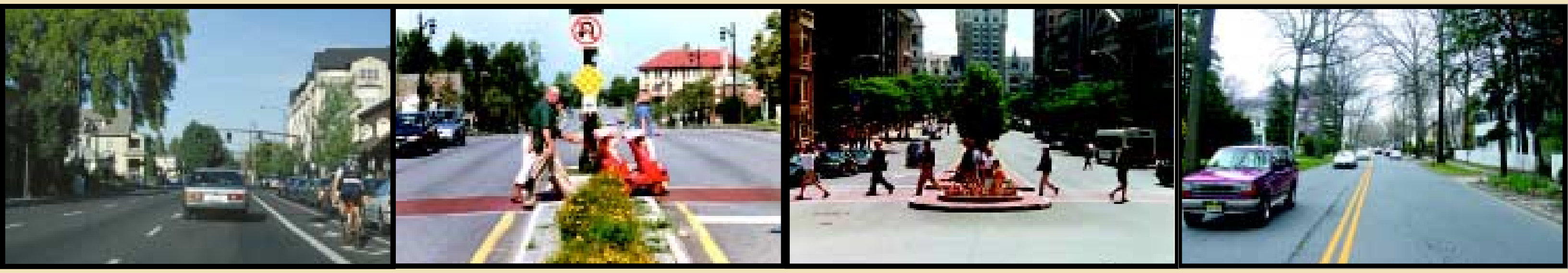

Flexible Design of New Jersey's Main Streets

prepared by the

Voorhees Transportation Policy Institute
Edward J. Bloustein School of Planning & Public Policy
Rutgers, The State University of New Jersey

for the

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DISCLAIMER STATEMENT

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Preface

It has been said that 95% of problem solving is properly defining the problem.

If the problem is defined as the need to move traffic quickly through a community, it will lead to one set of design solutions. If the problem is defined as the need to preserve livability in the face of growing traffic, it will lead to another set of design solutions. The innovative designs proposed by engineers during the New Jersey Department of Transportation's (DOT's) Context-Sensitive Design Training Course show that different problem definitions can lead to very different design solutions.

The Voorhees Transportation Policy Institute (TPI) study team is proposing a series of policy and practice changes that would add flexibility and context sensitivity to DOT's design process for main streets. The proposals span the highway design process, from planning to final design, for it is at many points along the project pipeline that roadway design can be influenced. Modest changes in geometric standards are also proposed for main streets to add flexibility and context sensitivity.

Recommendation highlights include:

- Establishment of broad purposes and measurable objectives for main street projects,
- Selective reclassification and de-designation of main streets,
- Context-sensitive design exceptions on main streets,
- Use of Main Street Overlays to relax particular design standards on main streets, and
- Development of traffic calming guidelines to take context-sensitive main street design to the next level.

If DOT agrees with the recommendations contained herein, the TPI study team would urge that they be incorporated into the Roadway Design Manual. The TPI study team would also urge that this report be distributed throughout DOT to foster context sensitivity at all levels in the organization.

The TPI study team consisted of Michael King, Petra Staats, and Trefor Williams, as well as myself. Our counterparts at DOT, particularly William Beetle, Danielle Outlaw, and Arthur Eisdorfer, provided valuable guidance and feedback. They were a pleasure to work with. Our thanks to them. Kevin Knutson provided publishing services, including line editing, proofreading and the layout of the final document. We also want to thank the project's Technical Review Committee of national experts. The TRC's membership and contribution are outlined in the report itself.

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Chapter 1

Introduction

The New Jersey Department of Transportation (DOT) asked the Voorhees Transportation Policy Institute (TPI) to investigate possible changes in design standards for highways passing through New Jersey's communities.

Through case studies and surveys, the TPI study team discovered a burgeoning national movement away from strict reliance on highway design templates and toward flexible highway design, especially in the Northeastern and Northwestern United States. The movement seems rooted in the notion that the nation's highways are essentially complete, and working with existing roadways will require special sensitivity to context.

This report concludes the project but not the process, for structural changes can only be achieved with diligent follow-through on DOT's part.

1.1 Definitions

DOT originally gave this project the title "Flexible Design Standards for Highways through Communities." DOT's scope of work makes reference to Context-Sensitive Design (CSD). Some definitions are in order. Both flexible design and CSD call for less rigid application of design standards to highway projects. Flexible design involves utilizing the flexibility inherent in the current design process and in current national guidelines and state standards. CSD implies tailoring designs to adjacent land uses with sensitivity to community values. The raison d'etre of this report is to promote, within DOT, flexibility in the interest of context sensitivity.

The project title also refers to "highways through communities," a broad phrase which requires some narrowing. Obviously, the need for flexibility and context sensitivity is greater for some highways than others, as some impact their environments more directly. In deciding which highways through communities particularly demand context sensitivity, a label was needed. Main street was chosen as a catch-all for highways with mixed functions, not just channels for vehicular movement but places in their own right worth preserving and enhancing. To be sure, the term "main street" conjures up images of narrow shopping streets in tourist towns, and many at DOT feel their work lies elsewhere. But the TPI study team defines the term more broadly. It includes all highways and streets whose adjacent land uses require accommodation of pedestrians and bicyclists, serious consideration of street aesthetics, and a degree of traffic calming. As such, the term includes not only traditional shopping streets but

Figure 1.1: Traditional shopping street, Cranbury, New Jersey.

Figure 1.2: Approach to Main Street, Lambertville, New Jersey.

Figure 1.3: Commercial street, Newark, New Jersey.

Figure 1.4: Residential arterial, Princeton, New Jersey.

approaches to those streets, other commercial streets with small building setbacks, main roads with fronting residences, and other highways directly impacting people's living environments.

This broad definition of main street was validated in a survey of local governments in New Jersey (see Appendix A.3). Absent a formal definition of "main street" in the questionnaire, mayors listed among main streets all manner of roadways, from traditional urban shopping streets to suburban arterials with commercial strips along them. If mayors define their main streets so broadly, it would be counter to the purpose of this project (reconciling DOT standards with local objectives) to define main streets too narrowly.

This broad definition was also validated in the visual preference survey given to the Technical Review Committee. Results confirmed our suspicion that main streets are distinguished not so much by street geometrics as by roadside conditions and relative scale. Results suggested that main streets appear in many different contexts, not just as traditional shopping streets, and that given the right roadside conditions, main streets can be created out of conventional highways by dropping travel lanes, widening sidewalks, planting trees, and other such measures.

Based on scores assigned by the Technical Review Committee to street scenes (50 centerline photos of diverse roadways from throughout the United States), it appears that "main streetness" can be quantified (see Table 1.1). Important context variables include proportion of street frontage with trees, proportion of street frontage with active (pedestrian-generating) uses, sidewalk width, and building setback from the street. DOT could use this formula, or one like it derived through a similar process, to qualify individual highways for special treatment as main streets. The formula could be applied to roadways as they currently exist, or to roadways as redesigned to function more like main streets. It would only be necessary to establish a minimum threshold score, and quantify the variables that comprise the formula. See Appendix A.4 for a complete discussion.

Score=
2.22
+0.0149 * Trees
+0.0132 * Active Uses
+0.125 * Sidewalk
-0.0258 * Setback

Table 1.1: Main Street equation.

In New Jersey, additional guidance is available for distinguishing between main streets and state highways generally. The New Jersey State Development and Redevelopment Plan uses a "Centers" designation to plan for and direct growth within the

Center	County	Type
Hudson County	Hudson	Urban
Jersey City	Hudson	Urban
Atlantic City	Atlantic	Urban
Camden	Camden	Urban
Elizabeth	Union	Urban
New Brunswick	Middlesex	Urban
Newark	Essex	Urban
Paterson	Passaic	Urban
Trenton	Mercer	Urban
Bridgeton City	Cumberland	Regional
Bridgewater-Raritan-Somerville	Somerset	Regional
Dover	Morris	Regional
Long Branch	Monmouth	Regional
Millville-Vineland	Cumberland	Regional
Morristown	Morris	Regional
Newton	Sussex	Regional
Princeton	Mercer	Regional
Red Bank	Monmouth	Regional
Salem	Salem	Regional
Stafford	Ocean	Regional
The Wildwoods	Cape May	Regional
Andover	Sussex	Town
Atlantic Highlands	Monmouth	Town
Avalon	Cape May	Town
Bernardsville	Somerset	Town
Bloomingdale	Passaic	Town
Bound Brook	Somerset	Town
Cape May	Cape May	Town
Elmer	Salem	Town
Flemington	Hunterdon	Town
Freehold	Monmouth	Town
Gloucester City	Camden	Town
Haledon	Passaic	Town
Hightstown	Mercer	Town
Hopatcong	Sussex	Town
Manasquan	Monmouth	Town
Manville	Somerset	Town
Metuchen	Middlesex	Town

Center	County	Type
Mystic Island	Ocean	Town
Netcong	Morris	Town
New Egypt	Ocean	Town
Pluckemin Village	Somerset	Town
Ridgefield	Bergen	Town
Smithville	Atlantic	Town
Stone Harbor	Cape May	Town
Totowa	Passaic	Town
Tuckerton	Ocean	Town
Wanaque	Passaic	Town
Washington	Warren	Town
Washington Town Ctr	Mercer	Town
Woodstown	Salem	Town
Wrangleboro Estates	Atlantic	Town
Bedminster Village	Somerset	Village
Cape May Point	Cape May	Village
Cranbury	Middlesex	Village
Crosswicks	Burlington	Village
Delmont	Cumberland	Village
Dorchester-Leesburg	Cumberland	Village
Far Hills Borough	Somerset	Village
Heislerville	Cumberland	Village
Hope	Warren	Village
Hopewell	Mercer	Village
Mendham	Morris	Village
Mt. Arlington (portion)	Morris	Village
Oceanville	Atlantic	Village
Oxford	Warren	Village
Parkertown	Ocean	Village
Port Elizabeth-Bricksboro	Cumberland	Village
TDC Receiving Area	Burlington	Village
Vincentown	Burlington	Village
Chesterfield	Burlington	Hamlet
Mauricetown Station	Cumberland	Hamlet
Mount Hermon	Warren	Hamlet
Sykesville	Burlington	Hamlet
Route 130-Delaware River Corridor	Burlington	Strategic Plan

Table 1.2: Designated Centers 2001.

state. Centers are urban areas ranging from the smallest hamlets to the largest cities—any place with a reasonable concentration of housing and commerce, and with good accessibility to the rest of the region. As of December 2001, the State Planning Commission had designated 73 Centers—eight Urban, 12 Regional, 31 Town, 18 Villages and four Hamlets (see Table 1.2). Over 200 additional Centers have been proposed.

Centers Policy 15 in the State Plan calls for scaled-down streets, accommodation of pedestrians, traffic calming, and place making within designated Centers. Perhaps most on-point, it calls for roadway design that reflects "adjacent land use conditions as well as the volume of traffic." This is tantamount to a definition of context-sensitive design. Thus, the main street policies recommended in Chapter 2, would best be applied preferentially to main streets (as defined in Table 1.1) located within Centers (as designated in Table 1.2). By affording special status to streets within Centers, DOT can contribute directly to the overall goals of the State Plan.

1.2 Federal Initiatives

Sensitivity to community context would be difficult without recent changes in federal law. Beginning with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and continuing with the National Highway System Act (NHS Act) of 1995 and Transportation Equity Act for the 21st Century (TEA-21) of 1998, the US Highway code now allows, and even encourages, a certain degree of flexibility in highway design.

Before 1991, all roads built in the U.S. and paid for even in part with federal funds had to meet guidelines in the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* (the "Green Book" in Figure 1.5). If officials wanted to do something different, their only options were to seek design exceptions from the Federal Highway Administration (FHWA) or to build entirely with state and local funds.

ISTEA changed all that by creating a National Highway System (NHS) of Interstate and other high-performance highways, and a larger system of non-NHS highways eligible for federal funding under the newly established Surface Transportation Program. For roads not on the NHS, ISTEA gave states latitude to adopt their own design, safety, and construction standards (see Table 1.3). The NHS Act provided that even NHS highways (other than Interstates) could be designed with due consideration for "environmental, scenic, aesthetic, historic, community, and preservation" impacts. In 1997 the FHWA published *Flexibility in Highway Design*, which forcefully argued for flexible design within AASHTO guidelines (Figure 1.6).

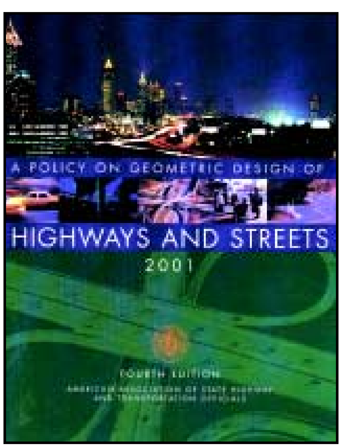

Figure 1.5: "Green Book," AASHTO 2001.

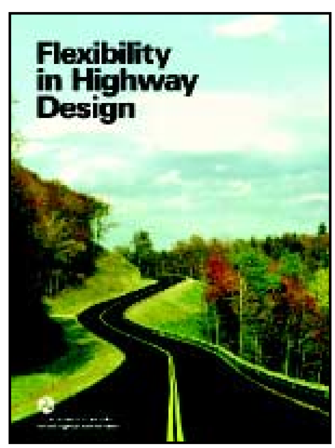

Figure 1.6: Flexibility in Highway Design, *FHWA 1997.*

Type of Road	New Construction	Rehabilitation Restoration Resurfacing
NHS, Interstate	AASHTO	state
NHS, non-Interstate	AASHTO/state	state
Non-NHS	state	state

Table 1.3: Control of standards by road type.

TEA-21 added language requiring highway projects to conform to local needs and allowing projects to be designed for desired rather than projected traffic levels. For a discussion of other relevant federal laws and initiatives, see Appendix A.5.

1.3 New Jersey Initiatives

Responding to widespread interest in context-sensitive design, the New Jersey State Legislature in re-authorizing the Transportation Trust Fund for 2000 declared that:

> *Many State highways run through fully developed cities and suburban towns. In addition, many small villages in rural areas have State highways, which pass through built-up residential areas or village centers. The traffic on many of these State highways, particularly large truck and speeding traffic, prevents these residential areas, town centers and future town centers from functioning as intended. The commissioner shall study this issue and develop a departmental program, which authorizes context-sensitive design and examines the functional classifications of State highways running through developed cities and suburban towns.*[1]

From this declaration, it is clear that DOT has a mandate to practice flexible highway design wherever the context demands it, as in town centers and built-up residential areas.

DOT has responded with several initiatives to promote CSD. It has sponsored what may be the nation's most ambitious training program for engineers. In the first round, 300 persons completed five day long courses on such unconventional topics as place making, respectful communication, conflict management, and traffic calming.

A second DOT initiative is the incorporation of planning and design guidelines for bicyclists and pedestrians, originally adopted in 1996, into the state's *Roadway Design Manual* (RDM). Before incorporation, these guidelines will be updated to reflect changes in knowledge and practice. There is much new research on pedestrian safety, traffic calming has come into its own right, and AASHTO released a new set of bicycle guidelines in 1999.

A final initiative involves DOT's design exception policies. New Jersey may be the only state in the nation to provide programmatic design exceptions for rehabilitation, restoration, and resurfacing (3R) projects. A broadening of these exceptions has been proposed by DOT, and is supported by the findings of this report.

1.4 Content and Structure of Report

This report is organized into three chapters and six appendices. The first chapter, this Introduction, places flexible highway design in a state and national context.

Chapter 2, Findings and Recommendations, is the heart of the report. The first section on proactive roadway design suggests changes in the design process to increase context sensitivity. The second section makes the case for reclassification or de-designation of certain state highway segments now functioning as local main streets. The third section recommends changes in design exception policies to

[1] Congestion Relief and Transportation Trust Fund Renewal Act (Senate Bill 16). New Jersey Public Law 2000, Chapter 73, Section 6, revised 2000.

promote context sensitivity and pedestrian safety. The fourth section proposes new design standards for main streets as part of Main Street Overlays. The fifth section recommends the incorporation of traffic calming guidance into the RDM to expand the design options available on main streets. The last section contains a conflicts-solutions matrix, offering practical solutions to conflicts between DOT standards and local objectives for main streets.

Chapter 3 contains local and regional Case Studies. There are four studies of context-sensitive design projects in New Jersey. One was written by a local practitioner and is rich in information about process and community objectives. The other three are engineering-oriented and follow a common format to permit easy comparison. There are six engineering-oriented case studies from nearby states. These represent a wider range of CSD projects than do the New Jersey studies. One additional case study was conducted in New Jersey, and four additional case studies were conducted in large metropolitan areas around the country. While not written up separately, these case studies were conducted in the same detail as the others and are given equal weight in our findings and recommendations.

Appendices are placed at end of the report. The first appendix introduces the project's Technical Review Committee (TRC) of leading experts in the field of context-sensitive design. The TRC reviewed the work at the mid-point of the project, provided case study information, and participated in the Main Street Visual Preference Survey. The second appendix is an article about this project published in *Planning* magazine. It reviews our findings in summary fashion. The next three appendices present results of surveys conducted for this project: a mail-out survey to all 566 New Jersey mayors to assess their experience with DOT main street projects; a visual preference survey administered to the TRC to define salient features of main streets; and a telephone survey of leading state DOTs to learn of policies, practices, and standards that might be applicable to New Jersey. The last appendix provides a summary of design exceptions granted by DOT from 1997 to 1999. To assess New Jersey's design exception policies and procedures, it was necessary to understand how these translated into actual practice.

The survey of leading state DOTs was presented at the 2001 Annual Meeting of the Transportation Research Board. It was one of two papers selected by TRB's Technical Activities Division for distribution to each state DOT.

Chapter 2

Findings and Recommendations

In this chapter, existing DOT policies and procedures are reviewed and changes are recommended. While the focus is on main streets, the review uncovers more general issues which directly or indirectly affect the design of all streets. Accordingly, some sections speak broadly to the planning, scoping, and design processes at DOT, while others relate specifically to state highways serving as main streets.

Greater flexibility can be exercised in the design of main streets in several ways. Minimum design standards can be relaxed. This is the approach taken in Vermont, and to a lesser degree, in Connecticut and Idaho. The TPI study team finds scant justification for sub-AASHTO standards. However, selective lowering of design standards, as applied to main streets, appears warranted.

Designers can exercise flexibility with respect to non-controlling design elements, such as curb return radius, or with respect to performance standards, such as roadway level-of-service. They can add pedestrian-friendly features to standard street designs, such as median islands that provide pedestrian refuge areas and, at the same time, better manage access from abutting properties. They can downgrade main streets in terms of functional class, and thereby lower design standards, when the function of state highways has changed due to construction of bypasses or secondary routes.

And designers can make better use of the built-in flexibility of the design exception process, which all states including New Jersey make available to them when the financial, social, and/or environmental costs of meeting existing design standards are too high. The TPI study team recommends liberal but appropriate use of design exceptions.

2.1 Proactive Roadway Design

Over the course of this project, DOT has been intensely reviewing and revising its project development process to incorporate context sensitivity, improve intra- and inter-agency coordination, and increase transparency of the process to the public. In this regard DOT is at the leading edge of state departments of transportation.

An example of ongoing changes within DOT is the proposed statement on Proactive Roadway Design.

> *In conceiving, scoping and designing projects, the NJDOT will consider the needs of all road users and neighbors... Highway designs must reflect a thoughtful understanding of the context of the improvement, in addition to adherence to standards and guidelines.*[1]

Designing roads proactively implies that the designer (or agency) is in control of the outcome of the project, as opposed to simply reacting to current or expected traffic conditions. To ensure proactivity throughout the project development process, the TPI study team offers suggestions concerning scope definition and project objectives.

Project Scope Definition

If a simple culvert replacement project is classified as reconstruction, DOT may be compelled (according to its own policies) to widen the road and bring

[1] New Jersey Department of Transportation (NJDOT), "Statement of Design Philosophy for 'Proactive Roadway Design,'" October 2001 draft.

it up to geometric standards in other respects. This is known as scope creep: expansion of scope beyond what was originally intended. Perhaps the road is unsafe and does require widening. Then again, the roadway may be operating fine and there are no other plans to widen the cross section. Conversely, there may be a need for improved bicycle and pedestrian facilities and adding them to a larger project is cost-effective. Scope creep can be positive if it reflects the needs of the agency and community, and negative if it does not.

Our research uncovered three notable examples of state processes to encourage positive and discourage negative scope creep. Vermont uses a Project Definition Team to define all substantial projects. A "substantial" project is one that costs more than $1.5 million, has a design phase that lasts longer than a year, and involves right-of-way purchase. The Project Definition covers the purpose of the project, need for the project, environment concerns, aesthetics, and alternatives considered (including no-build). The Project Definition Team also reviews all changes in project scope.[2]

New Hampshire has Public Involvement Procedures for all transportation projects. Each regional planning authority submits projects every other year. DOT reviews the submissions and prepares preliminary scopes. The scopes go to the governor, whose advisory group solicits comments from stakeholders and the public.[3] If everything is satisfactory, the list is submitted to the legislature to be made law and receive appropriations. Scopes are fixed from then on rather than subject to constant change.

Under the New York State Environmental Initiative, CSD is called for in all projects. One outcome is a broadening of project purpose, as in the Saratoga Springs case study (see Subsection 3.3.4). Here the fifth project objective was added at the urging of the City of Saratoga Springs.

- ❑ Provide adequate capacity and acceptable operation for 20 years,
- ❑ Restore pavement to good condition for 50 years,
- ❑ Accommodate pedestrians and cyclists,
- ❑ Add drainage, and
- ❑ Enhance the historic, recreational and visual aspects of the state park, and establish the corridor as a gateway to the spa and city.

This example of positive scope creep led to innovative features of the Saratoga Springs redesign.

Due to acknowledged problems of scope creep in New Jersey, DOT has begun employing Scope Teams. These teams are made up of both planners and engineers, who identify possible design exceptions during the scoping phase and must agree to any changes in scope later in the process. It is a bit premature to rule on the merits of this approach (vs. the approaches used by other states), but early signs are positive.

Measurable Project Objectives

While the above-described initiatives may help broaden project purposes and combat negative scope creep, they do not provide a mechanism for ensuring that agency and community goals are met. One way to accomplish this is to establish explicit and measurable project objectives related to project purpose and need. These would be agreed upon with the community at the outset of projects and used to evaluate proposed designs. They might include:

- ❑ Target speed,
- ❑ Multimodal LOS targets, and
- ❑ Safety targets.

[2] Vermont Agency of Transportation, "Project Definition Team Rules and Procedures," 1997.

[3] New Hampshire Department of Transportation, "Public Involvement Procedures," 1986, updated 1992.

Target speed is the desired speed of the 85th percentile vehicle. Agreement on this speed with the community allows the designer to select an acceptable design speed, and establish a new speed limit if necessary.

Multimodal LOS (level of service) targets relate to roadway service quality not only for vehicular traffic, but also for pedestrians and bicyclists. This is especially necessary in dense urban settings where the number of people on foot may approach or exceed the number in cars. Discussions with the community can clarify the relative priority to be given to different modes in right-of-way allocation, signal timing, and street design. There are many examples of multimodal LOSs around the U.S. Florida DOT's efforts in this regard are particularly noteworthy.

Safety concerns are always present in projects; indeed many projects are justified solely in these terms. Yet specifying safety targets for each project can assist in making that project more context-sensitive and perhaps more pedestrian- and bicycle-friendly. For example, if the objective were to reduce the number of vehicle-pedestrian collisions by some percentage, the onus would be on the project designer to moderate vehicle speed and reduce pedestrian exposure time.

The use of explicit and measurable objectives such as a target speed will provide a new way to evaluate projects after the fact, thereby increasing accountability. If a main street is designed for 25 mph, and "after" studies show an 85th percentile speed of 40 mph, there is a problem. Through quantification, goals agreed upon by the agency and community will more likely be met.

The TPI study team concludes:

- ❑ A well-defined project scope, established up front through an open process, can help guard against negative scope creep and ensure consideration of local objectives.
- ❑ Explicit and measurable project objectives can help ensure that agency and community goals are met.

The TPI study team recommends that:

- ❑ DOT closely monitor the use of Scope Teams to ensure that this new mechanism is discouraging negative and encouraging positive scope creep.
- ❑ DOT utilize measurable project objectives to ensure that final designs reflect agency and community goals.

2.2 Reclassification or De-Designation

Roadway classification is first and foremost among design controls (see Table 2.1). Roadways are classified according to function (arterials, collector, or local) and location (urban or rural). Classification has a bearing on design speed (and hence alignment) and cross section (lane width, shoulder width, type and median width). Because the function of roadways changes over time, there is a need to periodically update classifications.

	Functional Class	Traffic Volume	Design Speed
Rural lane width	X	X	X
Urban lane width	X		
Rural shoulder	X	X	
Width and type			
Urban shoulder			
Width and type	X		
Degree of curve radius	X		
Grades	X		X
Bridge clearances	X	X	
Stopping Sight Distance			X
Superelevation			X
Widening on curves			X
Rural design speeds	X	X	NA
Urban design speeds	X		NA

Table 2.1: Determinants of geometric standards.

State highway systems have many roads that once functioned as principal routes from town to town but have since been supplanted by bypasses or freeways. These can be reclassified to a lower functional level and retained on the state system. Or they can be de-designated and placed under local control. Both are viable options for relieving states of maintenance responsibility and liability for roads no longer integral to their systems, and at the same time, giving localities more control over roadway design.

Among the 15 case studies, no facility was actually reclassified to a lower functional class within a state system. However, a surprising number (eight) were subject to de-designation or similar action by the controlling DOT. Plainfield and York have assumed responsibility for main streets through maintenance agreements. Albuquerque, Maplewood, Red Bank, South Miami, and Westminster have had ownership transferred to them outright. Circumstances vary from case to case, but in all cases, the highway in question was no longer integral to the state or county system. In Westminster, East Main Street (MD 32) could be reconstructed and transferred to the city because the MD 140 bypass carried most of the through traffic. In York, Market Street (PA 462) could be reconstructed and transferred because the US 30 bypass was available and a parallel local street was redesignated as a truck route. In South Miami, Sunset Drive (SR 986) could be reconstructed and transferred because it lay at the end of the state route (see Figure 2.1). In Washington Township, NJ 33 will be reconstructed and transferred when a secondary route to US 130 is opened.

The most obvious hindrance to de-designation is money, or the lack thereof. Towns typically lack the resources to pay for reconstruction and maintenance. This burden may be partially alleviated through state or federal grants, through cost sharing arrangements, or through road swaps. In Westminster, the state paid for the reconstruction before transferring jurisdiction to local government. York utilized federal disaster relief money following a hurricane to pay for the reconstructed roadway. In Albuquerque and Red Bank, road swaps have allowed local governments to shed some costs at the same time they assumed others (see Figure 2.2).

The TPI study team concludes:

- ❑ Removing segments that no longer function as state or county routes may permit more context-sensitive main street design. Maintenance agreements between state and local governments may also permit more design flexibility.

The TPI study team recommends that:

- ❑ As part of any main street reconstruction project, DOT consider whether the segment should be de-designated and transferred to local government or retained by the state but reclassified to reflect changing function. The existing DOT de-designation process provides a mechanism for

Figure 2.1: Portion of SR 986 transferred to the City, South Miami, Florida.

Figure 2.2: Broad Street acquired through a road swap, Red Bank, New Jersey.

transfer of highways and should be utilized whenever local governments wish to assume responsibility and the segment in question is no longer critical to the state system.

2.3 Context-Sensitive Design Exceptions

From the survey of New Jersey local governments (Appendix A.3) and the New Jersey case studies (Section 3.2), it is clear that roadway design standards sometimes conflict with local desires for human-scale, walkable, aesthetically pleasing main streets. Design standards may not be the main source of conflict, nor a source of conflict in most communities. But the exceptions, such as Red Bank and Washington Township, prove the need for more flexibility in highway design.

Designers can make better use of the built-in flexibility of the design exception process, which all states including New Jersey make available to them when the financial, social, and/or environmental costs of meeting existing design standards are too high. Issues surrounding design exceptions include:

- ❑ Is "context" being given sufficient weight relative to safety, cost, and other considerations?
- ❑ Are safety impacts being analyzed in a way that ensures cost-effective decisions?
- ❑ Would main streets actually benefit from the addition of certain design features to the list of controlling design elements?
- ❑ Are 4R projects (3R and reconstruction projects) that do not alter basic roadway geometrics subject to appropriate design exception policies?
- ❑ Are DOT design exception policies in line with those of other progressive states, and might policies of other states be beneficial if adopted here?

To inform our answers, the TPI study team reviewed DOT's existing policies and conducted two supplemental studies: a review of all DOT design exceptions approved for the years 1997-1999 (Appendix A.6) and a survey of design exception policies of other states (described below).

Room for Design Exceptions

The bases for most geometric standards and guidelines are approximate at best, and generally conservative.[4] The Transportation Research Board's *Proceedings of the 2nd International Symposium on Highway Geometric Design* contains many examples of standards without adequate bases in fact.

Consider stopping sight distance (SSD). In a fascinating article, Ezra Hauser reviews the history of the AASHTO guideline and declares it "based not on empirical fact but on plausible conjecture."[5]

Until recently, the AASHTO guideline for stopping sight distance at a design speed of 60 kph (37 mph), typical of main streets, varied from 74.3 to 84.6 meters (244 to 278 feet), depending on the operating speed assumed at this design speed (see Table 2.2). New Jersey has adopted the lower end of the range as its minimum value, and the upper end as its desirable value. This alone suggests the approximate nature of standards.

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[4] A special study committee of the Transportation Research Board (TRB) put it this way: "In general, relationships between safety and highway safety features are not well understood quantitatively, and the linkage between these relationships and highway design standards has been neither straightforward nor explicit. The American Association of State Highway and Transportation Officials (AASHTO), which has historically assumed primary responsibility for setting design standards, relies on committees of experienced highway designers to do this work. The committees use a participatory process that relies heavily on professional judgment." Transportation Research Board (TRB), *Designing Safer Roads—Practices for Resurfacing, Restoration, and Rehabilitation*, Washington, D.C., 1987, p. 77.

[5] E. Hauer, "Safety in Geometric Design Standards I: Three Anecdotes," in R. Krammes and W. Brilon (eds.), *Proceedings of the 2nd International Symposium on Highway Geometric Design*, Transportation Research Board, 2000, p. 12.

Design Speed (km/h)	NJ Desirable (m)	NJ Minimum (m)	NJ Programmatic Design Exceptions (m)	Former AASHTO Minimums (m)	New AASHTO Minimums (m)	Other Countries[6] (m)
40	44.4	44.4	44.4	44.4	46.2	35
50	62.8	57.4	57.4	57.4-62.8	63.5	50
60	84.6	74.3	74.3	74.3-84.6	83.0	70
70	110.8	94.1	91.4	94.1-110.8	104.9	90
80	139.4	112.8	106.7	112.8-139.4	129.0	115

Table 2.2: Minimum Stopping Sight Distance from different sources.[7]

AASHTO minimum stopping sight distances have recently been raised based on a study by the Texas Transportation Institute (TTI). Critical to these revisions are three conservative assumptions, *cumulatively* producing very conservative minimum stopping sight distances. The three assumptions are: driver eye height of 1,080 mm (43 inches, 90th percentile), driver reaction time until brakes are applied of 2.5 seconds (95th percentile), and a deceleration rate once brakes are applied of 3.4 m/sec^2 (1 ft/sec^2, 90th percentile). Other countries have typically adopted shorter minimum stopping sight distances based on less conservative assumptions as shown in Table 2.2.

More Emphasis on Context

A report is required for every project involving design exceptions. The typical report reads something like this: A road is being reconstructed. To achieve a design speed (maximum safe speed under favorable conditions) of X mph, 10 mph over the posted speed limit, requires a minimum horizontal curve radius of Y feet at a superelevation rate of Z. This particular road has a sharper curve, which would have to be straightened, to meet the standard for horizontal curvature. This would mean someone's house or business would be taken, some park or cemetery would be encroached on, a lot of extra asphalt would have to be poured, etc. Or perhaps this particular road has a substandard superelevation rate, which if brought up to the DOT standard, would require the abutting property to be raised, utilities to be moved, and bulkhead improvements to be made.

The design engineer checks crash statistics for the roadway in question, focusing on the types of crashes associated with substandard horizontal curvature or substandard superelevation, and finds that these crashes are not over-represented relative to state norms. Noting that hundreds of thousands of dollars can be saved by only marginally straightening the existing curve or marginally increasing the superelevation, a design exception is requested and approved. The road didn't have a particular safety problem to begin with, and it will have less of one after the project.

Little consideration is given to "context" in this process unless it involves a huge outlay or an actual taking of property (in which case, cost enters the picture). There are exceptions, but the rule is clearly as described. It would not be difficult to extend the same deference, and procedures, to context as are currently applied to cost.

[6] These are median values for Australia, Austria, Canada, France, Germany, Great Britain, Greece, South Africa, Sweden, and Switzerland.

[7] D. Fambro et al., *Determination of Stopping Sight Distances*, National Cooperative Highway Research Program Report 400, Transportation Research Board, Washington, D.C., 1997, pp. 13 and 34. Metric units have been retained from the original source.

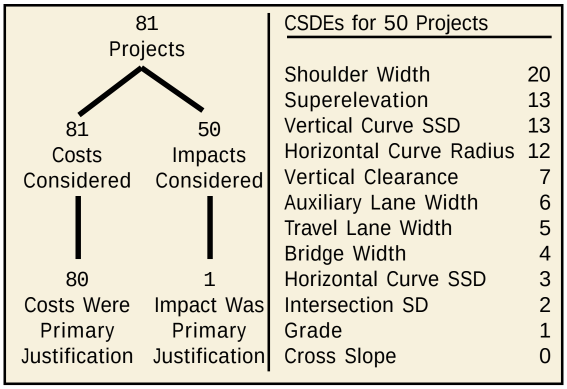

Figure 2.3: Design exceptions in New Jersey, 1997-1999.

Eighty-one design exception reports submitted between 1997 and 1999 were reviewed by the TPI study team (see Appendix A.6). This represents about one-third of all DOT construction, reconstruction, or 3R projects undertaken during the period, a sizable percentage.

Of the 81 design exception reports, 50 gave some consideration to community, historical, or environmental factors. However, other than one project involving historic preservation, land use impacts were always discussed within the context of the cost savings. Figure 2.3 shows the dominance of cost considerations.[8] It also shows that most design exceptions were for substandard design elements unlikely to be found on main streets.

DOT's current design exception policy requires an analysis of crashes and costs, and specifies how these analyses are to be conducted. Yet, when it comes to social and environmental impacts of design exceptions, the policies only encourage a discussion of such impacts "if appropriate."

The TPI study team concludes:

- ❑ Design exceptions are granted liberally in New Jersey, but almost entirely for reasons of cost saving, not "context saving." Social and environmental impacts are given short shrift.
- ❑ Most design exceptions are for controlling design elements ordinarily not a problem on main streets, such as horizontal curve radius. That such elements are so common in design exception cases, and other design elements such as lane width are so uncommon, indicates that design exceptions are either not required or not sought very often on main street projects.

The TPI study team recommends that:

- ❑ DOT's design exception format be revised to include a subsection on social, environmental, and community impacts of constructing to the standard design value vs. the proposed substandard design value; the subsection may simply state "no significant impact" for some projects, as in environment assessments (EAs).
- ❑ DOT provide guidance to its designers on the assessment of community impacts of roadway projects which will, by their nature, lead to higher traffic speeds and volumes; existing guidelines for EAs and EISs may be used for this purpose.

More Complete Analysis of Safety Impacts

It is sometimes assumed by highway designers that wider, straighter, and more open is safer. This is the underlying philosophy of the AASHTO Green Book and other highway design manuals.

The wider-straighter-more open approach to highway design is based on crash research from rural areas, where prevailing speeds are high. The National Cooperative Highway Research Program report, *Effect of Highway Standards on Safety*, summarizes the evidence on rural highway safety and, while mixed, it is compelling.[9] Urban areas are another matter. Not only are speeds lower, but

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[8] Other states justify design exceptions in the same terms as New Jersey, that is, in terms of cost saving and lack of documented safety problems. TRB, op. cit., p. 83.

[9] H.W. McGee, W.E. Hughes, and K. Daily, *Effect of Highway Standards on Safety*, National Cooperative Highway Research Program Report 374, Transportation Research Board, Washington, D.C., 1995, pp. 16-37.

contexts are very different. Design options are constrained by active land uses along urban rights-of-way. These same active uses generate pedestrian and bicycle traffic, which has to be a factor in design decisions.

The wider-straighter-more open approach to design will not be safer if it leads to higher speeds and, consequently, more frequent and severe crashes. Higher speeds may also lead to more vehicle miles of travel, increasing crash exposure. There is a real question whether highway "improvements" are collectively improving highway safety.[10]

Consider the following recent urban highway safety research:

- A study presented at the 2001 Transportation Research Board Annual Meeting determined that 23 "road diet" projects, involving the reduction in cross section from four lanes to three lanes (two through lanes plus a center turn lane), reduced crash rates by 2 to 42 percent.[11]
- A study published in the ITE Journal in 2000 found that pedestrian crash rates were primarily a function of traffic speed. An increase in average speed from 20 to 30 mph was associated with 7.6 times the risk of pedestrian injury.[12]
- An analysis of 20,000 crashes in the City of Longmont, Colorado, found that two out of 13 physical characteristics of streets were statistically related to injury crashes. Crash rates increased exponentially with street width, and were higher for straight than curvilinear streets.[13]

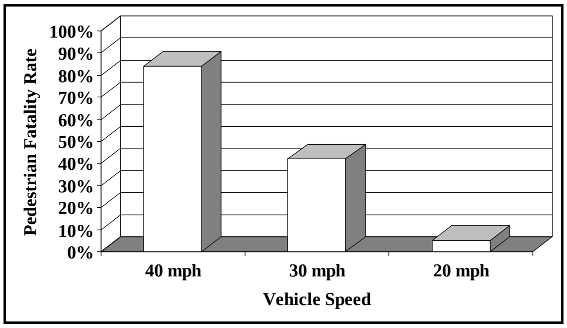

Figure 2.4: Vehicle speed vs. potential fatality rate.

Simple physics tells us that pedestrians hit by vehicles are thrown farther and the force of impact is greater the faster the speed of the vehicle. Lowering speeds from 40 to 30 mph, only 25 percent, halves the fatality risk. Between 30 and 20 mph the benefit is even greater (see Figure 2.4).

From reviews of DOT's current design exception policy and recent design exception reports, two shortcomings are evident with respect to traffic safety analysis. One is general. The other specific to urban streets.

One general shortcoming is that indicator crashes for each Controlling Substandard Design Element (CSDE) are assessed in percentage terms, relative to the total number of crashes within the project limits. Thus, unless indicator crashes are over-represented relative to other crashes on a stretch of roadway, when compared to statewide average percentages, no safety problem is detected. What if all types of crashes are significantly more common on a stretch of roadway than exposure levels would suggest? Still no problem is detected. The DOT design exception policy provides that crash analyses

[10] A study presented at the 2001 Annual Meeting of the Transportation Research Board found that, controlling for demographic changes, increased seatbelt use, and improved medical technology, highway improvements over the past 14 years had actually had a negative effect on highway safety. There were an estimated 2,000 additional fatalities, and 300,000 or more additional injuries, due to such "improvements." Increases in lane widths accounted for over half of the total increase in fatalities and about one-quarter of the increase in injuries. R. Noland, "Traffic Fatalities and Injuries: Are Reductions the Result of 'Improvements' in Highway Design Standards," paper presented at the 80th Annual Meeting, Transportation Research Board, Washington, D.C., 2001.

[11] H.F. Huang, C.V. Zegeer and J.R. Stewart, "Evaluation of Lane Reduction 'Road Diet' Measures on Crashes and Injuries," paper presented at the 80th Annual Meeting, Transportation Research Board, Washington, D.C., 2001.

[12] P. Peterson et al., "Child Pedestrian Injuries on Residential Streets: Implications for Traffic Engineering," *ITE Journal*, Feb. 2000, pp. 71-75. Also see W.A. Leaf and D.F. Preusser, *Literature Review on Vehicle Travel Speeds and Pedestrian Injuries*, National Highway Traffic Safety Administration, Washington, D.C., 1999.

[13] P. Swift and D. Painter, "Residential Street Typology and Injury Accident Frequency," pending.

should include "the overall accident rate" and "the statewide average accident rate for highways of similar cross section." The reference is to crash *rates*, not to crash *percentages*. Clearly, the intent is to compare safety across roadways of similar type. From our review of design exception reports, this policy is not being followed.

