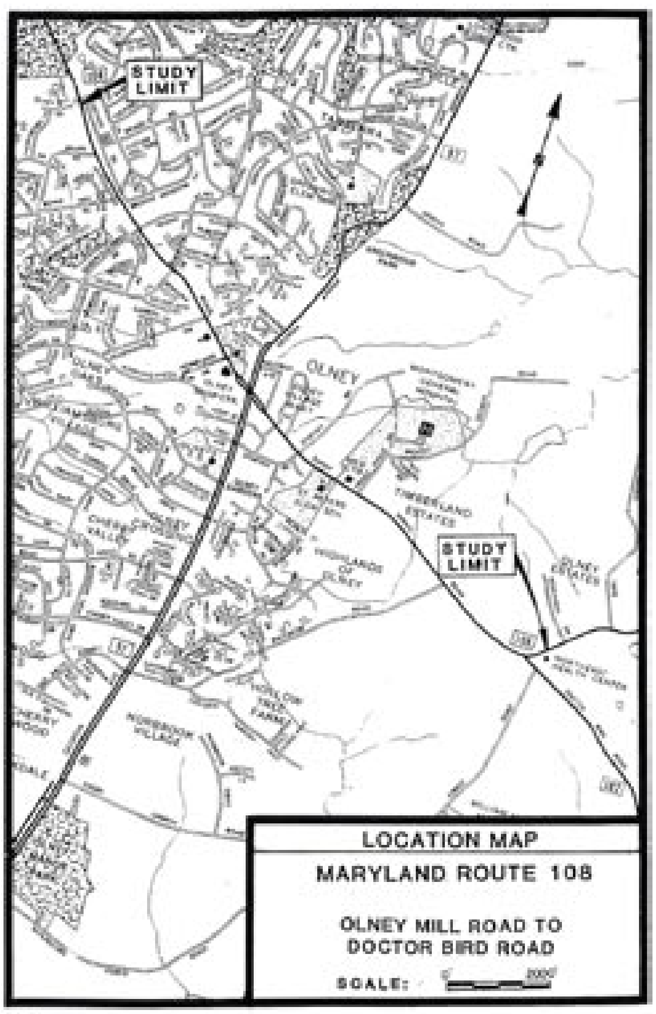
CASE STUDY NO. 3

MARYLAND ROUTE 108

SETTING

Maryland Route 108 is a two-lane major arterial in Olney Maryland, a suburb of Baltimore. It is one of two major highways providing principal access to and through the Olney area. The roadway widens to a four-lane section between Homeland Drive and Hillcrest Avenue. Major signalized intersections within the corridor are at Olney Mill Road, Maryland Route 97, Prince Phillip Drive, and Doctor Bird Road. The existing right-of-way varies throughout the study area.

The existing land use in the study area includes both residential and commercial land uses. Three historic sites (identified as potentially eligible for the National Register) were identified along the project corridor. Portions of the project corridor are within the 100-year floodplain of the James Creek, affecting two existing structures and raising concerns about erosion, increased run-off, and water quality.



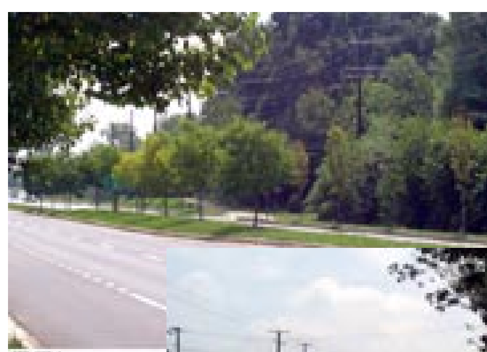
Significant land uses along the corridor include Montgomery General Hospital, an elementary school and a middle school, and commercial development centered around the intersection of Maryland Route 97 (Georgia Avenue) and Route 108.

By the mid 1980s, land development was rapidly occurring, and contributing to increased traffic and resultant congestion. Over 20,000 vehicles per day used the facility, with traffic forecasts indicating a potential for as much as 35,000 vehicles per day by 2010.

The highway network and land development within the general area are considered established. There were no plans for addition of other parallel or crossing facilities that would influence traffic patterns on Route 108.

PROBLEM TO BE SOLVED

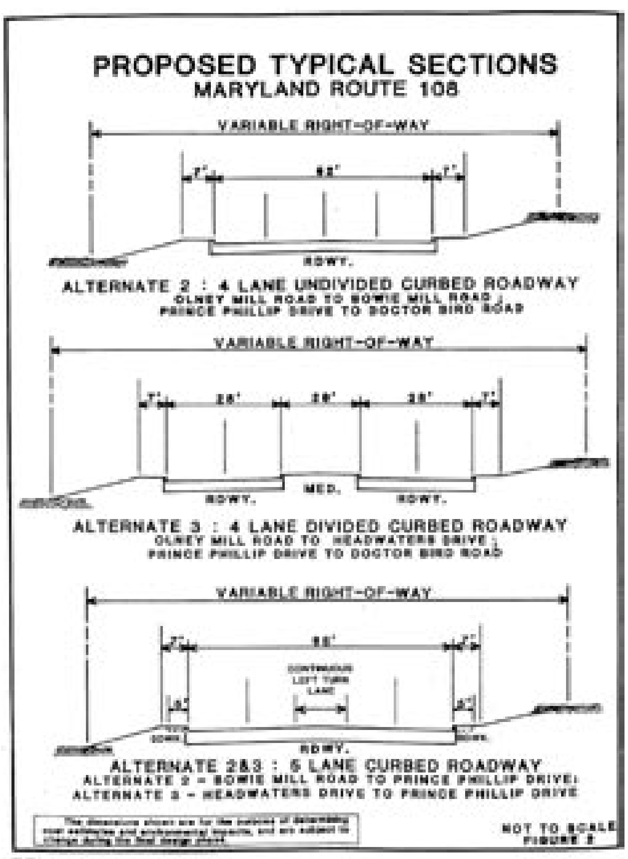
Traffic already on the corridor exceeded the capacity of Route 108. Expected future traffic increases would further increase congestion. As a principal arterial, the function of the route was to carry such regional traffic. There were no opportunities to divert traffic to other parallel arterials. Olney and the surrounding area is suburban in character, with relatively low density development. The primary transportation mode for regional through traffic was and would remain the automobile.



The problem to be solved was to maximize the capacity (traffic-carrying capability) of Route 108 to enable it to carry out its function as an arterial serving the region. Solving the problem required consideration of the context of the area, including both land use along the corridor and other transportation needs.

Thus, the primary problem to be solved was to relieve congestion and provide through capacity.

Initial efforts to address the project focused on standard solutions. The general plan called for Maryland Route 108 to become a multi-lane arterial throughout the project length, with intersection capacity improvements at the major intersections. Two alternatives were developed for the project, incorporating both five-lane and divided roadway solutions (see exhibit). One design speed was assigned to the entire project. Implementation of the plan would require right-of-way along the corridor and relocation of one residence on a church property was needed.



STAKEHOLDERS

- Town of Olney Mill
- Montgomery County, Maryland
- Consultants
- Maryland SHA
- Olney Mill Community Association
- Olney Mill Chamber of Commerce
- Individual business and property owners (numerous)
- Local state delegate (legislator)

CSD/CSS APPROACH

This project was conducted as the Maryland SHA was developing their "Thinking Beyond the Pavement" (TBTP) approach. It is illustrative of the need for this approach, the process, and the benefits.

As the project moved ahead during the late 1980s, there were concerns raised about the impacts of the proposed solutions, the character of the road, the final appearance of the highway, and other aspects such as treatment of pedestrians. While the stakeholders were generally accepting of the need for the project, there was some dissatisfaction with the solutions proposed. Stakeholder concerns included preservation of natural and historic features (including large trees along the corridor, split rail fencing, historic properties), inclusion of provision for bicycles and pedestrians across and along the corridor, safety and access to businesses, and the appearance of the corridor (a desire for landscaping and other visual features was expressed). Individual business owners were concerned about effects on driveway access associated with widening and vertical alignment.

The SHA initially conducted a normal, routine public involvement process consisting of coordination with the local town, location and design meetings, and a public

hearing. The public hearing was held in June 1988, at which almost concerns and objections to the plan were raised.

In response to these concerns, the SHA committed to re-evaluate the proposed design. Staff re-evaluated the project's history, justification, and commitments. The project was field reviewed and video-taped, with a focus on determining first hand which site features were significant. The re-evaluation looked at what was really needed, and questioned the scope of the improvements. Focus was placed on attempting to visualize the overall improvements.