A second shortcoming is that crash analyses focus almost exclusively on motor vehicle crashes, ignoring pedestrians and bicyclists. In New Jersey, pedestrians represent 20 percent of all traffic fatalities, the fourth highest percentage in the U.S. In some urban areas, the percentage is double or triple this number. And there are 14 pedestrian injuries for every pedestrian fatality. All of this suggests that pedestrian (and bicycle) safety is a serious problem worthy of attention in highway design.[14]

Yet, in only one of 81 design exception reports reviewed were pedestrian or bicycle collisions mentioned. It is not clear why, even considering the predominance of rural and suburban projects among the roadway projects for which design exceptions were sought. Perhaps it is because vehicle-pedestrian collisions are listed among the indicator crashes for only one type of CSDE, limited sight distance. Or it may be because the threshold for a crash analysis is five accidents, and at many locations, this threshold is not reached. Given the underreporting of vehicle-pedestrian collisions unless fatalities result (35 to 80 percent underreporting by some estimates), the paucity of reported vehicle-bicycle and vehicle-pedestrian crashes may be a poor indicator of pedestrian and bicycle safety.

The TPI study team concludes:

- ❑ In the design exception process, crashes are not assessed in a manner that reflects the true safety implications of alternative designs, particularly for pedestrians and bicyclists.

The TPI study team recommends that:

- ❑ DOT require its designers to assess whether roadway projects will lead to higher traffic speeds, and hence greater crash frequency and severity.
- ❑ DOT require analyses of indicator crash rates for roadways relative to statewide averages. Pedestrian accidents should be analyzed for all main street projects, regardless of the number of such accidents or the CSDEs involved.

Pedestrian-Friendly Features as Controlling Design Elements

While DOT is paying more attention nowadays to pedestrians and bicyclists in its design practice, its design exception policies have yet to catch up. DOT's existing set of controlling design elements and minimum standards are intended largely for the convenience and safety of motorists. In certain other states, we find more balanced approaches to design exceptions (see Table 2.3). A level of care has been extended to pedestrians and bicyclists.

In most states, design speed is a controlling design element. This means that minimum design speeds for any given functional class and location can be breached by design exception. By contrast, in New Jersey's urban areas, the minimum design speed on reconstruction projects is 30 mph, 5 mph over the minimum posted speed of 25 mph. The minimum design speed on new construction projects is 35 mph, 10 mph over the minimum posted speed. These are high speeds for a pedestrian environment. The possibility of adopting lower design speeds is discussed in Section 2.5.

From other states surveyed, controlling design elements are added sometimes to give higher priority to pedestrians and cyclists. Consider the case of medians on multilane highways. While the RDM declares medians "highly desirable" on arterials with

[14] Surface Transportation Policy Project (STPP), *Mean Streets 2000: Pedestrian Safety, Health and Federal Transportation Spending*, June 2000.

four or more lanes, medians do not rise to the level of controlling design element. No justification is required for a road widening that excludes a median.

As part of Main Street Overlays, raised medians or crossing islands would become controlling design elements for multilane roads. Minimum widths would be established (at least 6 feet, the distance between the front of a stroller and the back of the person pushing it, or the length of a bicycle). Medians would be raised at least six inches with barrier-type curbs. The median in Figure 2.5 would conform; the median in Figure 2.6 would not. While the standards

	NJ	CT	NM	NY	OH		VT		WI
					const reconst	3R	const reconst	3R	
Design Speed		X	X	X			X	X	X
Level of Service				X (Interstate only)			X		
Lane Width	X	X	X	X	X	X	X	X	X
Shoulder Width	X	X	X	X	X	X	X	X	X
Stopping Sight Distance	X	X	X	X	X	X	X	X	X
Cross Slope	X	X	X	X	X	X	X		X
Superelevation	X	X	X	X	X	X	X	X	X
Minimum Curve Radius (horizontal curves)	X	X	X	X	X	X	X	X	X
Minimum Curve Radius (vertical curves)	X		X		X (including grade breaks)	X (including grade breaks)	X	X	X
Minimum and Maximum Grades	X	X (maximum only)	X	X	X	X	X		X
Through-Lane Drop Transition Length	X								
Auxiliary Lane Length (interchanges)	X								
Bridge Width	X	X	X	X	X	X	X	X	X
Horizontal Clearance				X	X	X	X	X	X
Vertical Clearance	X	X	X	X	X	X	X		X
Structural Capacity	X	X	X	X	X	X	X		X
Guard Rail and Bridge Rail									X
Signs, Signals, and Pavement Markings							X	X	
Accessibility Requirements for the Handicapped			X						
Bicycle Lane Width							X		
Median Width				X					

Table 2.3: Design elements subject to design exceptions in various states.

could be breached, this would occur only by design exception.

The TPI study team concludes:

- ❑ DOT's design policies differ from those of certain other states in two important respects: design speeds are not subject to design exceptions, and no pedestrian- or bicycle-friendly design features qualify as controlling design elements.

The TPI study team recommends that:

- ❑ DOT provide for lower design speeds on main streets (as discussed in Section 2.5).
- ❑ DOT elevate certain pedestrian- and bicycle-friendly features to controlling design elements as part of Main Street Overlays (as discussed in Section 2.4).

Exemptions for Certain 4R Projects

3R projects are fundamentally different from new construction projects. There is a crash history for 3R projects from which to judge the adequacy of designs. There is no crash history for new construction projects. Even if a roadway has substandard design elements by current standards, the true test of safety is how the roadway is performing in its context. And this is known for 3R projects. The draft AASHTO Bridging document acknowledges this fundamental difference:

> *For projects involving resurfacing or rehabilitation, AASHTO Green Book criteria do not apply. Such projects by definition do not include substantive changes in the geometric character of the road. Most agencies employ special design criteria for 3R projects. Criteria generally reflect an acceptance of existing features regardless of whether they meet current agency criteria for a new highway.*[15]

Reconstruction projects may be more like 3R projects, when reconstruction is largely occurring within existing curb lines, or more like new construction, when a new cross section or new alignment is being established. In the former case, there is a relevant crash history to draw on; in the latter, there is not.

To a limited degree, the draft AASHTO Bridging document acknowledges the 3R-like nature of some reconstruction projects:

> *Where a project involves reconstruction of an existing highway which includes locations with nominally substandard vertical curvature and thus insufficient SSD, designers should study the known crash history of the road and the locations to determine the extent of actual safety risk. Research and experience suggest that marginally deficient SSD may not translate into actual safety problems.*[16]

Figure 2.5: Conforming median, Burlington, Vermont.

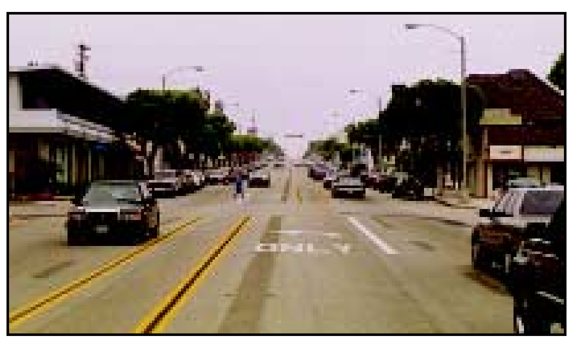

Figure 2.6: Nonconforming median, Los Angeles, California.

[15] American Association of State Highway and Transportation Officials (AASHTO), *Context-Sensitive Design for Integrating Highway and Street Projects with Communities and the Environment*, Chapter 1: Project Development Process, NCHRP 20-17-114, final draft, Feb. 2000, p. 16.

[16] AASHTO, op. cit., p. 8.

DOT's design policies distinguish between 3R and new construction projects. But are the distinctions commensurate with the differences discussed above? And should some reconstruction projects also qualify for special treatment?

Non-Interstate 3R projects are eligible for various Programmatic Design Exceptions (PDEs). These are categorical design exceptions requiring no justification or approval. There are PDEs related to lane width, shoulder width, stopping sight distance, and several other design elements. The various design exception possibilities are listed in Table 2.4.

Without reviewing project fact sheets, the TPI study team cannot tell how frequently PDEs are invoked. But on their face, the eligibility criteria for PDEs appear highly restrictive. An example follows.

Effectively, a PDE is not available for substandard lane width, since the minimum qualifying lane width for a PDE is at or above DOT's minimum design standard. A PDE is available for substandard shoulder width, but only if travel lanes are of standard width and only if shoulders are within a couple feet of the minimum design standard (see Table 2.5).

While restrictive, DOT's design exception policy for 3R projects is not out of line with the policies of most other states. Indeed, the availability of any programmatic design exceptions for 3R projects sets New Jersey apart from other states. DOT's design exception policy for reconstruction projects is also consistent with the policies of other states. No special treatment is given.

Controlling Design Elements	Eligibility for Design Exceptions	Eligibility for Programmatic Design Exceptions	Requirement of Problem Statement
Design Speed			
Lane Width	X	X	
Shoulder Width	X	X	
Stopping Sight Distance	X	X	X
Cross Slope	X		
Superelevation	X	X	
Minimum Curve Radius (horizontal curves)	X		X
Minimum Curve Radius (vertical curves)	X		X
Minimum and Maximum Grades	X	X	
Through-Lane Drop Transition Length	X		
Auxiliary Lane Length (interchanges)	X		
Bridge Width		X longer bridges	X
Horizontal Clearance			
Vertical Clearance	X	X 2R projects only	
Structural Capacity	X		

Table 2.4: DOT eligibility for design exemptions and programmatic design exemptions.

	Construction and 3R Desirable	Minimum	PDE Minimums 10% or More Trucks	Less Than 10% Trucks[17]
Lane Width	3.6 m (12 ft)	3.3 m (11 ft)	3.6 m (12 ft)	3.3 m (11 ft)
Outside Shoulder Width	3.0 m (10 ft)	2.4 m (8 ft)	1.8 m (6 ft)	1.8 m (6 ft)

Table 2.5: Lane and shoulder widths.

One state surveyed, Maryland, has taken a different tack. Under Maryland's new design policy, main street projects that remain within existing curb lines are exempt from design standards as long as crash analyses demonstrate no particular safety problem related to substandard design elements. This policy is now applied to all main streets in Maryland. See Subsection 3.3.5.

The TPI study team concludes:

- ❑ Crash histories can be used to judge the safety of existing highways for 3R and even reconstruction projects that remain within existing curb lines; such histories are far better indicators of safety *in context* than are comparisons of existing design values to current standards.
- ❑ On first reading, DOT's current design exception policy seems more permissive than those of most other states. Yet current programmatic design exceptions may be so limited as to have little practical effect.

The TPI study team recommends that:

- ❑ DOT exempt 4R projects (3R and reconstruction projects) on main streets from current geometric standards as long as curb-to-curb width is maintained and crash history is acceptable. Since crash analyses are already required for PDEs, this policy change would simply give these analyses more weight in design decisions.
- ❑ Regardless of context and crash history, DOT continue to impose new construction standards on any CSDEs viewed as too hazardous to permit blanket design exceptions for 4R projects. The three conditions currently requiring problem statements may fall into this category.[18]

[17] The minimums shown are for highways with ADTs over 2000 vehicles per day, which is typical of main streets.

[18] The three conditions are: (1) safe speed on horizontal curve more than 15 mph below posted speed and ADT greater than 750 vpd; (2) crest vertical curves where: curve hides major hazards such as intersections; or V calculated of vertical curve is more than 20 mph below project design speed; and (3) usable bridge widths below width of approach lanes plus some width which depends on ADT.

2.4 Main Street Overlays

The design of rural highways could be described as "centerline out." The designer begins with a standard cross section and bends the alignment around large, immovable objects so as to maintain the cross section. Roadside objects that cannot be avoided are removed. Designing in the urban setting is more of an "outside in" exercise. Tight geometrics may be required to pack all design elements into the space between property lines. This point is best illustrated in the Washington Township case study (Section 3.2.4). Washington Township will assume jurisdiction over two highways passing through its Town Center rather than build to state or county design standards.

As a means of fostering context-sensitive design, the TPI team recommends the adoption of Main Street Overlays. The idea of Main Street Overlays is simple. Highway segments that qualify as main streets would receive a special designation on the state system. For these segments, certain design standards, favoring motor vehicles, would be relaxed to AASHTO Green Book minimums. Other design features, favoring pedestrians and bicyclists, would be elevated to the status of controlling design elements. An array of new typical sections would be adopted, with the appropriate typical section depending on traffic conditions and land-use context.

"Ideal" Design Values

During the CSD training course conducted for DOT (see Section 1.3), DOT engineers were asked to define geometric and other characteristics of the ideal main street. They generally agreed on the following minimum design values:

- 25 or 30 mph design speeds,
- 10- or 11-foot travel lanes,
- No shoulders,
- Parking lanes with curb extensions,
- Two- to five-foot lateral clearance from curb to street trees and street furniture,
- 15- to 25-foot curb return radii at intersections,
- Six-inch vertical curbs,
- Five-foot sidewalk widths,
- Crosswalks on all intersection approaches, and at midblock locations on longer blocks, and
- Medians or refuge islands on multilane streets.

When asked to define the ideal main street, the engineers had a specific context in mind, a highly urban setting with low vehicle operating speeds, heavy pedestrian traffic, and limited rights-of-way. These minimums would not apply to rural roads, nor to all urban streets. But in the context of a main street, they seem reasonable.

RDM vs. AASHTO Minimums

The minimums suggested by DOT engineers are consistent with AASHTO Green Book guidelines. They are not, in all cases, consistent with roadway design standards of DOT. New Jersey's *Roadway Design Manual* (RDM) states: "Separate design standards are appropriate for different classes of roads." Yet, as a matter of design practice, flexibility is limited by typical sections that make no distinction between urban and rural, or between main street and standard urban arterial. Regardless of location, a typical two-lane "land service highway" has the cross section illustrated in Figure 2.7.

In the RDM, minimum lane widths are 3.3 m (11 ft) for all roads, regardless of context. Under DOT's current policy, 3.0 m (10 ft) lanes must be widened to the 3.3 m (11 ft) minimum at the time of resurfacing. In the absence of shoulders, outside lanes must be 4.5 m (15 ft) to accommodate bicyclists. This, again, is regardless of context.

Shoulders are required on all state highways, even main streets. Minimum shoulder widths are 2.4 m (8

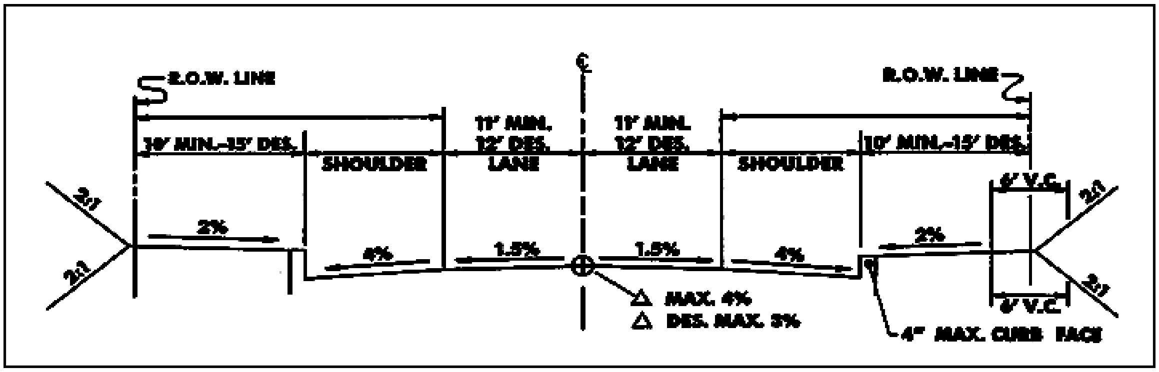

Figure 2.7: Typical section for a two-lane highway from New Jersey's Roadway Design Manual.

feet) on outside lanes and 0.9 meters (three feet) on inside lanes of divided roadways. Parking lanes ordinarily will not substitute for shoulders, and certainly will not substitute for shoulders if periodically interrupted by curb extensions (bulb-outs).

Clear zone distances of at least 4.5 meters (15 feet) are recommended for conditions typical of main streets (design volumes over 6,000 vehicles per day and design speeds less than 40 mph). The RDM does not distinguish between curbed and open roadway sections, nor between design speeds of 40 mph and design speeds well below 40 mph. Even assuming eight-foot shoulders, an additional seven-foot clearance is recommended. Trees of more than 150-millimeter (six inch) diameter are considered fixed objects. Acknowledging the aesthetic and environment appeal of trees, the RDM recommends replacement trees outside the clear zone when trees inside the clear zone must be removed.

Design Element	Minimum
Travel Lane Width	3.0 m (10 ft)
Parking Lane Width	2.4 m (8 ft)
Bike Lane Width	1.2 m (4 ft)
Outside Shoulder Width	none
Inside Shoulder Width	none
Clearance (from curb face)	0.5 m (1.5 ft)
Curb Return Radius (for minor cross streets)	3.0 m (10 ft)

Table 2.6: AASHTO minimum values.

Finally, corner radii (curb return radii) of at least 4.5 meters (15 feet) are recommended in the RDM. Theoretical or effective radii must be at least 9.0 meters (30 feet) are also recommended, considering shoulders and parking lanes that allow vehicles to swing wide when turning. The recommended radii are about twice that required to make a turn in a passenger car, and are designed to "allow an occasional truck or bus to turn without much encroachment."

By contrast, AASHTO minimums for urban arterials are summarized in Table 2.6. Virtually every value is different from DOT's.

The TPI study team concludes:

- ❑ DOT design practice does not distinguish sufficiently between rural and urban roads, or between main streets and other urban arterials.
- ❑ DOT standards are above AASHTO minimums for certain design elements critical to main streets.

The TPI study team recommends that:

- ❑ DOT relax geometric standards for designated Main Streets to AASHTO minimums.
- ❑ DOT qualify streets for this special status using the two criteria specified in Section 1.1: a qualifying score based on the "main streetness" formula, and location in a designated Center under the New Jersey State Plan. Other streets could qualify on a case-by-case basis.

- ❑ DOT include the Main Street designation on the Straight Line Diagram. This would allow the agency and community to decide in early project planning where a Main Street Overlay would begin and end to the tenth of a mile marker.

Minimum vs. Desirable Values

Under the proposed Main Street Overlay Program, design standards for designated Main Streets would equal AASHTO minimums. However, depending on traffic conditions and land use contexts, desirable values may exceed AASHTO minimums. In particular, the need to accommodate the full range of street uses (including buses, bicycles, and parked cars) may result in wider cross sections than AASHTO minimums alone would suggest.

This section provides guidance on cross sectional elements, keeping all street users in mind. The next section presents typical sections for different traffic conditions and land-use contexts.

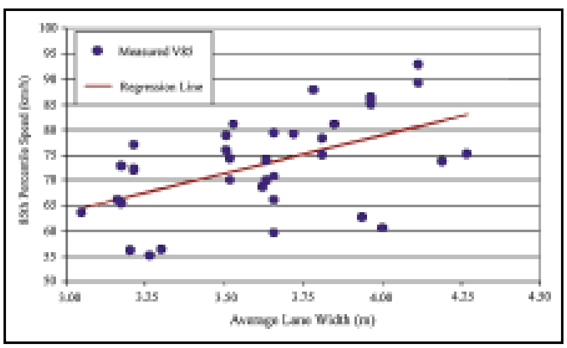

Figure 2.8: Speed in relation to lane width.[20]

Standard Lanes

The popular wisdom is that narrow travel lanes, say under 12 feet, are unsafe. Indeed, they may be in high-speed rural settings, particularly at higher traffic volumes.[19] Urban streets are another matter. As the draft AASHTO Bridging document states:

> *AASHTO policy values for lower speed urban street lane widths are less rigorously derived. There is less direct evidence of a safety benefit associated with incrementally wider lanes in urban areas...*

Wider lanes mean higher speeds. Recent urban and suburban research leaves little doubt about that (see Figure 2.8). Higher speeds mean more severe crashes. Thus, ipso facto, there may be some latitude to reduce lane width on urban streets without compromising safety.

The typical sections for main streets presented in Figure 2.33 (see page 33) and Table 2.9 (see page 33) have standard 11-foot lanes. This is the minimum lane width in the RDM, less than considered desirable by DOT but more than the AASHTO minimum under restricted conditions. It represents a compromise, intended to accommodate the full range of main street users. A review of transit-oriented design manuals disclosed that 11-foot lanes were the absolute minimum deemed necessary by transit operators. Commercial vehicles making deliveries to main street businesses will also appreciate the extra foot of lane width.

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[19] Even in rural areas, the empirical literature paints a complicated picture. In a National Cooperative Highway Research Program (NCHRP) study, low-volume rural roads with 9-foot lanes actually had crash rates as low as those with 11- and 12-foot lanes, probably because speeds were lower on the narrow roads. On the other hand, rural roads with 10-foot lanes had the highest crash rates, and particularly when they had substandard shoulders. Such lanes encouraged relatively fast driving, and when combined with narrow shoulders, provided little room for errant vehicles to recover. For a review of the evidence, see E. Hauer, “Safety in Geometric Design Standards I: Three Anecdotes,” in R. Krammes and W. Brilon (eds.), *Proceedings of the 2nd International Symposium on Highway Geometric Design*, Transportation Research Board, 2000, pp. 11-23.

[20] K. Fitzpatrick and P. Carlson, “Design Factors that Affect Driver Speed on Suburban Streets,” paper presented at the 80th Annual Meeting, Transportation Research Board, Washington, D.C., 2001.

Shared Lanes

Often in main street settings, accommodating cyclists via shared lanes or separate bike lanes conflicts with the desire to maximize pedestrian comfort and safety via narrow streets. At what speeds and volumes can cyclists safely share a lane with motor vehicles? Answers are suggested in Table 2.7 from *NJDOT Bicycle Compatible Roadways and Bikeways, Planning and Design Guidelines*.

These guidelines are the basis for typical sections in Figure 2.33. At 2,000 vehicles per day, typical sections transition from standard travel lanes to wider shared lanes; at 10,000 vehicles per day, they transition to separate bike lanes (see Figures 2.9 and 2.10). Danish bicycle guidelines suggest a transition from bike lanes to off-street bike tracks or bike paths when traffic volumes or speeds get high enough (as in Figure 2.11).[21] This is something for DOT to consider as it revises its bicycle guidelines and incorporates them into the RDM.

The narrowest typical sections in Figure 2.33 will not be applicable to many state highways, as traffic volumes on the state system are typically higher than 10,000 vpd, and nearly always higher than 2,000 vpd. These typical sections are presented anyway for two reasons. First, there are state highways with low traffic volumes, albeit not many of them.[22] Second, it is hoped that these typical sections, when endorsed by DOT, may be adopted by counties and cities for their lower volume main streets.

Facility	20 mph	25 mph	30 mph	35 mph
Existing Lane	<2000	<2000	<2000	<1200
Shared Lane	2-10k	2-10k	2-10k	1200-2000
Bike Lane	>10000	>10000	>10000	>2000

Table 2.7: New Jersey bicycle compatibility guidelines.[23]

Figure 2.9: Wide shared lane, Missoula, Montana.

Figure 2.10: Bicycle lane, Portland, Oregon.

Figure 2.11: Separate bicycle path, Burlington, Vermont.

[21] Road Directorate, Collection of Cycle Concepts, Denmark, 2000, p. 53.

[22] Our search uncovered 8 state route segments with ADTs less than 2,000 vpd, and 122 segments with ADTs between 2,000 and 10,000 vpd.

[23] *NJDOT Bicycle Compatible Roadways and Bikeways, Planning and Design Guidelines*, 1996. Recommended bicycles facilities, urban conditions with on-street parking, Tables 1 & 2, pp. 6, 7 & 38.

Edge Lines and Offsets

Wide shoulders are incompatible with main streets. Shoulders are breakdown lanes—space to slow down and pull over out of traffic. In a rural and some suburban contexts, such space may be essential. In a main street context, a motorist can turn onto a side street to change a flat.

As noted, DOT engineers participating in the CSD Training Course saw no need for shoulders on main streets. However, some did perceive the need for shy distance between travel lanes and curbs. They endorsed parking and cycle lanes to provide such distance. On streets without either, edge lines may be appropriate.

Edge lines have value as visual references under adverse weather and visibility conditions. The Manual on Uniform Traffic Control Devices (MUTCD 2000) requires edge lines on freeways, expressways, and rural arterials with high traffic volumes. MUTCD is silent regarding the use of edge lines on urban streets, other than to say that they "may be excluded...if the traveled way edges are delineated by curbs...."[24]

Figure 2.12: Edge lines with small offsets on Main Streets in Dublin, New Hampshire (top) and Deerfield Beach, Florida (bottom).

There are many examples of main streets with edge lines. They are particularly common in rural hamlets and suburbs, and are often used when cross sectional width varies (see Figure 2.12). Our proposed typical sections for main streets include edge lines with offsets when bike and parking lanes are not present (see Figure 2.33).

Edge lines may not be necessary where curbs are well-delineated. And, of course, they are not necessary on main streets with bike or parking lanes. Ultimately, whether or not to use edge lines on main streets is a judgment call best left to the designer and community.

When edge lines are used, edge lines and offsets should be subtracted from the total curb-to-curb width, not added as is standard practice. For streets with 12-foot travel lanes, the addition of a two-foot edge line/offset results in effective lane widths of 14 feet. This is wide enough to qualify as a shared lane. By subtracting rather than adding edge line and offset widths, the typical sections in Figure 2.33 visually narrow streets and minimize crossing distances for pedestrians while maintaining adequate clearance for motor vehicles.

On-Street Parking and Curb Extensions

While there are capacity and safety reasons to restrict on-street parking on open highways, lower speeds and increased street activity are desirable on main streets. In particular, traditional shopping streets nearly always have on-street parking. It is convenient for shoppers, who seem to prefer curbside to off-street parking. Parked cars act as buffers between the street and sidewalk. Our typical

[24] Federal Highway Administration (FHWA), *MUTCD 2000—Manual on Uniform Traffic Control Devices*, Washington, D.C., 2000, p. 3B-21.

sections for traditional shopping streets therefore incorporate parking lanes (see Figure 2.33).

The typical sections for gateway streets, residential arterials, and other main streets, do not incorporate parking lanes. There is less demand for curbside parking on such streets, and parking lanes, unless well-utilized, are an inefficient use of available space. Moreover, the added clear width associated with underutilized parking lanes may encourage speeding and compromise safety. Regarding safety, the available literature suggests that on-street parking accounts for a significant proportion of urban crashes.[25] Therefore, for these main streets, on-street parking should be provided on a case-by-case basis, only where the community and DOT agree it is appropriate.

Where on-street parking is provided, curb extensions should be constructed at regular intervals. These are used to define and protect parking bays, shorten crossing distances for pedestrians, and provide space for trees, street furniture, and bus stops (see Figures 2.13 and 2.14). Curb extensions, often referred to as bulb-outs, are basic features of good shopping streets. Despite business concerns about loss of on-street parking (as in the Westminster case study, Section 3.3.5), literally hundreds of traditional shopping streets around the U.S. have been improved with bulb-outs.

How far should bulb-outs extend from the curb? Wide bulb-outs, such as the eight-foot variety used in Plainfield, may calm traffic more than the narrower bulb-outs used in South Miami, Westminster, and most other main street applications. By "shadowing" parked cars more completely, wider bulb-outs may also provide a more substantial buffer from traffic for drivers getting into and out of their cars. Yet, when bulb-outs extend much beyond the line of parked cars, they represent an obstacle to passing motorists and bicyclists. In the first year after installation, there were 26 crashes in Plainfield linked to bulb-outs, and the overall crash rate in the business district more than doubled (see the Plainfield case study in Subsection 3.2.2). Thus, without more comparative safety data, the TPI team cannot recommend wide bulb-outs that encroach on the traveled way.

Figure 2.13: Curb extension with space for street furniture, Hollywood, Florida.

Figure 2.14: Curb extension with space for trees, San Fransisco, California.

[25] P.C. Box, "Curb Parking Findings Revisited," Transportation Research E-Circular, Transportation Research Board, December 2000, pp. B5/1-8. Also see Texas Transportation Institute (TTI), "On-Street Parking," *Synthesis of Safety Research Related to Traffic Control and Roadway Elements*, Federal Highway Administration, Washington, D.C., 1982, Chapter 9; and J.B. Humphreys et al., Safety Aspects of Curb Parking, Federal Highway Administration, Washington, D.C., 1978.

Figure 2.15: Five-foot clear width necessary for two strollers, New York, New York.

Figure 2.16: Less than five-foot clear width, Winter Park, Florida.

Sidewalks

The RDM establishes a minimum sidewalk width of 1.2 meters (four feet). This is a bit skimpy for a main street. Five feet is the accepted minimum sidewalk width. This is the minimum clear width of sidewalks, free of obstructions and including shy distances (see Figures 2.15 and 2.16). It will allow a person in a wheelchair to turn around or two people pushing strollers to walk comfortably together. If street furniture (street lights, trash cans, newspaper boxes, etc.) is plentiful, an extra 2-1/2 feet of width should be allowed for clearance. If buildings run up to the sidewalk, an additional 1 to 1-1/2 feet of width is desirable due to the tendency of pedestrians to maintain this clear distance from walls.

In a main street environment, sidewalk widths well above the minimum may be required to accommodate heavy pedestrian traffic. To allow walking at near-normal speeds, sidewalks must provide at least 25 square feet per pedestrian at peak times.[26] More space is required, perhaps 40 square feet per person, to permit maneuvering around slower pedestrians and complete avoidance of oncoming and crossing pedestrians. While still lively, all hint of crowding is eliminated at 100 to 150 square feet per person. Given such considerations, it is easy to see how some leading urban designers have arrived at sidewalk widths of 10, 15, even 20 feet as suitable for high-volume locations (as in Figure 2.17).

Pedestrian Crossings

One of the defining qualities of a main street, as opposed to a commercial strip, is a high degree of interplay between opposite sides of the street. Shoppers, residents, and other users engage in activities on one side and then the other, and the easier a street is to cross, the better a main street functions. Pedestrian movement back and forth

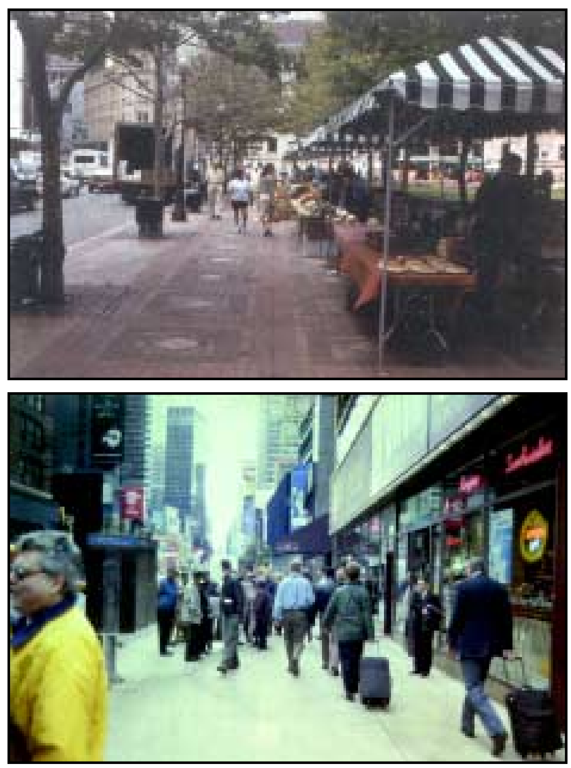

Figure 2.17: Wider sidewalks where needed, Boston, Massachusetts.

[26] J.J. Fruin, *Pedestrian Planning and Design*, Metropolitan Association of Urban Designers and Environmental Planners, Inc., New York, 1971, pp. 42 and 47-50. Fruin's work was the basis for *Highway Capacity Manual* sidewalk standards.

makes drivers behave less aggressively, which in turn makes the street easier to cross. The two phenomena reinforce each other. Pedestrian crossings may be as important in moderating driver behavior as geometric design.

On main streets, marked crosswalks should be provided on all approaches to signal or stop sign controlled intersections. Marked crosswalks both channel pedestrians to a common crossing point and alert drivers to the possibility of pedestrians. To encourage crossing at such points, and discourage jaywalking, pedestrian delays at signalized intersections should be kept to a reasonable minimum. Research has shown that a minute is the longest that pedestrians will voluntarily wait before trying to cross against a light. Therefore, main streets should have relatively short traffic signal lengths. Signals should be pre-timed in most cases to provide crossing opportunities automatically, without motor vehicle or pedestrian activation. Shorter cycles and pre-timed signals are consistent with low speed traffic progression, the desired condition on main streets.

At controlled intersections, the biggest threat to pedestrians is turning conflicts. Motorists making right turns tend to look to their left for oncoming traffic rather than their right for crossing pedestrians. Motorists making left turns under protected

Figure 2.18: First people (left), then cars (right).

conditions tend to make turns without carefully scanning the environment for pedestrians. In New York City, the second leading cause (17%) of pedestrian fatalities is "vehicle turned into pedestrian in crosswalk." Drivers are simply not yielding to pedestrians.

The best way to counter this tendency is to reduce pedestrian exposure times and vehicle turning speeds. Tight corners, curb extensions, medians, and refuge islands will have these effects and are recommended in subsequent subsections. At key intersections, there is also the possibility of leading pedestrian intervals (LPI), which give pedestrians time to cross before parallel traffic gets its green light (see Figures 2.18). In one study, leading pedestrian intervals were found to reduce vehicle-pedestrian collisions by 64 percent.[27]

Pedestrian crossing opportunities should be available every 300 feet or so along main streets. Accordingly, some crossings will be located at uncontrolled intersections or midblock locations. In such cases, refuge islands and/or curb extensions should be used to create safe crosses (see Figures 2.19 and 2.20). Marked crosswalks may be used as well. Recent research suggests that marked crosswalks may or may not improve pedestrian safety, depending on street width and traffic volumes (see Table 2.8). On wide, high-volume arterials, marked crosswalks may give pedestrians a false sense of security. However, for the cross sections recommended in this guide, including multilane main streets with medians, pedestrians are at least as safe with marked crosswalks as without them, and probably more comfortable crossing the street.

Particularly at midblock locations, pedestrian crossings should be as attention getting as possible. The MUTCD directs that:

> *Because non-intersection pedestrian crossings are generally unexpected by the road user, warning signs should be*

[27] M. King, "Calming New York City Intersections," Urban Street Symposium, Transportation Research Board, Dallas, 1999.

> *installed and adequate visibility should be provided by parking prohibitions.*[28]

In addition, the MUTCD suggests the use of high visibility pavement markings at locations where pedestrians crossings are not expected, such as at midblock crossings. At such locations, MUTCD favors diagonal and longitudinal marking patterns over standard transverse parallel lines (right and bottom favored over top in Figure 2.21). Even greater visibility can be achieved with wider stripes in a Continental pattern (as in Figure 2.22).

Other ways of drawing attention to midblock crossings include the use of advance warning signs, in-pavement warning lights, and pedestrian-activated signals. Bridgeport Way in University Place, WA, offers a good example in a suburban setting (see Figure 2.23). This particular cross section replaced a five-lane arterial with no provision for pedestrians or bicyclists and crash rates 70 percent higher than today.

Figure 2.19: Curb extensions at a midblock crossing, West Palm Beach, Florida.

Figure 2.20: Refuge island at a midblock school crossing, Portland, Oregon.

Medians or Crossing Islands

Recent research has found that raised medians significantly reduce pedestrian crash rates on multilane urban arterials.[29] Medians allow pedestrians to deal with one direction of traffic at a time, and to cross half way rather than having to wait for a gap in traffic in both directions. Where continuous medians cannot be provided, short crossing islands will perform as well or better.

Lanes	ADT	Median	Marked Crossing	Unmarked Crossing
1-2	all	–	equal	
3+	<12,000	–	equal	
3+	12,000 - 15,000	yes	safer	
3+	12,000 - 15,000	no		safer
3+	>15,000	–		safer

Table 2.8: Saftey of marked vs. unmarked crossings.[30]

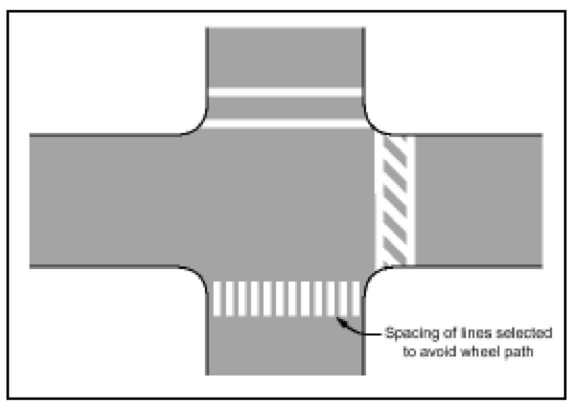

Figure 2.21: MUTCD crosswalk marking patterns.

[28] FHWA, op. cit., p. 3B-35.

[29] Zegeer et al., op. cit. Also see B.L. Bowman and R.L. Vecellio, "Effect of Urban and Suburban Median Types on Both Vehicular and Pedestrian Safety," *Transportation Research Record 1445*, 1994, pp. 169-179.

[30] C. Zegeer, J. Stewart, and H. Huang, "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Analysis of Pedestrian Crashes in 30 Cities", Transportation Research Board, July 2000.

Figure 2.22: High visibility pavement markings, New York, New York (top) and Sacramento, California (bottom).

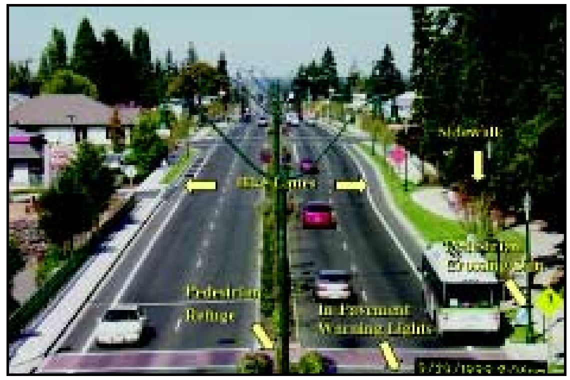

Figure 2.23: Midblock crossing designed for high visibility, University Place, Washington.

No mention is made in the RDM of pedestrian refuge as a function performed by medians, and no consideration is given to this function in establishing minimum median dimensions. While the RDM calls for medians "as wide as feasible," widths as narrow as 1.2 m (4 ft) are acceptable. Such widths are unsafe for bicyclists and pedestrians with carriages, strollers, and other equipment.

Many sources recommend raised medians or crossing islands on multilane highways. Nearly all recommend median or island widths of at least 1.8 m (6 ft) for use as pedestrian or bicycle refuges. This includes AASHTO's Green Book and the old MUTCD.[31] DOT's own pedestrian guidelines recommend a median width of 8 feet or more.[32] Thus, our typical sections for multilane main streets show raised medians or refuge islands of 6-foot minimum width, 8-foot desirable width. If the minimum width is not attainable, it may be better not to provide any pedestrian refuge at all. Better not to deceive pedestrians into thinking they are safe (compare Figures 2.24 and 2.25 on page 30).

Corner Radii

When it comes to corner radii (curb return radii at intersections), even advocates of context-sensitive design, walkable communities, and New Urbanism shy away from bold statements and departures from standard practice. It is one thing to reduce travel lanes to 11 feet or even 10 feet. This is still wider than any design vehicle, including a transit bus or an Interstate tractor-semitrailer (with design widths of 8.5 ft). It is another thing to recommend tight corners when AASHTO's design passenger car has an inside turning radius of 14.4 feet and its design transit bus and single unit truck have inside turning radii of 24.5 and 28.3 feet, respectively. Simple turning requirements seem to demand wide corners.

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[31] American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, Washington, D.C., 2001, p. 630; and Federal Highway Administration (FHWA), *Manual on Uniform Traffic Control Devices*, Washington, D.C., 1988, p. 5B-2. MUTCD 2000 is intentionally silent on geometric issues.

[32] New Jersey Department of Transportation (NJDOT), *Pedestrian Compatible Planning and Design Guidelines*, Trenton, 1996, p. 31.

Figure 2.24: Substandard refuge, Brooklyn, New York.

Figure 2.25: Standard refuge, Berkeley, California.

In main street contexts, there is general agreement that the corner radii should be as small as possible. The Green Book itself states: "For arterial street design, adequate radii for vehicle operation should be balanced against the needs of pedestrians..."[33] An increase in corner radius from 10 to 30 feet adds 15 feet to pedestrian crossing distance and increases the turning speed of autos from a crawl to about 12 mph, putting pedestrians at risk during free right turns.[34]

The question, then, is just how small can corner radii be without jeopardizing safety? In most main street applications, the combination of on-street parking and no-parking zones at corners doubles the effective or usable corner radius for turning vehicles. The actual vehicle fleet requires less space than indicated by AASHTO design vehicles, which are composites. And creative solutions are available for the odd case when these two conditions do not apply. The conflicts-solutions matrix in Section 2.6 offers a range of possibilities, several of which are illustrated by our case studies:

- ❑ Establish an alternate truck route to reduce the need for large radii corners on main streets (see Figure 2.26).
- ❑ Use small corner radii at all but main intersections with heavy cross street traffic and large turning volumes (see Figure 2.27).
- ❑ Use tight mountable corners for the occasional turning truck, a practice endorsed by the Technical Review Committee as safe in low-speed main street environments (see Figure 2.28).
- ❑ Allow the occasional truck to encroach on the opposing lane briefly, as the tight geometrics of Figure 2.29 necessitate. To minimize conflicts in such cases, stop lines on side streets may be set back from intersections far enough to accommodate the swept paths of larger vehicles (see Figure 2.31).

Corner radii of 10 to 15 feet are common in cities, and corner radii as small as five to 10 feet prove workable in many locations. Whatever the theoretical case for large radii, cities make do with small ones, and crashes between turning vehicles and side street traffic appear to be rare, perhaps because turns are made so cautiously under constrained conditions.

The TPI team recommends that DOT discard its guidelines for actual corner radii, and instead set standards for effective or usable corner radii accounting for parking and bike lane widths. Practical minimums should be used. Through the kind of creativity shown in our case studies, effective inside corner radii of 15 feet should prove adequate at most minor cross streets, while 25 feet should be adequate at most major cross streets. On

[33] AASHTO, op. cit., p. 618.

[34] These estimates come from the Green Book. The former estimate assumes that the sidewalk is set back 10 feet from the curb.

Figure 2.26: Twenty-foot corner with alternate truck route, York, Pennsylvania.

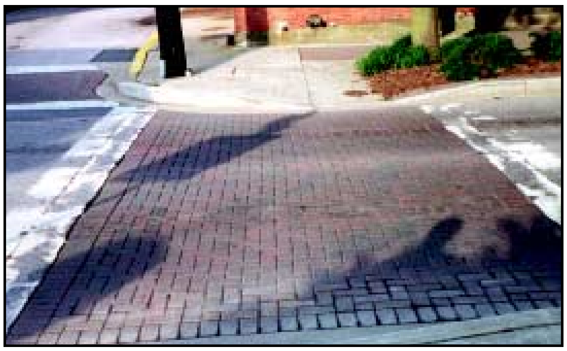

Figure 2.27: Five-foot corner at minor intersection, Westminster, Maryland.

Figure 2.28: Fifteen-foot mountable corner, South Miami, Florida.

Figure 2.29: Twenty-foot corner with planned encroachment, Plainfield, New Jersey.

corners without curb extensions, the corners themselves may have radii of 15 feet or less (as in Figures 2.30, 2.31 and 2.32 on Page 32).

The TPI study team recommends the following design values for use in the Main Street Overlay Program. Values in bold type would become controlling design elements for designated main streets; they could be breached only by design exception.

- ❑ Standard Travel Lanes—11 feet.
- ❑ Shared Lanes—14 feet (or 13 feet with an edge line and one-foot offset).
- ❑ Bike lanes—**5 feet**—for use at higher traffic volumes and speeds.
- ❑ Parking lanes—**8 feet**—on traditional shopping streets.
- ❑ Sidewalks—**5 feet**—sized to provide public space and avoid crowding.
- ❑ Medians or Crossing Islands—**6 feet** and raised or not at all.
- ❑ Shoulders—Never on main streets.
- ❑ Vertical Curbs—Always on main streets.
- ❑ Clear Zones—AASHTO minimums for curbed sections.
- ❑ Edge Lines—In rural hamlets and suburban settings.
- ❑ Pedestrian Crossings—Every 300 feet or so—at all controlled intersections and other locations with special treatments.
- ❑ Corner Radii—Effective inside radii of 15 feet at minor cross streets, 25 feet at major streets.
- ❑ Traffic Signals—Timed for 60-second maximum pedestrian wait.

Figure 2.30: Two-foot corner on a traditional main street, Dade City, Florida.

Figure 2.31: Fifteen-foot corner with stop lines set back, Princeton, New Jersey.

Figure 2.32: Fifteen-foot mountable corner with truck tire tracks, Queens, New York.

Typical Sections

Main street projects profiled in Chapter 3 fall into two distinct classes: traditional shopping streets and gateway streets. The gateway streets include approaches to main street, other commercial streets with small building setbacks, and main roads with fronting residences. In these case studies, traditional shopping streets typically get curb extensions and midblock crosswalks; gateway streets typically get medians or refuge islands and bicycle lanes or extra-wide shared-use lanes. Almost every main street gets wider sidewalks, and many get additional street trees and/or textured paving. That projects differ by class indicates that different design elements belong in different contexts.

With this in mind, the TPI team has prepared two different sets of typical sections, presented schematically in Figure 2.33. Typical sections are derived from Table 2.9.

Typical sections A through C and G are applicable to traditional shopping streets. Sections D through F and H apply to other main streets. The main difference between the two sets is in the provision of on-street parking on traditional shopping streets, as shoppers and delivery services value the ability to park in front of stores. Not shown in the typical sections (since the perspective is cross sectional) are periodic curb extensions on traditional main streets to create safe crosses and protected parking bays.

Both minimum and desirable design values are shown on the typical sections. The minimums come from AASHTO, the desirables from the preceding discussion of pedestrian- and bicycle-friendly design features. All assume a design speed of 25 mph, which for a Main Street Overlay, would be equal to the posted speed.

The TPI study team concludes:

- ❑ New typical sections are required for main streets. These typical sections should be multimodal and sensitive to both traffic conditions and land-use contexts.

The TPI study team recommends that:

- ❑ DOT adopt these typical sections for use on designated state highways under the Main Street Overlay Program.

Land Use Context	Average Annual Daily Traffic	Parking Lane	Bike Lane	Median	Section (Figure 2.34)
Traditional Shopping Street	>10000	X	X		A
	2000-10000	X			B
	<2000	X			C
	higher volumes	X	X	X	G
Other Main Street	>10000		X		D
	2000-10000				E
	<2000				F
	higher volumes		X	X	H

Table 2.9: Main street design controls and cross sections.

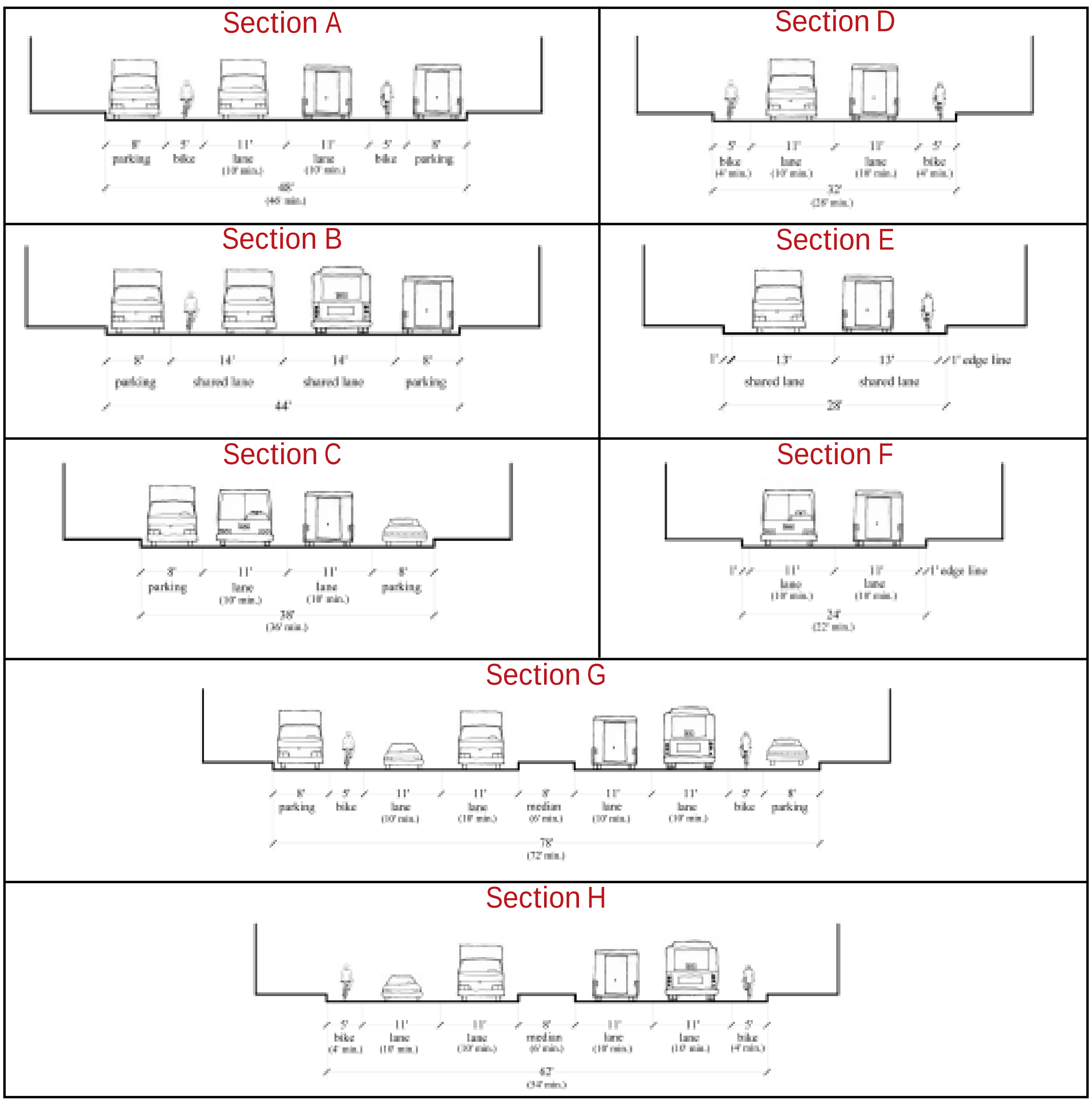

Figure 2.33: Typical cross sections for main streets.

2.5 Traffic Calming

In the TPI survey of New Jersey localities, three localities with recent DOT work on their main streets expressed dissatisfaction with resulting speeds. Two had wanted traffic calming elements to be part of these projects (see Appendix A.3).

These localities are caught in a vicious cycle. Their main streets are designed for speeds well above the posted speed. Since vehicle operating speeds often exceed design speeds, speed surveys done at some later date will likely find 85th percentile speeds high enough to justify raising speed limits. Higher speed limits, in turn, will raise minimum design speeds for all future roadwork. The result: current New Jersey policies do not discourage, and may actually encourage, higher speeds on main streets.

Figure 2.34: Traffic calmed main street in Recklinghausen, Germany.

Figure 2.35: Traffic calmed main street in York, Pennsylvania.

Nature of Traffic Calming

Traffic calming is integral to context-sensitive design in Europe.[35] Europeans use physical design to "enforce" low operating speeds and roadway appearance to "explain" to motorists how they should behave on a given roadway. Hence the use of the terms "self-enforcing" and "self-explaining" to describe the European approach to CSD.[36]

In a couple of case studies, sponsors referred to their main streets as "traffic calmed." They stretch the definition. Not to detract from the projects studied, for they are laudable by United States standards, but all fall short of the best European examples of traffic-calmed main streets (see Figure 2.34). We may beautify our main streets, or make them more pleasant to walk or bicycle along and easier to cross. But we seldom apply traffic calming measures, which compel motorists to slow down. When we begin narrowing our main streets to 18 feet or less at choke points, raising our intersections to sidewalk level, inserting dramatic lateral shifts into their alignments, and generally following European practice, we can lay claim to traffic calmed main streets—but not until.

Only one of our 15 case studies entails anything like European traffic calming, that being the redesigned Market Street in York, Pennsylvania (see Figure 2.35). Not only is Market Street choked down, but a shift in alignment produces lateral forces on motorists that cause them to slow down naturally. This tendency to slow down on curves does not require police enforcement, or heavy pedestrian traffic, or drivers pulling in and out of parking spaces. In this sense, it is self-enforcing 24 hours a day.

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[35] R. Ewing, *Traffic Calming: State-of-the-Practice*, Institute of Transportation Engineers/Federal Highway Administration, Washington, 1999, Chapter 9.

[36] J. Brewer et al., *Geometric Design Practices for European Roads*, Federal Highway Administration, Washington, D.C., 2001.

Lower Design Speeds

The TPI study team compared New Jersey's design standards and design exception policies to those of several other states (see Section 2.3). Design speeds, it turns out, are treated differently in New Jersey. Most other states have set minimum design speeds by facility type and allow design exceptions to these standards in low-speed environments.

High design speeds are promoted in the RDM: "For through roads, every effort should be made to use as high a design speed as practicable to attain a desired degree of safety, mobility and efficiency." DOT backs into design speeds through posted speed limits (see Table 2.10), and excludes design speed from the set of controlling design elements subject to design exceptions (see Table 2.11). Given New Jersey's presumptive speed limit in business districts of 25 mph, the minimum design speed for existing main streets is 50 kph (30 mph) and for new main streets is 60 kph (35 mph). These speeds are too high for most main street applications. Compare these to Vermont's minimum design speed for urban arterials (as low as 40 kph or 25 mph) or Idaho's (as low as 30 kph or 19 mph). These two states took advantage of the flexibility in ISTEA to adopt sub-AASHTO design standards for non-NHS roads. Design speed was among the few AASHTO minimums they considered too high (see Table 2.12).

A reasonable minimum design speed for traditional main streets might be 25 or even 20 mph. For their traffic calmed streets, the British have established 20 mph per hour zones, and northern Europeans 30 kph (19 mph) zones. Traffic calming measures are used to enforce these low speed limits. Pedestrians and motor vehicles comfortably coexist at such speeds. Pedestrian-motor vehicle crashes are rare at these speeds, and, when they occur, are seldom fatal. The British main street in Figure 2.36 is traffic calmed by means of a raised crosswalk and lateral shifts. The average travel speed is only 20 mph.

Posted Speed	Design Speed	
	Existing	New
25 mph	50 kph (30 mph)	60 kph (35 mph)
30 mph	60 kph (35 mph)	60 kph (35 mph)
35 mph	60 kph (35 mph)	70 kph (40 mph)

Table 2.10: New Jersey design speeds in relation to posted speeds.

Cross Slope
Travel Lane Width
Shoulder Width
Horizontal Curve Radius
Grade
Stopping Sight Distance
Intersection Sight Distance
Superelevation
Auxiliary Lane Length
Through Lane Drop Transition Length
Bridge Width
Structural Capacity
Vertical Clearance to Structures

Table 2.11: New Jersey controlling design elements.

	CT	ID	VT
Design Speed		X	X
Design Year Volume	X	X	
Level-of-Service			X
Travel Lane Width			X
Parking Lane Width	X		
Shoulder Width			
Intersection Sight Distance	X		
Stopping Sight Distance			X
Horizontal Curvature			X
Vertical Curvature			
Maximum Grade	X		X
Horizontal Clearance			
Vertical Clearance			
Grade			
Superelevation			

Table 2.12: Sub-AASHTO design standards adopted by three states.

Figure 2.36: Traffic calmed to 20 mph.

Policies, Procedures, and Standards

The recently revised New Jersey State Plan specifically encourages:

> *...the use of traffic calming techniques to enhance pedestrian and bicycle circulation and safety within compact communities and other locations where local travel and land access are a higher priority than regional travel.*

In its draft "bridging" document, even AASHTO endorses traffic calming in certain settings:

> *In general, the designer should consider traffic calming measures as a tool to address congestion, safety, and quality of life issues in response to one or more of the following:*
>
> *1. …*
>
> *2. A project is scheduled for a village/main street, school zone, or other subarea, and scoping indicates that inclusion of traffic calming would satisfy identified subarea needs such as a significant existing safety problem whose severity could reasonably be expected to be reduced by the application of traffic calming...*[37]

About a half dozen state DOTs have begun to promote traffic calming. Virginia has a pilot program, Pennsylvania and South Carolina have illustrated guidebooks, and New York has application guidelines and a training program. Illinois and Vermont are just beginning initiatives. The most ambitious effort to date is in Delaware. The Delaware Department of Transportation (DelDOT) has established a traffic calming program, developed a traffic calming design manual, and incorporated the manual, through the rule-making process, into the state's roadway design manual (see Figure 2.37). The traffic calming design manual prescribes standard procedures for planning and implementing traffic calming; establishes warrant-like guidelines for when and where different traffic calming measures may be deployed; provides typical geometric designs for different measures and

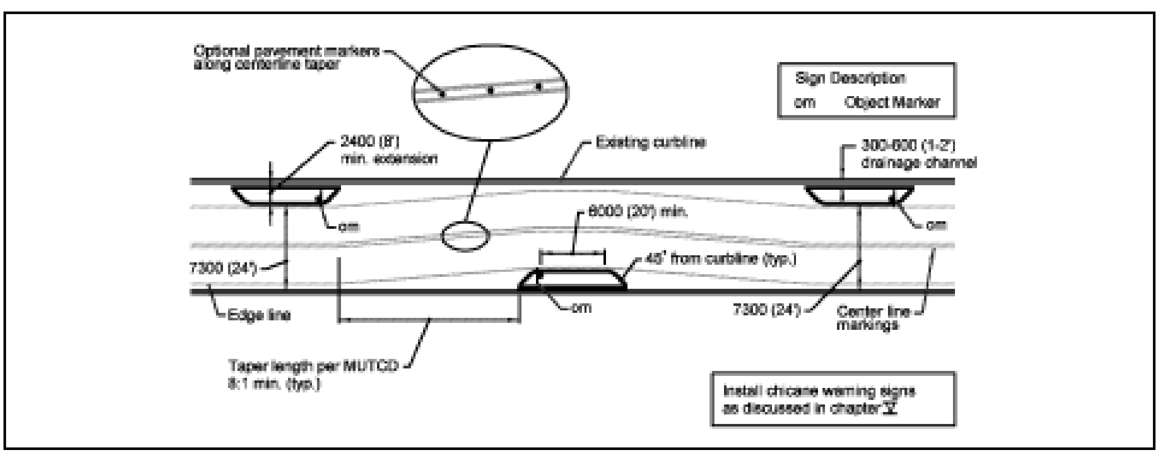


Figure 2.37: Delaware's typical chicane.

[37] American Association of State Highway and Transportation Officials (AASHTO), "Context-Sensitive Design for Integrating Highway and Street Projects with Communities and the Environment," *Highway Geometric Elements—Design And Safety Considerations*, NCHRP 20-17-114, final draft, March 2000, p. 29.

a range of acceptable design alternatives; and establishes standard signing and marking practices for each measure.

DOT has the option of traffic calming its main streets on an ad hoc basis, or establishing policies, procedures, and standards for main street traffic calming as Delaware did. DelDOT chose to institutionalize and codify traffic calming after the ad hoc approach produced public discord in two high profile cases.

The TPI study team concludes:

- ❑ To actively engage in European-style traffic calming, DOT would need to lower design speeds on main streets and develop traffic calming policies, procedures, and standards.

The TPI study team recommends that:

- ❑ DOT allow design speeds of 25 mph on main streets, equal to the minimum posted speed. This speed should be made self-enforcing via traffic calming measures.
- ❑ DOT consider seeking statutory authority for design and posted speeds of 20 mph on traditional shopping streets. Again, this speed should be made self-enforcing via traffic calming measures.
- ❑ DOT develop traffic calming guidelines for incorporation into its Roadway Design Manual. The Delaware Traffic Calming Design Manual provides a good starting point for New Jersey.

2.6 Conflicts-Solutions Matrix

Previous sections recommend process changes, design overlays, and new manuals as means of fostering context-sensitive main street design. Yet, as high-level DOT staff stress, such changes are less critical than the exercise of common sense and creativity on the part of highway designers. If designers understand the environmental and community context, and the safety and mobility needs to be addressed, common sense and creativity will usually produce designs that meet everyone's objectives.

To assist designers in this regard, a conflict-solutions matrix was developed. The matrix is intended as a reference for use in everyday design activities. Case studies were also prepared and are presented in the next chapter. They are replete with examples of creative thinking and problem solving in main street contexts.

The matrix has two parts. The first part considers each roadway design control or standard in turn, indicates its effect on roadway geometrics, presents the purpose of the standard from a DOT perspective, identifies the nature and magnitude of conflicts with local objectives, and suggests design solutions that may lessen conflicts without unduly compromising DOT purposes. The second part is the converse of the first. It considers each pedestrian-friendly design feature in turn, presents its purpose, identifies potential conflicts with DOT purposes, and indicates how these conflicts can be minimized.

The matrix was developed with the assistance of the Technical Review Committee (TRC). It incorporates ideas from guidance documents on pedestrian-friendly roadway design, and even more so, workable ideas from our case studies. References are provided in the matrix to the guidance documents and case studies that served as sources or illustrations of particular ideas. Designers are referred to the guidance documents and case studies for more detailed information.

At one point, the project team attempted to screen and prioritize solutions. This proved unworkable. Instead, the final matrix presents ideas for further consideration, and encourages designers to judge their applicability on a case-by-case basis.

In sum, the conflicts-solutions matrix offers a range of possibilities for reconciling the local desire for pedestrian convenience and safety with DOT's policy of accommodating the entire traffic mix.

high minimums generally	see below	see below	see below	high	downgrade functional class of roadway, swap roadways to place main street under local control (Albuquerque/Red Bank), de-designate roadways and transfer to locals (Maplewood/South Miami/Washington Township/ Westminster), transfer operation and maintenance to locals (Plainfield), reclassify rural roadway through village as urban (Brooklyn/Danville), (all of these may be used in connection with construction of bypasses or secondary routes that alter state highway functions)
minimum LOS	more traffic lanes, wider intersections, exclusive turn lanes	driver convenience, traffic throughput	faster traffic, aggressive driving, longer pedestrian crossing distances, poor street aesthetics, taking of property, higher construction costs, induced traffic, loss of curbside parking, narrowing of sidewalks	high	waive or relax LOS standard on main streets (Brooklyn/South Miami), adopt a multimodal LOS standard, shorten signal cycle length/retime signals (Maplewood/York), judge LOS on a section basis, adopt a peak period LOS standard, adopt a different design hour volume for LOS determination, widen intersection but not roadway (Albuquerque), use roundabouts instead of signals (Sag Harbor—PFUG/NJPED/ FLLC), convert from 4-lane to 3-lane (Anchorage/South Miami/South Orange/ Maplewood—OSTA/OMSH—NJPED opposes two-way left-turn lanes), create secondary routes (Washington Township/ York—OSTA), enhance local street network (Red Bank/Washington Township), add traffic signals to improve platooning and facilitate turns and crossings (Saratoga Springs/Washington Township), convert to one-way couplets (rejected in Anchorage/Red Bank), create bypass routes (rejected in Brooklyn)
20-year design volume (10-year for 3R projects)	more traffic lanes, wider lanes, wider intersections	driver convenience, life-cycle cost savings	faster traffic, more aggressive driving, longer pedestrian crossing distances, induced traffic	medium	design for planned (desired) traffic (TEA-21), design for projected traffic <20 years out (Anchorage initially—5 year design volume), use conservative growth rate for background traffic (Washington Township)
minimum design speed	larger radius curves, more superelevation on curves, greater stopping sight distance, greater roadside clearance, gentler grades, greater separation between modes, wider lanes (indirectly), wide shoulders (indirectly)	driver convenience, traffic throughput, traffic safety	faster traffic, reduced pedestrian comfort and safety, reduced cyclist comfort and safety, longer pedestrian crossing distances (indirectly), poor street aesthetics, greater crash severity	medium	reduce design speed (Anchorage/ Brooklyn/Plainfield/Washington Township), set design speed = to posted speed (APFG/Bennington), set design speed 5 mph rather than the standard 10 mph above posted speed (bypass in Washington Township), set design speed below posted speed (main street in Washington Township/gateway in Danville)

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Design Control or Standard	Geometric Effects	Design Impetus	Sources of Conflict	Magnitude of Conflict	Potential Solutions
large design vehicle	wider lanes, wider intersections	traffic safety, accommodation of large vehicles, emergency response	faster traffic, higher turning speeds, longer pedestrian crossing distances	medium	establish alternate truck route (York), prohibit turns by large vehicles, use different design vehicles at different intersections, use one design vehicle for thru movements, another for turns
adoption of a single typical section	wider streets, abrupt transitions from rural to urban	design standardization, reduced liability	faster traffic, poor street aesthetics (out of scale with surroundings), higher construction costs	high, medium	use multiple sections along a stretch of road (Anchorage/Albuquerque/Sag Harbor/Saratoga Springs/South Miami), discontinue use of typical sections (Maryland)
minimum lane width	wider streets	traffic safety, accommodation of large vehicles	faster traffic, longer pedestrian crossing distances, higher construction costs	medium	adopt lower design speed, reduce lane width standard (Sag Harbor - may require design exception—down to 10'), (in suburban context, apply NJDOT low cost safety measures)
minimum shoulder width	wider streets	traffic safety, speed enforcement, breakdown lane, bicycle safety	faster traffic, longer pedestrian crossing distances, suggestion of rural design, higher construction costs, unsafe passing maneuvers	medium, high	use colored or textured materials in shoulders (OMSH on rural-urban transitions), eliminate shoulders on urban streets (Albuquerque/Danville/Sag Harbor), use narrow shoulders (Brooklyn/Bennington/Washington Township), substitute parking lanes for shoulders (Sag Harbor), use gutter pans in lieu of shoulders (as long as "bike safe") (Anchorage/Orlando)
minimum corner (curb return) radius	wider intersections	accommodation of large vehicles, traffic safety, faster emergency response	high turning speeds, long pedestrian crossing distances, poor street aesthetics	high	use mountable curbs at corners with vertical elements set back from the curbs (South Miami), establish alternate truck routes (York), use wide outside traffic, parking, or bicycle lanes to increase effective radius (APFG—use effective turning radius), adopt substandard corner radii (South Miami/York), use compound curves at corners (Brooklyn—OMSH), use simple radius curves with tapers at corners (OMSH), set back stop lines on side streets, place crosswalks upstream/downstream of curb return (Plainfield/York—PM), use larger corner radii in combination with curb extensions (Maplewood/York), design for larger vehicles only at selected intersections (Anchorage/Westminster), accept large vehicles crossing the center line (Plainfield), compute effective radius at corners considering parking lanes, setback stop lines on side streets to allow wider turns off main streets, install triangular islands of special design to create slip lanes (PFUG/NJPED)

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Design Control or Standard	Geometric Effects	Design Impetus	Sources of Conflict	Magnitude of Conflict	Potential Solutions
minimum horizontal curve radius	no chicanes, lateral shifts, or traffic circles (if interpreted literally)	traffic safety, driver comfort	faster traffic, taking of property, higher construction costs	low (not generally a problem on main streets except in connection with traffic calming)	mark and sign as traffic calming measures, recalculate minimum curve radius, adopt lower speed limit on curve, display lower advisory speed, accept design speed below posted speed (Danville), (in suburban context, apply NJDOT low cost safety measures)
minimum vertical curve radius	no speed humps or tables (if interpreted literally)	traffic safety	faster traffic, higher construction costs	low (not generally a problem on main streets except in connection with traffic calming)	mark and sign as traffic calming measures, recalculate minimum curve radius, adopt lower speed limit on curve, display lower advisory speed, (in suburban context, apply NJDOT low cost safety measures)
minimum stopping sight distance	straighter sections, wider road-side clearance	traffic safety, pedestrian safety	faster traffic, taking of property, tree removal	medium, low	provide warning signs and lower advisory speeds, recalculate stopping sight distances based on new research
right-turn lanes	wider intersections	driver convenience, traffic throughput	longer ped-estrian crossing distances, turning conflicts with pedestrians crossing side streets	medium, low	eliminate turn lanes on main streets (PM with bike traffic), set crosswalks back on side streets to provide yield space out of traffic flow (York), install triangular islands of special design to create slip lanes (Sag Harbor—PFUG), allow right-turn-on-red from shared lanes, use narrow right-turn lanes
left-turn lanes	wider intersections	driver convenience, traffic safety, traffic throughput	longer pedestrian crossing distances, longer pedestrian crossing delays, turning conflicts with pedestrians crossing side streets	low	convert from 4-lanes to 3-lanes with left-turn pockets (Maplewood/South Miami/South Orange), eliminate turn lanes on main streets (Brooklyn—OMSH for left-turn stacking lanes), use narrow left-turn lanes, install pedestrian refuge islands adjacent to left-turn lanes, convert to one-way couplets, route left turns around block via right turns , convert from 4-lanes to 3-lanes with continuous left-turn lanes
speed-change lanes	wider streets	driver convenience, traffic safety at high speeds	faster traffic, more aggressive driving, longer pedestrian crossing distances, suggestion of rural design, conflicts with bicyclists	medium	eliminate acceleration lanes on main streets (Brooklyn—climbing lanes rejected—OMSH)

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Design Control or Standard	Geometric Effects	Design Impetus	Sources of Conflict	Magnitude of Conflict	Potential Solutions
through-lane drop transition length	shadow lanes for lane drop at intersections (even if marked as turn lane)	traffic safety	faster traffic, more aggressive driving, poor street aesthetics, suggestion of rural design, conflicts with bicyclists	low, medium	drop lane prior to an intersection and add turn pockets (Saratoga Springs), adopt lower design speeds, establish lower advisory speeds, use mountable curbs and breakaway elements on far side of intersection (Saratoga Springs)
shifting lane transition length	gentler lateral shifts	traffic safety	faster traffic	low	mark and sign lateral shifts as traffic calming measures (York), adopt lower design and posted speeds, establish lower advisory speeds
right turn on red		driver convenience, traffic throughput	turning conflicts with pedestrians crossing side streets	medium	eliminate RTOR on main streets (APFG/OSTA/NJPED), allow RTOR with yield-to-pedestrians signing
minimum lateral clearances	wider median islands (if trees planted in median), wider ROW (if trees planted on edge)	traffic safety, pedestrian visibility, room for utilities	poor street aesthetics, reduced sidewalk clear width	low	place trees behind vertical curbs (Bennington—only 1 ½'/York - only 2'), plant smaller trees of yielding variety (Saratoga Springs), lower design and posted speeds (Saratoga Springs), use object markers with mature trees
offsets at curbs (both edge and median)	wider streets, narrower sidewalks, narrower median islands, poor alignment between old & new curbs	traffic safety	faster traffic, longer pedestrian crossing distances	medium	waive or reduce offset requirements, use mountable curbs, lower design and posted speeds
MUTCD marking and signing requirements		traffic safety, pedestrian safety, universal recognition	poor street aesthetics	low, medium	relax MUTCD requirements on main streets, use landscaping to draw attention to hazards, use textured surfaces to draw attention to hazards, install and remove portable signage as needed

PFUG—FHWA Pedestrian Facilities Users Guide
NJPED—New Jersey Pedestrian Design Guidelines
OSTA—Oregon Special Transportation Areas
APFG—AASHTO Pedestrian Facilities Guide
OMSH—Oregon Main Street Handbook
PM—Portland Metro Street Design Guidelines
FLLC—Florida Livable Communities Directive

Table 2.13: Conflicts and Solutions for Main Streets (Design Controls and Standards)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
narrow down streets (Anchorage/ Atlanta/ Maplewood/Sag Harbor/South Miami—PFUG)	slower traffic, pedestrian safety, space for wider sidewalks, bike lanes, etc.	traffic safety	high	narrow street at midblock but maintain intersection capacity, eliminate underutilized parking lane, narrow oversized lanes to make room for other design elements (Atlanta)
widen sidewalks (Anchorage/ Atlanta/ Maplewood/ Plainfield/Red Bank/Saratoga Springs/South Miami/ Washington Township/York—sidewalks added in Albuquerque/ University Place—PFUM/PM/FLLC)	pedestrian comfort, space for street furn-iture, space for sidewalk activity	less cross sectional width for traffic, higher construction and main-tenance cost	high	relate sidewalk width to land use intensity, provide a clear width free of street furniture (PFUG), turn over sidewalk maintenance to locals or other agencies (Anchorage/Maplewood/Plainfield/ Saratoga Springs/York)
mark crosswalks at intersections on all approaches (Bennington/ South Orange/ York—PM)	pedestrian saftey	false sense of security for pedestrians	medium	place street lights at crossings (OMSH/NJPED), install traffic signals to create gaps in traffic (Washington Township/Saratoga Springs), use high visibility crosswalk markings such as ladder pattern (PFUG/OSTA/ OMSH/NJPED), extend curbs at crossings to reduce exposure time (many places—NJPED), place pedestrian refuge islands at crossings, install pedestrian-activated flashing inset warning lightsplace only on selected approaches (Maplewood and Saratoga Springs), use textured surface on crosswalks, use textured surface at edges of cross-walks (OMSH), use reflective inlay tape on crosswalks (PFUG), raise crosswalks to sidewalk height or just below, use "countdown" signals, use audible ped-estrian signals (Burlington), place stop lines back from crosswalks (Maplewood)
provide pedestrian push-buttons and signal heads (Saratoga Springs—PM/ NJPED/FLLC)	pedestrian convenience, pedestrian safety, compliance with ADA	driver convenience	medium	install automated pedestrian detection, provide walk phase on every cycle, provide leading walk phase prior to cross street movement (South Orange)
provide raised medians on wide streets (Anchorage/ Maplewood/ Saratoga Springs/ University Place—NJPED)	pedestrian refuge, street beautification, access management, presumed slower traffic, traffic safety	snow removal problems, landscape maintenance, increased construction cost, possible increased speeds	high	turn over landscape maintenance to locals (Anchorage/Saratoga Springs), use minimum median width (Maplewood below minimum with 4'/ University Place at minimum with 6-11'), place trees, object markers, etc. on islands for delineation in snow, use bollards and/or textured surfaces without landscaping, widen medians at locations without on-street parking, make medians mountable (Maplewood), install pedestrian pushbuttons in medians (NJPED)
provide center refuge islands (where not pos-sible to provide a relatively contin-uous median) (Sag Harbor/ South Orange—PFUG/PM/FLLC)	pedestrian refuge, street beautification, slower traffic if done with deflection	landscape maintenance, increased construction cost, conflict with on-street parking	medium	turn over landscape maintenance to locals (Sag Harbor), alternate between center islands and on-street parking bays

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
create gateways (Danville/Sag Harbor/Saratoga Springs/South Orange—OSTA)	slower traffic, smoother transition from rural to urban	traffic safety, landscape maintenance, textured surface maintenance	medium	turn over maintenance to locals (Danville/Saratoga Springs), use monument signage and other vertical elements to mark gateways (Danville/Sag Harbor), install rumble strips for pre-warning (Sag Harbor), install street lights at gateways (Sag Harbor)
install barrier curbs (curb and gutter added in Albuquerque/Saratoga Springs/University Place)	pedestrian safety and comfort, inability to park on street edge, suggestion of urban design	wider streets due to offsets, higher construction costs, vehicle instability upon high-speed impact, false security for pedestrians, loss of emergency parking	medium	adopt lower design speed, use higher curbs to deflect vehicles at low speeds, place fixed objects behind curbs, use mountable beveled curbs (Saratoga Springs)
install curb ramps and median channel (two ramps per corner—PFUG/NJPED)	pedestrian comfort and safety, compliance with ADA	higher construction costs, wider streets (if use curb ramps on medians)	high	use median cutouts rather than median ramps, provide detectable warning at ramps and cutouts for visually impaired, use diagonal curb ramps only where diagonal crossings allowed
provide bicycle lanes (Albuquerque/Sag Harbor/University Place/Washington Township—PFUG/FLLC)	bicycle comfort and safety, driver convenience, improved sight distance at intersections, traffic buffer for pedestrians, pull-out space for deliveries	wider street, faster traffic, bicycle conflicts with right-turning traffic, bicycle conflicts with parked cars, bicycle conflicts with pedestrians, impression that bicyclists should ride only on marked streets	low, medium	use colored surface on bike lanes (Sag Harbor—PFUG/PM through intersections), avoid right-turn lanes on main streets, separate from traffic lane with extra wide stripes (8" in Sag Harbor), adopt low design speed so bikes can use traffic lanes, use extra-wide curb lanes so bikes can share traffic lanes (Sag Harbor/Saratoga Springs/South Orange—PM at lower ADT), separate from traffic lane with flush reflectors (Sag Harbor), recess drainage inlets (as opposed to using catch basins) (PM), use bicycle-friendly drainage grates (Bennington), provide offset from parking lane, provide gutter pan wide enough for bikes (Anchorage/Orlando), eliminate on-street parking (particularly angled), extend bicycle lanes to intersection (PM), provide skip markings through intersection (PM), place bicycle lanes between through and turn lanes, place bicycle lanes on parallel routes
install midblock crosswalks (Plainfield/South Orange/University Place/Westminster/York—PM/FLLC)	pedestrian convenience, traffic throughput at intersections	presumed pedestrian danger, driver inconvenience	medium, high (depending on block length)	place temporary object markers at crosswalks, use high visibility crosswalk markings (OSTA and PM), install flashing overhead beacons, place street lights at crossings (OMSH/NJPED), extend curbs at crossings to reduce exposure time (Plainfield/South Orange/Westminster/York), place pedestrian refuge islands at crossings, install pedestrian-activated flashing inset warning lights (University Place), provide pedestrian activated traffic signals (NJPED), use textured surface on crosswalks (South Orange/Westminster), line up midblock crosswalks with alleys (Maplewood/South Orange), use textured surface at edges of crosswalks (OMSH), raise crosswalks to sidewalk height or just below, angle median cut-out to increase pedestrian visibility, limit midblock crosswalks to long blocks (NJPED)

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
extend curbs at pedestrian crossings (Maplewood/ Plainfield/Red Bank/Sag Harbor/ South Miami/ South Orange/ Washington Township/ Westminster/York —OSTA/NJPED/ FLLC)	shorter pedestrian crossing distances, slower traffic, streetscape improvement, no illegal parking in crosswalks	loss of on-street parking when used at midblock, loss of transit pull-out space, problem for large vehicles turning at intersections, obstruction for storm-water runoff	high	delineate individual parking spaces (Westminster), delineate curb extensions with bollards, trees, or other vertical elements (Plainfield/Westminster/York), provide mountable curbs with vertical elements set back from the curbs (South Miami), set back stop lines on side streets (Plainfield/South Orange), use larger corner radii in connection with curb extensions (Maplewood/York), maintain standard travel lane widths (all cases), make curb extensions no wider than parked cars (South Miami/Westminster), provide edge lines and offsets (Plainfield), provide catch basins on upstream side of extensions (Plainfield/ Sag Harbor/York), use reverse pavement slopes to channel drainage around extensions (Plainfield)
provide buffer zone (Anchorage/ Washington Township on CR 526— PFUG/NJPED/ OMSH at rural-urban transitions)	street beautification, traffic buffer for pedestrians, traffic buffer for property owners	landscape maintenance	medium	turn over landscape maintenance to locals (Anchorage/Sag Harbor/Saratoga Springs), use only where less intense pedestrian traffic, use low-maintenance, drought-resistant vegetation
plant street trees (Plainfield/ Saratoga Springs/ South Miami/ Washington Township/ Westminster/ York—PM)	street beautification, weather protection for pedestrians, traffic buffer for pedestrians, traffic buffer for property owners	danger to traffic, landscape maintenance, obstructed view of store fronts and signs, obstructed sight lines at crossings, root damage to streets and sidewalks, reduced functional clearance for pedestrians	high	place trees in wells with tree grates (PM), turn over landscape maintenance to locals (Plainfield/Sag Harbor/Westminster/York), place trees behind barrier curbs (most places), place trees on curb extensions (Westminster/York), plant taller trees with higher crowns, trim trees to maintain clear stem heights, use root barriers, allow variable sidewalk widths to accommodate existing trees (Plainfield), plant smaller trees of yielding variety (Saratoga Springs)
convert to two-way operation (York—already on George St and planned for Market St—PFUG)	slower traffic, presumed pedestrian safety, improved business access	reduced traffic throughput, increased delays for drivers	high	accept lower LOS, time for progression in peak direction, ban turns during peak hours, upgrade signal system to traffic-responsive or traffic-adaptive control
time signals for lower speeds (Maplewood/ Washington Township—OSTA)	speed reduction, increased traffic throughput	lower LOS for drivers, poor progression in one direction	low, high (depending on signal spacing)	accept lower LOS, install demand-actuated signals, upgrade signal system to traffic-responsive operation, upgrade signal system to traffic-adaptive operation
provide exclusive pedestrian phase in signal cycle (PM/FLLC)	pedestrian convenience, pedestrian safety	lower LOS for drivers, poor progression	low	only use at high pedestrian volumes
narrow or consolidate driveways (Maplewood— PFUG/NJPED)	pedestrian safety and comfort, traffic safety, increased traffic throughput	taking of property or easements, business opposition	medium	other access management measures such as continuous medians and right-in, right-out operation (PFUG), provide median dividers on wide driveways (PFUG)

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Pedestrian Friendly Features	Design Impetus	Sources of Conflict	Value to Pedestrians	Potential Solutions
add on-street parking (Washington Township/York—OSTA/PM/FLLC)	easy access to property, traffic buffer for ped-estrians, slower traffic, reduced need for off-street parking	wider streets, reduced traffic through-put, higher crash rate but possibly less severe crashes, obstructed view of pedestrians	medium	combine with curb extensions at crosswalks (PM and OMSH), provide only in high intensity areas, prohibit on-street parking near crosswalks, choose parallel parking over angle parking due to safety concerns (Red Bank), leave gaps between parking spaces, combine with wide outside lane to allow passing while cars are parking (South Orange), use back-in angle parking, use parallel parking only (PM with bike traffic and OMSH)
install textured surface materials (brick, cobble-stone, concrete pavers, etc.) (Maplewood/Plainfield/Red Bank/South Orange/Westminster/York—PM/FLLC)	street beautification, unified pedestrian realm	higher noise levels with some materials, rougher surface for disabled, slippery in wet weather, higher construction costs, higher maintenance costs	low	use stamped asphalt or concrete rather than pavers, turn over pavement maintenance to locals (Westminster—locals also maintain in Maplewood, Plainfield, Red Bank, York, etc.), supplement with white lines when used on crosswalks, use construction techniques that avoid settling of bricks or pavers, used tinted rather than textured materials (South Miami), extend textured materials to the entire pedestrian realm (Maplewood/South Orange—tinted materials are extended in South Miami), use pavers with rough surfaces (Red Bank), strip asphalt to reveal old bricks (Atlanta/Orlando)
install street lights (Sag Harbor—PFUG/NJPED/FLLC)	pedestrian visibility	higher construction costs	low	fund with special assessments, use only at inter-sections and other conflict points, provide special pedestrian-oriented lighting (NJPED)
square off inter-sections (Sag Harbor—two examples—OMSH)	shorter corssing distance, slower turns, better angle of vision for entering traffic		low	align stop lines perpendicular to travel lanes at diagonal intersections (Maplewood)
install traffic calming measures (York—PFUG)	slower traffic, safer motor vehicle operation, safer pedestrian crossings, street beautification	reduced throughput, higher construction and maintenance costs, slower emergency response, slower snow clearance	high	fund with special assessments, design for emergency vehicles and snow plows, use volunteers for land-scape maintenance, use special snow plowing equipment

PFUG—FHWA Pedestrian Facilities Users Guide
NJPED—New Jersey Pedestrian Design Guidelines
OSTA—Oregon Special Transportation Areas
APFG—AASHTO Pedestrian Facilities Guide
OMSH—Oregon Main Street Handbook
PM—Portland Metro Street Design Guidelines
FLLC—Florida Livable Communities Directive

Table 2.14: Conflicts and Solutions for Main Streets (Pedestrian-Friendly Features)

Chapter 3
Case Studies

3.1 Case Study Comparison

In researching context sensitive design (CSD) for this guidebook, the existing literature was not of much help. The field is in its infancy, and available literature is largely promotional. So a knowledge base had to be constructed from case studies. In all, 15 case studies of context-sensitive main street projects were conducted; of these, 10 were written up and appear in this chapter.