Design Flexibility and Application of Design Criteria

It was decided that the standard template solution would not suffice throughout the 2.7-mile corridor. The corridor was segmented into three areas defined by the surrounding land uses – a residential zone, institutional zone, and commercial zone. The operating speeds and speed limits would vary by zone, as would treatment of the median.

The design approach also involved varying the alignment of the road through the corridor to better fit surrounding land uses and minimize conflicts.

The SHA demonstrated flexibility in criteria by accepting in spot locations variability in offset dimensions for the bike path relative to the roadway, and by varying the median treatment. Full standard lane widths were maintained throughout the corridor. Right-turn lanes were provided at high volume intersections to maximize capacity. Care was taken in the design of all landscaping to assure that intersection sight distance criteria were not violated.

Utilities were placed along the border area (not in the median as is typically done) to preserve the median for planting trees.

Given the urban context and design for speeds of 40 mph or less, landscaping with full-size trees in both medians and the roadside was considered acceptable from a safety perspective.

Design Enhancements – Fitting the Context

Different design challenges required different approaches in each of these zones to meet the character and local context. In the residential zone (northwest project limits) a less structured landscaping theme was developed (see photos), with the hiker/biker trail designed to meander.

In the commercial zone, the right-of-way and median are narrower, and design treatment more structured. Provision for left-turn lanes precluded the ability to provide treed landscaping, but plantings along the roadside in keeping with the commercial district's environment were provided. In the institutional zone, the design focused on providing for a transition in view between the other two zones.

Stakeholder Involvement

The SHA and its consultants committed to working closely with the residents and community to address all concerns. The CSD approach relied on numerous meetings with town staff, elected officials, civic organizations and business owners, and the public. Plans were continuously reviewed, ideas suggested, and refinements made. Discussions about trees, split rail fencing, the location and design of bike trails, commercial area traffic patterns and access, and pedestrian safety were held over a series of months. Professional staff demonstrated a willingness to be flexible, propose different solutions, and strive for a consensus. Note, however, that the fundamental purpose was retained, the addition of through-carrying capacity.

In summary, Maryland's CSD approach focused on active, field-involvement of their staff to visualize the project, work directly with local stakeholders, and strive for a tailored solution that addressed the problem but was designed to fit the local context.

LESSONS LEARNED

This project was initiated in the mid-1980s and continued through the mid-1990s. As such, it followed Maryland's advance into TBTP and CSD. This project contributed greatly to Maryland's knowledge base and advancement in CSD. A number of specific lessons were learned by Maryland's staff :

- Early in the project, review and confirm the planning framework, including the functional classification for the project and speeds (design speed).
- Assess what is proposed, what is desired, and what is needed. Look beyond mere mitigation; and look beyond the right-of-way to assess how the project will relate to the area.
- Multidisciplinary teams, including specifically landscape architects, were recognized as being essential to project success.
- Project engineers should get out in the field to visualize the project.
- Develop the project with an emphasis on design principles, utilizing engineering principles to achieve desired safety and functionality.

"A standard design template approach will not allow, or usually doesn't provide, the opportunity to address site-specific issues. This point is particularly important given what we perceive to be a trend toward having computers (CADD) design projects. Software programs should be used for engineering. Design requires more attention to detail, and is something that computers can't do."

MD 108 Re-evaluation process report by Dan Uebersax and Jeff Smith

CASE STUDY NO. 4

MARYLAND ROUTE 355

SETTING

Maryland Route 355 was a two-lane highway in Montgomery County linking communities in the Gaithersburg/Germantown area. The arterial parallels Interstate 270. The route passes through Great Seneca Creek State Park. At the southeast project limit is one major signalized intersection with Maryland Route 124. Other signalized intersections along the corridor include Middlebrook Road, Maryland 118, and Maryland 27. The 2.6-mile route passes through residential areas, parks and open space, and commercial areas.

Significant regional traffic growth and localized development resulted in traffic increases along Route 355. The two-lane highway, originally designed as a rural road, became congested. Reconstruction of the route to accommodate existing and projected future traffic demand was apparent.

PROBLEM TO BE SOLVED

The identified problem was to provide enhanced mobility for those using the Maryland Route 355 corridor. Mobility issues included through traffic, intersection conflicts and bottlenecks, access management, and providing for pedestrians and bicyclists.

STAKEHOLDERS

- City of Gaithersburg
- Maryland National Capital Park and Planning Commission
- Maryland Department of Natural Resources
- Numerous utility companies (water, gas, cable TV, telephone electric)
- Community associations (Wheatfield Homeowners Association, Foxchapel Homeowners Association, Montgomery Village Foundation)
- Individual residential property owners
- Major employers (Lockheed Martin)
- Other business owners along the corridor (e.g., Holiday Inn, Aamco)

CSD/CSS APPROACH

Completion of this major project required a comprehensive approach involving design creativity, stakeholder involvement, and agency coordination. This project also illustrated well the importance of maintaining context sensitivity and flexibility all the way through construction. Staff from Maryland SHA noted that this project illustrated well that having good people involved who were flexible, who could "roll with the punches," was a critical success factor.

While stakeholders recognized the need for the project and understood the proposed solution, they expressed concerns and desires about the execution of the design. Through numerous meetings, design revisions, and tailoring of the project, a context sensitive design solution was accomplished.

Design Flexibility and Application of Design Criteria

Fitting the desired cross section (a six-lane divided arterial with 12-foot lanes) into the corridor required design flexibility along the route. Three notable examples are illustrated in the following photos.

At one location, a special modular masonry retaining wall was constructed to retain parking areas and driveway access to commercial businesses. Special design was necessitated when a problem with design mapping was found; the solution retained the key functionality of the plan.

At another location, preservation of mature trees required special design due to widening and profile requirements. Rather than a concrete or masonry wall, special timber wall designs were used that blended into the surrounding area better.

Perhaps the most notable feature of the project is the design to accommodate the retention of a prominent, beautiful mature oak tree. Original plans for the widening showed the tree needed to be taken. Design staff from the SHA reviewed the alignment and cross section, inspected the tree and surrounding areas in the field, and committed themselves to preserving the tree through re-design. The cross section and horizontal alignment were adjusted to place the tree in the median of Route 355. The profile of one direction of travel was raised to create space for the tree's root system, and a special irrigation and monitoring system was designed. Steel-backed, timber -faced guardrail (meeting NCHRP 350 crash testing requirements) was used to shield the tree. (This more expensive guardrail system was used elsewhere on the project, including at Great Seneca Park, to blend into the natural surroundings.)

The design also demonstrated a commitment to enhance the mobility of pedestrians. An 8-foot-wide, multi-use (pedestrians and bicyclists) path was constructed, including brick splitter islands and special crosswalk treatments at intersections. Plantings were used at certain locations to protect bicycle riders from steep slopes at drainage structures. At a high volume bus shelter, the area for the multi-use pathway was expanded to accommodate both users and transit riders.

Design and Construction Enhancements – Fitting the Context

Design and construction staff made a concerted effort to minimize the adverse effects of this major widening project. At Great Seneca Park, the project included reforestation and provision for a parking area and access pathway into the park. At other locations, similar field changes were made to drainage swales, pathway location, and utility relocation to enable retention of large trees. During construction, field staff noted that changes in the grading plan would enable the retention rather than loss of a significant number of major trees along the right-of-way; the changes were made.

Special plantings were used at stormwater ponds for neighborhoods, preserving the natural feel for the area. At another stormwater pond on the Lockheed-Martin property, an agreement was reached between the SHA and Lockheed-Martin for the use of the pond, and for replacement and additional plantings. Other field changes were made to accommodate plantings at a number of commercial and residential properties (Holiday Inn, Montgomery Village Apartments).

Application of Montgomery County's stormwater management ordinance would have required taking of trees at one location. An alternative, use of a wetland bank, was agreed to by all stakeholders as the preferred solution.

Design enhancements even extended to individual property owners. SHA's construction engineer, noticing a difficulty that would be faced by a resident using a reconstructed driveway, offered to construct a driveway T on the resident's property to facilitate safely turning around and entering the arterial (rather than backing onto it).

Stakeholder Involvement

Tailoring of the design, resolving problems, and developing site-specific solutions required significant effort to work with individual stakeholders. The discussion above highlights some of this activity. There were many other examples of working with stakeholders to accomplish a finished design. For example, the SHA negotiated an Memorandum of Agreement with the City of Gaithersburg in which the city agreed to take responsibility for median and roadside plantings within city limits. In turn, SHA was able to commit to an enhanced landscaping plan above that they otherwise would have implemented.