The case studies came to the TPI team via nomination. Some were nominated by their respective state transportation departments. Others were suggested by the Technical Review Committee. Those in New Jersey were nominated by DOT engineers.

In writing the case studies, the TPI team let the facts speak for themselves—for better or worse. They are not meant to be promotional.

Synthesis

As a way to distill salient points from the case studies, the TPI team reviewed case studies for common and contrasting themes. The idea: If the same elements appear time-and-time-again, then these elements may be considered fundamental to context-sensitive main street design.

The case studies are summarized in four tables below. The first table (Table 3.1) establishes the context of the project, the original design (where one was proposed), and the original purpose of and need for the project. Only six of the 15 case studies involve traditional main streets, that is, pedestrian-oriented shopping streets. The rest involve highways through villages, main streets of suburban communities, gateway streets to downtown, or residential arterials. For almost half of the projects, another design was proposed originally and a more context-sensitive design solution was developed in reaction. These "reactive" projects most often occurred in settings other than traditional main streets, and had conventional purposes such as highway safety improvement, pavement restoration, utility replacement, or capacity enhancement. By contrast, projects involving traditional main streets tended to be proactive and have enhancement of the street environment as their main purpose.

The second table (Table 3.2) identifies impediments to CSD that were at work, at least to a degree, in the individual case studies. The main impediments were:

- ❑ State or county geometric design standards above AASHTO minimums,
- ❑ Level-of-service standards requiring additional lanes,
- ❑ Reliance on typical sections insensitive to context,
- ❑ Reluctance to approve design exceptions for purposes other than cost savings,
- ❑ Application of new construction standards to 3R and reconstruction projects,
- ❑ Misclassification of roads with respect to function or location, and
- ❑ Reluctance to maintain enhanced streetscapes.

Less common impediments included construction budget limitations and emergency response concerns. These impediments are described and illustrated in Appendix A.2. Note the relatively small role played by geometric standards in the scheme of things.

The third table (Table 3.3) summarizes the effects of the case study projects. In nearly all cases, the road was made more pedestrian-friendly through installation or widening of sidewalks, addition of crosswalks, construction of barrier curbs, and the like. In fewer than half of the cases, the road was also rendered more bicycle-friendly through the addition of bike lanes or extra-wide shared-use lanes. In nearly all cases, street aesthetics were improved by means of street trees, colored or textured paving, antique streetlights, undergrounding of utilities, and similar measures. Safer motor vehicle operations were a less common outcome of these projects. While travel ways were narrowed in many cases, this is not always the case in context-sensitive projects. Indeed, six of the 15 projects studied involved modest road widening. Finally, only one of the projects, the one in York, included measures that could be classified as traffic calming, in that they compel motorists to slow down through changes in vertical or horizontal alignment, or through dramatic narrowings.

The final table (Table 3.4) lists the design elements included in each case study project. Studying this table, it is apparent that main street projects fall into distinct categories: traditional shopping streets get curb extensions and midblock crosswalks; gateway streets get medians or refuge islands and bicycle lanes or extra-wide shared-use lanes. Almost everyone gets wider sidewalks, and many get additional street trees or textured paving. That projects differ by category indicates that there is no single way to design or re-design a main street, and that different design elements belong in different contexts. At the same time, the repetition of certain combinations of elements suggests that main street templates could be developed for different contexts. Indeed, the typical sections in Section 2.4 are an attempt to develop such templates.

	Context	Original Design Proposal	Original Purpose
Albuquerque	highway through town	5 lanes throughout with sidewalks added	safety and LOS improvement; accommodation of pedestrians
Anchorage	highway through town	conversion to one-way pair	safety improvement
Bennington	approach to town	wider lanes and shoulders	pavement reconstruction; utility replacement
Brooklyn	highway through village	rural cross section with high design speed	safety improvement
Maplewood	traditional shopping street	none	restoration of main street
Plainfield	highway through town	none	sense of place at rail station
Red Bank	traditional shopping street	none	restoration of main street
Sag Harbor	highway through village	none	safety and LOS improvement; accommodation of pedestrians
Saratoga Springs	approach to town	none	pavement restoration; accommodation of pedestrians/cyclists; drainage improvement
South Miami	traditional shopping street	none	restoration of main street
South Orange	traditional shopping street	none	restoration of main street
University Place	highway through town	5 lane reconstruction with sidewalks added	safety improvement; accomodation of pedestrians/cyclists
Washington Township	highway through town	cloverleaf at 130/33/526	LOS maintenance in face of growing traffic
Westminster	traditional shopping street	wider lanes	pavement reconstruction; utility replacement
York	traditional shopping street	none	restoration of main street

Table 3.1: Context, Original Design, and Original Purpose.

	High Geometric Standards	LOS Standards	Typical Sections	Limited Use of DEs	Treatment of 4R	Misclassification	Maintenance Concerns
Albuquerque		X	X			X	
Anchorage	X		X	X			X
Bennington	X				X		
Brooklyn		X		X		X	
Maplewood		X				X	X
Plainfield	X						
Red Bank	X						X
Sag Harbor							X
Saratoga Springs			X	X			X
South Miami	X	X				X	
South Orange		X					X
University Place							
Washington Twp.	X	X		X		X	
Westminster	X			X	X	X	X
York							X

Table 3.2: Impediments to Context-Sensitive Design.

	More Pedestrian-Friendly	More Bicycle-Friendly	Better Aesthetics	Safer for Motorists	Narrower	Traffic Calmed	Other Effects
Albuquerque	X	X	X	X			cost savings more parking spaces urban revitalization
Anchorage	X	X	X	X	X fewer lanes		more snow storage
Bennington		X	X				uniform cross section
Brooklyn	X			X			
Maplewood	X		X		X fewer lanes		
Plainfield	X		X		X narrower lanes		
Red Bank	X		X		X narrower lanes		
Sag Harbor	X	X	X		X narrower lanes		uniform lane widths
Saratoga Springs	X	X	X	X			improved LOS
South Miami	X		X		X fewer lanes		
South Orange	X	X	X		X fewer lanes		
University Place	X	X	X	X	X fewer lanes		access managed
Washington Twp.	X	X	X				access managed
Westminster	X		X				uniform cross section
York	X		X		X fewer lanes	X	

Table 3.3: Effects of Context-Sensitive Design.

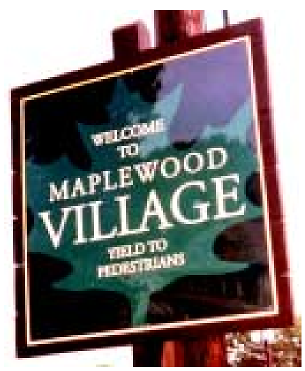
	Curb Extensions/ On-Street Parking	Medians/ Refuge Islands	Wider Sidewalks	Bicycle Lanes	Midblock Crosswalks	Street Trees (new)	Special Pavement Surfaces
Albuquerque		X	X	X			
Anchorage		X	X			X	X
Bennington							
Brooklyn		X					
Maplewood	X	X	X				X
Plainfield	X		X		X	X	X
Red Bank	X		X			X	X
Sag Harbor	X				X		
Saratoga Springs		X	X			X	
South Miami	X	X				X	
South Orange	X	X	X		X	X	X
University Place		X	X		X	X	X
Washington Twp.	X	X	X	X		X	
Westminster	X				X	X	X
York	X		X		X	X	X

Table 3.4: Design elements.

Chapter 3.2
New Jersey

3.2.1 Maplewood, Springfield Avenue (NJ 124)

In 1997 the Township of Maplewood, (pop. 22,000) through its Economic Development Commission, hired a national consulting firm to assist in preparing an economic development strategy for the town that would shore up its commercial and industrial sectors and maximize its tax base. A major focus of that strategy was to revitalize the Springfield Avenue business district, the largest commercial district in town.



Springfield Avenue (State Route 124) extends from downtown Newark west to Maplewood and beyond. Historically a main thoroughfare, Route 124 has been replaced as a long-distance route by the adjacent expressway network, specifically Route 24 and Interstate 78. In fact, the state route designation presently ends at the eastern edge of Maplewood, making this the stub end of the "official" highway. Nevertheless, Route 124 is still heavily used by commuters and other through traffic. With its high traffic volumes, the Township sees the street as a barrier separating neighborhoods.

The Township's goals for Springfield Avenue are stated in the Maplewood Economic Development Plan:

- ❑ Increase property values both on the Avenue and in the surrounding neighborhoods,
- ❑ Increase total retail expenditures made in the town, and
- ❑ Improve the image of the entire town.

Strategies range from physical streetscape improvements to business recruitment and assistance programs. Streetscape improvements will include curb extensions, medians, street trees, better façades, and new lighting. These physical improve-

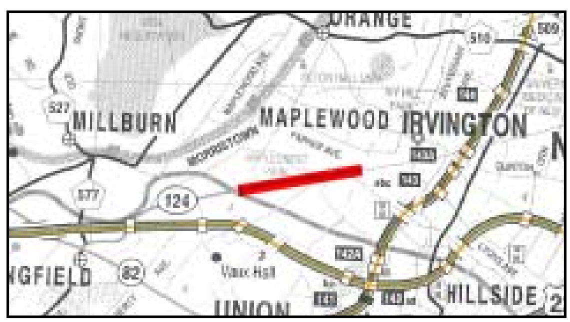


Figure 3.2.1.1: Maplewood area map.

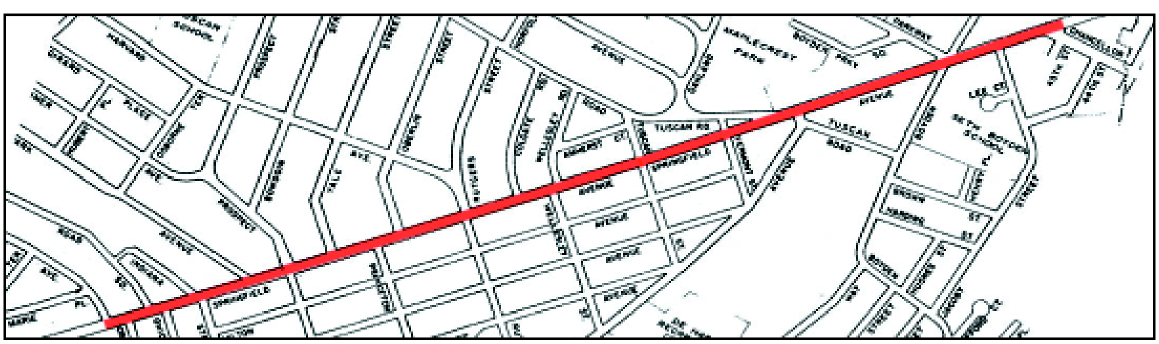


Figure 3.2.1.2: Springfield Avenue.

ments are intended to “slow the fast-moving traffic in order to create a handsome and walkable ‘boulevard.’” The street’s auto orientation will not be abandoned, merely tamed so as to improve conditions for walking. Ultimately the Township wants Springfield Avenue to be the center of community activity and a bridge between neighborhoods.

Geometric Flexibility

Prior to and concurrent with the economic development plan, the Township and the Springfield Avenue Partnership approached DOT about operational and geometric changes in the street. The street was listed as a four-lane Urban Principal Arterial with parking on only one side. The state evaluated this condition and approved on-street parking on the north curb as well. The street was re-striped to include one travel lane in either direction and a center left-turn lane. Signs were posted announcing the new traffic pattern. Nevertheless, when no one is parked at the north curb, especially at the eastern end, the street still operates as if it has two travel lanes westbound. The redesigned road will more accurately reflect the desired operation.

Condition	Lanes				
Former	WB	WB	EB	EB	P
Present	P	WB	TWLT	EB	P
Present (where no cars park)	WB	WB	TWLT	EB	EB
Proposed (with curb extensions)		WB	LT	EB	
Proposed (with medians)	P	WB	M	EB	P

Table 3.2.1.1: Present and proposed lanes.

Figure 3.2.1.4: Former centerline, existing two-way left-turn lane.

Figure 3.2.1.5: Existing Springfield Avenue.

Figure 3.2.1.6: Existing at Yale Street.

Figure 3.2.1.3: Proposed “West Gate.”

Figure 3.2.1.7: Proposed at Yale Street.

Figure 3.2.1.8: Existing at Ohio Street.

Figure 3.2.1.9: Proposed at Ohio Street.

The proposal to redesign Springfield Avenue has as its main features medians and curb extensions. Instead of a continuous 50-foot wide cross section divided by lane markings, the cross section will vary to reflect the intended use. At some points both curbs will be extended to restrict driving in the parking lanes. At other points medians will be constructed to provide the requisite "boulevard" aesthetic, separate opposing traffic and eliminate swerving. Turn lanes will be constructed where appropriate. In sum, the new design will dictate driver behavior in terms of lane use, turning, and parking.

The design of the median has received considerable attention. Originally the town proposed a wide, tree-lined median; then concerns about emergency access surfaced. The specific issue was the amount of room provided for emergency service vehicles to pass cars and trucks where the street is narrowed to 34 feet (at the curb extensions). The current design calls for a four-foot wide mountable median with no

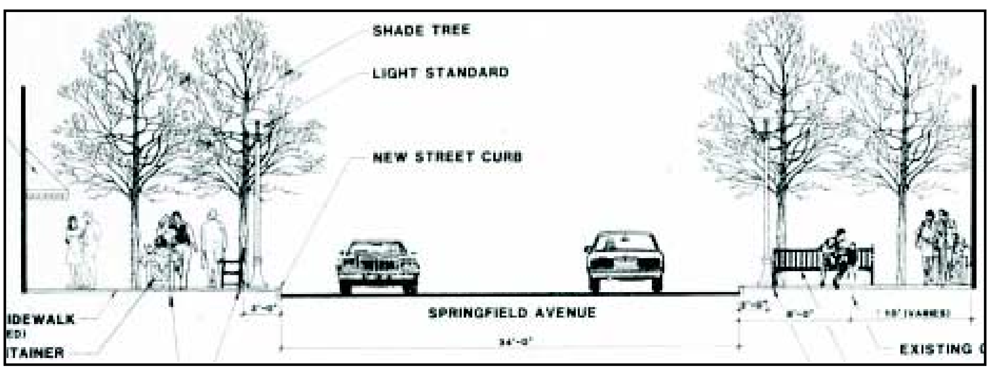


Figure 3.2.1.10: Proposed typical section at curb extensions.

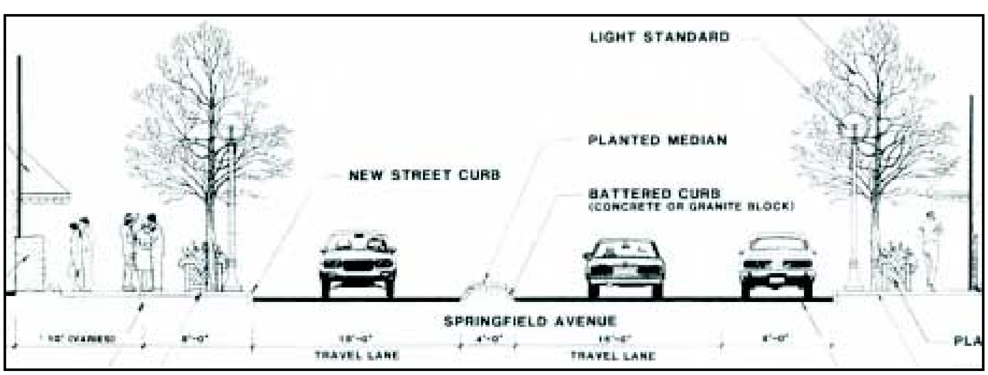


Figure 3.2.1.11: Proposed typical section at median.

Condition	Lane Widths (ft)	Street Width (ft)
Former	10+11+11+10+8	50
Present	8+12+10+12+8	50
Proposed at curb extensions	12+10+12	34
Proposed at median	8+12+3+4+3+12+8	50
Proposed at median & curb extensions	12+3+4+3+12	34

Table 3.2.1.2: Comparison of lane and street widths.

Condition	Lane Widths (ft)
Marked at median & parking lane	8+12+3+4+3+12+8
Possible at median & parked car	6+17+4+17+6
Marked at median & curb extensions	12+3+4+3+12
Possible at median & curb extensions	15+4+15
Marked median width	10
Actual raised median width	4

Table 3.2.1.3: Comparison of marked and physical dimensions.

trees. This provides 15 feet curb to curb in each direction—plus the mountable median. If a car is stalled or illegally parked, the fire engine simply mounts the median.

Other Design Solutions

Sidewalks & Alleys

Outside of the curb-to-curb changes, the redesign includes numerous other streetscape improvements. Primary is a series of beautified alleyways leading to "shared" parking lots in the rear of buildings. These will require the coordination of the merchants association and property owners, as they lie outside the town's right-of-way. Additionally there have been discussions about narrowing some driveways as a means of increasing on-street parking and allowing more planting area.

The clear sidewalk width is presently four to seven feet, depending on pavement width and obstacles. In the proposed redesign, the curb-to-building distance will generally remain the same but grow to 18 feet at the curb extensions. It is envisioned that street furniture will be consolidated so that the clear walking zone will be wider and more consistent.

Crossings

In terms of street crossings, pedestrians are currently assisted only by traffic signals, clear corner zones, and "Yield to Pedestrians in Crosswalk" signs at the uncontrolled crosswalks. Few drivers actually yield, and pedestrians have to wait for a gap in traffic during a red light, before attempting to cross. The proposed changes will improve this condition by:

- Reducing pedestrian crossing distance by 16 feet at the curb extensions, and
- Providing a refuge area for pedestrians at the medians so they can cross one direction of traffic at a time.

Even though the four-foot wide median meets the minimum DOT standard, it is less than the generally recommended six feet for pedestrian refuge islands.

Intersections

In redesigning the intersections, the corner radii will be increased to provide for larger turning vehicles. Yet with the curb extensions, the overall crossing distance will be reduced.

Figure 3.2.1.12: Existing narrow sidewalk.

Figure 3.2.1.13: Existing uncontrolled crosswalk.

The stop lines at the signalized intersections will be set back from the crosswalks and aligned with street trees or street furniture. This coordination will give drivers a visual cue as to where to stop and hopefully keep them from blocking crosswalks (and pedestrian ramps). At the diagonal intersections, the stop lines will be aligned perpendicular to the travel lanes. This will effectively widen the crosswalks and reduce the crossing distances.

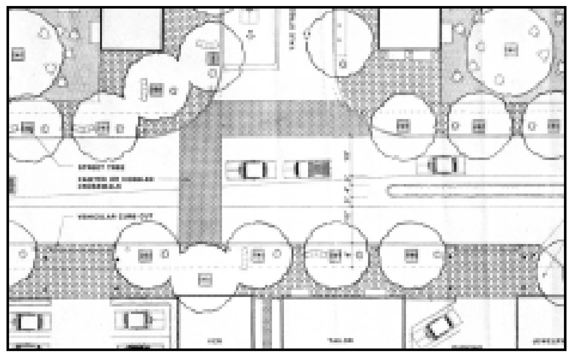


Figure 3.2.1.14: Proposed Yale Street intersection.

Performance Flexibility

The posted speed limit on Springfield Avenue is 35 mph; the town has proposed changing this to 25 mph. Although a design speed has not yet been established, it is expected that the redesigned road will self-enforce the posted speed.

Counterintuitive as it may seem, the proposed reconfiguration of Springfield Avenue may actually improve level of service (LOS) at certain intersections. A traffic analysis showed this could be achieved by re-timing the signals to 90-second cycles, removing one of the ten signals, and restricting turns at another intersection. The proposed reconfiguration will cause LOS for the arterial as a whole, end-to-end, to suffer. Yet with the expected de-designation of Route 124, state DOT should have no objections.

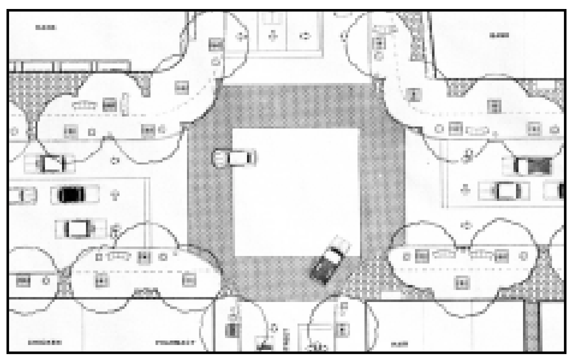


Figure 3.2.1.15: Proposed Prospect Street intersection.

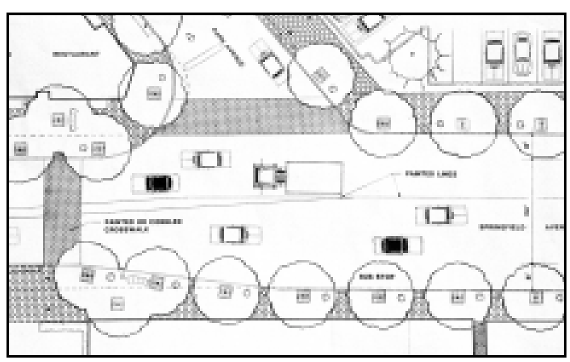


Figure 3.2.1.16: Proposed Park Avenue intersection.

	Existing (1999)	Proposed (2004)
ADT	15,000–20,000	16,200–21,500
Intersection LOS	B-F	B-D
Arterial LOS	C	C-D
Signal Cycle (sec)	120	90

Table 3.2.1.4: Springfield Avenue performance.

Institutional Collaboration

The manner in which DOT worked with local government to change the roadway from four to three travel lanes was exemplary. DOT installed temporary markings and placed cones at strategic locations to test the proposed design. It performed traffic counts and assessed level of service. Finding the design was satisfactory, the state made the changes permanent.

In January 2000 the town approached DOT with its plan to further redesign the street. At first the plan appeared too radical for DOT, particularly since the street is currently on the National Highway System. But when DOT realized that the state route designation ended at the city line, its attitude changed. To the east of Maplewood (Irvington) the road becomes a county route. Hence, the state came to view the de-designation not as breaking a chain, but merely removing the last link. The de-designation is forthcoming. With de-designation, it is expected that Route 124 will be taken off the National Highway System.

Public Response

In preparing the Economic Development Plan, the Township and consultant performed substantial community outreach. Three detailed surveys were taken of businesses, consumers and residents, along with a series of public meetings and work sessions. Specifically the Economic Development Commission worked with the Township Committee, the Springfield Avenue Partnership, and the Hilton Neighborhood Association. The outreach confirmed that stakeholders were concerned with, among other things:

- ❑ Adequacy of street lighting,
- ❑ Speed of traffic,
- ❑ Timing of traffic lights, and
- ❑ Difficulty in crossing the street.

As of now the town officials are leading the design process, having hired planners, landscape architects and engineers. They are negotiating with the state and are selling the project within their own community. The major sticking point is the cost of repaving—$400,000 every ten years. The town's entire capital budget is only $1.5 million annually and to assume this cost will be a burden. In addition the project construction costs are estimated to the $7.5 million. The town is floating bonds to pay for the project. It has also proposed that the county maintain the signal equipment, even though the municipality will control the timing.

Construction on phase I (from the western town boundary to Yale Street) is expected to commence soon. It is hoped that the project can be completed by 2003.

[All sketches and plans courtesy Zion & Breen Associates—Site Planners & Landscape Architects. All traffic data courtesy Orth-Rodgers Associates Transportation Engineers & Planners.]

Project Status	Planning Phase
City Population	22,000
Adjacent Land Use	Commercial, Institutional, Park
Road Classification	Urban Principal Arterial
Road Ownership	To Be De-designated By State
Design Exception Required	No
Project Cost	$7.5 Million
Economic Data	Enhanced Road Expected To Increase Tax Revenues

Table 3.2.1.5: Project status summary.

Element	Before	After
Number Of Lanes	4	3
Lane Width + offset, feet	10-11	10-15
Shoulder Width or Cycle Lane, feet	—	—
Street width, feet	50	34-50
On-street Parking	One side	Both sides
On-street Parking width, feet	8	8
Sidewalk Width, feet	4-7	4-18
Posted Speed, mph	35	35
85^{th} Percentile or Design Speed, mph	—	—
Vehicle Volume, ADT (DY-2004)	15,000-20,000	16,200-21,500
Level of Service	B-F (intersection) B-D (intersection)	C (arterial) C-D (arterial)
Crash Data, reportable	—	—
Truck Volume	—	—
Pedestrian Volume	—	—
Bike Volume	—	—
Corner Radii, feet	15-25	25 (overall intersection area decreases with curb extensions)
Stopping Sight Distance, feet	—	Increased with curb extensions

Table 3.2.1.6: Data summary for Springfield Avenue, Maplewood, New Jersey.

3.2.2 Plainfield, South Avenue (NJ 28)

Route 28 parallels the New Jersey Transit Raritan Valley Line and serves as the main street for a series of towns along this valley. While many of these towns (Westfield, Plainfield, Cranford) have distinct pedestrian-friendly downtowns, the Netherwood section of Plainfield lacks one. In recent years, much of the business activity has been automobile-oriented. Seeking to change this, the City of Plainfield recently obtained funding to create a sense of place and identifiable center around the Historic Netherwood Train Station.

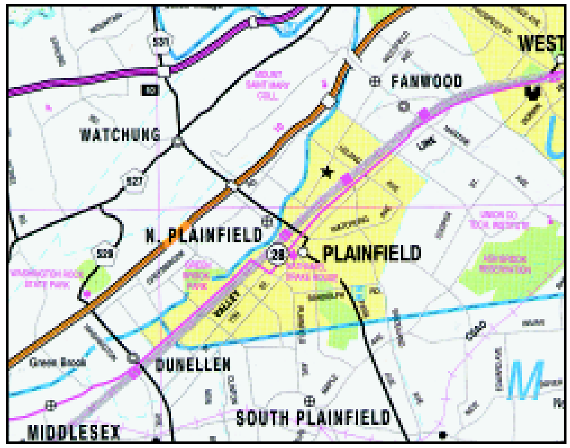


Figure 3.2.2.2: Area map of Plainfield, New Jersey.

Geometric Flexibility

The South Avenue project is seven blocks and 0.8 mile long. It is classified as an Urban Principal Arterial but is not on the National Highway System. Even though it is designated a state route, Route 28 is not maintained by the state through Plainfield. This allows a certain amount of design flexibility, for the roadway need not conform to DOT's *Roadway Design Manual*.

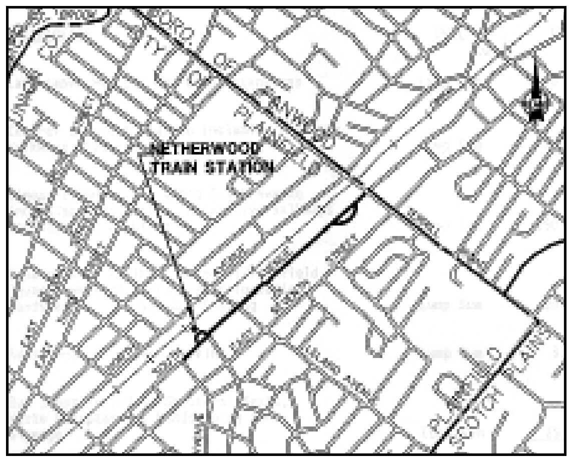


Figure 3.2.2.3: Project plan.

South Avenue before the reconstruction varied between 40 and 41 feet wide with two 12 to 13-foot travel lanes and two eight-foot parking lanes. Originally the town proposed to narrow the travel

Figure 3.2.2.1: South Avenue construction.

	LANE WIDTHS (ft)		
	Travel	Parking	Total
Former	12-13	8	40-41
Town Proposal	9	8	34
NJDOT Probable	12	8	40
AASHTO Minimum	10	8	36
As built	11	8	38

Table 3.2.2.1: Cross-section comparison.

lanes to nine feet and install medians and curb extensions. Had this street been maintained by the state, the project manager at DOT stated that he likely would have insisted on 12-foot travel lanes. Instead, travel lanes were constructed to a compromise width of 11 feet

At Old South Avenue, an arcing street connected at both ends to South Avenue, the South Avenue cross section was narrowed to 30 feet wide. This was accomplished by eliminating the parking lane and enlarging the park. Along the remainder of the project on-street parking is now allowed in most areas.

Other Design Solutions

Curb Extensions

Curb extensions were part of the original proposal and were retained in the final design. The extensions visually narrow the road, define parking bays, and act as a gateway to the town. They are eight feet wide, match the width of the parking lane, and align with the mid-block crosswalks. Trees and street furniture are planned for the extensions. The DOT project manager speculates that had this route been built to state standards, there would likely have been neither curb extensions nor on-street parking.

The curb extensions have been hit a few times by passing motorists. Whether this was due to driver error or design of the extensions themselves is unclear. The issue has become somewhat politicized and the design itself has been questioned by the opposition. The extensions are eight-feet wide—the width of the parking lane, yet slightly wider than a parked car. As a safety measure the City installed edge lines before each extension. It is expected that with street furniture, street lamps, and more visible crosswalks, drivers will become more aware of the geometry.

Another issue with curb extensions is drainage. Because non-linear curbs have a tendency to block stormwater runoff, drainage has to be handled with care. In some locations catch basins were added, and in others a reverse slope was designed into the roadway to direct water around the extensions.

Crosswalks

As this street parallels the train tracks, there is little cross traffic and some blocks stretch up to 700 feet. One of the primary purposes of the project was to encourage pedestrian traffic in the area. Because of the futility of expecting pedestrians to walk out of their way to cross the narrowed street, especially in a commercial environment, uncontrolled mid-block crosswalks were added. The crosswalks are of brick

Figure 3.2.2.4: Before at Train Station Plaza.

Figure 3.2.2.5: After at Train Station Plaza.

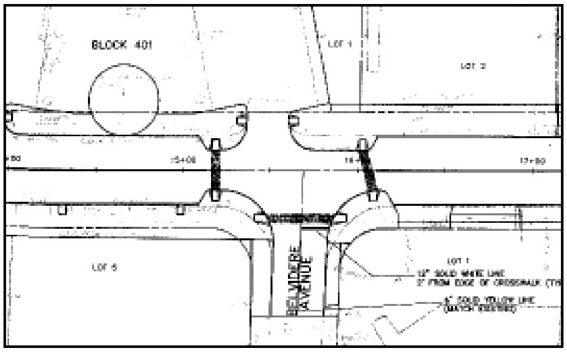


Figure 3.2.2.6: Typical plan.

Figure 3.2.2.7: Typical curb extensions.

Figure 3.2.2.8: Inlet at curb extension.

paving stones, similar to the sidewalks and plaza. While the pavers do not by themselves calm traffic, their frequency and coordination with bulb-outs accentuate the pedestrian-friendly nature of the street.

The legal status of mid-block crosswalks in New Jersey is not entirely clear. According to State

Figure 3.2.2.9: Curb extension poking out between parked cars.

Figure 3.2.2.10: Edge line before curb extension.

Statute:

> *In the case of totally self-contained streets under municipal jurisdiction which have no direct connection with any street in any other municipality… the municipality… may, by ordinance or resolution, as appropriate, without the approval of the Commissioner of Transportation, designate parking restrictions, no passing*

Figure 3.2.2.11: Mid-block crosswalk.

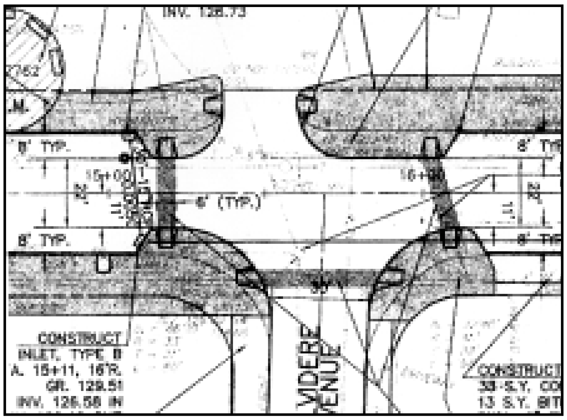


Figure 3.2.2.12: Belvidere Avenue intersection.

> *zones,* mid-block crosswalks *and cross-walks at intersections… [emphasis added]*[1]

While South Avenue clearly connects to roads outside Plainfield, the DOT project manager did not object to the mid-block crosswalks because the street is owned and maintained by the city and is technically not a state highway.

At one intersection, crosswalks are offset 22-30 feet from the sidewalk on the side street. This is done at the intersection with Belvidere Avenue to allow a perpendicular alignment between the curb cut and crosswalk. While this is beneficial for those in wheelchairs, it is problematic for the visually impaired traveler. When the crosswalk is not a natural extension of the sidewalk, it is a challenge to find it with a cane. It will be instructive to observe whether pedestrians simply ignore the crosswalk and cross following their desire lines.

Figure 3.2.2.13: Originally proposed medians.

Medians

The originally proposed medians were not included in the final design for two reasons. Using a standard Single Unit truck (SU) turning template, it was predicted that trucks would mount the median at precisely the point where pedestrians would wait to cross the street. The other reason is that the medians would be only two-feet wide. This is narrower than the DOT standard of four feet, and much less than the six feet required to protect a person pushing a baby stroller or bicycle. This is a good example of balancing the many uses of a street.

Corner Radii

At the intersection with Belvidere Avenue, the combination of lane width, corner radius, and curb extension creates a condition where the SU design vehicle turning onto South Avenue will cross the centerline. This is inconsistent with standard practice. At this intersection, though, traffic on South Avenue is free flowing with no stop sign or signal control, so the DOT project manager concluded that traffic will not queue up, thereby blocking the turning path. He also concluded that trucks turning onto South Avenue will be able to find appropriate gaps in traffic, and travel speeds will be slow enough to keep encroachment into the opposing lane from causing a hazard.

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[1] Title 39: Motor Vehicles and Traffic Regulation, Section 39:4-8.b.

At the intersections with Old South Avenue, an interesting geometry occurs. At the entrance, the controlling corner radius is shortened somewhat, thus reducing possible turning speeds. At the exit, the corner radius is similarly reduced and a curb extension is added, thus limiting turning speeds even more. By shortening the radius, the stop sign is placed closer to where vehicles actually stop. Previously the corner radius was so large that the stop sign was about 90 feet removed from the point of tangent. Now the geometry orients the driver to have a better view of oncoming traffic.

Sidewalks & Curbs

The former sidewalks along South Avenue were four feet wide, separated from the curb by three to five feet of buffer strip. The new sidewalks typically maintain this width yet grow to six feet where there is no buffer strip and to 28 feet across from the train station. The wider sidewalks and curbs are constructed of pavers. At several locations the sidewalk narrows to 3.5 feet wide. At first glance this is problematic, yet many large Sycamore trees were spared. This is an exemplary case of flexibility, and is within the Americans with Disabilities Act guidelines.

Performance Flexibility

Directly to the east and west of the project, the speed limit is 35 mph. According to the Straight Line Diagram, the Netherwood section of Route 28 also has a 35 mph limit. In fact, however, this section had no posted speed. In the project proposal, it was recognized that the default speed limit for this type of road (a main street) is 25 mph. A 25-mph speed limit is thus being posted along this section, a fact

Figure 3.2.2.14: Entrance to Old South Avenue.

Figure 3.2.2.15: Exit from Old South Avenue.

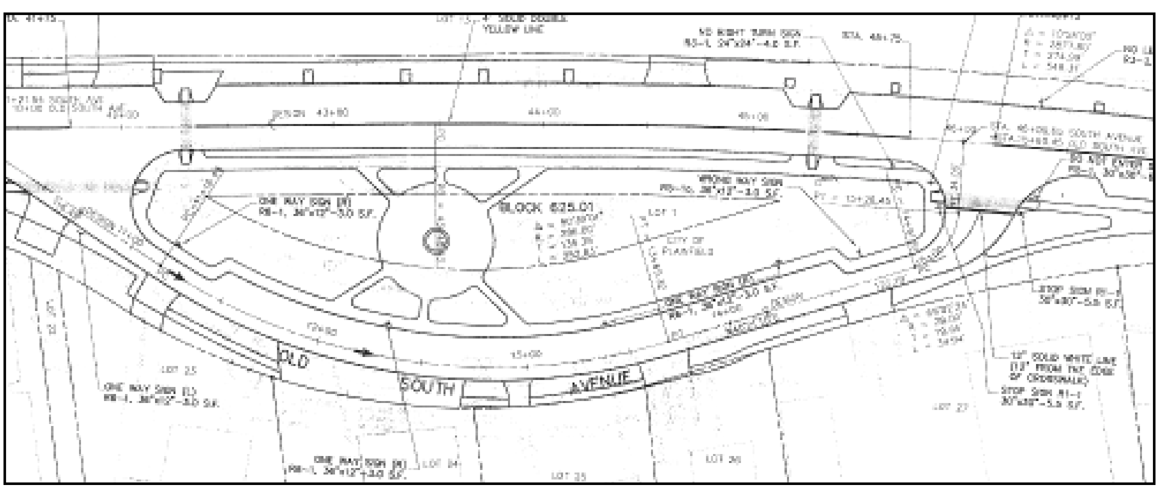

Figure 3.2.2.16: Plan at South Avenue and Old South Avenue.