Individual agreements with homeowner associations were also reached for plantings and aesthetic treatments. In one location, agreements were reached with property owners to include wood fencing on top of retaining walls for nose attenuation and improved privacy.

Extensive coordination with other governmental agency stakeholders also occurred. In addition to the design improvements at Great Seneca Park, parking and pathway improvements, use of timber faced rail illustrate concerns about the facility blending in with the Park.

LESSONS LEARNED

A number of key lessons can be gleaned from this case study. First, CSD/CSS applies all the way through construction. Indeed, many of the long lasting positive features of the constructed solution were arrived at in the construction phase. Second, related to the above, effective CSD/CSS requires a local presence in the field. Third, active engagement with individual stakeholders is necessary to maintain context sensitivity. Solving problems one by one requires working on an individual basis. Fourth, paying attention to details is important. The cumulative effect of a long series of small, seemingly insignificant actions can have a measurable effect on the final product and on stakeholder perceptions of the agency (SHA).

Finally, a lesson learned is that bringing the right resources with the right sense of professional responsibility and environmental stewardship, who are flexible and able to deal with a number of unforeseen circumstances, is essential to project success. Converting a two-lane highway into a six-lane arterial in a built-up area, and doing so in a manner that the finished project fits with the surrounding area, is no small feat.

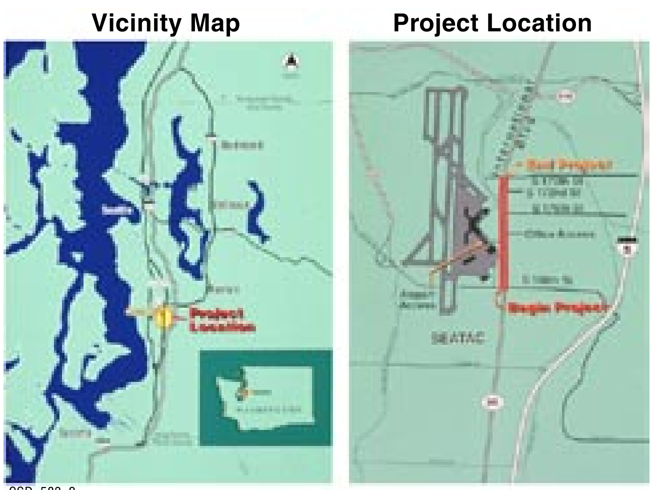
CASE STUDY NO. 5

WASHINGTON SR 99

INTERNATIONAL BOULEVARD

SETTING

The International Boulevard project is located within the City of SeaTac in King County, Washington (see Figure 1). King County, which includes the City of Seattle, is the most populous county in Washington. The City of SeaTac, incorporated in 1990, has an area of roughly 16 square miles and a population of about 23,000. Seattle-Tacoma (Sea-Tac) International Airport is located within the SeaTac city limits.



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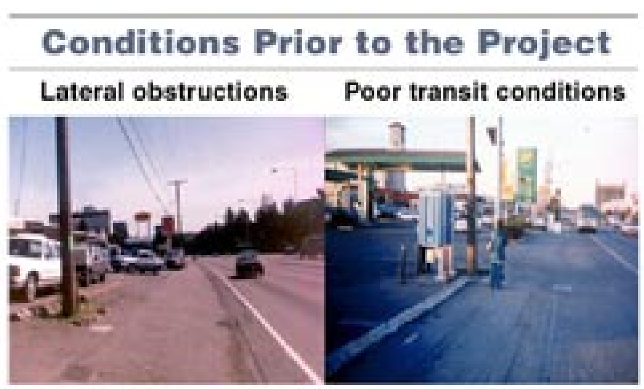
The newly incorporated City developed Comprehensive and Transportation Plans that established land use goals and proposed transportation facility improvements. The City was designated as an urban center under the State's Growth Management Act and under that designation was identified for substantial increases in the development density along the City's existing commercial corridor. This development follows the International Boulevard corridor. Existing land uses include some of the region's largest motels, Sea-Tac International Airport, office towers, airport-related rental car and park-and-fly facilities, and other retail uses. The Transportation Plan proposed expansion of International Boulevard to increase traffic capacity and improve pedestrian access.

International Boulevard is a major north/south arterial that serves local and regional traffic within the City of SeaTac, Washington (see Figure 2). International Boulevard, is part of signed State Route 99 (SR 99) which spans three counties and over 50 miles from South Snohomish County to North Pierce County. Prior to the construction of the Interstate System, SR 99 was a major Pacific coast route spanning Washington, Oregon, and California. Today, that portion of SR 99 within the Puget Sound region serves as a regional link between cities and as a major route to Sea-Tac Airport, with access to the terminal and airport parking. It is also a part of the State's urban arterial system, and has been designated as a National Highway of Significance, as well as an emergency evacuation route.

Average 1992 daily traffic volumes on International Boulevard varied from 31,600 vehicles per day (vpd) at South 170th Street to over 40,000 vpd at South 188th Street, with the highest daily traffic volumes (over 42,000 vpd) occurring directly adjacent to the airport entrance.

PROBLEM TO BE SOLVED

The project described in this case study is the first of these segments, from South 188th Street to South 170th Street. This section of International Boulevard fronts Sea-Tac Airport. Sea-Tac Airport and International Boulevard serve as a gateway to the United States and Puget Sound region for many visitors from around the world. International Boulevard has experienced significant traffic congestion, substantive safety problems, inadequate pedestrian facilities, and unsightly commercial strip development. Solutions to the transportation problems were sought that would promote and enhance re-development of the corridor as an attractive gateway.



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The following is a summary of the transportation problems to be addressed:

SAFETY PROBLEMS

Accident rates for mid-block segments were as high as 4.9 accidents per million vehicle miles for the section between South 188th Street and the Airport Access. Approximately 55 percent of the accidents in the corridor are property damage only; the remaining 45 percent are injury accidents. There were two fatal accidents in the corridor during the period between 1990 and 1993. A number of the more serious crashes involved pedestrians. Other crash problems were associated with the lack of access control along the corridor and the strip commercial development.

CONGESTION AND MOBILITY PROBLEMS

The level of service (LOS) for the existing p.m. peak hour for five key intersections ranged from B to F in the project corridor. The corridor is well-served by transit. Prior to the project, there were ten transit stops within the project limits (five northbound and five southbound). Only three of the ten transit stops provided a shelter for transit users.

Significant design constraints included limited existing right-of-way (100 feet), and substantial underground and overhead utilities.

Utility Undergrounding

CSD_584_2

Before and After

CSD_586_2

Before and After

CSD_585_2

Before and After

CSD_587_2

STAKEHOLDERS

- SeaTac Community Planning Department
- International Boulevard Committee
- Washington State Department of Transportation (WSDOT)
- King County/Metro Transit (Metro)
- Port of Seattle
- Puget Power
- General public

CSD/CSS APPROACH

Stakeholders were able to obtain funding for improvements to the corridor. The amount of the funding available for design, construction, and right-of-way was $7.3 million. Restrictions on the limit of funds were available meant that the project had a tight schedule, with an advertising for bids required within 15 months from beginning of the project development process.

Initial funding was based on a plan that envisioned widening International Boulevard to a seven-lane cross-section, including sidewalks. Concurrently, with initial planning, the City of SeaTac's Department of Community Development was working with a citizen and business advisory committee, the International Boulevard Corridor Advisory Committee, (IBC Committee), to develop a land use plan for the corridor, which also included urban design and transportation infrastructure considerations. The City assigned the IBC Committee a responsibility to review the development of the street design.

Other major stakeholders for the project included WSDOT, Metro, and the Port of Seattle. Each made financial contributions to the construction budget. WSDOT had partial jurisdiction for this project given their responsibility and authority for geometric design and safety for SR 99. WSDOT concerns focused on their recently adopted statewide Access Management Plan, which called for reconstruction projects along state routes to meet specified access management standards. Metro was concerned about the speed and reliability of transit services along SR 99. Because SR 99 is a primary access route to Sea-Tac Airport, the Port of Seattle was concerned about increasing the capacity of the roadway.

The schedule, number of stakeholders with different interests, and complexity of the project required close coordination and a comprehensive but focused planning process. The process was designed to identify issues and needs, develop alternatives, and evaluate and establish the preferred alternative. The alternative selected (presented in detail in the next section) included a center, raised median and other access management measures. Information on the planning work was provided at two open houses and in citywide newsletters. This initial effort was completed in May 1994 with the adoption of the plan at a City Council meeting.

Opposition to the plan surfaced after the City Council had acted to adopt it, when meetings were held with individual property owners to discuss right-of-way needs and property interface designs. The IBC Committee included some representatives from adjacent businesses.

A series of meetings with property owners and WSDOT was held over several months to develop solutions to property owner concerns regarding reduced access. Generally, the concepts developed consisted of various configurations for mid-block median breaks to enable partial or full access movements. Driveway consolidations were also considered, along with joint access between properties. Ultimately, a final public hearing was held to review the need for access management and the alternative access concepts that had been discussed with property owners throughout the summer, and to get City Council adoption of the access concepts that would be integrated into the final design. This hearing resulted in a majority consensus on acceptable access concepts, although a small number of property owners were not satisfied with the final plan.

Design Flexibility and Application of Design Criteria

The project design development process included consideration of three build alternatives and a no-build alternative. The alternatives included five-, six-, and seven-lane configurations for the roadway. The alternatives represented a spectrum of possible traffic improvements for International Boulevard. All alternatives provided sidewalks for pedestrians and widened curb lanes to accommodate bicycles and transit. Optional design features were also developed that could be incorporated into any one of the three build alternatives. The design options included either a raised, landscaped center median or a median consisting of a continuous two-way, left-turn lane. Alternative capacity improvements, HOV/transit treatments, access management measures, non-motorized mode options, signal system improvements, utility modifications, illumination concepts, and landscaping treatments were also developed.

Many of the design challenges on the International Boulevard project are described below, and discussed as to how they were accommodated.

Public and agency opinions regarding capacity needs ranged from reducing the number of lanes and emphasizing local access to widening the arterial to seven or more lanes provide additional regional capacity. Limited construction funding and right-of-way constraints made cost-efficiency an important consideration. Decisions were made to add an HOV lane in the p.m. peak flow direction (southbound), add approach lanes at congested intersections, incorporate access management measures, improve the signal system, and enhance facilities for transit and non-motorized modes.

Treatments to improve the accessibility, speed, and reliability for transit and HOVs included the southbound HOV lane, new bus shelters, bus stop enhancements, and signal design to enable transit signal priority. New guidelines on arterial HOV lane signing and striping, recently established through a regional ad hoc committee, were incorporated into the design.

Pedestrian amenities included sidewalks, decorative lighting at bus zones, sidewalk linkages to adjacent land uses, and two mid-block signalized pedestrian crossings (one of these is combined with a new signalized driveway access). Because this roadway is currently the only north-south route for bicycle travel, Class IV Bikeway lanes were also provided.

All existing and new signals were furnished with NEMA-type controllers to allow integration with the rest of the City's signal system. These signals were interconnected and controlled with an arterial master controller. In addition, the system included equipment to enable signal priority in the future.

The need to relocate utilities due to the road reconstruction and public concern regarding the poor aesthetics of overhead utility lines led to a decision to underground and reconfigure the utilities. Electrical power distribution lines and telephone and television cables were placed underground. Power transmission lines were relocated on new poles at greater spacing. The illumination system was improved to meet current lighting standards. To save money and improve construction coordination, this work was included in the roadway construction contract (ordinarily the utility companies construct these improvements).

Aesthetics were improved by planting trees along the sidewalks, special sidewalk paving patterns, a landscaped median, and landscaped transitions with adjacent properties.

The most controversial issue for this project involved implementation of raised medians for access control and safety. The combination of speed (45-mph speed limit), high traffic volume, and number of lanes led to an agreement to replace the center two-way, left-turn lane with a raised median; driveway controls and consolidations were also included. Compromises included the incorporation of U-turn designs into key intersections and the development of two mid-block median openings (one of these was signalized to provide consolidated driveway access).

Trees in Narrow Median

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Integration of Public Art

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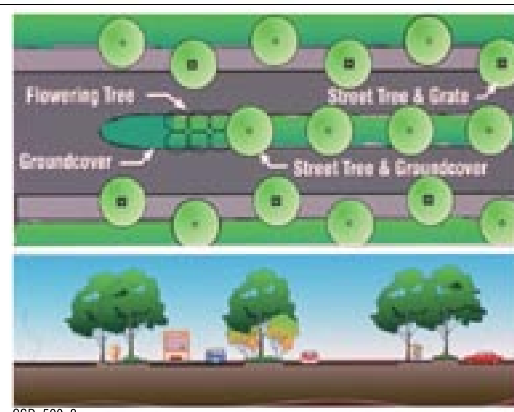
Landscape Treatments



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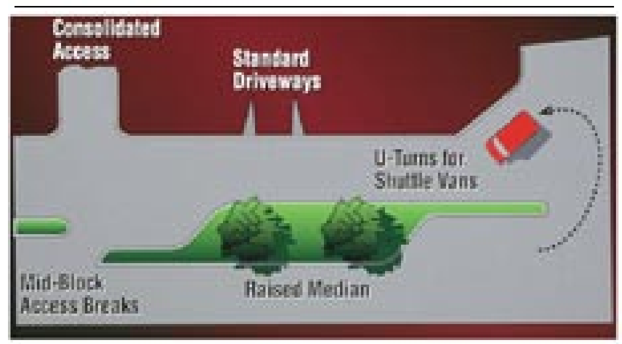
Access Management



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STAKEHOLDER INVOLVEMENT

The plan reflected an active and ongoing effort to negotiate solutions and design compromises among the various stakeholders. The final plan included some concepts that did not meet WSDOT standard design approaches. Unusual features included U-turn median openings, provision for landscaping in the median, and a mid-block pedestrian signal. WSDOT was involved in the decision process and understood the required compromises. Land owners compromised as well, accepting access consolidation and the raised median in return for other amenities. The City of SeaTac submitted requests and justifications for several design exceptions to WSDOT and received approval to implement the adopted plan.

LESSONS LEARNED

This project illustrated well that dealing with multiple, conflicting stakeholders within a constrained budget and schedule is possible as long as the key stakeholders understand the problem, have a clear vision of the solution, employ an open and creative process, and commit themselves to compromise. The project also illustrated well that CSD/CSS represents a series of choices, not mandates. Issues of number of lanes, mobility for different users, different ways to treat access safety problems were all looked at from different perspectives.

Many design issues and constraints needed to be addressed during the course of planning and design of the project. The affected community and agencies were actively involved in the development and evaluation of alternatives, and negotiation of modifications to the design. Diverse views of the various community and agency stakeholders needed to be considered. The adopted design was a comprehensive solution to the conditions, and the design incorporated elements of transportation capacity, HOV/transit treatments, access management measures, non-motorized mode improvements, signal system improvements, utility and illumination enhancements, and landscaping improvements.

Specific lessons learned dealt with access management, which is generally the most difficult issue to address in built-up urban arterials. For the International Boulevard project, access management was the single most controversial and challenging aspect of the project.

- Access management is only one part of the design for reconstruction of an arterial street. Access management measures were integrated into the overall, comprehensive design. Access management measures alone would not have satisfied all of the conditions at hand, including the needs of the community and agency stakeholders.
- Use of raised medians within the arterial cross-section is only one of the access management tools to be considered. Access management should be considered as a solution to solve traffic safety concerns. Other measures such as driveway designs, controls, reductions, and consolidations should also be emphasized to address safety problems.
- Inclusion of medians on arterial reconstruction projects has some problems that need to be considered. These include change or reduction of access to some properties and generation of U-turn demand at intersections, which affects safety and traffic capacity. Therefore, it is likely that reconstruction to include a median may only be warranted under certain conditions such as high volumes (e.g. greater than 30 thousand vehicles per day), high speeds (e.g. greater than 40 miles per hour), and multi-lane cross-sections (e.g. greater than four lanes).
- Medians can provide other benefits (beyond vehicle traffic safety) for a comprehensive design solution. These can include safety for transit, bicycles, and pedestrians. They provide opportunity for landscaping and aesthetic improvements. They can help reduce the amount of impervious surface and thereby reduce the amount of stormwater drainage and detention system requirements.
- Substantial public education and involvement is needed when considering access management as a part of a major arterial design solution. Business owners are almost always going to oppose these measures at the beginning of the design process. The community and agency stakeholders need to be brought along slowly, first understanding the issues and problems (such as accident problems), then looking at the solutions (which may include some access management measures).

While good technical guidance is important for agencies to employ, in actual application it is likely that compromises will be needed in order to get agreement to include any access management measures in a typical design problem. In the case of the International Boulevard project, if compromise breaks in the raised median were not identified and accepted, the project may not have been acceptable to the key stakeholders.