Figure 3.2.2.17: Wide sidewalk at Commercial.

Figure 3.2.2.18: Sidewalk at tree.

that made the DOT project manager comfortable with progressive design features such as curb extensions, narrower lanes, reduced corner radii. These were viewed as consistent with the expected travel speeds on the road.

Volumes

As this is not officially a state route and no traffic control was altered, no traffic analysis was performed. Volumes in 1998 were about 13,000 per day according to the Straight Line Diagram.

Institutional Collaboration

The project cost about $1.5 million—half a million from federal T-21 Enhancement funds, and half a million from the New Jersey Transportation Trust Fund. DOT distributes these funds and so has an interest in the project. While DOT has taken no

Figure 3.2.2.19: Modular curbs.

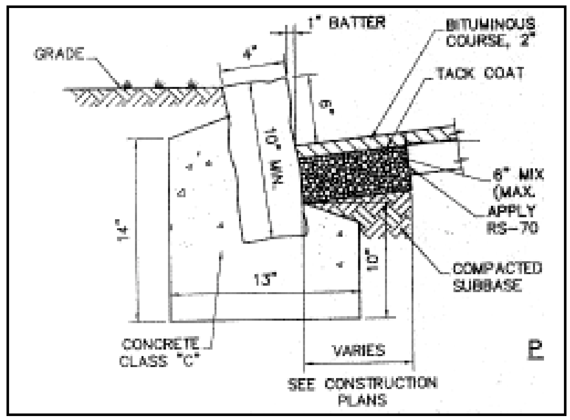

Figure 3.2.2.20: Curb detail.

position on performance of the street, it has had a responsibility to see that the design meets standard engineering guidelines.

The Netherwood Train Station was listed in the National Register of Historic Places in 1984. In 1993 the train station was selected by New Jersey Transit (NJT) as a demonstration project to show how a renovated station could serve as a catalyst for the improvement of the surrounding community. Over one million dollars was spent by NJT in remodeling the station, and the street improvement work is seen as a happy complement. There has been a subsequent agreement between the City, NJT, and the Friends of Sleepy Hollow (FOSH) to maintain the station.

In the City of Plainfield's Master Plan, South Avenue is to receive special planning consideration. Plainfield is a designated Center in the NJ State Plan. The area has been designated a Neighborhood Empowerment Zone by the state, and it is a NJRA

Urban Coordinating Council designated community. These designations have given the town priority for state funding.

Public Outreach and Response

Before the start of the project there was an active streetscape improvement effort by the local community. Flower planters were placed at the station, historic lights were installed, restaurants held special events, and businesses improved their façades.

Public reaction to the project is positive with FOSH, the local neighborhood association, and the Plainwood Square Business Association fully and publicly supporting the project. These organizations had been involved since the early planning of the project.

Project Status	2000 (completed)
City Population	50,000
Adjacent Land Use	Commercial, Transit, Park, Residential
Road Classification	Urban Principal Arterial
Road Ownership	City
Design Exception Required	No
Project Cost	$1.5 million
Economic Data	–

Table 3.2.2.2: Project status summary.

The local newspapers chronicled the project and editorialized in favor of the project and its intent. There was some concern due to minor construction zone related mishaps; these incidents have abated as the project nears completion. Traffic has slowed visibly in the area and is expected to slow more once the project is complete. With the finished product, positive public sentiment is expected to grow as additional fruits of the work are realized. These include economic development due to increased foot traffic throughout the corridor.

The project received a 1997 New Jersey Planning Officials' Planning Achievement Award.

Figure 3.2.2.21: Former train station.

Figure 3.2.2.22: Renovated train station.

Element	Before	After
Number Of Lanes	2-4	2
Lane Width + offset, feet	12-13	11
Shoulder Width or Cycle Lane, feet	8	8
Street width, feet	40-41	38
On-street Parking	some	increased
On-street Parking width, feet	8	8
Sidewalk Width, feet	4	3.5-28
Posted Speed, mph	25	25
85^{th} Percentile or Design Speed, mph	—	—
Vehicle Volume, ADT (DY-2004)	13,000	—
Level of Service	—	—
Crash Data, reportable	—	—
Truck Volume	—	—
Pedestrian Volume	—	—
Bike Volume	—	—
Corner Radii, feet	varied	30
Stopping Sight Distance, feet	—	—

Table 3.2.2.3: Data summary for South Avenue, Plainfield, New Jersey.

3.2.3 South Orange, South Orange Avenue (CR 510)

South Orange is a suburban town of about 16,500 people in northern New Jersey on the Morristown New Jersey Transit line. Over the years its main street, South Orange Avenue (County Route 510), had grown into a four-lane thoroughfare where too many cars whizzed past too few active storefronts. The town felt that South Orange Avenue was cutting the village in half, and resolved to do something about it.

In the mid-1990s, the commuter rail station and environs were redeveloped. Between 1997 and 2000 the roadway was shrunk to one lane in each direction with center left-turn lanes. Sidewalks were expanded, intersections narrowed, and medians and islands installed. As a result, vehicular speeds fell, the pedestrian environment improved, and businesses became more successful.

Figure 3.2.3.1 South Orange Avenue.

Geometric Flexibility

Prior to its reconstruction, South Orange Avenue had a constant 60-foot cross section with two travel lanes and one parking lane in each direction. The county and city agreed to narrow the street by

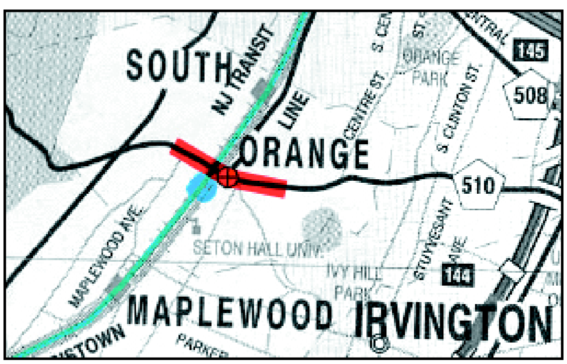

Figure 3.2.3.2 Area map.

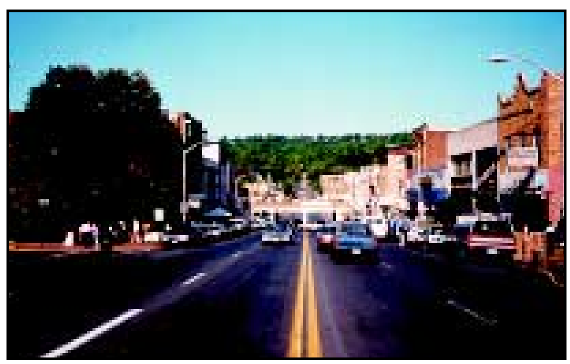

Figure 3.2.3.4 Before at Valley Street.

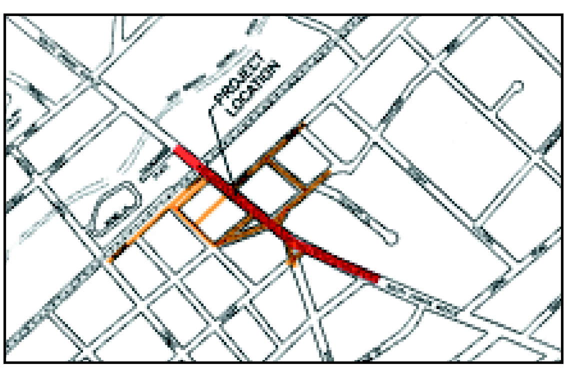

Figure 3.2.3.3 Downtown area plan.

Figure 3.2.3.5 After at Valley Street.

Figure 3.2.3.6 Before at Academy Street.

Figure 3.2.3.7 After at Academy Street.

removing one lane in each direction, adding center turn lanes, expanding a center island, and widening the travel lanes so cars could pass those parking or double parked. The reconstructed road is generally 54-56 feet in width with 12-15-foot wide travel lanes. Eight-foot parking lanes framed by curb extensions remain on both sides. At intersections the lanes narrow to allow for turn lanes. In sum, the road now better reflects the travel patterns and land use of the area.

To the west is a rather steep grade from which drivers gain momentum just as they are entering the downtown area. To counter this, a raised median was installed which narrows the roadway and removes the opportunity to pass slower drivers. In case of errant driving, the curbs are fully mountable. Even so, the median is planted, and the effect is clearly a gateway into town.

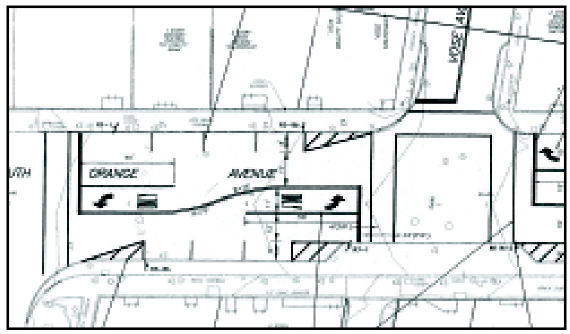

Figure 3.2.3.8 Plan at Vose Avenue.

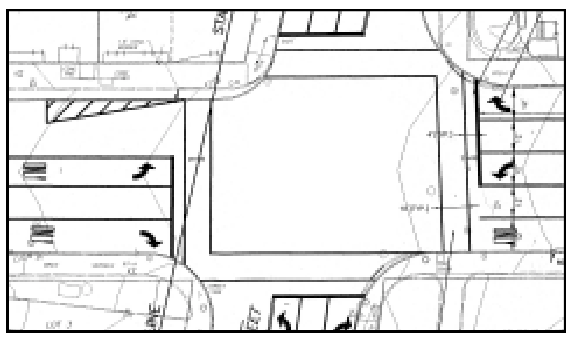

Figure 3.2.3.9 Plan at Village Plaza.

Condition	Lanes	Lane width (ft)	Curb-to-curb (ft)
Former	P+T+T+T+T+P	8+11+11+11+11+8	60
New at Valley Street/Scotland Road	P+T+LT+T+RT	8+13+11+12+12	56
New at Sloan Street	P+T+LT+T+P	8+15+11+12+8	54
New at Vose Avenue	P+T+T+P+RT	8+16+15+15	54
New at Village Plaza	T+T	17+17	34
New at Mid-Block Crosswalks	T+T	15+15	30

Table 3.2.3.1: Lanes before and after.

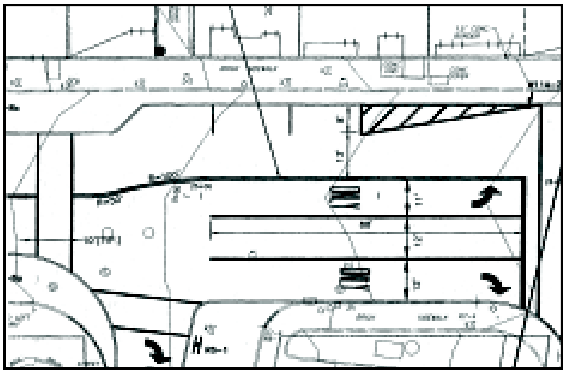

Figure 3.2.3.10 Plan at Valley Street/Scotland Road.

Reconstruction plans for South Orange Avenue did not include marked cycle lanes since the number of turning movements precluded continuous lanes. However, the generally 15-foot wide lanes are to shared-use standards, and the travel speeds are such that cyclists can merge with vehicles.

Other Design Solutions

Intersections and Mid-Block Crosswalks

The crossing distance for pedestrians at intersections has been reduced via curb extensions and the narrowed cross section. At the intersection with Vose Avenue, the widened sidewalk and curb extension reduce the crossing distance for pedestrians by 14 feet. At the intersection with Village Plaza, curb extensions on both sides reduce the crossing distance by approximately 25 feet. At the eastern end of the main downtown area where Academy Street and Irvington merge into South Orange Avenue, an existing center island was significantly expanded, which reduced the width of the travelway from 60 to 30 feet. Crosswalks leading to and from the island on both sides were also reoriented to better reflect pedestrian design lines. For the uncontrolled mid-block crosswalks, a new City ordinance was required as per state statute.

The new mid-block crosswalks give people more “sanctioned” options to cross the street. As these are away from the signals and turning conflicts of intersections, they may be safer and impose less delay on pedestrians. The fact that the crosswalks are brick paved and coordinated with curb extensions and vertical streetscape elements means that drivers are more apt to yield to crossing pedestrians, as drivers are legally required to do. More pedestrians crossing has the effect of further slowing traffic. In a way, pedestrians, seen as “flow interrupters” in terms of vehicle LOS, are doing just that. The result is organic traffic calming.

At the intersection with Valley Street, there is a button-actuated seven-second leading pedestrian interval in one direction. This provides pedestrians an opportunity to cross ahead of turning vehicles, but the button is not in an obvious location. The LPI is not automatic, for the county did not want to sacrifice vehicular level-of-service. Nevertheless, drivers were observed generally yielding to pedestrians, and LOS is compromised anyway.

Figure 3.2.3.11 Edge lines where street width is reduced in segments.

Figure 3.2.3.12 Raised median as a gateway into town.

Crossing	Former (ft)	Present (ft)	Change in crossing distance (ft)
Academy Street	60	30	-30
Village Plaza	62	37	-25
Mid-Block	60	38	-22
Vose Avenue	60	46	-14
Sloan	60	54	-6
Valley Street	67	63	-4

Table 3.2.3.2 Change in crossing distance.

Figure 3.2.3.15 Before crosswalk at Academey Street.

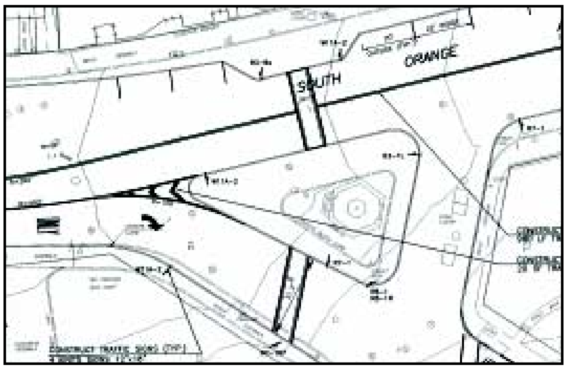

Figure 3.2.3.13 Center island reconstruction at Irvington Avenue/Academey Street.

Figure 3.2.3.16 After crosswalk with island expansion at Academey Street.

Figure 3.2.3.14 Pedestrian push button.

Figure 3.2.3.17 Curb extension narrows mid-block crossing.

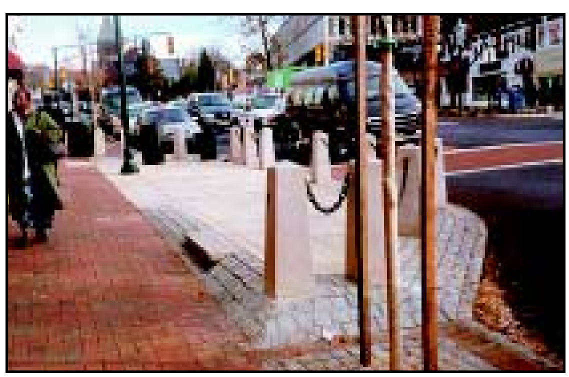

Figure 3.2.3.18 Curb extension with bollards.

Figure 3.2.3.19: Before sidewalk.

Figure 3.2.3.20: After sidewalk.

Stop lines were added at all controlled intersections. They are placed where the designer wants the driver to stop, not necessary parallel to the crosswalk nor four feet in front, as in the MUTCD. Stop line locations are based on turning radii of trucks, ensuring they will have ample room to turn. The greater setback also allows cyclists to queue ahead of waiting vehicles.

With the curb extensions, seven parking spaces were lost. One bus stop was moved from a turn lane location to mid-block, which eliminated three parking spaces but improved travel flow. Initially this seemed to be a concern for local merchants. Yet, since there has been an obvious increase of pedestrian activity, the trade-off is now seen as worthwhile.

Brick Sidewalks & Crosswalks

Several crosswalks have been made of brick to emphasize the pedestrian environment and further differentiating the crossing locations. The pavers are similar to those used on the sidewalks, alleys, side streets, and around the train station. Previously-closed alleys and short cuts have been opened to provide shorter links to the various stores and offices throughout town. Numerous streetscape elements were added such as bollards with chains, pedestrian-scaled streetlights, benches, and planters and planting beds. These amenities take advantage of changes in elevation to yield a more interesting design. Lighting was improved to enhance security. The result is a unified whole where the driver can be seen as a guest through town.

Figure 3.2.3.21: Crosswalks corrdinated with alleys.

Figure 3.2.3.22: Improved aesthetics and lighting in alleys.

Performance Flexibility

The speed limit through town remains at 25 mph. While no speed data have been collected, interviews reveal that people perceive cars going much slower since the reconstruction.

When the town began planning the redesign, the following point was raised: Although the road serves as a major arterial between Newark and South Mountain, it narrows to two lanes on either side of town. It was argued that the section through downtown South Orange could be likewise reduced to two lanes. Although the county preferred a higher LOS, the town of South Orange was content to reach LOS D with the new design, which was considered acceptable for a downtown.

Institutional Collaboration

South Orange Avenue is a county route, and the work was coordinated with Essex County. The county engineer at the time was opposed to the project but the county executive was in favor. As a compromise, the town passed a resolution pledging to return the street to its previous condition if the project failed in some respect. The resolution, however, never defined objective criteria of success or failure. As such it somewhat favored the town.

The greatest concern for the county besides LOS was maintenance. The county worried that plowing, for example, would become much more complicated and expensive. So the town and county eventually agreed to split responsibilities; the town plows the parking bays and maintains other pedestrian features and the county plows the travel lanes.

In designing the project, the town actively consulted ADA guidelines and worked with local disabled activists. As a result, pedestrian facilities are as ADA-friendly as possible.

Public Response

The improvements to South Orange Avenue were spearheaded by a group of local merchants and residents known as "Main Street South Orange." In collaboration with the town, the group commissioned a study and laid plans for calming traffic and improving pedestrian amenities in order to attract people to downtown. To finance the $1.6 million project, including all streetscape elements, the city issued bonds.

The renovation of the shops and plaza at the train station was financed with a Community Development Block grant from HUD. It went a long way toward convincing citizens and business people to

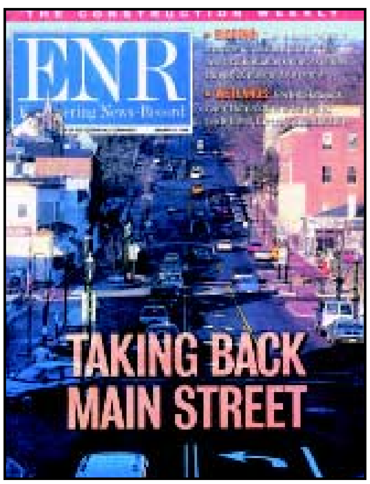

Figure 3.2.3.23: Cover of Engineering News-Record, *January 1998.*

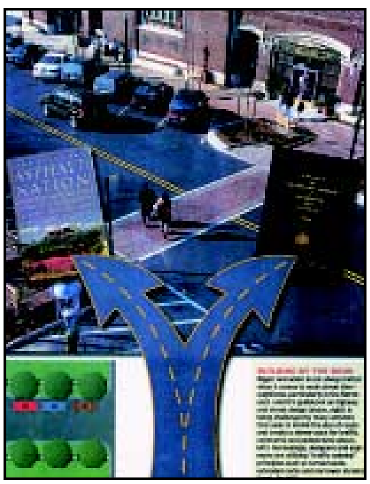

Figure 3.2.3.24: Inside Engineering News-Record, *January 1998.*

support the bond issue. South Orange residents and officials seem happy with the results of their Main Street today, and the town has received much attention throughout the state for its successful project. Data from stores that were affected as part of the first phase (at the train station) show an increase in sales tax revenues.

Project Status	2000
City Population	16,500
Adjacent Land Use	Commercial, Transit,
Road Classification	Urban Arterial
Road Ownership	County
Design Exception Required	No
Project Cost	$1.6 million
Economic Data	Increased sales tax revenue from first phase improvements

Table 3.2.2.3: Project status summary.

Element	Before	After
Number Of Lanes	4	2
Lane Width + offset, feet	11	11-17
Shoulder Width or Cycle Lane, feet	—	—
Street width, feet	60	30-56
On-street Parking	yes	yes
On-street Parking width, feet	8	8
Sidewalk Width, feet	—	—
Posted Speed, mph	25	25
85^{th} Percentile or Design Speed, mph	—	—
Vehicle Volume, ADT (DY-2004)	—	—
Level of Service	—	D
Crash Data, reportable	—	—
Truck Volume	—	—
Pedestrian Volume	—	increased (perceived)
Bike Volume	—	—
Corner Radii, feet	—	increased, but intersection area decreased
Stopping Sight Distance, feet	—	—

Table 3.2.2.4: Data summary for South Orange Avenue, South Orange, New Jersey.

3.2.4 Washington Township, Town Center (NJ 33 and US 130)

(This case study was prepared by Charles Carmalt and is far more detailed and process-oriented than the other case studies. As such, it provides a different perspective on the opportunities and obstacles inherent in context-sensitive design.)

Washington Township (pop. 8,700) is located in Mercer County at the geographic center of New Jersey near the intersection of the New Jersey Turnpike and Interstate 195. Because of its central location, important transportation routes have long crossed the township, linking northern and southern New Jersey (and linking New York and New England with Philadelphia, Washington and the South).

The historic village of Robbinsville evolved at the intersection of US 130 (the Bordentown-Amboy Turnpike), and NJ 33 (Nottingham Way), roads that were state arteries long before there was a state highway department. US 130 had been laid out during the early nineteenth century to serve stagecoaches that connected Philadelphia and New York City. During the 1930s it had been recon-

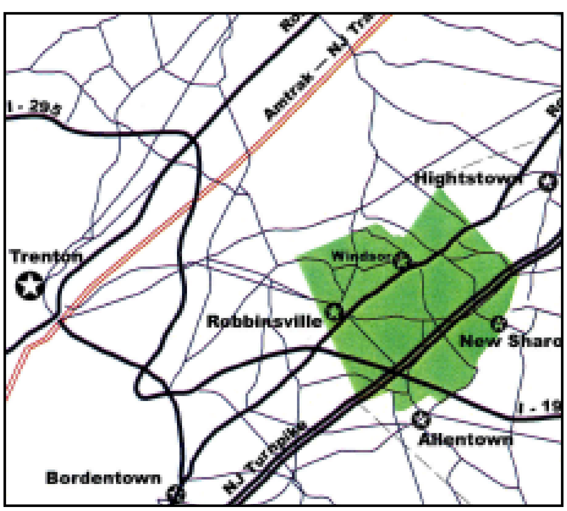

Figure 3.2.4.1: Area map.

Figure 3.2.4.2: County Route 526.

Figure 3.2.4.3: State Route 130.

structed as a divided highway and had served as the major north-south highway through New Jersey prior to the construction of the New Jersey Turnpike. Unlike other towns located along the highway, such as Cranbury, Hightstown and Yardville, a bypass had never been constructed around Robbinsville, and as a result the divided highway had severed both the village and the township.

Since construction of the New Jersey Turnpike, Route 130's function has become more limited, primarily serving regional rather than statewide and national travel needs. Likewise, since construction of parallel I-195, NJ 33 serves more localized travel needs, with most trips having at least one trip end in either Washington Township or a nearby municipality.

The two highways passing through Robbinsville provide the village, and the planned Town Center, with excellent accessibility to the rest of the region.

At the same time, the fact that Route 33 no longer serve strategic national and statewide travel needs provides the opportunity for creative redesigns.

Plans for the Town Center

Despite its central location, the township experienced only limited development prior to 1985. The majority of its land was still in farming. Two historic villages, Robbinsville and Windsor, were the principal settlements. People moved to Washington Township because of its rural character, and the protection of that rural character was an important community goal.

By 1985, it had become evident that the township lay in the path of growth. That year, Washington Township officials decided that they would seek to manage growth by developing a master plan and zoning ordinance that concentrated development in a new town center. The town center would be created by expanding the traditional village center of Robbinsville. Officials would also seek to limit development in the remainder of the township.

The passage of state statutes such as the Freshwater Wetlands Protection Act and the State Planning Act substantially changed how development would be planned and regulated in New Jersey and Washington Township. The township committee ultimately adopted the Town Center Ordinance in 1997, which created planning and design regulations governing development within the Town Center Zone, and which established strict controls over how development within the center would occur.

Washington Township wants its Town Center to be a walkable place with a diversity of land uses and housing types. The 450-acre development should function as a town center to the rest of the township. It should be seamlessly woven into the land use fabric of the 20 square mile township.

Washington Township has used Traditional Neighborhood Design (TND) principles to design its Town Center. Because of the mixture of land uses proposed, most homes will be within walking distance of a wide range of community commercial uses. A commercial center will provide approximately 250,000 square feet of commercial space in two- and three-story buildings. Additional commercial space will be constructed along NJ 33, which the Town Center plan proposes will become a "Main Street."

As a result of the synergy between land uses, and their location in the plan, the number of external trips by residents should be reduced, especially on weekends and other non-peak travel periods. At the same time, the accessibility provided by the regional roadways that penetrate the Town Center will ensure that businesses are able to market themselves to surrounding communities, thereby attracting external trips.

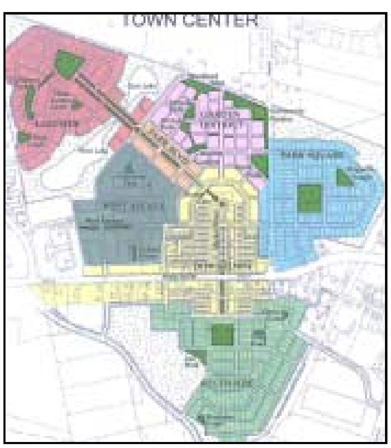

Figure 3.2.4.4: Mixed-use plan.

Figure 3.2.4.5: Traditional Neighborhood Design.

Seamless Connections

To weave the Town Center seamlessly into the fabric of Washington Township, streets were laid out to link to the Town Center. The adjoining Foxmoor Shopping Center is the terminus for an important east-west avenue between the Foxmoor development and Town Center. Both developments will have direct access to a newly constructed lake and park.

Similarly, the street network of the Town Center has been designed to flow into the historic village of Robbinsville so that, in the future, Robbinsville will appear to be the oldest portion of the Town Center and not a separate area. In addition, lands along US 130 were carefully analyzed, and development was envisioned that would make the highway corridor, where it passes through Robbinsville, appear to be a major artery passing through the center of town rather than a barrier separating two halves of a town.

Trails will link the Town Center to surrounding land uses where appropriate. A pedestrian bridge is proposed across US 130 to connect the township's existing municipal complex on the east side of US 130 with the Town Center. A recreational trail is proposed along the north side of the Washington Boulevard Extension, linking neighborhoods within the Town Center to a proposed rails-to-trails path along the old Amboy rail line.

Modal Balance

The pattern of land uses and network of streets in the Town Center are designed to encourage pedestrian activity, and assure a safe and friendly environment that invites future residents, workers and visitors to walk whenever possible. The center will be approachable from all directions, assuring that future residents have a short and enjoyable walk to the commercial center of the town.

The goal of pedestrian-friendliness was important in its own right. A place where people walk is a place that generates community spirit, promotes successful commerce, and frustrates the forces of anonymity that can turn neighbors into strangers.

A pedestrian-friendly environment can also help to reduce the total number of vehicle trips generated within a development. Where trip ends are sufficiently close, people can walk and leave their cars behind. Children can gain mobility and autonomy, no longer requiring parents to chauffeur them everywhere.

Figure 3.2.4.6: Streets in the Lakeside Village area of Town Center, inviting to pedestrians, will flow into surrounding sections of the Foxmoor development.

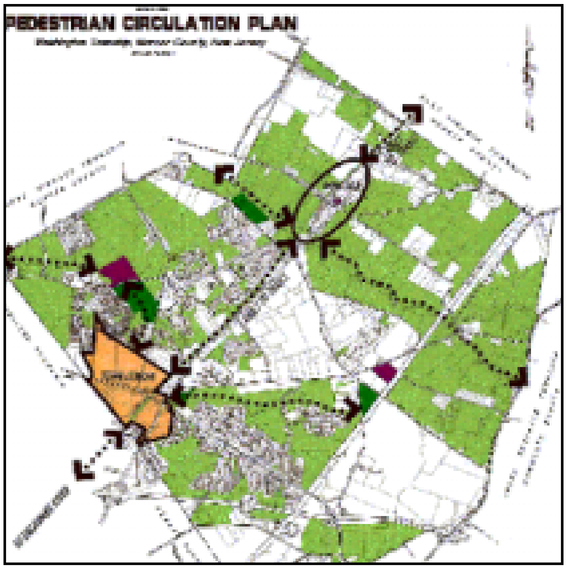

Figure 3.2.4.7: Pedestrian circulation plan.

Although the needs of pedestrians were considered first, the needs of all travel modes had to be balanced in the Town Center. The integrated network of streets will allow auto traffic to flow easily through the Town Center. The concentration of residences, jobs, and shopping destinations should be sufficient to support transit services to major employment centers including downtown Trenton, the Route 1 corridor, and Philadelphia and New York.

Hierarchy of Streets

To accomplish its other objectives, the township soon recognized that it had to develop a new roadway hierarchy sensitive to the different land uses and travel needs served. For each roadway, the appropriate function had to be defined and the competing needs of motor vehicles and other users balanced.

A central element of the Town Center Plan was a "Street Regulating Plan." This plan specified the alignment of each street, the function of each street within the hierarchical network, and the typical cross-section of each class of street. Any change in the plan would constitute a Master Plan change and a zoning variance.

All properties will be served by rear or side *alleys* that provide access to garages and are used by garbage trucks and other service vehicles. By concentrating vehicular access function in alleys, the street frontage of properties will be uninterrupted by driveways, building setbacks can be reduced, and more on-street parking can be supplied. This will allow all streets to function more efficiently, both for motor vehicles and pedestrians. The use of alleys assures that individual driveways will not be constructed along the major roadways.

Most of the streets within the Town Center will be *residential streets* or *residential lanes* with little through traffic; the majority of housing units will front on these streets. Because residential streets and lanes in the Town Center will have low traffic volumes, and will not have to serve turning movements into driveways, their widths can be reduced compared to typical subdivision streets, and the amounts of rights-of-way devoted to street trees and sidewalks increased.

Figure 3.2.4.8: Pedestrian-friendly site plan.

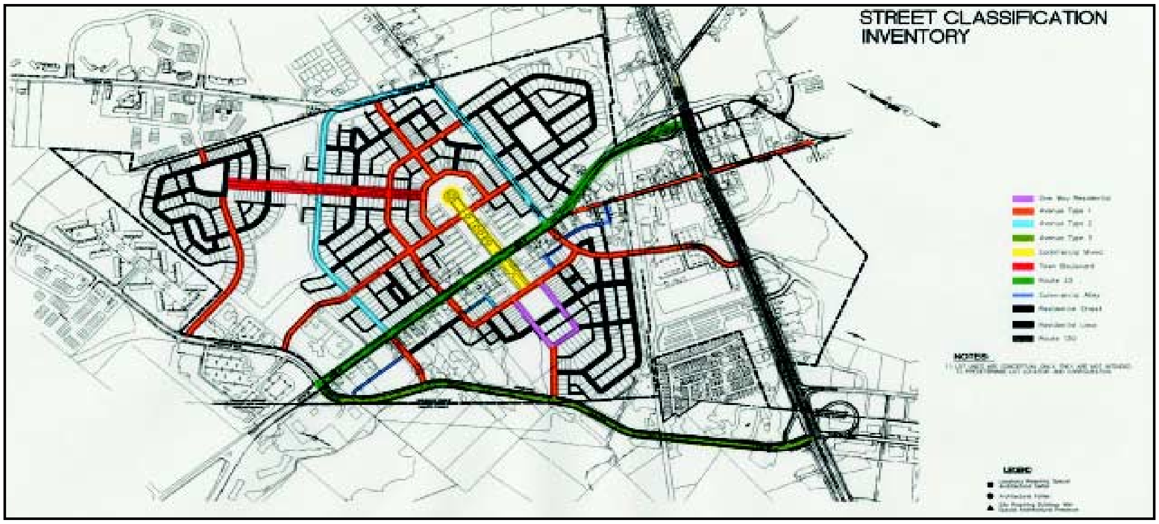

Figure 3.2.4.9: Street regulating plan.

A limited number of *avenues* are proposed in the Street Regulating Plan to serve heavier traffic volumes. Some of these avenues will allow regional trips to flow around the commercial center, reducing the amount of traffic that must be accommodated on Main Street. Other avenues will serve as major spines to the Town Center, drawing both pedestrians and motor vehicles from the periphery into the commercial center. Since traffic volumes are anticipated to be higher on the avenues, these roadways will be designed wider, providing sufficient room for two vehicles traveling in opposite directions to pass each other without slowing down. These avenues will also provide greater separation between the street and sidewalk in order to buffer pedestrians from motor vehicle traffic.

A central *boulevard* is proposed as a ceremonial roadway along a central spine. Like the avenues, the boulevard will carry more pedestrian and vehicle trips, and hence have a wider cross-section. Other roadway types in the new hierarchy include redesigned NJ 33 and US 130, described later on.

Bypasses

In developing the Town Center Plan, the township knew that it would need more capacity for east-west traffic in the NJ 33 corridor. A key element of the plan was a new roadway allowing NJ 33 traffic to bypass the Town Center. This new road would be an extension of Washington Boulevard, designed to capture traffic on Route 33 headed for southbound Route 130.

Other roads allowing motor vehicle trips to bypass the central portion of the Town Center include:

- The southerly extension of the Robbinsville-Edinburg Road to US 130,
- The easterly extension of existing Route 33 to the Robbinsville-Allentown Road east of Route 130, and
- An avenue to the north and west of the commercial center that will link the Robbinsville-Edinburg Road to NJ 33.

Design Flexibility and Context Sensitivity

Three main highways will pass through/by the Town Center, NJ 33, CR 526, and US 130. The design of these highways will include:

- Prohibition of direct driveway access to abutting properties,
- Control of vehicular speeds through the Town Center,
- Provision of appropriate pedestrian amenities, especially sidewalks, street trees, and street lighting,

- Limitation of roadway widths and intersection curb radii so that roadways remain crossable by pedestrians, and
- Provision of traffic signals to allow vehicles and pedestrians to cross more heavily traveled routes.

The Street Regulating Plan proposed context-sensitive redesigns of all three highways. In all cases, the agencies with jurisdiction wanted to maintain acceptable levels of service for motorists. So the agreements that emerged represent no small victory for CSD.

Main Street

One of the most novel aspects of Washington Town Center is the proposal to convert existing NJ Route 33 into a pedestrian-oriented main street. The Street Regulating Plan proposes a cross-section for this street that recognizes both its transportation function and its ceremonial function.

Existing NJ 33, and its eastward extension as the Robbinsville-Allentown Road, has long been the theoretical main street of Washington Township, linking Robbinsville with the more urbanized municipalities to the west and with Allentown and other communities to the east. However, the road has lacked the geometric design of a main street.

The redesigned Main Street will be similar to several other state highways that pass through New Jersey's existing town centers, such as NJ 27 in Princeton, NJ 79 In Freehold, and NJ 124 through several Morris County boroughs. Sixteen-foot wide sidewalks are proposed, and a wide tree-planting strip will be provided. Although the paved surface of the street will be wider than other streets in the Town Center, it will not be so wide that pedestrians feel intimidated. In particular, the crossing distance at intersections will remain approximately 40 feet, a width readily negotiated by pedestrians. Commercial buildings will be built at the sidewalk edge, and other than on-street parking, all parking will be in the rear of buildings.

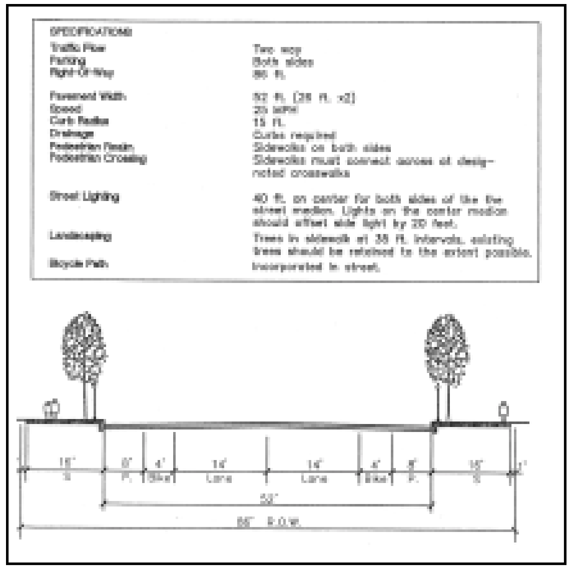

Figure 3.2.4.10: Proposed main street cross-section.

The street will have a parking lane, a bicycle lane, and a 14-foot travel lane in each direction. At intersections, curb extensions (bulbouts) will be used to reduce crossing distances for pedestrians and prevent vehicles from parking too close to corners. The absence of parking near intersections will create sufficient room for narrow center left-turn lanes at intersections with high turning volumes. Elsewhere the roadway will provide sufficient room for a through vehicle to swing around a single vehicle waiting to turn left.

Bicycle lanes will assure that all travel modes are accommodated. They will also create a buffer between parked cars and moving cars to mitigate the potential safety impacts of on-street parking. This type of cross-section has been found to be desirable on downtown streets, and many four-lane and five-lane roadways have been placed on "road diets" in order to enhance roadway safety, give greater priority to non-motorized travel modes, and improve traffic flow.

The township anticipates that traffic signals will be needed at proposed intersections, both to assist pedestrians in crossing the street and to provide access to the commercial core of the development. The additional signals will improve the platooning of vehicles through the Town Center and will distribute turning movements so that no one intersection gets overloaded.

To assure a pleasant pedestrian environment the speed limit along this roadway will be posted at 25 miles per hour. The current speed limit is 45 mph. The reduced speed is consistent with the altered character of land uses in the corridor, and will be controlled by progressive timing of the traffic signals. With good traffic progression from signal to signal, the chief source of delay along a signalized roadway, delay at signals, will be minimized.

Although the capacity of Main Street will be sufficient to accommodate projected traffic, DOT would not accept a lower travel speed on this state highway. As a result, DOT agreed that the township could assume jurisdiction over Main Street following the construction of the extension of Washington Boulevard to US 130. DOT will construct the Washington Boulevard Extension and assume jurisdiction over that roadway. The state route designation will be shifted to the extension. This kind of road swap is common in context-sensitive roadway projects.

For the township, the arrangement is ideal. The township will gain control over the road and activities within the right-of-way. No DOT approvals will be required for a parade or sidewalk sale. Also, the township will not have to worry about future widening of the street or removal of on-street parking.

Washington Boulevard Extension

Washington Boulevard, a roadway originally planned to provide a beltway around the Robbinsville area, is a key link in the Town Center Plan. The central section of the roadway has already been reconstructed as part of the Foxmoor development and is now a main collector road within the township.

A northern extension of the roadway to US 130 was found to be infeasible because of environmental constraints. However, a southern extension of Washington Boulevard to US 130 was both feasible and necessary to mitigate traffic impacts resulting from development of Town Center.

On the south side of the roadway extension is a large contiguous area of forested wetlands which limits development. Initially, the township had assumed that the north side of the Washington Boulevard Extension would provide some frontage for residential lots. Later, as a result of detailed planning, it was determined that land development was precluded along both sides of the roadway. The elimination of lots fronting on the roadway allowed the Washington Boulevard Extension to be reconceived as a two-lane parkway. The broad wetlands south of the roadway, and open space, wetlands, and detention basins north of the roadway, will assure that the road looks and functions like a genuine parkway.

The cross-section of the new road will have one 12-foot travel lane and one five-foot bicycle lane in each direction. The design speed originally proposed was 40 miles per hour. A series of horizontal curves consistent with the design speed would control the speed of vehicles on the roadway and allow wetlands to be avoided.

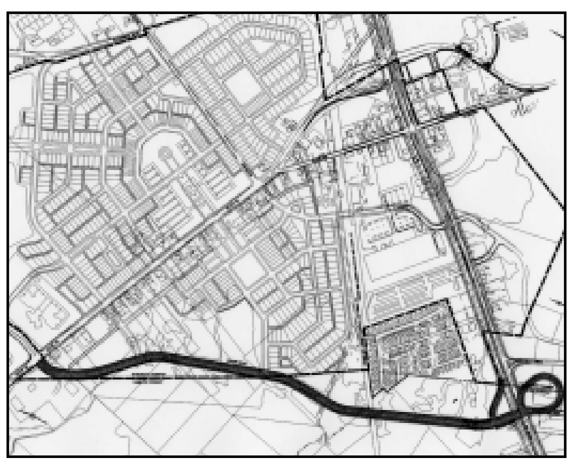

Figure 3.2.4.11: Proposed alignment of Washington Boulevard Extension.