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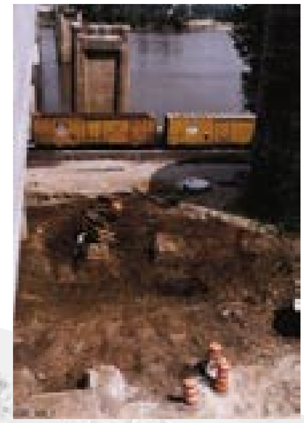
CASE STUDY NO. 6

COBBLESTONE STREET INTERPRETIVE PARK

BOONVILLE, MISSOURI



SETTING

Boonville, Missouri lies along the south bank of the Missouri River about 90 miles east of Kansas City. The Missouri Department of Transportation (MoDOT) was planning the construction of a new bridge over the Missouri River to carry traffic using U.S. Route 40.

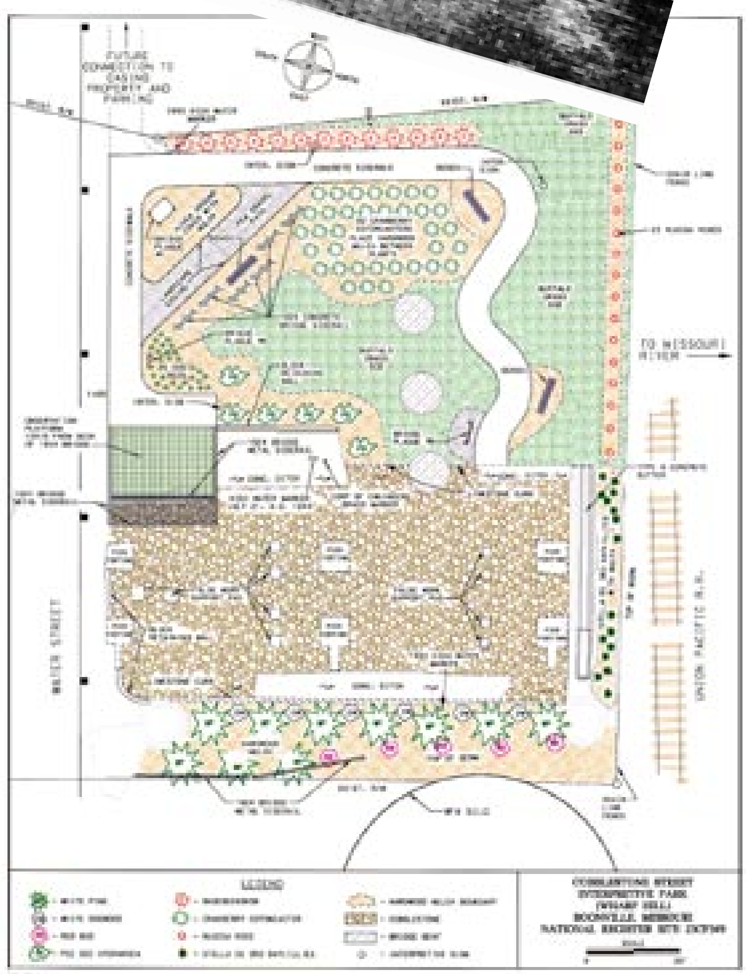
As part of the site investigations and planning, a cobblestone street in Boonville was re-discovered. The street was believed to be the first paved street west of St. Louis. Its construction consisted of cut limestone curbs set about 50 feet apart with unmortared limestone cobbles of various sizes, Cobblestone drainage ditches extended the length of the street.

The cobblestone street represented a precious link to the days of steamboat traffic. From the 1830s to early 1860s, hundreds of steamboats docked at the Boonville wharf each year. Mulecarts and horse-drawn wagons carried freight up the steep slope of the river bank to the businesses at the top of the wharf. Boonville was a regional center of trade; with farmers and merchants shipping pork, flour, tobacco, and other products down river to St. Louis.

After the Civil War, railroads began to replace steamboats. The first railroad reached Boonville in 1869; busy steamboat traffic ended shortly thereafter.

Through the intervening years, the cobblestone street entered into disuse. Three to 4 feet of soil accumulated gradually over the northern block of the street. The southern block remained untouched until construction of the 1924 Old Trails National Highway Bridge.

In 1989, as the MoDOT began planning efforts for the new bridge, the Director of Friends of Historic Boonville called MoDOT's attention to the wharf area and street. Wharf Hill had recently been placed in the National Register of Historic Places, and the Director wanted assurances that the historic property would be preserved and/or protected during bridge construction.



PROBLEM TO BE SOLVED

The problem was essentially to investigate the site and determine what measures would be needed to preserve the cobblestone street and other elements of the historic site.

STAKEHOLDERS

- Missouri Department of Transportation
- City of Boonville
- Friends of Historic Boonville
- Missouri Department of Natural Resources
- Missouri Historic Preservation Program Office
- Advisory Council for Historic Preservation
- Americans with Disabilities Act Project of Columbia

CSD/CSS APPROACH

The CSD/CSS approach combined active discussions among the stakeholders involving field investigations, negotiations, and the development of a plan to not only preserve, but indeed enhance the historic resource.

Archaeological investigations of the street showed that much of it was disturbed through portions, but other portions remained undamaged. There were difficulties in fully investigating the status of the street as an existing railroad bed crossed over the street.

Stakeholders (MoDOT and the Friends of Historic Boonville) agreed upon a plan wherein preservation of the street would be accomplished through development of an interpretative park. Preliminary design plans were developed and approved by the Department of Natural Resources and other state offices. It was agreed that upon completion of the park the City of Boonville would retain ownership.

Construction of the park required careful planning. Special rubber-tired equipment was used in removing the overburden to minimize possible damage to the cobblestones. Some areas were repaired, with cobbles and cut limestone curbing salvaged from damaged locations and replaced to resemble the original 1830s paving.

The design of the park itself involved collaboration among the many stakeholders. The park was designed to be ADA-accessible. Other objectives in planning the park included preservation of the street in its original location, incorporation of the Old Trails National Highway Bridge elements into the park, provision for interpretive stations to inform visitors of the history and importance of the site, and pleasing landscaping.

Eleven years after being informed of the cobblestone street, the interpretive park was completed and opened for all to enjoy. It has become a local landmark, and a source of pride within not only Boonville, but also the Missouri Department of Transportation.

CSD_564_1

LESSONS LEARNED

Local stakeholders are the key to identifying and preserving local historic and other cultural resources. A commitment to work with them can yield projects of great value and pride.

This project also illustrates that the job of a DOT goes beyond the mere provision of safe and efficient transportation. Seizing opportunities to preserve and enhance a community are what CSD/CSS is all about.

CASE STUDY NO. 7

U.S. ROUTE 6

BROOKLYN, CONNECTICUT

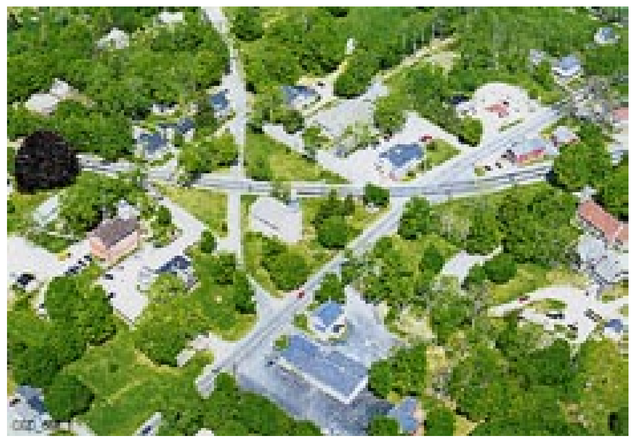
SETTING

U.S. Route 6 is the primary regional arterial carrying east-west traffic between Hartford, Connecticut and Providence, Rhode Island. U.S. Route 6 passes through the Town of Brooklyn roughly half way between the two cities. Route 6 is a major, principal arterial in rolling terrain operating with 8,000 to 10,000 vehicles per day at relatively high speeds on the approaches to the town. The Route carries substantial through truck traffic.

The Town of Brooklyn is typical of small Connecticut towns. The main road proceeds through the center of town. There are many historic and treasured features within the town, including the Town Hall, Unitarian-Universalist Church, the Town Green, an historic Well House, and a 150-year-old Copper Beach Tree. The Center of Brooklyn is designated as the Brooklyn Green Historic District and is listed in the National Register of Historic Places.

U.S. Route 169, a north-south primary arterial, crosses U.S. Route 6. U.S. Route 169 is a Connecticut Scenic Road and a National Scenic Highway.

The existing road for Route 6 is narrow, with narrow or no shoulders in many places. The horizontal and vertical alignment reflect outdated design criteria, produce sight distance deficiencies, and create difficulties for drivers. For much of the project area, residences abut the highway. The difficult alignment and poor sight distance adversely affect drivers entering and exiting driveways.



Improvements to U.S. Route 6 were identified as necessary as far back as the 1950s. Planning studies were conducted in the 1970s to investigate the potential for developing an expressway facility on independent alignment parallel to U.S. Route 6. Environmental concerns and opposition to the expressway resulted in it being dropped from consideration in the early 1980s. At that point, it was recognized that improvements to existing east-west corridors, and in particular to U.S. Route 6, were necessary.

PROBLEM TO BE SOLVED

The 5-mile section of U.S. Route 6 was the last segment not upgraded. Problems to be addressed included replacement of the pavement that had deteriorated due to heavy truck traffic, improvements to the alignment to address safety problems, and improvements to the cross section to facilitate safe operations. The following specific traffic operational problems were identified associated with the combination of the geometry, traffic, and roadside conditions:

- Turning vehicles delay through traffic and create rear-end conflicts, and lack of shoulders limits the ability to perform emergency avoidance maneuvers
- Enforcement of speed limits is difficult due to lack of shoulders

- Driveway access and local mail delivery is a safety concern, due to poor sight distance and lack of shoulders
- Rock cuts, trees, drainage structures, and other objects represent hazards to drivers
- Poor pavement condition and inadequate drainage exists in many locations
- Four creeks cross U.S. 6 within the project limits

STAKEHOLDERS

- Town of Brooklyn (general public, adjacent landowners)
- Town Council
- Local wetland commission
- State Department of Environmental Protection
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Environmental Protection Agency

CSD/CSS APPROACH

The Connecticut DOT looked at multiple alternatives to address the need to maintain and even upgrade the traffic carrying capability of U.S. Route 6. Among the alternatives considered was a bypass of the center of town. This would have meant running traffic through residential neighborhoods so focus was placed on improving the existing alignment.

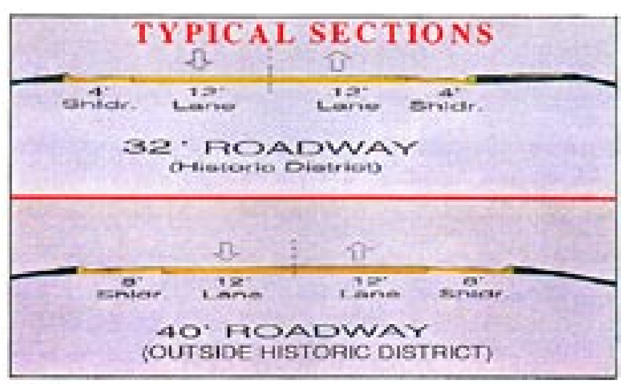
Given the overall context, U.S. Route 6 was to remain a two-lane principal arterial. While residents of Brooklyn recognized the function of the highway, and also acknowledged their own concerns about its safety, they expressed strong preference for a design that did not adversely effect the character of the town, and specifically, the Green. Indeed, a concern of the town was the speeds of through traffic and conflicts with pedestrians and local business traffic in the town.

The project represented a design challenge. Improving the vertical alignment resulted in potential adverse effects on front yards, older trees, stone fences, and wetlands. Similarly, developing a functional, wider shoulder offered similar adverse impacts. It was necessary to select a design speed and execute a design that balanced the through-traffic carrying capability of the road with its impact on the community.

DESIGN FLEXIBILITY AND THE APPLICATION OF DESIGN STANDARDS

Connecticut DOT staff reduced the design speed from 55 mph to 45 mph on the approach to the town. This had the desirable effect of minimizing roadside impacts and facilitating driveway access. Emphasis in the align-

ment and cross section design was placed on developing speed consistency and reducing speeds gradually on the approaches to the town. Achieving this involved varying the cross section. On either side of the Historic District, full 12-foot lanes and 8-foot shoulders were designed, representing substantial geometric improvements over the existing cross section. Vertical alignment upgrades were accomplished, and minor horizontal alignment improvements were made. On the approach to the Historic District, the roadway is tapered from 40-foot total to 32 feet by narrowing the shoulders (the 40-foot width was retained in some locations that included commercial driveways). The narrowing of the shoulder was accompanied by signing and landscaping to visually narrow the feel of the road and promote lower speeds through the town. Sidewalks were added along one side of the road at the request of the Town.



Some horizontal curve improvements were made, and intersection improvements (including closing of some minor intersections to eliminate conflict points) were included. Signal system improvements were also included.

Throughout the design process, Connecticut DOT staff worked closely with all stakeholders to avoid adverse effects. Some operational and safety features, most notably a proposed truck climbing lane, were eliminated to minimize adverse effects.

Stakeholder Involvement

Town of Brooklyn stakeholders were initially skeptical of Connecticut DOT staff. A long and contentious history related to studies of the proposed expressway was a legacy to overcome. It was necessary to work hard to establish a positive working relationship.

The relatively close right-of-way and frequent points of conflict represented challenges to the DOT staff attempting to explain design concepts, and to town residents concerned about effects on the Green, the church, and the Copper Beach tree.

Connecticut DOT staff used visualization techniques for one of the first times to help depict designs and discuss alternatives with the townspeople. Visualizations were particularly helpful in investigating alignment and intersection concepts through the Green.

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CASE STUDY NO. 8

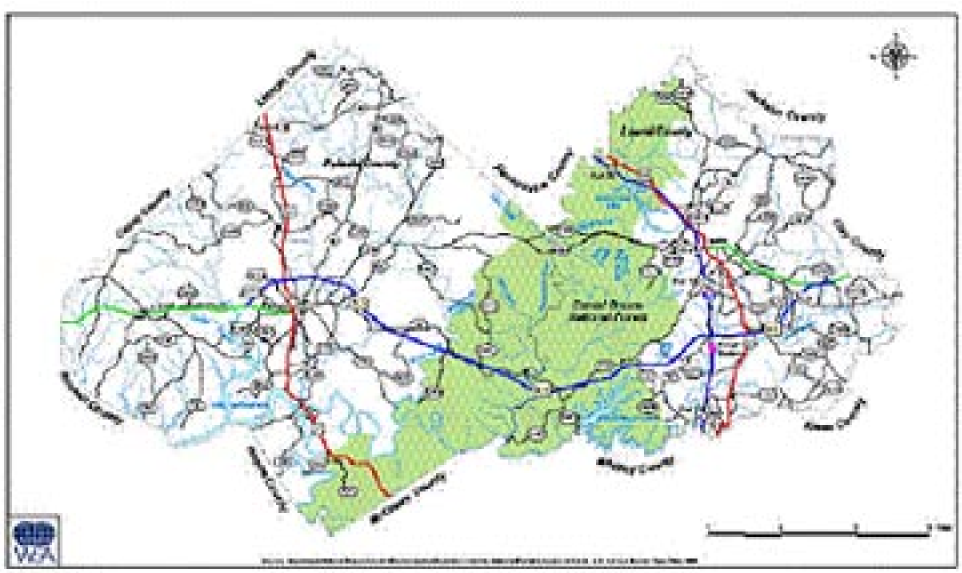
KENTUCKY PROPOSED I-66

SETTING

In 1997, the Kentucky Transportation Cabinet (KYTC) completed a study that concluded that the Southern Kentucky Corridor (I-66), previously identified as part of a priority corridor in the Intermodal Surface Transportation Efficiency Act (ISTEA) was feasible. The longer corridor was subdivided into segments with independent utility. The segment from Somerset to London was identified as a high priority corridor in the Transportation Equity Act for the 21st Century (TEA-21).

The Somerset to London segment of I-66 would provide an interstate-level connection between the Daniel Boone Parkway to the east and the Louis B. Nunn (Cumberland) Parkway to the west. There are two existing linkages, KY 80 and KY 192. KY 80, to the northern side of the study area, consists of two-and four-lane sections and has only partial access control. KY 192, to the southern side of the study area, is an older two-lane highway with two nine-foot-wide lanes and two-foot shoulders.

Both existing linkages experience both safety and emerging traffic operational problems typical for their age and design characteristics. Twenty eight percent of the mileage along KY 80 is considered to be "high accident" mileage, and fully 59 percent of KY 192 similarly high accident mileage. Existing traffic volumes are highly variable along both routes but are forecast to increase from 100 to 200 percent over the next 30 years. Current traffic operates at level of service (LOS) B to C, but will decline to LOS D/E/F conditions by 2030 if no action is taken in the Somerset to London segment.