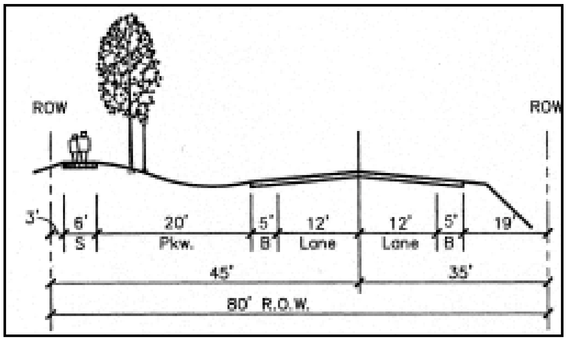

Figure 3.2.4.12: Proposed Washington Boulevard extension cross section.

The low design speed of the new roadway was of concern to DOT. If the extension was to serve as a replacement for NJ 33, DOT felt that it should maintain operating speeds equal to the existing roadway segment, which has a speed limit of 45 mph. Under DOT policy, a new roadway with a posted speed of 45 mph should have a design speed 10 mph higher. A compromise was reached to design five mph over the target speed of 40 mph.

The narrow cross section was also of concern to DOT. While consistent with many other rural state highways and AASHTO minimums for an urban arterial highway, DOT design standards require that new land service highways have 3.0 m (10 ft) shoulders. DOT permits the use of narrower shoulders only in areas of difficult terrain.

In order to reach consensus on roadway design, compromises were made. The design speed was increased from 40 to 45 mph, an adjustment that could be made without impacting the acreage of wetlands taken. While the paved shoulder width was held to five feet, an area beyond the shoulder will be stabilized, permitting the grassy area to support a disabled vehicle pulled entirely off of the roadway.

Robbinsville-Edinburg Road—Route 526

The Robbinsville-Edinburg Road cuts through the Town Center. As with Main Street, the township recognized that the roadway, unless redesigned, would become a barrier to pedestrians. Numerous county roads throughout Mercer County and adjoining counties are designed as avenues that accommodate pedestrians while still serving the mobility needs of drivers. The township wanted the Robbinsville-Edinburg Road to be designed as such.

The Robbinsville-Edinburg Road will be extended south to US 130. The extension will provide an additional intersection with US 130 within the Robbinsville area and will better connect the north and south sides of the Town Center. The extension will have the same collector function as the existing roadway and will relieve traffic congestion on the Robbinsville-Allentown Road.

The Street Regulating Plan designates this road an avenue with an 11-foot travel lane and an eight-foot parking lane in each direction. Approaching the Town Center, a transition area is planned. Here, the cross section will be only 30 feet wide, with 11-foot travel lanes and four-foot shoulders. This mirrors the existing cross section.

At intersections, curbs will be extended to control parking and reduce crossing distances for pedestrians. The Street Regulating Plan initially proposed

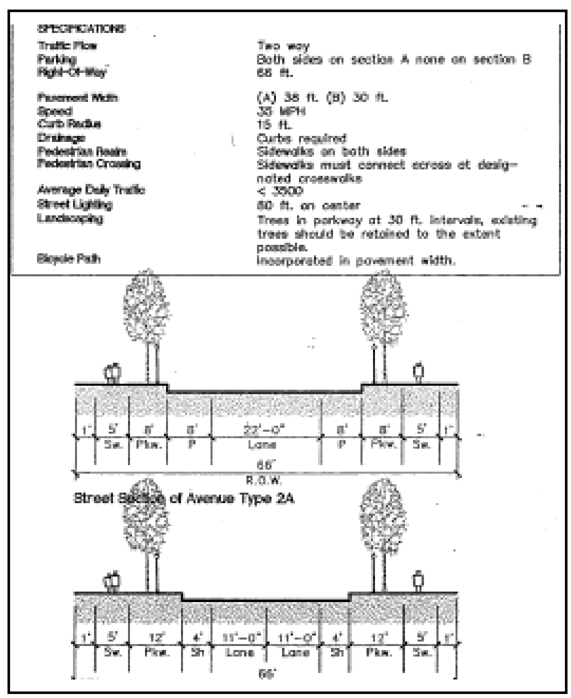

Figure 3.2.4.13: Proposed Robbinsville-Edinburg Road (Rt. 526) cross section.

small traffic circles at some intersections to calm traffic. These were later replaced with rumble strip crosswalks.

Sidewalks will be provided on both sides of the avenue, and residential lots will line it. An eight-foot wide tree-planting strip is proposed where there is on-street parking, widening to 12 feet where there is no on-street parking. Planting strips will separate pedestrians from vehicular traffic and create an urban environment along more heavily traveled avenues within the Town Center.

The county was concerned about on-street parking along a county highway and about the use of four-foot shoulders, as opposed to its standard eight-foot shoulders. The county objected to the use of bulbouts at intersections, and was adamantly opposed to the installation of traffic circles to calm traffic.

Because of these concerns and objections, the county agreed that the township should assume jurisdiction over the roadway through the Town Center.

US 130

US 130, a high-speed arterial highway, currently divides the historic village of Robbinsville. DOT operates the highway to facilitate through movements. Long traffic signal cycles create substantial delays on cross streets. The highway environment makes pedestrian crossings difficult. No sidewalks are provided along the corridor. The township's Municipal Building, located in a converted school, fronts on the highway, but the noise of trucks and the absence of pedestrians has made the front of the building dead space.

In the 1980s, the New Jersey Department of Transportation (DOT) conducted an analysis of a 27-mile Section of US 130 between Bordentown and New Brunswick. The projected growth of regional traffic would necessitate various highway improvements, which were incorporated into DOT's corridor plan:

- Elimination of left turn lanes at all intersections, providing for these movements with jughandles,
- Major reconstruction at selected intersections, and
- Widening of the highway through Robbinsville from four to six lanes.

Based on this corridor plan, DOT initiated a scoping study for the reconstruction of the complex intersection of US 130 and NJ 33. The first proposal for the intersection included a grade separated interchange that would have taken part of the Town Center area for ramps and new roadways. Township officials rejected this proposal. DOT then proposed a series of major at-grade intersection reconstruction projects that were equally unacceptable to township officials.

The township's preference, later incorporated into the Street Regulating Plan, was to convert the section of Route 130 passing through the Town Center into a boulevard. The existing right-of-way and cross-section of the highway would be maintained, and urban design features would be added to alert drivers that they were passing through the Town Center. Street trees would be planted in the median and along the sides of the highway. Parallel parking would be permitted in the existing 10-foot wide shoulders and decorative lighting fixtures would be installed both in the median and along new sidewalks. DOT found the township's plan as unacceptable as had the township found DOT's earlier plan for US 130.

What the township and DOT have agreed on is:

- The need for additional intersections along the highway to ease the load on existing congested intersections. Additional intersections will provide additional east-west capacity without requiring intersection widening at the expense of pedestrians. The extensions of Washington Boulevard and Robbinsville-Edinburg Road will create two such intersections, both signalized.

- The need for a pedestrian bridge between the municipal complex on the east side of US 130 and the Town Center on the west side. Regardless of intersection design, pedestrians will have difficulty crossing US 130 at grade, which argues for a grade-separated crossing. The pedestrian bridge will connect to an extensive pedestrian network east of the municipal complex, and to a grid of pedestrian-friendly streets in the Town Center.

- The need to phase capacity increases on US 130. DOT believes that delay associated with multiple traffic signals in the corridor will require widening to six travel lanes. The township agrees, but strongly argues for a wider median to visually soften the impact of the wider highway. DOT's consultants concluded that a median wider than 35 feet would require substantial additional signal time to permit east-west traffic to cross the corridor. Therefore, the township and DOT compromised on a 30-foot wide median, an increase of 10 feet over existing conditions (see Figure 3.2.4.14).

What the township and DOT cannot agree on is:

- Operating Speed. The township wanted to reduce the operating speed through the Town Center to 35 mph. The reduced speed would facilitate operation of the more closely spaced traffic signals and would reduce the impact of noise and wind on pedestrians and users of abutting property. Since only a short section of highway would be affected, the impact on travel time would be minimal—for a half-mile section, an extra half minute. DOT, however, would not accept a vehicle operating speed below 45 mph or a level of service below LOS D.

- Clear Zone. The township wanted to soften the roadway environment within the Town Center by planting trees and providing street lighting both in the median and along the sides of the roadway. DOT wanted a wide clear zone between the traveled way and these objects. Ample clear zones are most critical on high-speed highways where the potential damage of striking a fixed object is magnified. Such a wide clear zone would not be necessary if DOT were not insisting a relatively high operating speed.

- Cross Section. The township wanted a narrow cross section that would be easy for pedestrians to cross. DOT insisted on standard 3.6 m (12-ft) lane widths, 3.0 m (10-ft) outside shoulders, and 1.5m (5-ft) inside shoulders.

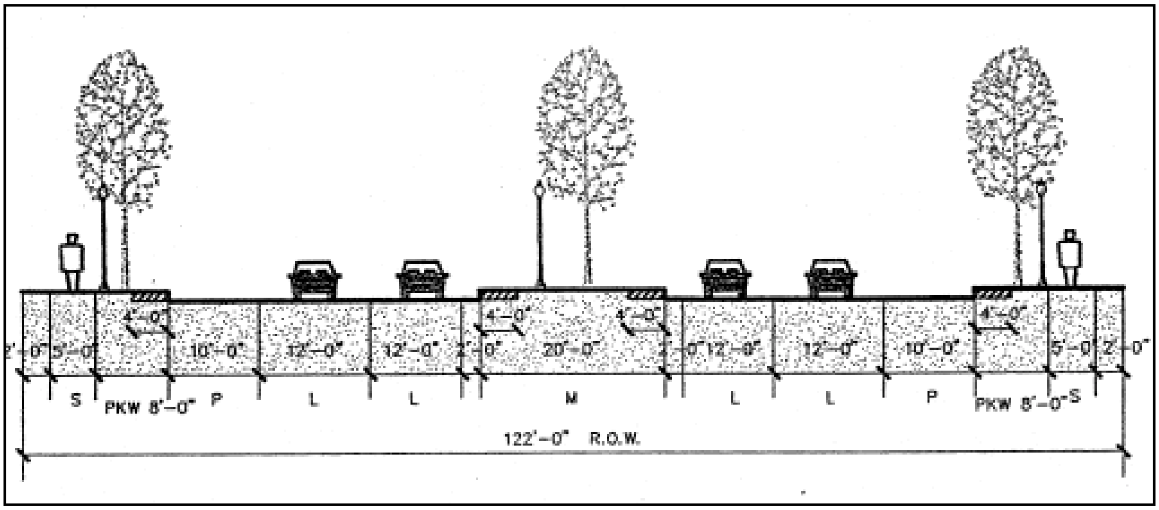

Figure 3.2.4.14: Proposed US 130 cross-section.

Institutional Collaboration

The adoption of the Town Center Plan and the Street Regulating Plan gave the township substantial control over how the Town Center would develop, more than localities usually have. Developers would have less control over design than they have elsewhere. To compensate, the township wanted to assure developers a speedy review of plans that conformed to the township's ordinances.

To expedite its own reviews, the township streamlined the development application process. Expediting the reviews of other agencies—in particular NJDEP for water resources, DOT for access permits, and Mercer County for drainage and county highway impacts—proved more difficult.

The first step was to apply for and receive a "Center" designation from the New Jersey State Planning Commission. This occurred in 1997. State agencies have a mandate to promote development in designated Centers.

Then, the township sought state approval to:

- Analyze the impacts of the Town Center holistically,
- Define mitigation measures holistically, and
- Allow conforming developments to be approved without further analysis or mitigation.

Environmental Permitting

The principal environmental impact of the Town Center will be the loss of wetlands. Were the Town Center to be developed as a series of individual projects, substantially more wetland acreage would be disturbed because each property owner would be granted a limited right to fill. As it is, wetland loss will be kept to a minimum.

While NJDEP faced regulatory hurdles in treating the Town Center as a unified development, a mechanism was found to grant approval for the entire development. The permit allows a total of 4.75 acres of wetlands to be filled—3.5 acres for the realigned Route 33 and 1.25 acres for Town Center housing units. Individual developments that comply with the permit can proceed without further NJDEP review.

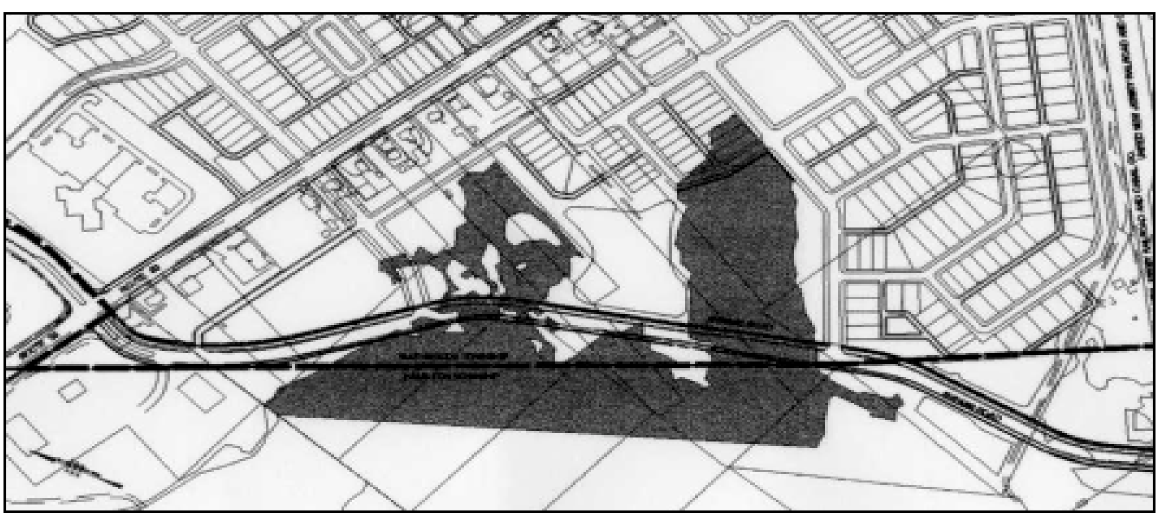

Figure 3.2.4.15: Dilineated wetlands along the Washington Boulevard extension.

Highway Access Permitting

As with environmental permitting, the township sought blanket approval for highway access within the Town Center. Access management was not expected to be a major impediment in this case, and was not, since the Street Regulating Plan prohibits direct access to arterial highways and instead provides for access via alleys.

The State Highway Access Management Law offers a mechanism for streamlined access approval of individual driveways. It involves the preparation of an access management plan for an entire stretch of state highway. Location and means of access must be defined for all properties, and shown to be consistent or better than the access design criteria established by DOT's access management code.

This mechanism was used in the Town Center. State law requires that all affected parties be involved in a joint planning process to develop the access management plan. In this case the process involved a Steering Committee of representatives from Hamilton and Washington townships, Mercer County, various units of DOT, DVRPC, NJDEP and the NJ Turnpike Authority, the Greater Mercer Transportation Management Association, and all property owners interested in developing within the Town Center.

Chapter 3.3

Regional

3.3.1 Bennington/Danville, Vermont, South Street (US 7)

Sometimes the need to rebuild a crumbling road or perform necessary utility work provides a rationale for highway departments to widen, straighten, and flatten a community's main street. In the case of South Street in Bennington, Vermont, state and local governments worked together to rebuild a crumbling arterial, while maintaining its existing low-speed design.

US 7 travels north-south through Bennington, a city of about 20,000 in southwestern Vermont. As South Street, US 7 has one lane in each direction and carries 7,100-9,300 vehicles per day. While US 7 has never had on-street parking or other sources of side friction, the dramatic change in vertical alignment going downhill into town and the sudden appearance of fronting residences, has a calming effect on traffic.

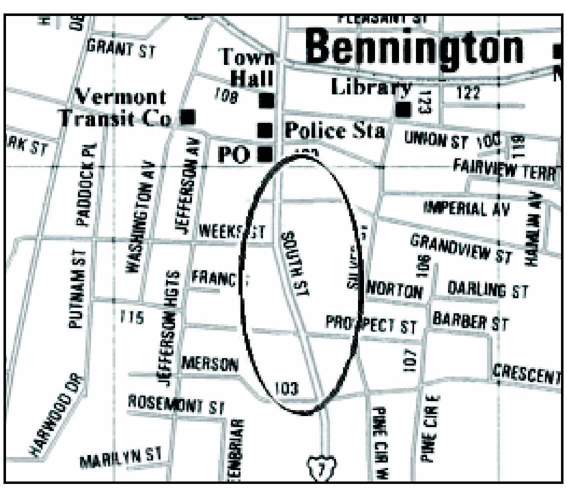

Figure 3.3.1.1: Bennington area map.

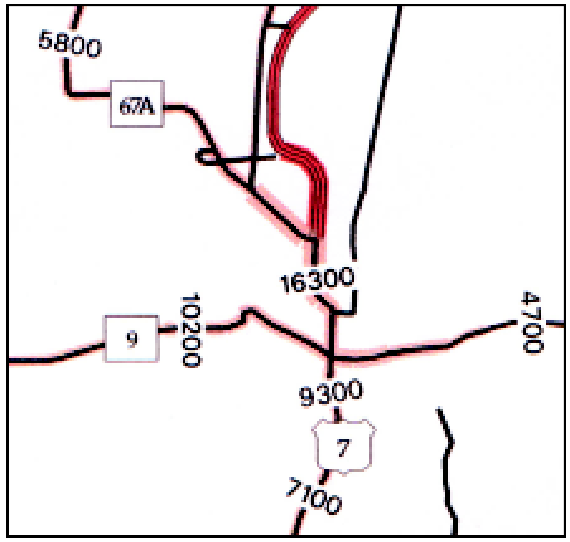

Figure 3.3.1.2: Daily traffic volumes (ADT).

Figure 3.3.1.3: Typical section with wider shoulder south of town.

Figure 3.3.1.4: Typical section with narrow shoulder entering town.

Cross section	Lanes (ft)	Total width (ft)	Percent of original width
Original (average)	13+13	26	-
Previous VAOT standard	8+12+12+8	40	+54%
Probable cross section	4+12+12+4	32	+25%
New VAOT standard (min)	13+13	26	=
Rebuilt (average)	3+11+11+3	28	+8%

Table 3.3.1.1: South Street cross section design history.

US 7 is on the National Highway System (NHS) and is classified as an Urban Principal Arterial. It is the main highway through the western part of the state, at times limited-access, and connects Rutland and Burlington to the north with New York City to the south. As such, one would expect that it would come under the jurisdiction of the Federal Highway Administration (FHWA). In fact, VAOT has an agreement with FHWA that delegates all responsibility for design, plans, specifications, estimates, right-of-way certification statements, contract awards, and inspections/final acceptance to VAOT for all non-Interstate projects.

The rebuilding of South Street from Prospect Street to Hillside Avenue, began as a "rehabilitation" project in the early 1990s. The Vermont Agency of Transportation (VAOT) set out to repair the deteriorating, 20-foot wide concrete roadbed, and extend it all the way to the curbs (many roads only have concrete in the center portion, typically covering sewer lines). In the process, the cross section, which varied from 25 to 27 feet, would be widened to a uniform width of 28 feet. A typical section was chosen with no shoulders and 14-foot shared use lanes; the road sees a fair amount of cycle traffic.

While the project was in preliminary design, the city decided to upgrade the sewer and water mains, which meant removing the old roadbed. This elevated the project to "reconstruction" status. Reclassification meant that the project could not utilize the flexibility inherent in 3R projects, but would have to adhere to more stringent "new/reconstruction" standards. In Vermont, as in many other states, this meant a default cross section of 12-foot lanes and 8-foot shoulders—a total of 40 feet.

VAOT realized that a 40-foot cross section would be unacceptable to the community. The project engineer speculates that South Street would instead have been rebuilt with 12-foot travel lanes and four-foot shoulders—32 feet wide. Yet even this width would mean moving lots of dirt, building more retaining walls, and narrowing sidewalks.

Luckily this project overlapped with the development of Vermont's new state highway design standards. The new standards became effective just as this project switched to "reconstruction." They allowed pavement width of 26 feet, and did not differentiate between 3R and non-3R work. In order to salvage as much of the design as possible, the designers opted to continue with the 28-foot width. It is marked with 11-foot travel lanes and a very narrow shoulder averaging three feet (more like an edge line than a true shoulder).

Other Design Solutions

Urban v. Rural

When bringing a principal highway into a small urban area, some agencies opt for a rural classification and its attendant design standards. VAOT realized that wide roadside clearance would be impossible to achieve on South Street, where land is already built up. Therefore, they maintained an urban classification, used seven-inch high barrier curbs, and adopted the AASHTO minimum setback of 18 inches to trees and other vertical elements.

Figure 3.3.1.5: Drainage grate and edge line.

Figure 3.3.1.7: Crossing at intersection.

Figure 3.3.1.6: Truck traffic through downtown.

Figure 3.3.1.8: Crossing mid-block.

Cyclists

The need to accommodate cyclists influenced the final design. The original design had 14-foot shared use lanes. The new state standards allow for a 13-foot shared lane, but only if catch basin inlets are beyond the curb-line. On South Street the sidewalks are adjacent to the curbs, so moving the inlets into the sidewalk zone would have been problematic. The volume of truck traffic also called for wider lanes. In the end, flush, cycle-tire-friendly precast catch basins were used and the lanes are marked at 11 feet. The final design accommodates cyclists and trucks and uses striping to visually narrow the road.

Performance Flexibility

South Street has a design speed of 30 mph, which is the same as the posted speed. This is consistent with the new state standards.

Level of Service was not an issue in the rebuilding of South Street. Although it is expected to carry 10,620 vehicles per day in 2017, the capacity and level of service are governed more by the surrounding intersections than the width of the road. VAOT concluded in preliminary design that the addition of lanes would only oversaturate the intersections.

Institutional Collaboration

As is typical in Vermont, South Street is maintained by the town of Bennington, even though the state owns the road and reconstructed it. Reconstruction cost was shared, with the town paying 10%, the state paying 10%, and the federal government picking up the balance. And the town piggybacked on the road reconstruction to upgrade its water and sewer lines.

Public Response

The land along South Street is occupied by traditional single-family detached houses with driveways set close to the street and walkways leading to the front doors. The terrain in the area is such that some of the homes are elevated from the roadway, thus necessitating the use of retaining walls and stairways. To introduce any section greater than 28 feet would have had a dramatic impact on the front yards of most South Street residents. VAOT accepted the fact that this was neither politically nor economically feasible. The project with its narrow cross section enjoyed wide public support.

Subsequent Projects

The first "main street" project to be fully designed under the new state standards is US 2 through Danville. This route is on the NHS and connects the state capital Montpelier to St. Johnsbury, a distance of 40 miles. The route is generally posted 50 mph, yet VAOT has made a conscious decision to slow traffic through this town. Its philosophy is that the small increase in travel time between cities is justified by the benefit to town residents.

Cross section	Lanes (ft)	Total width (ft)
Existing	12+12 (avg)	24 (avg)
Preferred rural	8+12+12+8	40
Preferred urban (proposed)	2+11+11+2	26

Table 3.3.1.2: US 2 cross section comparison.

Prior to the new standards, this section of road would have been classified as rural and designed per the Green Book. Danville has less than 5,000 population, and less than 1,000 people per square mile. The preferred rural roadway width is 40 feet, and implementation would have involved the removal of many trees and some homes.

The proposed width of Route 2 is 26 feet, per the new VAOT standards. Urban classification negates the need for excessive roadside clearance, allows curbs to protect pedestrians, and permits design speeds more consistent with the surrounding built-up area. In the end only one tree, an elderly Oak, will be sacrificed.

To slow traffic entering the town from the west, a splitter "gateway" island will be installed with a design speed 10 mph below the speed limit. It is located precisely at the point where the speed limit changes. According to the new standards, design speed may be 10 mph below the posted without a formal design exception if required to meet a specific environmental objective. Transitioning to a lower speed limit is one example. The gateway island will also include locally produced public art.

This project illustrates the fact that the new Vermont standards will have their greatest impact small towns. Cities full of pedestrians and other activity already have side friction to slow traffic. In towns such as Danville without a pedestrian environment as yet, reduced speeds and roadway width will give such an environment a chance to flourish.

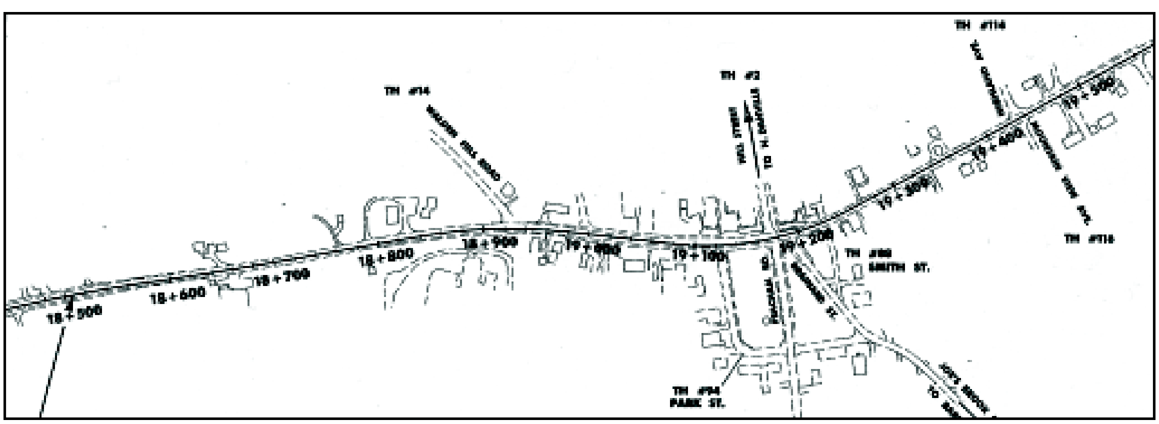

Figure 3.3.1.9: Danville project plan.

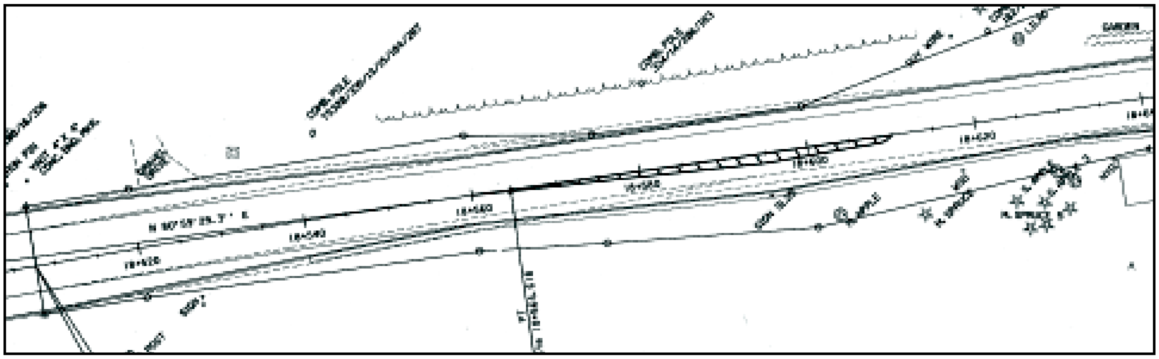

Figure 3.3.1.10: Danville gateway island.

Project Status	2000 (completed)
City Population	20,000
Adjacent Land Use	Commercial, Residential
Road Classification	Urban Principal Arterial
Road Ownership	State
Design Exception Required	No
Project Cost	$1.2 Million
Economic Data	—

Table 3.3.1.3: Project status summary.

Element	Before	After
Number Of Lanes	2	2
Lane Width + offset, feet	13	14
Shoulder Width or Cycle Lane, feet	0	3
Street width, feet	26	28
On-street Parking	none	none
On-street Parking width, feet	—	—
Sidewalk Width, feet	<5	5
Posted Speed, mph	30	30
85th Percentile or Design Speed, mph	>30	30
Vehicle Volume, ADT (DY-2004)	9,300	10,620 (DY 2017)
Level of Service	—	unchanged
Crash Data, reportable	—	—
Truck Volume	—	—
Pedestrian Volume	—	—
Bike Volume	—	—
Corner Radii, feet	—	unchanged
Stopping Sight Distance, feet	—	unchanged

Table 3.3.1.4: Data summary for South Street, Bennington, Vermont.

3.3.2 Brooklyn, Connecticut, US Route 6 (US 6)

The concepts of flexibility and context-sensitivity in highway design are new ones without much case history. There is a highway project in eastern Connecticut that clearly demonstrates just how design practice has changed in recent years. The project, involving reconstruction of US Route 6 though Brooklyn, evolved from an expressway proposal in the 1950s, to a 32-foot wide road following the existing alignment and respecting historic elements. This case study reviews critical decisions made during the planning and design process in an attempt to understand the ultimate outcome.

Brooklyn, Connecticut sits about halfway between the state capitals of Hartford, Connecticut and Providence, Rhode Island. US 6 is the primary regional arterial running the 74 mile distance. A 1950s plan to upgrade the entire corridor to expressway conditions (an extension to Interstate 84) was rejected in the early 1980s due to environmental impacts on the Scituate Reservoir in Rhode Island. In 1984 the Connecticut Department of Transportation (ConnDOT) decided to build an expressway just between Hartford and Windham (about 17 miles to the west of Brooklyn) and to “upgrade” the rest of the corridor to the Rhode Island state line. The project was broken into 11 parts, eight of which were completed. The last three, those in and around Brooklyn, met with stiff opposition from local citizens. As DOT itself describes it, locals were opposed to the “traditional, narrowly focused goals of meeting transportation demands without regard to the surrounding community.”

Figure 3.3.2.1: Aerial view of Brooklyn, Connecticut.

Figure 3.3.2.2: Hartford-Providence corridor.

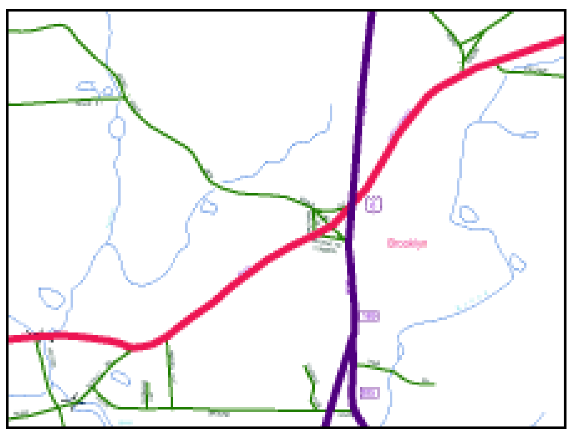

Figure 3.3.2.3: Brooklyn street network.

Geometric Flexibility

Route 6 through Brooklyn is a two-lane roadway varying in paved width but predominantly 26 feet wide, thus affording minimal shoulders. The road winds through rolling terrain with light to medium residential development, and past the Town Green. Trucks represent up to 14 percent of the total traffic. As it exists, this section is not consistent with the rest of the “upgraded” Route 6 in terms of geometry

Figure 3.3.2.4: Typical section west of town.

Figure 3.3.2.6: Coming into town from west.

Figure 3.3.2.5: Curve west of town.

Figure 3.3.2.7: US 6 past Town Green.

or level of service. Problematic design features include:

- Limited stopping sight distance,
- Little roadside clear zone,
- Steep grades,
- No passing zones,
- Difficult and dangerous driveway access, and
- Backups and congestion during mail delivery.

Even with these "substandard" features, the 85th percentile speed is 54 mph east of town and 40 mph at the Town Green.

In 1991 ConnDOT developed a road plan with 60-mph design speeds, eight-foot shoulders, four lanes east of the Town Green and climbing lanes for the two-lane section west of town. The town opposed the plan and petitioned to the federal government (federal funds were to be used). The Federal Highway Administration agreed that the three sections should be analyzed as one. ConnDOT returned to the drawing board and by 1995 had developed several bypass alternatives. These, too, were rejected by the town, and the ConnDOT realized that the objectives of the project would have to be substantially revised in order to overcome opposition.

Between 1996 and 1998 the basic project scope and highway design were "flexed" to better respond to community concerns. DOT agreed to:

- Maintain the existing alignment through the center of town,
- Raise, lower, or shift the alignment to avoid unnecessary adverse effects on the adjacent land uses,
- Reduce design speed from 60 to 50 mph for the east and west sections, and to 45 mph through the historic district,

	Existing (average) (ft)	1991 Design (ft)	1998 Design (ft)
West section	2+11+11+2 26	8+12+12+12+8 42	8+12+12+8 40
Town Green	2+11+11+2 26	8+12+12+8 40	4+12+12+4 32
East section	2+11+11+2 26	8+12+12+12+12+8 64	8+12+12+8 40

Table 3.3.2.1: Cross section widths.

	Existing	1991 Design	1998 Design
West section	2	3 (2+1 climbing)	2
Town Green	2	2	2
East section	2	4	2

Table 3.3.2.2: Number of lanes.

	Existing 85th Percentile (mph)	1991 Design (mph)	1998 Design (mph)	Posted (mph)
West section	30-55	60-65	50	40
Town Green	40	60-65	45	35
East section	30-54	60-65	60	45

Table 3.3.2.3: 85th percentile, design and posted speeds.

- ❑ Reduce shoulder widths from eight to four feet through the historic district,
- ❑ Design for LOS B at the Town Green,
- ❑ Eliminate the westbound climbing lane,
- ❑ Not pursue turning lanes at the intersection with Route 169, and
- ❑ Maintain two-way traffic around the Town Green.

Construction is to be completed in 2003 for a total cost of $16 million.

Other Design Solutions

Town Green

The 1998 design includes many context-sensitive design features. Sidewalks will be constructed through the central portion of the town, stone walls will be relocated (as opposed to destroyed) and vegetation removed will be replaced. To illustrate the context sensitivity, the survival of a copper beech tree near the road at the town green will be ensured by having the sidewalk discontinued or modified within the tree's drip-line. At the intersection with Route 169, a slight shift in the alignment, together with the use of a compound curb return, will make it possible to accommodate a large truck turning from eastbound Route 6 to southbound Route 169 without removing the historic well house.

In addition to preserving the rural village character of the area, the design makes safety of motorists and pedestrians a priority. The town hall and bookstore are eight and six feet respectively from the existing edge of Route 6. The stone masonry well house opposite the town hall is 14 feet from the road. The intersection with Route 169 has restricted sightlines. There are numerous conflict points at intersecting side roads and commercial driveways throughout its length. These hazards were taken into consideration when setting the design speed at 45 mph through the village center.

Figure 3.3.2.8: Town Green before.

Figure 3.3.2.9: Town Green after.

Curve at Tatnic Road

As one enters town from the west, there is a curve at Tatnic Road. This curve has been deemed seriously substandard, for it combines a marginal radius with elevated properties supported by tall retaining walls within five feet of the inside of the curve. Stopping sight distance is limited at one point to 250 feet. The 1998 design calls for this curve to be realigned, but in a manner that does not fundamentally alter the surrounding landscape. Among the factors considered were property lines, historic resources, sight distances, lateral clearances, existing speeds, and the need to slow drivers as they approached the Town Green. The alignment proposed originally would have allowed speeds of over 55 mph. The current design minimizes impacts by leaving the curve as tight as safety will allow. The realignment will still require the taking of four residences and

Figure 3.3.2.10: Curve at Tatnic Road.

		Existing (no build)	1991 Design	1998 Design
Current (2000)	ADT	8000-10,000	8000-10,000	8000-10,000
	ADT per lane	4000-5000	2500-2667	4000-5000
	LOS	B	A	B
Design Year (2020)	ADT	11,900-14,400	11,900-14,400	11,900-14,400
	ADT per lane	5950-7200	3600-3967	5950-7200
	LOS	<B	A	<B

Table 3.3.2.4: Volume and LOS.

one rental/commercial property. Yet, during the extensive public involvement process, it became clear that the community did not consider these takings unjustified.

Performance Flexibility

The average daily traffic (ADT) on US 6 through Brooklyn ranges from 8,000 on the western end to 10,000 in the east. In the design year of 2020, these volumes are expected to rise to 11,900 and 14,400, respectively. The 1991 design would have maintained LOS A for the entire length. The 1998 compromise allows LOS B at current volumes, and less than LOS B in the design year. In that the current design does not add lanes, the LOS achieved will be similar to that of the "no-build" option.

As a footnote, the new ConnDOT standards allow for LOS D in an urban setting. The only problem is that this roadway is classified as rural, despite the 6,800 people living in Brooklyn.

Institutional Collaboration

Prior to 1995 ConnDOT and the community mostly assumed adversarial roles. Since the intervention of FHWA, the relationship has become more collaborative. Participants in the 1996 scoping and subsequent designs have included:

- Town officials, elected representatives, and citizens from the community,
- A planning/architectural firm hired by the town and members of the "workshop" group organized by the consultant,
- The regional planning agency,
- The State Historic Preservation Office (the Town Green is a National Historic Landmark, Route 169 is a state Scenic route, and a West Brooklyn Historic District is being proposed).

In the end a total of 15 community meetings were held over 26 months.

The issue of how to preserve the Town Green illustrates the collaborative process. The planning/architectural consultant developed an alternative design concept that was then refined by ConnDOT to produce a level of service equivalent to the agency's earlier design. The two plans were presented to the community for comment, and the alternative was selected.

Public Response

It took a well-organized effort by the community to head off the proposed widening and straightening of US 6 through Brooklyn. Most responsible for this was the town's first selectman, who challenged ConnDOT beginning in 1987. He objected to the use of federal design standards, the leapfrogging of segments, and the closing off of access to local roads. Ultimately the State Historic Preservation Office commended ConnDOT on its mitigation measures, and the town approved the reconstituted project.

Project Status	2003 (expected completion)
City Population	6,800
Adjacent Land Use	Residential, Institutional
Road Classification	Rural Principal Arterial
Road Ownership	State
Design Exception Required	No
Project Cost	$16 Million
Economic Data	—

Table 3.3.2.5: Project status summary.

Element	Before	After
Number Of Lanes	2	2
Lane Width + offset, feet	12	12
Shoulder Width or Cycle Lane, feet	1	4-8
Street width, feet	26	32-40
On-street Parking	none	none
On-street Parking width, feet	—	—
Sidewalk Width, feet	<5	5
Posted Speed, mph	35-45	35-45
85th Percentile or Design Speed, mph	30-55	45-60
Vehicle Volume, ADT (DY-2004)	8,000-10,000	11,900-14,400 (DY 2020)
Level of Service	B	<B
Crash Data, reportable	—	—
Truck Volume	8-14%	8-14%
Pedestrian Volume	—	—
Bike Volume	—	—
Corner Radii, feet	—	WB-50 (design vehicle)
Stopping Sight Distance, feet	<250	increased

Table 3.3.2.6: Data summary for US Route 6, Brooklyn, Connecticut.

3.3.3 Sag Harbor, New York, Route 114 (NY 114)

New York Route 114 runs along the south fork of Long Island through the Villages of Sag Harbor and North Haven. The route serves as the main street of these villages and as the main conduit between the Shelter Island Ferry and the eastern reaches of the island. In Sag Harbor, the primary focus of this case study, Route 114 is classified as a Minor Urban Arterial. It is not on the National Highway System. Sag Harbor is a small port town with a history of whaling and a rich architectural tradition. Commercial, residential and educational uses line the road through town.

In 1997 the New York State Department of Transportation (NYSDOT) was rehabilitating the bridge between Sag Harbor and North Haven, just to the northwest of town. Officials and residents of Sag Harbor and North Haven approached the NYSDOT with concerns over ever-increasing traffic speeds, volumes and the lack of pedestrian and bicycle amenities or safety features. NYSDOT acknowledged these concerns and committed time and money to its first comprehensive traffic calming study. They hired a consulting firm (the RBA Group) to interact with the public, evaluate opportunities, and develop traffic calming solutions. The planning and design process was completed in July 2000.

Figure 3.3.3.1: Sag Harbor area map.

Figure 3.3.3.2: Typical condition.