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The study area is home to many natural, scenic, and sensitive areas such as the Daniel Boone National Forest, the state designated wild river portion of Rockcastle River, Cane Creek Wildlife Management Area, Laurel River Lake, Lake Cumberland, Cumberland Falls State Park, General Burnside State Park, Levi Jackson State Park, and the Sheltowee Trace National Recreation Trail. These are areas of scenic beauty and biodiversity with numerous blue-line streams, natural wetlands, and, throughout the western portion of the study area, an extensive cave system.

In June 1999, KYTC presented an initially preferred corridor at public meetings in the two communities. An alternative that largely followed existing KY 192 was presented as the preferred alternative. Generalized corridors north and to the middle of the study area had been considered by KYTC staff but not carried forward. The southerly location of KY 192 offers the advantage of not crossing the wild river portion of Rockcastle River, of having less adjacent development that would require either acquisition or access roads, and of providing more accessibility to the tourism and recreation areas important to the region's economy.

While many citizens who attended the public meetings favored improving KY 192 or at least supported the concept of constructing I-66, there was considerable opposition to the KYTC identified preferred corridor based on concerns with the environmental impacts along the corridor. Approximately two-thirds of those responding favored I-66 but about half of those responding identified an alternative other than KYTC's initially preferred alternative.

PROBLEM TO BE SOLVED

The problem faced by KYTC was how to:

- Address a priority corridor identified in TEA-21 and receiving considerable Congressional attention
- Prevent extensive LOS "F" as traffic volumes increased in a popular recreation area
- Reduce already high accident rates likely to increase as traffic volume increased
- Improve economic conditions in a traditionally higher unemployment/lower income area through improved transportation facilities
- Provide a revised process for corridor(s) evaluation that would involve stakeholders while yielding recommendations consistent with the project goals

STAKEHOLDERS

A wide range of stakeholders representing environmental, economic development, statewide, and local interests were involved in the project. Due to the sensitive nature of the study area, many resource and regulatory agencies were also directly involved.

- Cumberland Valley Area Development District
- Federal Highway Administration
- Kentuckians for the Commonwealth
- Kentucky Department of Fish and Wildlife
- Kentucky Heartwood
- Kentucky Heritage Council
- Kentucky Tourism Development Cabinet
- Kentucky Transportation Cabinet
- KICK 66
- Lake Cumberland Area Development District
- National Speleological Society
- Sierra Club Cumberland Chapter
- U.S. Fish and Wildlife Service
- U.S. Forest Service, Daniel Boone National Forest

CSD APPROACH

The planning phase of I-66 Somerset to London segment occurred about the same time that Kentucky was moving into the national forefront of the context sensitive design movement. While not yet in the final design stage where design flexibility is most appropriate, KYTC has been implementing the spirit of CSD/CSS on I-66 through their approach to public involvement, environmental considerations, and open decision making.

This approach was evident in the KYTC's reaction to public input from the 1999 meetings. Following the June 1999 meetings, KYTC acknowledged the need to reexamine the criteria and process that led them to identify the initially preferred alternative.

The northern corridors, including the KY 80 corridor, that were previously not given detailed consideration in part because of the crossing of a wild river, were reexamined with a realization that use of the existing right-of-way would not constitute the same level of impact as the need for new right-of-way.

An alternative corridor was identified that would cross more National Forest land, but would cross through areas that have been extensively modified through logging and mining.

The level of information available to the public was expanded substantially. The data and decision making processes are well documented on the Internet as well as through more traditional media. The Evaluation Matrix explicitly shows the tradeoffs involved in this complex multi-disciplinary decision.

Through the new alternatives development process and active stakeholder engagement, KYTC staff determined that an overall better alignment solution was available. The selection of what is known as the N-4 Alternative as the preferred alternative kept open the door for ongoing refinements, particularly still greater use of the KY 80 corridor near Somerset.

In the planning stage, KYTC decided to use fairly typical AASHTO design criteria. However, even in a planning report KYTC acknowledges the role flexibility plays in highway design. Future phases of the I-66 corridor project may involve further geometric criteria and issues, at which point it would be appropriate to begin consideration of potential flexible design components. The purpose of flexible design methods is to aid designers in the design and construction of a roadway while preserving or enhancing scenic, historic, environmental and community resources in the vicinity of the project.

Current preliminary design efforts in the vicinity of Somerset include a stakeholder group that has developed criteria to evaluate alternatives. These evaluations will be part of the data reviewed by the project team as they make project decisions.

Public involvement near Somerset has resulted in refinement of preliminary alternatives so that they do not divide areas that are already developed.

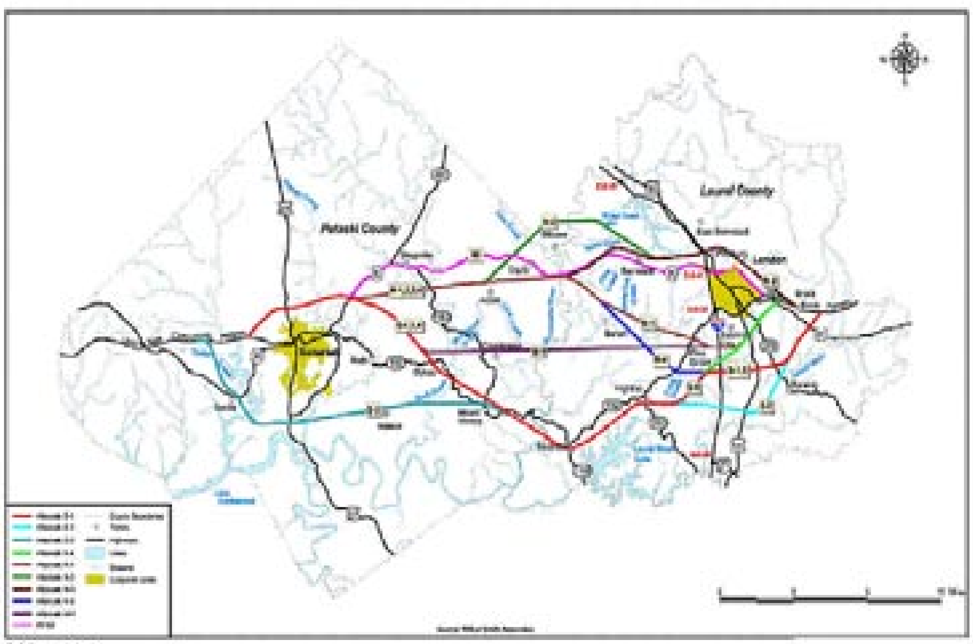
LESSONS LEARNED

In one form or another, the I-66 project has been under consideration in Kentucky since the mid-1980s and is actively moving forward today. In some respects the project is one of the reasons Kentucky has not only embraced Thinking Beyond the Pavement and Context Sensitive Design, they have become a leader.

Public involvement needs to be a more significant part of the planning process than it has been in the past. Although Kentuckians are historically more receptive of new highway projects than citizens elsewhere, the level of dissatisfaction on this project threatened to stop what had the hallmarks of a popular and needed project.

Initial impressions of desirable features are not necessarily correct. In part, a southerly alternative was initially preferred in order to bring more traffic to tourist recreation areas. However, these areas are heavily used now and may not be able to accommodate significant increased traffic.

Although all of the corridor alternates pass through the Daniel Boone National Forest, more detailed review determined that there were major differences among the corridors with regard to the levels of impacts. Examining alternatives and highlighting the differences led to a different decision than was earlier made, but one that has appeared to garner more widespread support.



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CASE STUDY NO. 9

TOWSON ROUNDABOUT

TOWSON, MARYLAND

SETTING

Towson, Maryland is a suburb of Baltimore, in Baltimore County, Maryland. Near the central part of the Towson business district, four major arterials converge at a single location. Joppa Road, York Road, Alleghany Avenue, and Dulaney Valley Road meet at a large, complex multi-leg signalized intersection.

Towson is the Baltimore County seat. A number of historically significant governmental buildings are near the downtown, including the Baltimore County Courthouse. The town is also home to a number of businesses and universities.

PROBLEM TO BE SOLVED

The transportation problem to be solved was relieving the congestion and improving the safety of the awkward, multi-leg signalized intersection. In addition, the business community and City of Towson believed that improvements to the economic viability of the downtown businesses were needed.

The project thus became a combination of congestion relief and local economic enhancement.

STAKEHOLDERS

- City of Towson
- Baltimore County
- Maryland State Highway Administration
- Towson Business Association
- Goucher College
- Individual business owners
- Utility companies

CSD/CSS APPROACH

The Maryland SHA took a proactive approach involving substantial public outreach to understand all problems and issues and to develop a plan for the intersection and surrounding street system that would enjoy widespread support. The project became more than just an intersection improvement project, but instead became a downtown Towson enhancement project.

The circumstances required both a unique design solution as well as extensive community involvement.

DESIGN FLEXIBILITY AND APPLICATION OF DESIGN CRITERIA

Original efforts by Maryland SHA staff to solve the traffic operational problem focused on traditional solutions – removing one or more legs of the intersection to simplify operations. These solutions, however, were not well received as they would have produced substantial changes to traffic patterns and would have disadvantaged many businesses. The SHA took another look at the project. A number of alternatives were developed. Eventually, a signalized roundabout emerged as the preferred solution. At the time this alternative was proposed (mid-1990s) roundabouts were relatively new to the U.S. The SHA engaged expert consultants to help development in analysis of roundabout solutions. SHA staff were open to considering a new and "untested" design solution for this difficult location.

After the decision was made to build the roundabout, plans to incorporate major streetscape improvements to the approach streets were developed and included in the project. The purpose of the streetscape program was to enhance the downtown, and promote the Towson businesses.

STAKEHOLDER INVOLVEMENT

The many stakeholders required an intensive effort to engage and work with all groups. A task force was formed comprised of representatives of the SHA, Baltimore County, the community, and Towson Business Association. This 30-to 40-member group met monthly to keep informed, trade information, consider design issues, and deal with funding and local coordination issues. The Towson Business Association served as a conduit for individual businesses to raise questions or seek information about the project. Issues of importance ranged from policies on cost sharing of streetscaping, to on-street parking, utility coordination, maintenance of traffic, and business impacts during construction.

One of the colleges in the town has a special program for the disabled. A major concern was the accommodation of blind pedestrians in the downtown. There is also a large population of elderly in the area, many of which walk in the downtown area. Special outreach to this constituency was part of the stakeholder program.

The Maryland SHA and Task Force recognized that many citizens would be apprehensive about or not understand the new, unique design solution of the roundabout. An extensive public information and outreach campaign was developed to explain the project and demonstrate and educate how roundabouts work (driver behavior, pedestrian accommodation). Visualizations were used to show how the streetscape and roundabout would change the downtown atmosphere for the better . A special video was produced that explained how roundabouts worked. Given the nature of many of the constituents, it was necessary to hold many group meetings at churches, retirement centers, and other venues. There were many small group meetings held throughout the area during the project.

Stakeholder involvement was also viewed as critical during actual construction of the roundabout and streetscape program, due to the tight working areas and concerns of local businesses about adverse effects during construction. The SHA assigned an on site construction liaison, who was a day-to-day presence during construction. Problems were identified immediately and dealt with expeditiously during construction. Continual contact with stakeholders gave the business community a sense that their concerns were being addressed and everything was being done that could be to minimize adverse impacts.

FITTING THE CONTEXT – A SUCCESSFUL TOTAL SOLUTION

The roundabout and streetscape project are considered a major success. Traffic flow has improved greatly. After an initial 6-month 'learning curve' by drivers and pedestrians, crashes have reduced and their severity is less than before construction.

The roundabout itself and the improvements to the streets are a local source of pride. Moreover, addressing the traffic problems and improving the appearance of the downtown has been credited with re-vitalization of the local business community. A large retail building that was vacant prior to construction has since been acquired and opened by a major retailer. According to the Towson Business Association's Year 2000 Business Directory, "*The Roundabout has relieved traffic congestion in this busy area. Other improvements such as streetscaping and landscaping make Towson an even more attractive place for people to live, attend school, or take a break for a day of shopping.*"

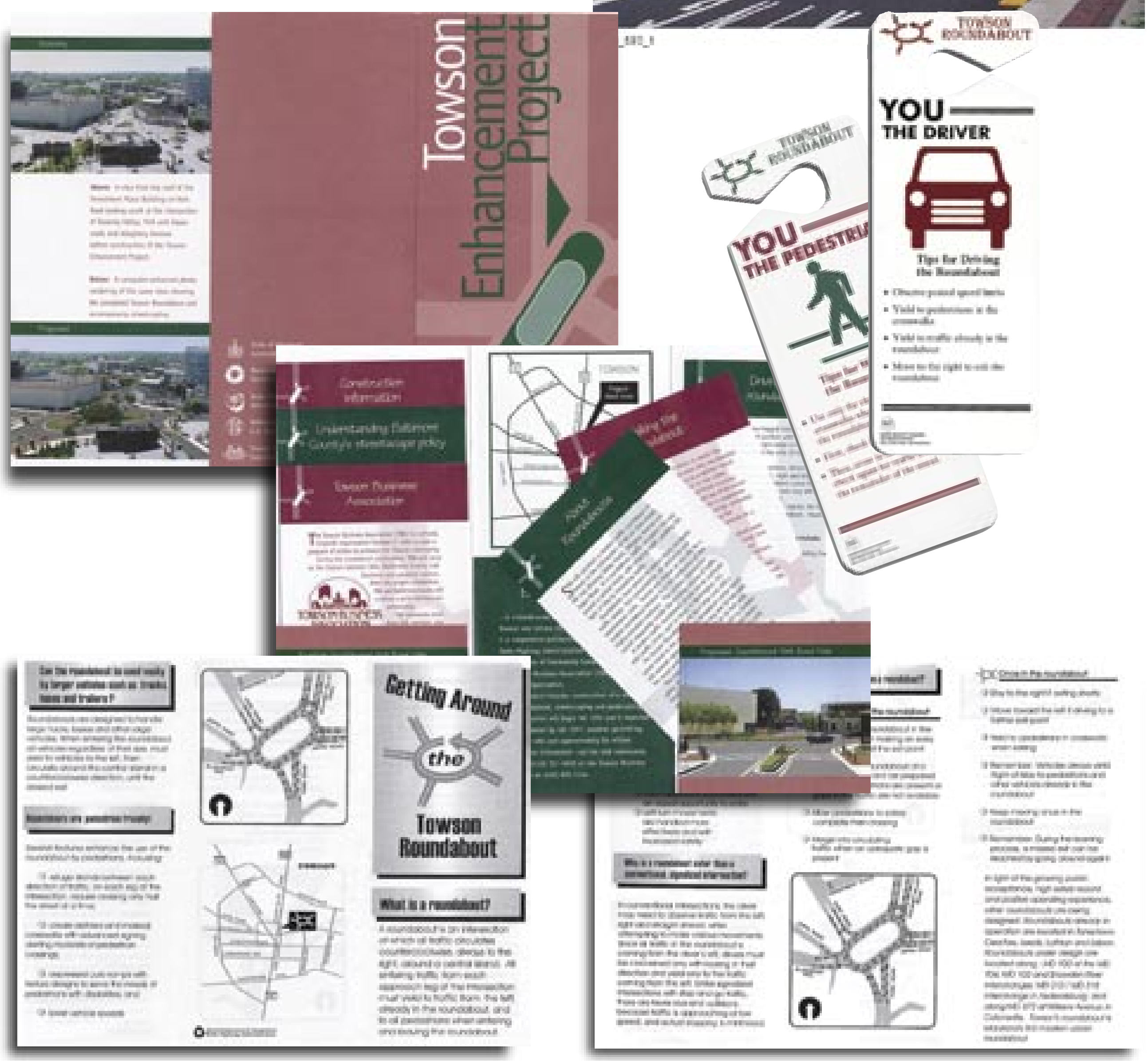
LESSONS LEARNED

This project illustrates the importance of understanding the entire problem and looking at traffic or congestion problem as more than just a traffic engineering issue. There is a relationship between congestion, safety, and livability.

Using the intersection project as a means of enhancing an important downtown business district is being context sensitive in the true sense of the term.

Other lessons learned include the importance of an intensive and tailored public involvement program that reaches all stakeholders in ways that fit their needs. Part of this effort includes the business community. Another part included the specific messages (what are roundabouts, how do they work, what should drivers and pedestrians do) as well as the different media used for delivering the messages. Maintaining constant stakeholder contact through construction is also viewed as critical to project success.

The Maryland SHA and Baltimore County also gained important experience in dealing with practical issues such as maintenance of streetscape and landscaping. Investments in landscaping must be accompanied by a commitment from some entity to maintain the landscaping. SHA staff noted this was a lesson learned after they had completed this project; and it is one that helped shape their current policies with other communities.



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Appendices

All appendices can be found on the CD accompanying this document.

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Example Charter Meeting Notes – I-74 Quad Cities Study

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Hypothetical Case Study Consensus Building, Alternative Selection, and Decision Making for Transportation Projects – Don Speicher

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Overview of FHWA's Interactive Highway Safety Design Module

Key Reseazrch References for Determining the Substantive Safety of Geometric Highway Design Alternatives

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