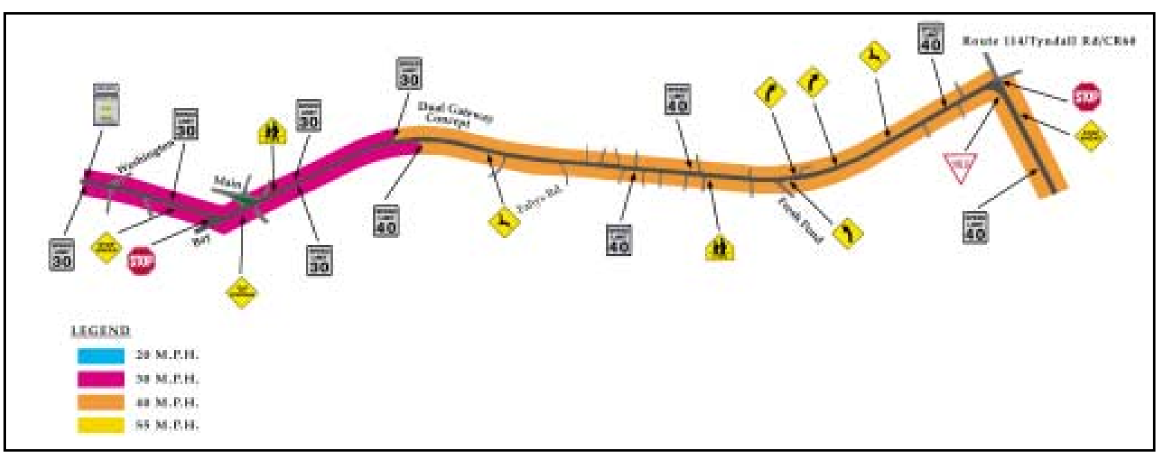

Figure 3.3.3.3: Project plan.

The project objectives as stated in the design report are to:

- Reduce motor vehicle speeds to the posted speed limit thereby improving vehicle, pedestrian and cyclist safety;
- Improve traffic (motorized and non-motorized) operations and circulation at specific intersection locations by modifying existing geometric conditions using traffic calming features.

To meet these objectives the design makes use of corridor-wide treatments and specific geometric changes at 16 intersections. The treatments include improved lighting, curbed sidewalks, bike lanes, rumble strips, curb extensions, and two roundabouts. Yet for all the creativity of the design, there are no nonstandard or nonconforming elements in the project.

Geometric Flexibility

The design makes use of consistent and narrowed lane widths to calm traffic and reduce pedestrian crossing time/distance. Specifically the lanes will be reduced from 12 feet to 10-11 feet in the 30 mph zone.

Other Design Solutions

Intersections

The intersection with Hempstead and Jermain Avenues is a combination Y and T-intersection. Because of the geometry, the pedestrian crossing distance is upwards of 65 feet. One pedestrian was hit by a car here during the study period. Also there is a tendency for drivers to speed as they turn the shallow corner. The design calls for squaring off the intersection, thus making it rectilinear and more easily traversable by walkers and more predictable to drivers. The other curbs will also be extended and the corner radii tightened.

Figure 3.3.3.4: Temporary island at intersection with Hempstead Street.

Lane Widths (ft)	Existing			Proposed			
	Travel	Shoulder	Total	Travel	Shoulder		Total
Bike lane south of town	11-12.5	0-11	22-47	11	3 (buffer)	5 (bike lane)	38
In-town without parking	12.5-13.5	0-6	25-39	10	4 (shoulder)		28
In-town with parking	12.5-13.5	0-6	25-39	10	4 (shoulder)	7 (parking)	42
Village Center	12.5-13.5	0-6	25-39	14 (shared use)			28
Bike lane north of town	11-12.5	4.5-7.5	31-41	11	6 (bike lane)		34

Table 3.3.3.1: Cross section comparison.

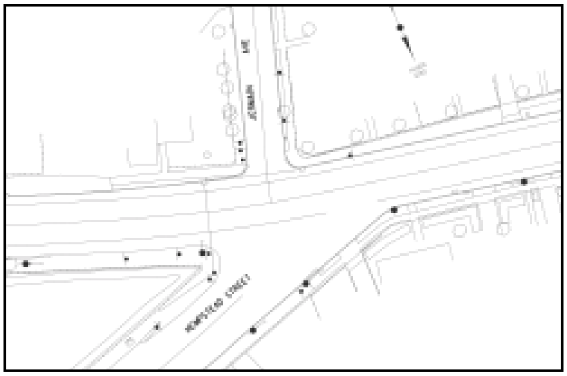

Figure 3.3.3.5: Existing intersection with Hempstead Street and Jermain Avenue.

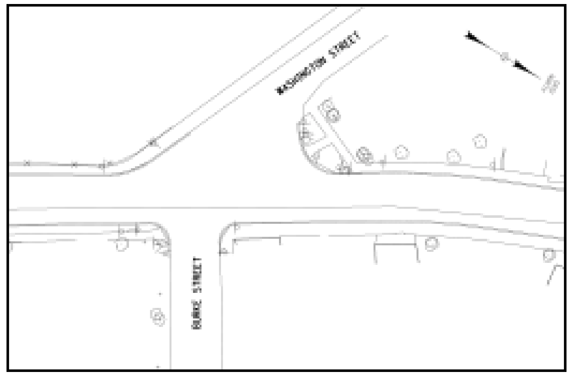

Figure 3.3.3.8: Existing intersection with Washington and Burke Streets.

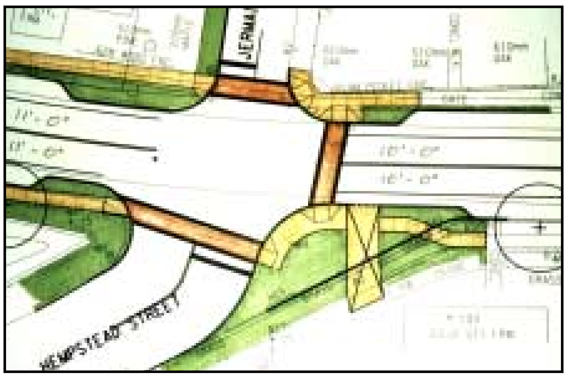

Figure 3.3.3.6: Proposed intersection with Hempstead Street and Jermain Avenue.

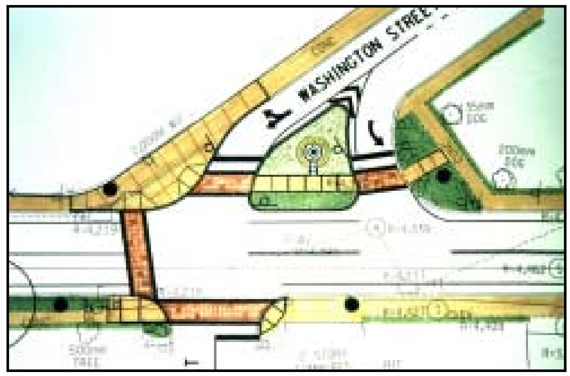

Figure 3.3.3.9: Proposed intersection with Washington and Burke Streets.

At the Washington and Burke Streets junction, another Y- and T-intersection, instead of narrowing the road, it is divided. Washington Street is one-way out and drivers have been known to mistakenly turn in to the street. An island will be installed to separate traffic and discourage wrong turns. It will also reduce the distance that pedestrians must cross by two-thirds—from about 75 to 25 feet.

One roundabout is proposed for downtown Sag Harbor at the intersection of Route 114, Main Street, Wharf Street, Bay Street and Long Island Avenue. This is a skewed intersection where five roads meet and there is the heaviest pedestrian traffic in the project. A second roundabout has already been constructed at the intersection of State Route 114 and County Route 60 between Sag Harbor and

Figure 3.3.3.7: Intersection with Washington Street.

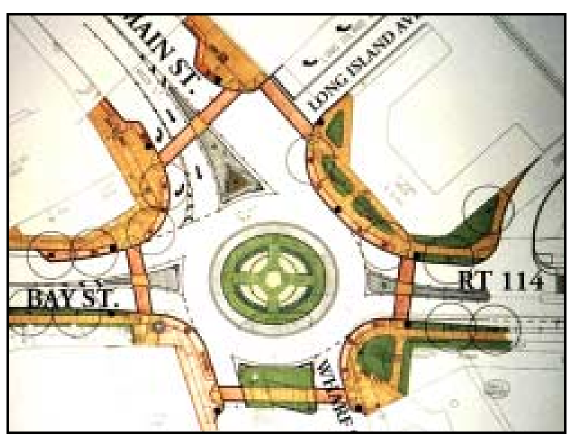

Figure 3.3.3.10: Proposed roundabout in Sag Harbor Village Center.

Figure 3.3.3.11: New roundabout between Sag Harbor and North Haven.

Figure 3.3.3.13: Southern entry to Sag Harbor.

North Haven. Here the state highway turns and traffic volumes are at their highest. The roundabout was constructed in May 2001.

Pedestrian Crossings

The Sag Harbor Elementary School sits at the corner of Clinton Street, where the 85th percentile travel speed is 32-33 miles per hour. In an effort to minimize the exposure rate for those children who must cross the highway to attend school, the design calls for curb extensions on both sides of the intersection. The extensions reduce the width of the shoulder but still allow four feet for cyclists.

Gateway

At the southern end of the project, where the road transitions from a 55-mph rural highway to a 40-mph suburban street, a gateway will be constructed to visually inform drivers of the change in driving expectations. The principal feature of the gateway is a raised four-foot wide center island median paved with granite block. The gateway will also feature lighted signs with the village names and plantings. 100 feet before the gateway rumble strips will audibly announce the speed change. Directly after

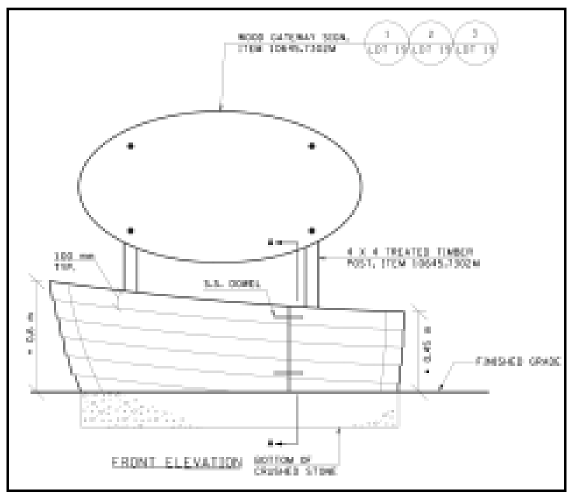

Figure 3.3.3.14: Proposed gateway elevation.

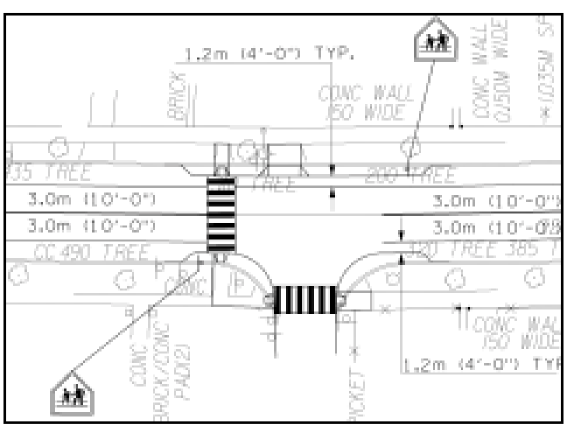

Figure 3.3.3.12: Proposed intersection with Clinton Street.

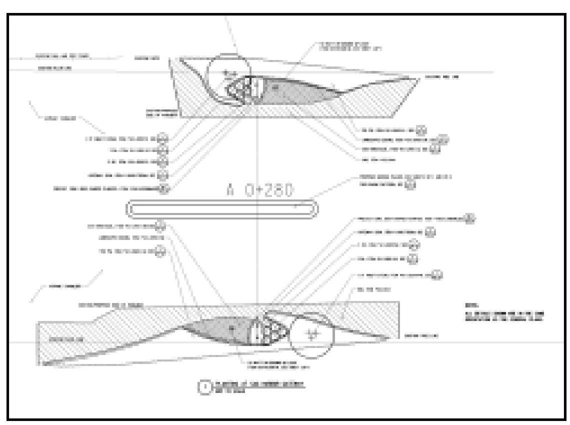

Figure 3.3.3.15: Proposed gateway details.

the gateway, five-foot cycle lanes will begin in the shoulder. They will be separated from the travel lanes by a three-foot buffer.

Cyclists

Route 114 is a designated bike route and the project provides for cyclists. The project calls for five- to six-foot marked bike lanes through much of the project and a 14-foor shared use lane through the Sag Harbor village center. The bike lanes will be pigmented red, the buffer in Sag Harbor will be colored gray and textured to resemble granite block.

In North Haven, where right-of-way restrictions do not permit the installation of a buffer, the thermoplastic stripe that separates the cycle lane from the travel lane will be eight inches wide instead of the usual four inches. Further, the North Haven bike lane will be flanked by “plowable” reflectors spaced every 15 feet on straight sections and 10 feet on curves (typical spacing for reflectors is 30 feet). They are being installed to help improve safety for cyclists traveling at night and also to create a mild vibration for wandering vehicles.

Performance Flexibility

Route 114 is posted at 40 mph through the town of Sag Harbor. Between the bridge and Hamilton Street the speed limit drops to 30 mph. Outside the town limits it is posted at 55 mph. Compared below are off-peak travel speeds and the proposed design speeds. According to the project objectives the design hopes to slow drivers to the posted speeds. Interestingly though the design speed chosen, while just over the posted speed, may actually allow drivers to travel faster than they presently are, especially near the schools.

Volumes

In 1995 Route 114 carried about 6,600 vehicles per day through Sag Harbor. Four percent of those were trucks. In general, intersection configurations will remain the same. Consistent with local objectives, this project does not increase throughput nor improve LOS. The exception are at the two roundabouts which will both improve LOS from F to A. Further, there will be a net reduction in the overall intersection delay with the roundabouts.

Institutional Collaboration

Route 114 is owned and maintained by NYSDOT and the project is 100% state funded. The Village of Sag Harbor will maintain the proposed landscape amenities and areas behind the curbs. The village will also be responsible for snow and ice removal at its roundabout.

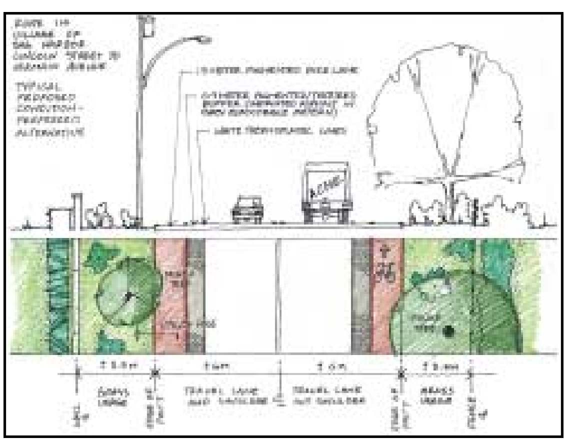

Figure 3.3.3.16: Details of proposed bike lane.

Speeds (mph)	Posted	Existing 85th percentile	Proposed Design
Southside	40	45	43
At Clinton Street	30 (20 at school)	33	31
At Sage Street	30 (20 at school)	28	31
Northside	40	50	43

Table 3.3.3.2: Posted, existing, and design speeds in Sag Harbor.

A portion of the project is within the Sag Harbor Historic District and historic preservation was considered in the Task Force process. The design was reviewed and approved by the State Historic Preservation Officer who came down from Albany to walk the site with the project designers.

Public Outreach and Response

For this project a 10-person Task Force was convened to build a consensus among local officials, residents, businesses, students, and community groups. Throughout the process the task force and community at large were kept abreast of project developments and educated about the latest traffic calming strategies. Likewise NYSDOT and its consultant relied on the task force to identify major stakeholders and interpret public opinion. Meetings and events were held on a monthly basis and included charettes, focus groups, interviews, surveys, workshops and open house forums/public information centers. Public information was disseminated via slide shows, computer simulations, and press releases.

Some of the concerns identified through the public involvement process were:

- ❑ Existing street design allows excessive speeds,
- ❑ Congestion is increasing with apparent cut-through traffic,
- ❑ Vehicular noise and pollution are increasing,
- ❑ Sidewalks are not always continuous,
- ❑ Cyclists are not provided for,
- ❑ Intersection geometry and vegetation limit sight distance, and
- ❑ Village boundaries and reduced speed limits are not obvious to drivers.

Project Status

When the project was in final design, a change of administration in the village of Sag Harbor resulted in the elimination of the Sag Harbor portion from the construction contract. The North Haven portion was completed in 2001. The local State Assemblyman conducted a survey which showed overwhelming approval of the new work as well as support for the Sag Harbor portion of the project. At this juncture it is not known when and if the project will be completed.

Project Status	2000 (Design) 2001 (North Haven Section Constructed)
City Population	2,200
Adjacent Land Use	Residential, Institutional, Commercial
Road Classification	Minor Urban Arterial
Road Ownership	State
Design Exception Required	No
Project Cost	$4.9 Million
Economic Data	–

Table 3.3.3.3: Project status summary.

Element	Before	After
Number Of Lanes	2	2
Lane Width + offset, feet	12.5-13.5	10-14
Shoulder Width or Cycle Lane, feet	6	6
Street width, feet	25-39	28-42
On-street Parking	yes	yes
On-street Parking width, feet	4.5-8	7
Sidewalk Width, feet	4	5
Posted Speed, mph	30	30
85^{th} Percentile or Design Speed, mph	33	—
Vehicle Volume, ADT (DY-2004)	6,600	22,490 (DY 2021)
Level of Service	D	D
Crash Data, reportable	18/year	—
Truck Volume	4%	4%
Pedestrian Volume	—	—
Bike Volume	—	—
Corner Radii, feet	varies	decreased
Stopping Sight Distance, feet	>197	>197

Table 3.3.3.4: Data summary for NY 114, Sag Harbor, New York.

3.3.4 Saratoga Springs, New York, South Broadway (US 9)

A context-sensitive project has been constructed as the gateway to Saratoga Springs, an historic city in upstate New York. The project is located on South Broadway (US Route 9), the southern entrance to the city. The road is classified as an Urban Principal Arterial but is not on the National Highway System. It is located within the boundaries of the Saratoga Spa State Park and passes the Lincoln Baths and the Museum of Dance. The newly reconstructed boulevard uses lane drops, curbs, a raised median, sidewalks, and landscaping to simultaneously calm traffic, provide a gateway to the city, and be in context with its surroundings.

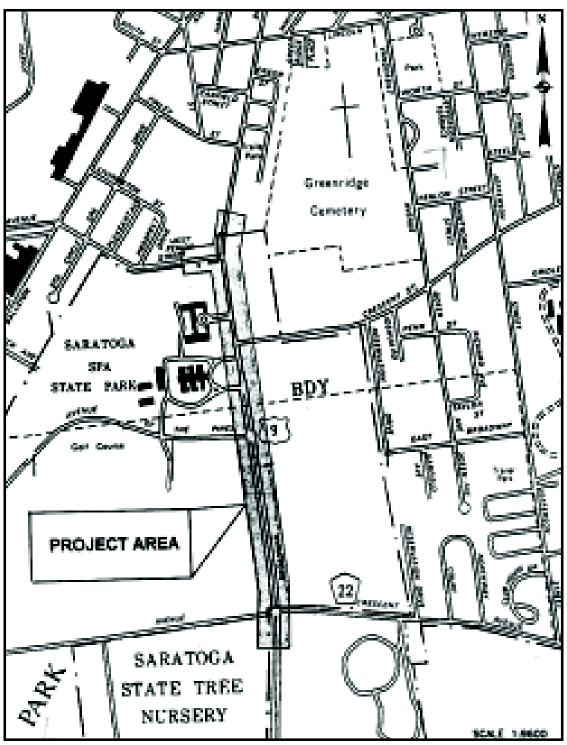

Figure 3.3.4.1: Saratoga Springs area map.

Geometric Flexibility

The project objectives were to:

- Provide adequate capacity and acceptable operation for 20 years,
- Restore pavement to good condition for 50 years,
- Accommodate pedestrians and cyclists,
- Add drainage, and
- Enhance the historic, recreational and visual aspects of the state park, and establish the corridor as a gateway to the spa and city.[2]

Central to meeting these objectives was the need to transition from a rural four-lane 55-mph highway section to a three-lane, 30-mph city street. Previously the only indication of a changed speed environment was a 30-mph sign. Given no other cues, drivers far exceeded the speed limit.

This project introduced a transition speed zone and physically altered the roadway. The resulting design is both self-enforcing and attractive. South of the project is a rural cross section with four travel lanes

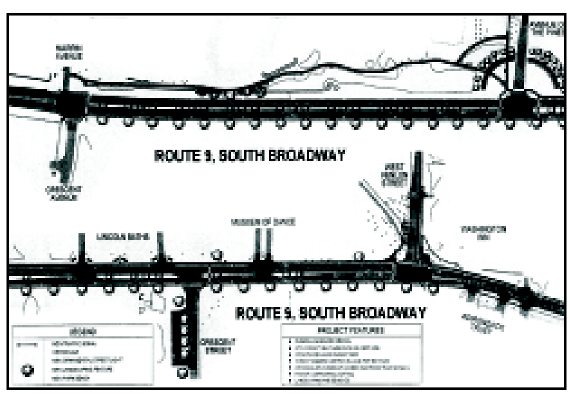

Figure 3.3.4.2: Site plan.

[2] NYS-DOT Final Design Report.

Section	Posted Speed (mph)	Lanes	Lane Widths (ft)	Total Width (ft)
Highway	55	S-T-T-T-T-S	8+12+13+13+12+8	66
Flush Median	55	S-T-T-M-T-T-S	8+12+13+4+13+12+8	70
Curbs, Raised Median	40	T-T-M-T-T	14+13+12+13+14	66
Curbs, Median, Forced Left Turn	40	T-LT-M-T-T	14+13+12+13+14	66
Curbs, Median	30	T-M-T-T	16+23+13+14	66
Curbs, Median w/Turn Lane	30	T-LT-M-T-T	14+13+6+13+14	60
Curbs, transition to TWLT	30	T-LT-T	12+10+15	37

Table 3.3.4.1: Cross section progression.

and a four-foot flush median. South of the intersection with Crescent Avenue, the flush median widens to 12 feet and aligns with the raised median to the north. Both northbound lanes continue through the intersection, but at this point, the character of the highway changes from rural to urban. The median is raised, curbs are added, and a 40-mph speed limit is established.

Later the inside lane ends with a forced turn into the Spa complex—consistent with travel patterns. Immediately thereafter the speed limit drops to 30 mph and turn lanes are inset into a wider median. At the north end of the project, where South Broadway intersects West Fenlon Avenue, the median narrows and travel lanes also narrow to align with lanes north of the project. Later, in the center of downtown, the street expands to six lanes (four moving, two parking). But by this time, thanks in part to the calming effects of the new boulevard, vehicle speeds have been already reduced.

Before reconstruction, Route 9 did not have curbs, a continuous sidewalk, or a transition speed zone. The project's Design Supervisor speculated that 10 years ago the road would have been rebuilt as a four-lane section, without trees, raised median, sidewalks, or street lights. The boulevard ultimately built has all of these positive features, and therefore satisfies community and other stakeholders as well as the New York State Department of Transportation (NYSDOT).

Other Design Solutions

Median, Trees, Curbs and Fixed Objects

South Broadway was reconstructed largely to the standards of the state Highway Design Manual (HDM) and within AASHTO guidelines. The one possible exception resulted from the combination of a narrow median, mountable curbing, and good size street trees.

A tree-lined median was desired both by the community and by NYSDOT designers who wanted to separate opposing traffic to improve safety. However, coming up with a good design proved challenging. The project is near the Saratoga Performing Arts Center where overflow parking is a problem. On-street parking is prohibited, and non-mountable curbs were requested by the New York State Office of Parks, Recreation, and Historic Preservation to enforce this prohibition. In that this project sits next to a National Historic Landmark, granite curbs were favored.

In the 30 mph section there are only three travel lanes, so the median could be 23 feet wide. This section received standard six-inch granite curbs with vertical faces, in keeping with its low speeds. Lateral clearance to trees and other fixed objects presented no problem.

In the 40 mph section, there are four travel lanes so the widest median possible was only 12 feet, limiting the clearance to trees and other fixed objects to

Figure 3.3.4.3: Four-foot flush median.

Figure 3.3.4.6: Forced left turn.

Figure 3.3.4.4: Twelve-foot flush median.

Figure 3.3.4.7: Twenty-three foot raised median with turn bays.

Figure 3.3.4.5: Twelve-foot raised median.

Figure 3.3.4.8: Two-way left turn.

under six feet. Where the clearance is less than 10 feet, the HDM requires the use of barrier curbs. But six-inch "barrier" curbs were seen as a hazard to out-of-control motorists at these higher operating speeds.

Working within these constraints, the project designer put together a creative palette of solutions.

- ❑ The light fixtures in the median are on breakaway bases, and thus are not fixed objects. The bollards are hollow cast aluminum, which crumble upon impact. This has already been demonstrated (see below).

- ❑ The project designer found a type of tree, which in the opinion of the DOT Environmental Services Unit, could meet all HDM criteria. The Aristocrat Pear tree (*Pyrus Calleryana Aristocrat*) is a relatively small tree that grows upright and maintains a compact root ball. Under ideal growing conditions, the trunk may grow to more than a four-inch caliper. Yet, constrained by a 12-foot median in Saratoga Springs' climate, this tree will probably not reach four inches. In addition, the compactness of its root ball may cause it to react like a shrub when hit by vehicle, just rolling over (or so DOT Environmental Services avowed).

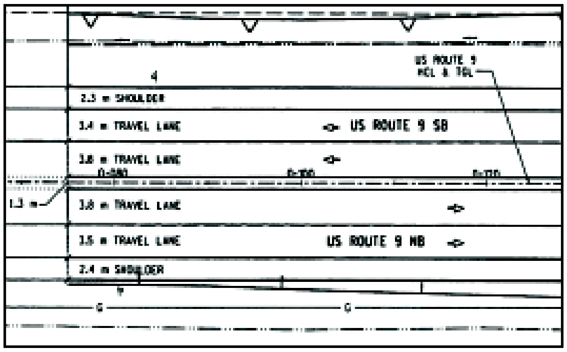

Figure 3.3.4.9: Flush median.

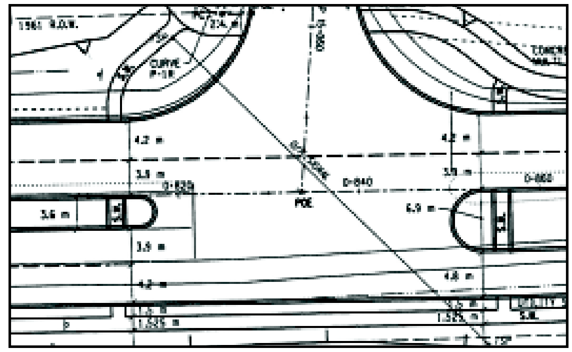

Figure 3.3.4.11: Forced left turn.

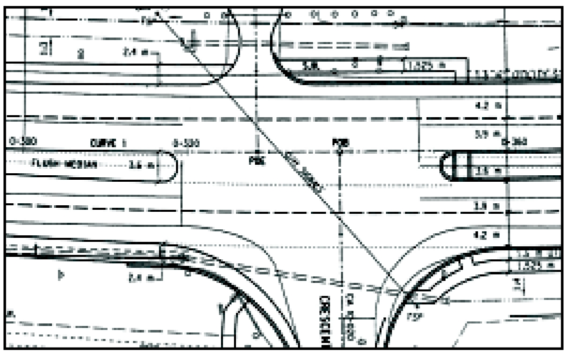

Figure 3.3.4.10: Flush to raised median.

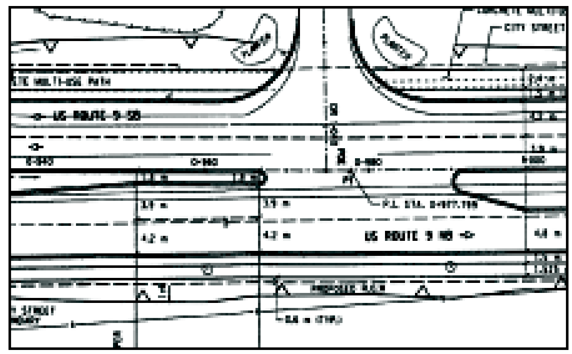

Figure 3.3.4.12: Median with turn bays.

- ❑ Four-inch "traversable" curbs with a 30-degree slope were originally selected. While consistent with DOT standards, these curbs would not self-enforce the parking regulations. Also, during construction, these curbs in granite were determined to be prohibitively expensive. A change order was issued to standard four-inch mountable type E curbs with a 45 degree bevel. From a safety standpoint it was agreed that the expected reductions in vehicle speed would allow this type of curb. It has worked well to prevent cars from parking on the buffer strip since construction.

In the end, the road was built with a tree-lined median, attractive light fixtures, relatively low curbs, and few signs. A similar section of road in Saratoga (with a median and trees) was constantly referenced for its safety record. The flexibility shown in researching and finding an appropriate solution is a testament to the quality of the project and staff.

Forced Left Turn

At Avenue of the Pines, a main entrance to the Spa complex, a forced left turn condition existed before this project. Traffic in the inside lane must turn left, for the lane is not continued beyond the intersection. This created a safety hazard, as through traffic often got caught in the drop lane and had to reenter the traffic stream.

In the new design this forced turn is formalized via the highly visible median. The median opposite has a mountable curb and breakaway bollards in case a driver should fail to make the turn and continue through the intersection. This provides a more context-sensitive design than the alternative of cutting back the median to provide a large recovery area for reentering vehicles. In effect, the design of the drop lane is more urban than rural—consistent with the goals of the project.

A review of crash history showed that the vast majority of incidents involved turning vehicles and rear-ends. In 1995 additional signage was installed to aid drivers. It is unclear whether this had any effect on the crash rate. The addition of the median seeks to further address these problems by physically altering the roadway to reflect the operation. In other words, the design reinforces the signage.

Following construction, the right hand bollard was hit by a driver who, while turning onto South Broadway, swerved to avoid a red light runner. No injuries occurred as the bollard crumpled on cue.

Sidewalks

Standard-width sidewalks were added on both sides of the street. The original road had a sidewalk in only one quadrant, and it was of substandard width. Signalized intersections now have pedestrian actuated signals and marked crosswalks. Linkages are provided to roads and paths in the State Park.

Type	Rear-End	Turns	Fixed Object	Over-taking	TOTAL
Count	7	5	2	1	15
Percentage	57%	33%	13%	7%	100%

Table 3.3.4.2: Crash history at Avenue of Pines, 1993-1995.

An added benefit of the crosswalks is to direct pedestrians to different park entrances so as to relieve congestion at the main entrance.

Cycle Lanes/Paths

Another purpose of this project was to enhance Saratoga's cycle route system. According to the NYSDOT design manual, six-foot bike lanes or wide shared lanes are to be provided along all official cycle routes. Prior to the reconstruction cyclists rode in the wide, but varied, shoulders. This was a challenge as vehicle speeds and driver behavior, coupled with overflow parking during summer events, compromised safety. The new outside lanes

Figure 3.3.4.13: Avenue of the Pines intersection before.

Figure 3.3.4.14: Avenue of the Pines intersection after.

Figure 3.3.4.15: Missing bollard at Avenue of the Pines intersection.

Figure 3.3.4.16: Evidence of a crash.

Figure 3.3.4.17: Former sidewalk condition.

Figure 3.3.4.18: New sidewalk condition.

are 14 to 16 feet wide and intended to be shared by cyclists and drivers. In addition, a mixed-use path was constructed through the park. Both get less use than expected as cyclists seem to prefer the side-walks.

Performance Flexibility

Speeds

In 1997, the 85th percentile speed of northbound drivers (entering town) just south of Avenue of the Pines was 53 mph. The posted speed at that time was 55 mph. Studies performed about six months after the project showed that speeds fell to 46 mph.

At West Fenlon Street, the combined 85th percentile speed for traffic in both directions was 38 mph in 1994. After the project the speed rose to 40 mph, an unexpected result that requires some analysis.

Figure 3.3.4.19: Well-marked crosswalk and accessible median.

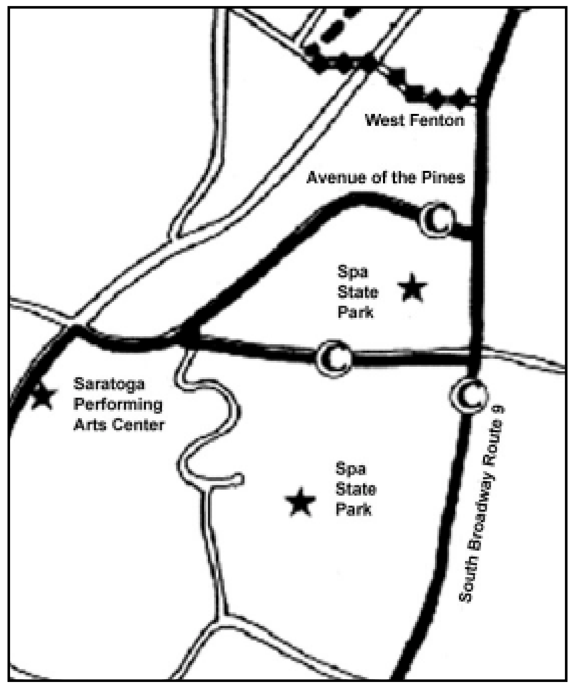

Figure 3.3.4.20: Saratoga bike route map along South Broadway.

Volumes and LOS

A primary justification for the project was intersec-tion capacity. The previous road, while sufficient for the volumes present, was largely uncontrolled in terms of traffic operations. A review of the level of service found failure within 20 years at the West Fenlon Street intersection. This was addressed through the addition of a traffic signal. At other locations, left turn bays will provide additional capacity. The two southbound lanes remain in order to maintain LOS exiting the city. In this direction, speed is of less concern as drivers are approaching a rural highway environment.

Institutional Collaboration

Maintenance responsibility has been divided among the participating agencies. Half of the project is within the Saratoga Springs city limits and the city will assume responsibility there. NYSDOT will maintain the road and signals outside the city limits. The New York State Office of Parks, Recreation, and Historic Preservation will maintain the new sidewalks and pathways.

The decision to provide a context-sensitive gateway increased the cost of the project. This additional cost was questioned but accepted by the local metropolitan planning organization, the Capital District Transportation Committee. The City of Saratoga Springs provided funding to remove all of the overhead utilities for the length of the project and place them underground.

Public Outreach and Response

Responding to the governor's Environmental Initiative (EI), NYSDOT began to follow context-sensitive design principles in 1999. The EI defines CSD as a proactive approach that considers a project within its natural and man-made context. Public input is to be sought throughout the design process.

Discussions pertaining to the reconstruction of South Broadway began in 1997 between the city, NYSDOT, and New York State Office of Parks, Recreation and Historic Preservation. During the scoping process the boulevard treatment arose as the preferred alternative. The fact that there were clear project objectives assisted both in the acceptance of the project and quality of design. The project has won internal design awards within NYSDOT.

Following the success of this project, NYSDOT has shown increased interest in "transition" designs for highways as they enter communities. The agency recognizes the need to slow traffic through road design, and at the same time, maintain traffic safety. The HDM is being revised to include more information on medians and curbs, as the burden is currently on the designer to demonstrate the effect of these elements on vehicle speed. Speed prediction models will also allow the agency to better interface with the public when a project's stated purpose is speed reduction.

Cross street	Former (1999)	No-build (2019)	As built (2019)
Crescent Avenue	A-C	A-C	A-C
Avenue of the Pines	A-C	A-D	A-D
West Fenlon Street	A-F	B-F (stop)	A-D (signal)

Table 3.3.4.3: Intersection level of service.

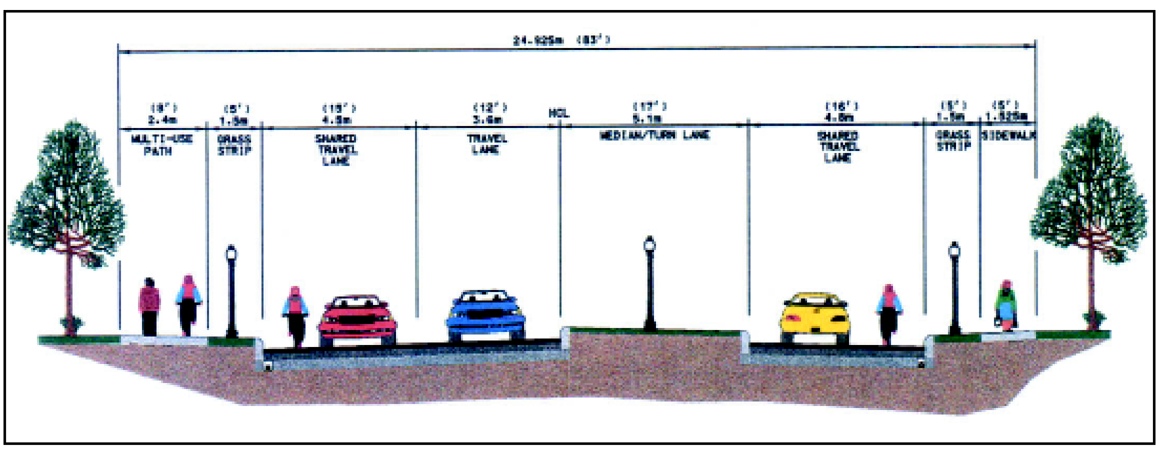

Figure 3.3.4.21: Section with one lane inbound and two out.

Project Status	2000 (Completed)
City Population	2,200
Adjacent Land Use	Residential, Park
Road Classification	Urban Principal Arterial
Road Ownership	State/City
Design Exception Required	Field Change
Project Cost	$2.2 Million
Economic Data	—

Table 3.3.4.4: Project status summary.

Element	Before	After
Number Of Lanes	2-4	3-4
Lane Width + offset, feet	Varied	13-16
Shoulder Width or Cycle Lane, feet	Varied	0-8
Street width, feet	Varied	37-70
On-street Parking	No	No
On-street Parking width, feet	—	—
Sidewalk Width, feet	Not continuous	5-8
Posted Speed, mph	30, 55	30, 40, 55
85th Percentile or Design Speed, mph	38-53	40-46
Vehicle Volume, ADT (DY-2004)	17,300	27,300 (DY 2019)
Level of Service	C-F	D (DY 2019)
Crash Data, reportable	22/year	9/year (since June 2000)
Truck Volume	7%	7%
Pedestrian Volume	—	+500%
Bike Volume	—	+500%
Corner Radii, feet	No curbs	Varies
Stopping Sight Distance, feet	Substandard at one intersection	Improved

Table 3.3.4.5: Data summary for South Broadway, Saratoga Springs, New York.

3.3.5 Westminster, Maryland, East Main Street (MD 32)

The first example of flexible roadway design from the Maryland State Highway Administration (MSHA) is East Main Street in Westminster, or MD 32. This historic street was functioning fine from a traffic standpoint in the early Nineties, but eight blocks were in need of base reconstruction. Also, the underground utility lines were in need of replacement and the storm drain system had to be upgraded.

Figure 3.3.5.1: East Main Street.

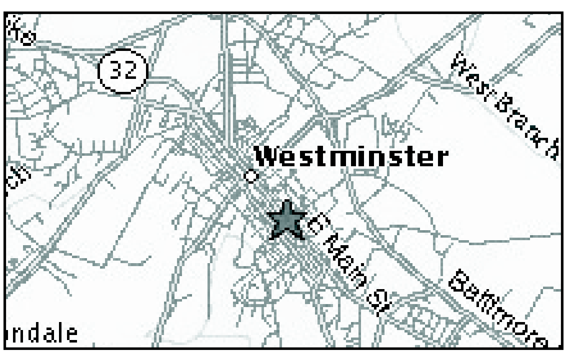

Figure 3.3.5.2: Westminster area map.

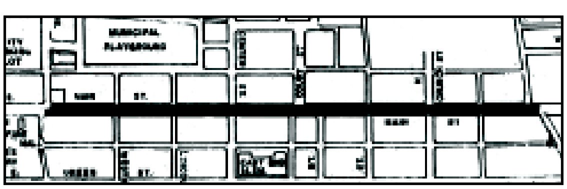

Figure 3.3.5.3: Street network.

Geometric Flexibility

Upon beginning the project, the design engineer checked the Maryland Highway Development Manual and, consistent with the standards at the time, proposed widening the road to 40 feet. The existing cross section, ranging from 34 to 36 feet, was substandard from his perspective. Widening would have provided 12-foot travel lanes and eight-foot parking lanes on each side. It also would have eliminated nearly all street trees and reduced the sidewalk width to two feet in places.

When she learned of the widening, a citizen activist began a campaign to preserve the street's historic character. She enlisted the mayor's assistance, and the mayor convinced the MSHA to redesign the project in a way that would enhance the street's historic character. The redesign produced a consistent 36- to 38-foot paved width, with 10- to 11-foot travel lanes and eight-foot parking lanes. Thirty-four of 42 existing street trees were preserved, and 118 new trees were planted to create a more even and continuous canopy.

The operative roadway design standards at project inception were those of the Maryland Highway Development Manual. The redesign would have required multiple design exceptions. The MSHA

	Lanes (ft)	Total Parking (ft)	Width (ft)
Former	9-10	8	34-36
Former MSHA Standard	12	8	40
New 10-11	7-8	36-38	
At Curb Extensions	11	2 (offset)	26

Table 3.3.5.1: Cross section comparison.

Figure 3.3.5.4: During construction.

Figure 3.3.5.5: After construction.

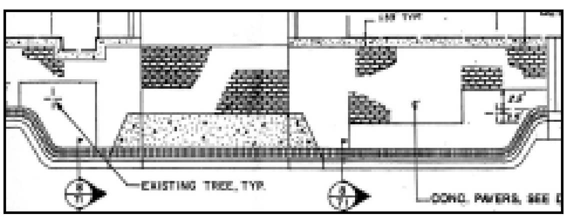

Figure 3.3.5.6: Curb extension at driveway.

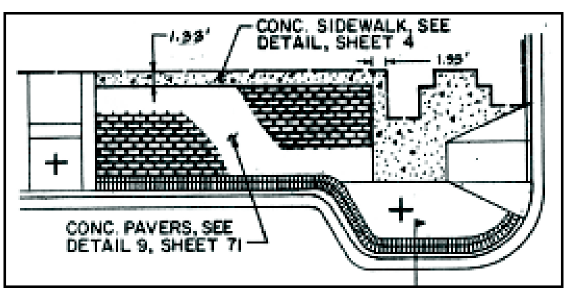

Figure 3.3.5.7: Curb extension at pedestrian ramp.

Curb Extensions	Count
Intersection w/Crosswalk	3
Mid-block w/Crosswalk	3
Driveway	1
Planting Area Only	6
Total	**13**

Table 3.3.5.2: Number of curb extensions.

avoided this by discarding its own design manual and typical sections in favor of the more flexible AASHTO Green Book, which has become the state's de facto design manual. The redesign meets all AASHTO minimum dimensions.

The relationship between the curb extension and lane widths is interesting for the way it maintains lane consistency. While the lanes vary from 10 to 11 feet, the street has a constant two percent slope for the center 22 feet. From this point to the curb the cross slope is six percent. This gives the illusion of constant 11-foot lanes.

The curb extensions are six feet wide, generally the same width as a parked car. This is appropriate for this speed environment, but means that the lane at the curb extension is realistically 13 feet wide. This is positive for cyclists as it is almost a standard 14-foot shared use lane. Yet the narrow appearance is maintained by the contrasting concrete gutter pan.

Other Design Solutions

Curb Extensions

Landscaped curb extensions (known euphemistically as planting areas) were added to protect parked cars and shorten crossing distances for pedestrians. The planting areas were coordinated with mid-block crosswalks, intersections, and a driveway. In addition they provide space for pedestrian ramps outside the central sidewalk area, and permit the ramps to align directly with the crosswalks.

Marked Parking Bays

The curb extensions, while positive from traffic calming and street crossing standpoints, raised concerns among downtown merchants about loss of on-street parking. These concerns were allayed when MSHA showed that by marking individual parking spaces at 22 feet long, and thus eliminating scattered parking patterns, Main Street would have more parking capacity after the reconstruction than before.

Figure 3.3.5.8: Mid-block crosswalk.

Figure 3.3.5.10: Marked parking places.

Figure 3.3.5.9: New tree canopy.

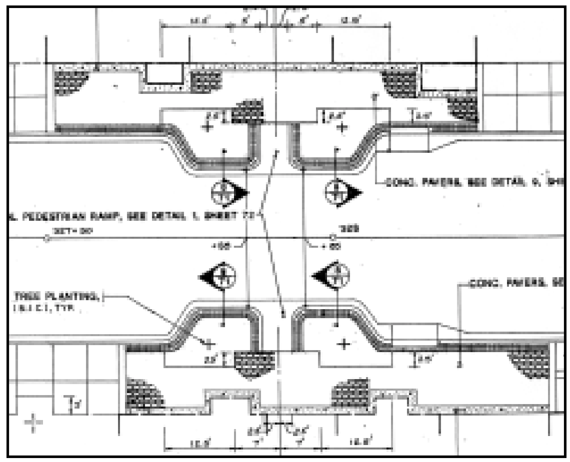

Figure 3.3.5.11: Narrowed mid-block crossing.

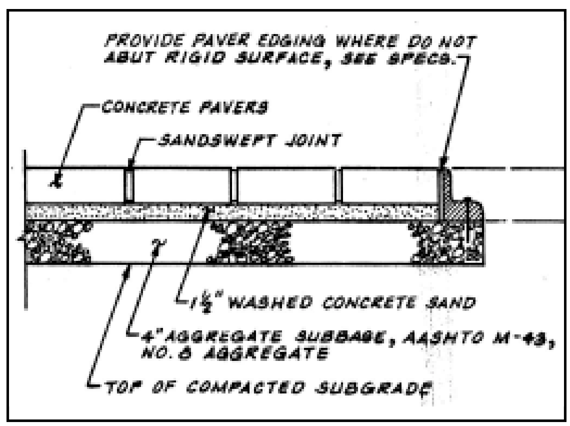

Figure 3.3.5.12: Detail of brick pavers.

Crosswalks

Crosswalks at intersections and mid-block were accentuated with colored brick pavers. Those at mid-block were coordinated with pedestrian generators so that the walking public might be more apt to use them. The mid-block crosswalks initially raised safety concerns within MSHA, since drivers might not anticipate pedestrians crossing at these locations. In time, the colored pavers, curb extensions, and low-speed environment were judged to provide adequate pedestrian visibility and driver response time.

Performance Flexibility

Speed

The design speed for East Main Street is 30 mph while the posted speed is 25 mph. This is consistent with standard practice, even though this is a straight, uncontrolled section of road. As such drivers could theoretically travel as fast as they want, for the curb extensions, tree canopy and brick crosswalks do little to physically restrict speed. Nevertheless the psychological effect of these features is unquestioned.

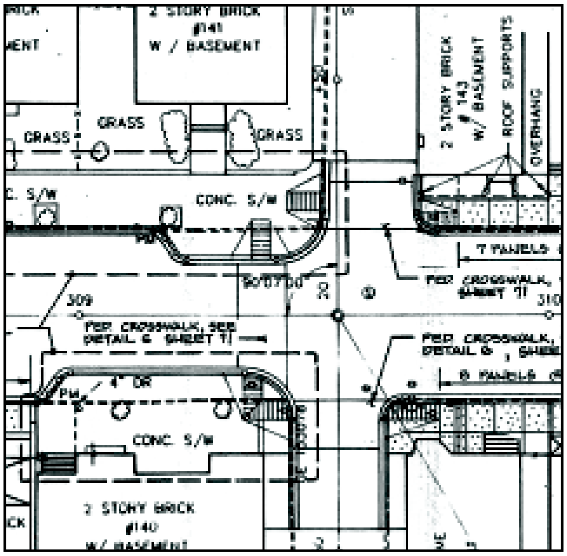

Figure 3.3.5.13: Narrowed intersection (note detail of surroundingbuilt form).

Volume

In that the number of lanes was not reduced, nor was traffic control altered, the capacity of the road was largely unchanged. The level of service could be a little lower, given the increase in pedestrian and on-street parking activity, yet this was acceptable in Westminster.

Institutional Collaboration

The redesign and reconstruction involved collaboration between the City of Westminster and MSHA. MSHA paid for the reconstruction, and then transferred the road to the city for operation and maintenance. The transfer of control was consistent with the changing function of East Main Street, which has functioned more like a local street since the MD 140 bypass opened. Technically this portion of MD 32 was removed from the Maryland State Highway System after reconstruction, although it is still a signed route.

Could this road have been reconstructed to these specifications while remaining on the State Highway System? Or was the transfer of ownership necessary to effectuate this flexible design? Certainly, the transfer of ownership made it easier to redesign the road flexibly. The curb extensions would have complicated street sweeping and snow removal for department maintenance crews. The use of concrete pavers and extensive landscape materials could have complicated maintenance functions as well. Nonetheless, two policy changes make redesigns like Westminster's Main Street not only feasible but now preferred by MSHA: the first policy change was the adoption of AASHTO's Green Book as the state's design manual; the second was the decision to treat all subsequent main street reconstructions as 3R projects, leaving the existing cross sections and street trees alone unless there is a demonstrated safety problem. As additional main streets are reconstructed in Maryland, they are being retained on the State Highway System.

Public Response

In the end, the residents and merchants of Westminster were delighted with the result, and

Figure 3.3.5.14: MD 144 through Hancock before.

Figure 3.3.5.15: MD 144 through Hancock after.

MSHA has a great example of flexible design for its Thinking Beyond the Pavement Program. MSHA has received kudos from the Governor's office for its contribution to urban revitalization, a major priority of his Smart Growth initiative. The project received a 1996 National Preservation Honor Award and a 1997 FHWA Environmental Excellence Award for Historic and Archaeological Preservation.

Project Status	1994 (completed)
City Population	13,000
Adjacent Land Use	Commercial, Institutional
Road Classification	Urban Collector
Road Ownership	State
Design Exception Required	No
Project Cost	$3.2 million
Economic Data	Increased tax revenue expected to pay for additional work in four years.

Table 3.3.5.3: Project status summary.

Other Projects

Another example of flexible highway design in Maryland is state route 114 through Hancock in the western panhandle. This project demonstrates the new approach of the MSHA. It was designed following the elimination of state roadway standards. It also followed a change in scoping policy; the built environment now has precedence over through traffic for all but 'new' highways. The before and after photos below illustrate that the roadway remained essentially the unchanged following reconstruction. The only substantial changes were sidewalk improvements and the addition of street trees—this in spite of the traffic volumes carried on this street—5,270 ADT in year 1998 and 7,500 ADT projected for design year 2018.

Element	Before	After
Number Of Lanes	2	2
Lane Width + offset, feet	9-10	10-11
Shoulder Width or Cycle Lane, feet	—	—
Street width, feet	34-36	36-38
On-street Parking	Yes	Yes
On-street Parking width, feet	8	8
Sidewalk Width, feet	5	5-10
Posted Speed, mph	25	25
85^{th} Percentile or Design Speed, mph	—	30
Vehicle Volume, ADT (DY-2004)	14,100	22,000 (DY 2010)
Level of Service	—	—
Crash Data, reportable	—	—
Truck Volume	6%	6%
Pedestrian Volume	—	—
Bike Volume	—	—
Corner Radii, feet	—	—
Stopping Sight Distance, feet	—	—

Table 3.3.4.5: Data summary for East Main Street, Westminster, Maryland.

3.3.6 York, Pennsylvania, Market Street

Towards the end of the 1970s, just as the wave of downtown pedestrian malls was coming to a close, the City of York decided to redevelop Market Street, their main east-west arterial. In the 1950s many downtown streets were converted into one-way pairs in order to speed travel to and through downtown. With an eye toward halting the hemorrhaging of business and people to the suburbs, the city won an Urban Development Action Grant from the federal government. Instead of a pedestrian mall, Market Street became one of the first successful traffic calming projects in the country. In all, six million public and private dollars were spent on and around West Market Street.

Geometric Flexibility

Market Street (State Route 462) runs eastbound and is a one-way pair with Philadelphia Street. Coming from the west, the street seems unusually wide at 50 feet. The three lanes are 11 and 12 feet in width with eight-foot parking lanes on both sides. There are few trees or crosswalks and it functions primarily as a vehicle conduit, even though it is posted at 25 mph. Before 1980 a similar section continued through downtown.

Just before the Market Street enters downtown it crosses Codorus Creek, the York County Heritage Rail-Trail, and the North Central Railroad Rail-Trail.

Figure 3.3.6.1: Market Street at Beaver Street, 1979.

Figure 3.3.6.2: Market Street at George Street, 1979.

Figure 3.3.6.3: Market Street at Beaver Street, 2000.

Figure 3.3.6.4: Market Street at George Street, 2000.

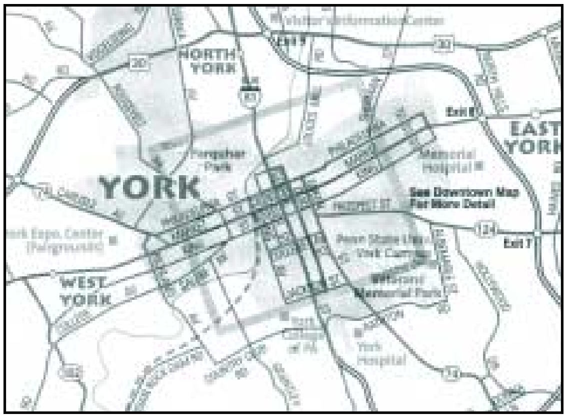

Figure 3.3.6.5: York area map.

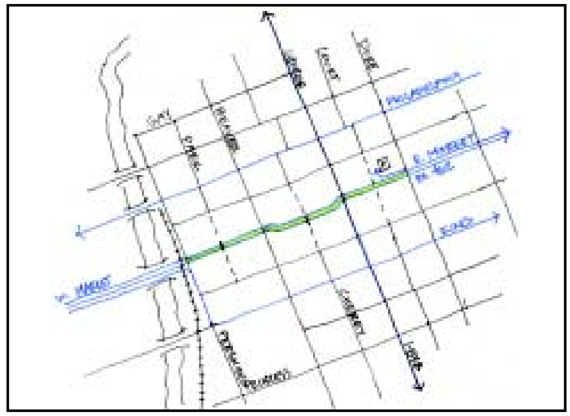

Figure 3.3.6.9: Downtown area plan.

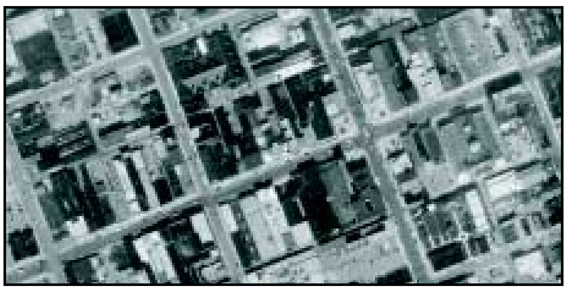

Figure 3.3.6.6: Aerial view, 1972.

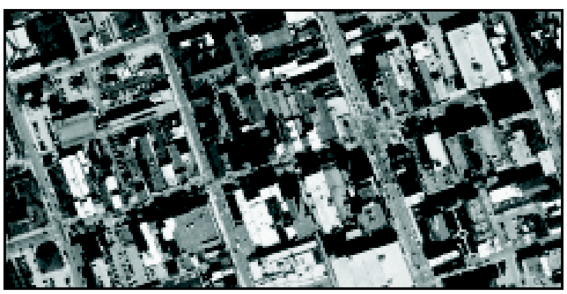

Figure 3.3.6.7: Aerial view, 1992.

It is here that the traffic calming project begins. The right lane must turn and the left and center lanes continue straight. Truck traffic is directed right to King Street where the signals were re-timed to speed their passage.

Passing through the first block of the project one finds wider sidewalks, corner and mid-block curb extensions forming parking bays only on the right. The cross section is 30 feet. In the second block, what were the left and center lanes shift into the center and right lanes respectively. Parking is now on the left side. At the end of the block the traffic shifts back to the left. The third block returns to the same configuration as the first, with the addition of an 8-foot contra-flow lane leading to a parking garage. A 4-foot median divides the two opposing lanes.

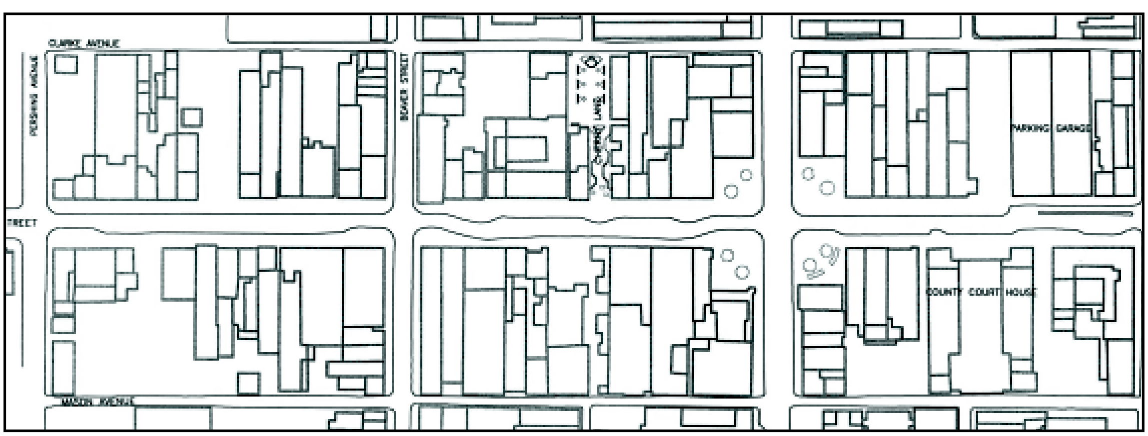

Figure 3.3.6.8: Site plan.

Cross Section	Sidewalk & Lane Widths (ft)	Curb-to-Curb Right of Way (ft)
Adjacent/orginial section	15+8+11+12+11+8+15	50/80
Pershing–Beaver	27+11+11+8+23	30/80
Beaver–George	22+8+11+11+28	30/80
George–Duke	27+11+11+8+23	30/80
George–Duke contra-flow	15+8+4+11+11+8+23	42/80

Table 3.3.6.1: Cross section comparison.

Figure 3.3.6.10: Market Street to the west of downtown (typical three-lane section).

Figure 3.3.6.13: Market Street through downtown (lane shift).

Figure 3.3.6.11: Market Street as it enters downtown (forced right turn).

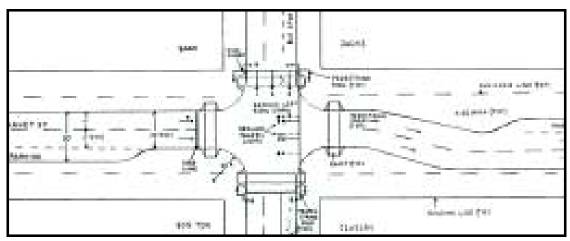

Figure 3.3.6.14: Lane shift plan.

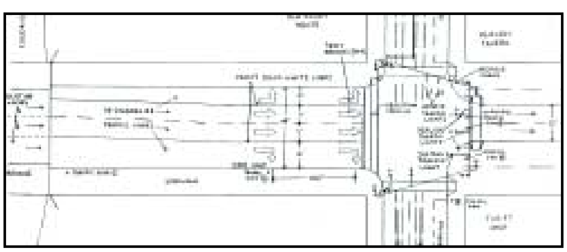

Figure 3.3.6.12: Forced right turn plan.

Figure 3.3.6.15: Market Street at parking garage (conta-flow lane).

Other Design Solutions

In addition to the lane shifts, the reborn Market Street contains other items that reinforce the low speed, pedestrian-friendly nature of the street.

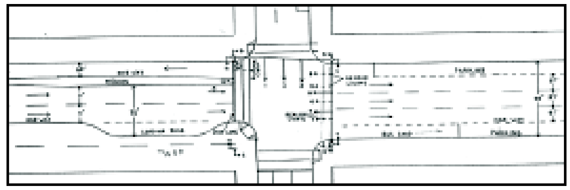

Figure 3.3.6.16: Contra-flow plan.

Intersections

Crosswalks at intersections are set back 13 to 22 feet, but still in line with pedestrian travel. This is largely accomplished through curb extensions. The resultant "yield" space allows turning drivers to wait for people in the crosswalk out of the way of the moving lanes. This increases both vehicular and pedestrian level of service, and reduces conflicts.

Figure 3.3.6.17: Market Street as it leaves downtown (typical two-lane section).

Corner radii have been reduced from 30 to 20 feet. This has the dual effect of slowing turning traffic while allowing the pedestrian ramp to be aligned directly with the crosswalk, simplifying travel in a wheelchair. On the tip of the enlarged corners are planters, trees and bollards. These define the corner and help to keep errant vehicles off the sidewalk.

Figure 3.3.6.18: Plantings and set back crosswalk.

The signal timing is broken into three phases so as to temporally separate conflicting movements. Phase A gives 28-34 seconds to Market Street. Phase B provides 18 seconds to the cross street and turning movements. Phase C gives 18-24 seconds to the cross street through movement only, thus eliminating any conflict with pedestrian traffic. While the total cycle is only 70 seconds, thus reducing overall delay, the fact that drivers are allowed to turn (phase B) before walkers get to cross (phase C) is problematic. A more progressive solution would be to provide a leading pedestrian interval, thereby reinforcing pedestrian priority.

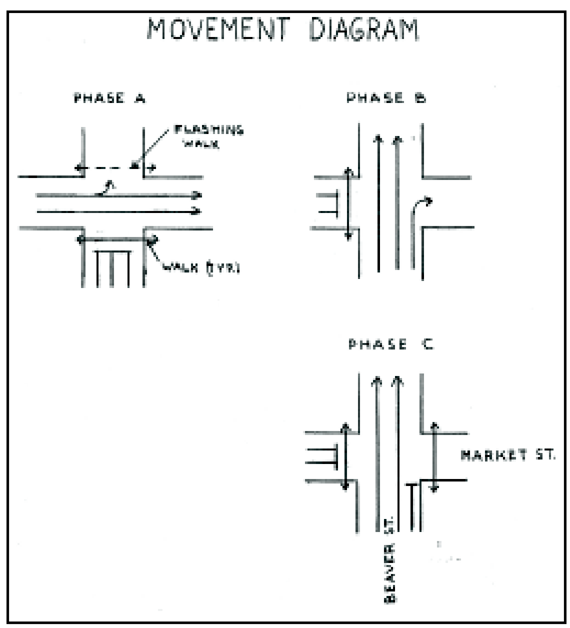

Figure 3.3.6.19: Typical signal timing.

Mid-block Crosswalk

The trees, now 20 years old, provide much shade and are set back just two feet from the curb. There is a well-marked mid-block crosswalk aligned with a mid-block passageway. This leads to a farmers market, parking lots and connects to the rest of the street network. The crosswalk is uncontrolled to minimize pedestrian delay, and the curbs are extended to reduce exposure time.

Performance Flexibility

Speeds

The 13-foot offset in 66 feet has a design speed of 28-29 mph as calculated using British design guides.[3] Set in a posted 25 mph zone this is consistent with US engineering practice, yet it limits the ability of motorists to drive at excessive speeds.

Figure 3.3.6.20: Mid-block crossing aligned with mid-block passage.

Figure 3.3.6.21: Curb extension and signage at mid-block crosswalk.

	1980 ADT	Per Lane	2000 ADT	Per Lane
Adjacent Section (3 lanes)	14,100	4,700	22,300	7,433
Through Project (2 lanes)	-	-	18,700	9,350

Table 3.3.6.2: Average Daily Traffic.

Volumes

When the project was completed, some of the traffic (especially trucks) was diverted to King Street. In 1986 Market Street carried 13,803 ADT through the two-lane section. By 1989 the ADT had grown to 17,518 to the west of the project. The city uses a 2.2 percent growth projection and from that one can derive and compare traffic volumes for the two-lane and three-lane sections.

Institutional Collaboration

As with many projects where a town wishes to reclaim its street from through traffic, the city of York designed, engineered and constructed this project with the help of a consultant, WMRT (Wallace, McHard, Roberts & Todd) Planners & Engineers. They designed it essentially independent of the county and state highway departments. Although it is still officially a state route, the state highway department transferred maintenance responsibility to the city at the time of the project.

Public Response

The success of the traffic calming of Market Street can be measured by other traffic calming projects it spurred. The city recently began a five million dollar project to enhance the retail and streetscape

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[3] DETR Traffic Advisory Leaflets 9/94 and 12/97.

environment of the two blocks directly to the west of the original project. While not as extensive a traffic calming project as in 1980, the street will receive more trees, curb extensions, and improved crosswalks. Outside of downtown, the Avenues Neighborhood Traffic Calming Study is currently underway, with installation expected in 2001. In 1999, two traffic circles replaced four-way stops in a heavily traveled residential area.

With the upgrading of the US 30 bypass (originally built in the late 1960s, to the north of town, there are plans to return Market and the other east-west streets downtown to two-way operation. This follows the successful reintroduction of two-way traffic on George Street, the primary north-south arterial through town. Where there were three lanes south bound, now there is one lane in each direction, a left turn lane, curb extensions, and improved crosswalks.

The details of this two-way conversion are instructive. In 1997, the average daily traffic on George Street measured between 13,000 and 17,500 in the eight blocks downtown. The reason for the fluctuation is turning movements within the one-way street network. In 1998 most of George Street was converted, but the four central blocks were left one-way, to accommodate the higher volumes there. Within two years the benefits of a two-way street were apparent to the community. Traffic in the central four blocks had dissipated to the point that the city was comfortable with completing the conversion.

Project Status	1980 (completed)
City Population	45,000
Adjacent Land Use	Commercial
Road Classification	Urban Arterial
Road Ownership	City
Design Exception Required	No
Project Cost	$6.0 million
Economic Data	Led to $5.0 million more work.

Table 3.3.5.3: Project status summary.

Element	Before	After
Number Of Lanes	3	2
Lane Width + offset, feet	11-12	11
Shoulder Width or Cycle Lane, feet	—	—
Street width, feet	50	30
On-street Parking	Both Sides	One Side
On-street Parking width, feet	8	8
Sidewalk Width, feet	15	23-28
Posted Speed, mph	25	25
85^{th} Percentile or Design Speed, mph	—	28-29
Vehicle Volume, ADT (DY-2004)	13,100	28,700
Level of Service	—	—
Crash Data, reportable	—	—
Truck Volume	Truck Route	Not a Truck Route
Pedestrian Volume	—	—
Bike Volume	—	—
Corner Radii, feet	30	20
Stopping Sight Distance, feet	—	Increased with wider sidewalks

Table 3.3.4.5: Data summary for Market Street, York, Pennsylvania.

Appendix A.1
Technical Review Committee

The first task of this project was to establish a Technical Review Committee (TRC) of leading experts and practitioners in the field of context-sensitive design. These professionals were identified through outreach to prominent planners and engineers, postings on national e-mail list serves, and recommendations from DOT.

The TRC played a significant role in this project. The group met at the midpoint of the project to review and comment on progress, and redirect efforts as necessary.

The TRC also participated in a Main Street Visual Preference Survey to help the TPI team better understand what constitutes a main street, and what attributes make a particular main street a good one. Results of the survey are presented in Appendix A.4.

Finally, the TRC was consulted on the nature of conflicts between DOT standards and community objectives, and on means for resolving them. The end product is the conflicts-solutions matrix in Section 2.6.

Brief biographies of the members follow.

Charles B. Adams, RLA, Director of Environmental Design with the Maryland State Highway Administration. Mr. Adams is chair of the Community Involvement Subcommittee for Maryland's "Thinking Beyond the Pavement" initiative. The stated goal of the initiative is to integrate highway development with community and environment preservation. Maryland has taken the lead in a national effort, coordinated by AASHTO and the National Highway Cooperative Research Program, to promote context-sensitive design.

Janine G. Bauer, JD, Executive Director of the Tri-State Transportation Campaign, Inc., New York, NY. Ms. Bauer coordinates and supervises collaborative projects of thirteen member organizations promoting "centered" land use, rail freight, sustainable port investments, expanded transit, and environmentally-friendly transportation infrastructure spending. She conducts policy and legal analyses associated with transport, economic, and environmental issues facing New York, Connecticut, and New Jersey.

James M. Daisa, PE, Fehr & Peers Associates. Among his publications, Mr. Daisa authored *Creating Livable Streets: Street Design Guidelines for 2040* for Portland Metro (Portland, Oregon's metropolitan government). The publication won the Environmental Protection Agency's "Way to Go" Award in 1998. Mr. Daisa has been in charge of most of the traffic engineering for land development projects planned by Peter Calthorpe, a leading New Urbanist planner.

Michael Moule, PE, City Traffic Engineer, Asheville, NC. Before starting his current job as City Traffic Engineer of Asheville, Mr. Moule was Bicycle and Pedestrian Facility Specialist at Oregon DOT. There, he rotated among offices of highway construction, preliminary highway design, and bridge design. Mr. Moule uses his experience with alternate transportation modes and his background in transportation engineering to provide the City of Asheville with a balanced transportation system.

Carlos Rodrigues, PP, AICP, New Jersey Office of State Planning. Mr. Rodrigues is coordinator of Designing New Jersey. He is responsible for policy development in the areas of physical planning and urban design and is involved with a variety of activities related to implementation of the community design vision of the State Plan. He has worked in Europe, Asia, and Canada, for a variety of private and public organizations.

David Scott, PE, Director of Project Development with the Vermont Agency of Transportation. Vermont is the acknowledged leader among states that have taken up the ISTEA challenge to tailor highway design standards to state needs. Mr. Scott is charged with developing projects according to the new policies and standards, and as such has daily involvement with context-sensitive highway design.

Ben Yazici, PE, Director of Public Works/Financial Services, Sammamish, WA. Mr. Yazici has 19 years of management experience, 10 years as Assistant City Manager/Public Works Director/City Engineer. He is a registered Professional Engineer in the States of Washington and Oregon. His context-sensitive design projects in Sammamish, University Park, and Gig Harbor recently won Mr. Yazici a national award from the Surface Transportation Policy Project, *Walking* Magazine, and Walkable Communities, Inc.

Appendix A.2

From Highway to My Way

by Reid Ewing

Reproduced from *Planning* magazine, January 2000 (some material deleted during the editorial process has been reinserted).

You know the world is changing when everyone from the Federal Highway Administration to state and local transportation officials uses words such as "flexible" and "context-sensitive" to describe highway design. Now that the nation's highways are nearly complete, transportation professionals are turning their sights on local communities and the inherent links between transportation systems and surrounding land uses.

There is a lot of confusion about exactly what constitutes context-sensitive highway design, what latitude exists under current standards and guidelines, what tort liability attaches to such efforts, and what effect context-sensitive designs will have on traffic safety and service levels. This article seeks to sort out myth from fact.

Main Street Destroyed

In the course of writing Best Development Practices (APA Planners Press, 1996), I visited every medium-sized town with any historic character in the state of Florida. I was on a quest for the best traditional small towns in the state, hoping to find lessons applicable to contemporary development projects. In fact, I found very few good examples, mostly because of what happened along Main Street.

Main Street, usually part of the state highway

Figure A.2.1: Preserved main street, Dade City, Florida.

system, no longer functioned as a comfortable shopping street. It was too wide, and on-street parking had been removed, street trees replaced with asphalt, and sidewalks narrowed. Strip commercial development seemed the only practical land use. The traditional towns that did end up in the book, such as Dade City, had somehow managed to evade the standard DOT definition of "progress."

The problem of context-insensitive highways is not, of course, unique to Florida, nor to small towns, nor to state highways. Instead of gracious boulevards, avenues, and shopping streets, America's urban areas are crisscrossed by arterials and collectors that move traffic but have no power to move mens' souls.

DOTs vs. dots

Here are several examples proving that change is in the air. U.S. Route 6 narrows to two lanes as it runs through the town of Brooklyn, Connecticut. Sight distance is less than 250 feet at one point, driveways are closely spaced, and there is little roadside clearance should a driver lose control. Yet traffic speeds through the town still range up to 54 mph.

A 1991 state plan sought to correct these dangerous conditions by widening the road to four lanes, straightening the alignment, and adding eight-foot shoulders. The village appealed the plan, and the Connecticut Department of Transportation went back to the drawing board.

ConnDOT's next proposal was for a bypass around the town, which was also rejected. Finally, after years of additional planning, a compromise was reached in 1998. It keeps the existing alignment through the town center, retains the two-lane cross section, adds narrow shoulders and standard-width sidewalks, and realigns the road marginally at the most dangerous curve. Reconstruction will be completed in 2003.

In Albuquerque, New Mexico, Isleta Boulevard is a two-lane road with no sidewalks, no curbs, no landscaping or other amenities. The tendency of drivers to use the shoulder to pass left-turning vehicles on the right makes driving on Isleta Boulevard a free-for-all. The engineers' solution was to widen the southern leg of Isleta Boulevard from two to five lanes, two travel lanes in each direction and a continuous left turn lane in the center.

Activists, who had witnessed the decline of commerce and street life on a nearby street after it was five-laned, challenged the Environmental Assessment (EA) of the project and Finding of No Significant Impact (FONZI). Their grounds: safety problems with the current roadway were not documented, only assumed; land-use impacts were never analyzed; and more context-sensitive highway design alternatives were not considered. FHWA agreed and refused to accept the EA and FONZI. This led to a new hybrid design, with the central section of road widened to only three lanes, sidewalks added, and landscaped median islands installed.

In Anchorage, Alaska, engineers proposed the conversion of 15th Avenue into a one-way couplet with 14th Avenue after a safety study documented high accident rates and substandard geometrics. Residents of the adjacent Rogers Park neighborhood had seen one-way couplets in operation in midtown, and this was exactly what they didn't want. The couplets moved traffic efficiently but divided the community much as a freeway would.

And so began a four-year process of redesign that in 1998 resulted in a four-lane, tree-lined boulevard on the east end, and a narrowed three-lane cross section on the west. When construction is completed later this year (2001), travel lanes will be maintained at their current 11-foot width, and shoulders excluded. Instead of shoulders, wide gutter pans will provide a refuge area and bike-friendly surface. Sidewalks will be set back from the street for the first time.

In Westminster, Maryland, the base layer of East Main Street needed reconstruction, underground utility lines had to be replaced, and the storm drain system needed upgrading. After checking the Maryland *Roadway Design Manual*, the district engineer proposed widening the road to 40 feet.

Figure A.2.2: Section of Isleta Boulevard requiring reconstruction, Albuquerque, New Mexico

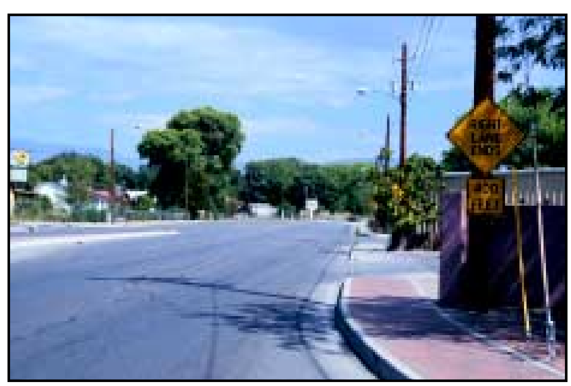

Figure A.2.3: Reconstructed northern section of Isleta Boulevard, Albuquerque, New Mexico

Figure A.2.4: East Main Street during reconstruction, Westminster, Maryland

Figure A.2.5: East Main Street as reconstructed, Westminster, Maryland

Widening would have provided 12-foot travel lanes and eight-foot parking lanes on each side. It also would have eliminated nearly all street trees and reduced the sidewalk width to two feet in places.

After learning about the widening, a local resident began a campaign to preserve the street's historic character. She appealed to the mayor, who convinced the Maryland State Highway Administration to reconstruct within the street's existing dimensions. The result is a classic main street with "bulb-out" curb extensions at intersections, midblock crosswalks, hundreds of additional street trees, and brick surfacing in the crosswalks.

In these and many other cases uncovered in our research, the need for road improvements was undeniable, but standard design solutions were unacceptable to the people most affected by them—those along the right-of-way. The resulting tension between DOT and community goals led to compromise and context-sensitive designs.

Reform at the Top

Before 1991, all roads built in the U.S. and paid for even in part with federal funds had to meet guidelines in the American Association of State Highway and Transportation Officials (AASHTO) Green Book (*A Policy on Geometric Design of Highways and Streets*). If officials wanted to do something different, their only options were to seek design exceptions from the Federal Highway Administration or to build entirely with state and local funds.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) changed all of that by creating a National Highway System made up of the interstate system and other high-performance state highways, 160,000 miles of roadway in all. Other roads became eligible for federal funding under a separate surface transportation program. For roads not on the NHS, ISTEA gave states latitude to adopt alternative design, safety, and construction standards.

ISTEA was followed by two other milestones. The National Highway System Act of 1995 provided that even NHS highways (other than Interstate highways) could be designed to take into account the environmental, scenic, aesthetic, historic, community, and preservation impacts of any proposed activity. Two years later, the Federal Highway Administration published *Flexibility in Highway Design*, which forcefully advocates flexible design of highways running through communities, encouraging highway designers to exercise flexibility within existing AASHTO guidelines.

Reform in the States

At the state level, much of the effort to promote context sensitivity has been process- and people-oriented. Five states (Connecticut, Kentucky, Maryland, Minnesota, and Utah) are participating in a joint FHWA/AASHTO effort to train engineers in context sensitivity through the National Cooperative Highway Research Program (NCHRP). Many states, including New Jersey, have launched training efforts of their own. The New Jersey training consists of five day-long sessions on such unconventional topics (at least for highway engineers) as place making, respectful communication, conflict management, and traffic calming.

While such efforts are laudable, they inevitably run up against engineering constraints unless DOT standards and policies are revised. Michael King, a consultant on the NJDOT flexible highway design project, surveyed more than a dozen states to find out about their efforts to develop new standards and policies. His conclusion: Substantive changes are happening all over the United States.

Don't Blame the Green Book

King found that few states have adopted sub-AASHTO geometric standards. Among those that have, deviations from Green Book values are relatively slight. The difference between the cross sectional width of a two-lane urban arterial under Vermont's much heralded design standards and that under the Green Book minimums is only three feet (43 vs. 46 feet). Notably, Dave Scott, Director of Project Development and keeper of the Vermont standards, has advised our New Jersey study team not to recommend anything less than AASHTO minimums because there is little to gain on urban main streets.

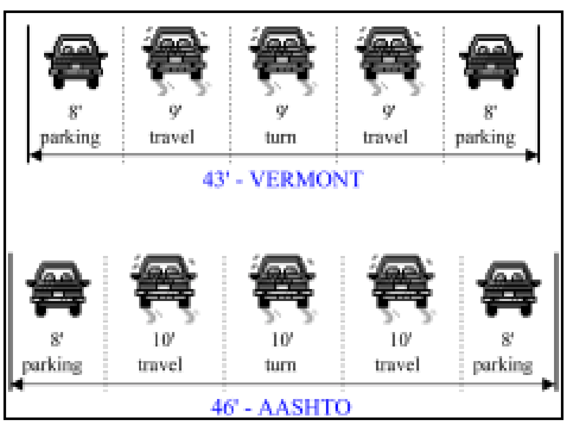

Figure A.2.6: Vermont vs. AASHTO minimums.

This is not to say that the AASHTO Green Book is without shortcomings. Its design guidelines are often based on studies dating from a time when tires, braking systems, pavements, and vehicle dimensions were less forgiving than today's. However, these guidelines mostly affect the design of high-speed rural roads. The issue in the New Jersey study is whether good urban streets can be accomplished under AASHTO guidelines.

Here are some of the AASHTO guidelines for urban arterials:

- ❑ Design speed. AASHTO allows design speeds as low as 30 mph in central business districts and intermediate areas. Posted speeds would ordinarily be considerably lower.
- ❑ Lane width. The minimum lane width is 3.0 m (10 ft) for urban arterials with little or no truck traffic. A minimum of 3.3 m (11 ft) is prescribed for general traffic on urban arterials designed for speeds up to 37 mph.
- ❑ Shoulders. AASHTO declares shoulders "desirable on any highway, and urban arterials are no exception." However, in urban contexts where right-of-way is limited, the Green Book neither requires shoulders nor establishes minimum widths.
- ❑ Setback of street trees. On curbed sections, the minimum clearance from the curb face is 1.5 feet. A 3.3-foot clearance is considered desirable, particularly near intersections and driveways where turning vehicles may overhang the curb.
- ❑ Midblock crosswalks. AASHTO is neutral on these.
- ❑ On-street parking. Parallel parking is allowed where adequate street capacity is available.

- Corners. Corner radii of 10 to 15 feet are reasonable under constrained conditions. On arterials carrying high volumes, larger radii are recommended (in some cases, much larger) to facilitate turns to and from the through lanes.
- Pedestrian refuge islands. Median islands are encouraged where space permits.
- Sidewalks. The minimum border width, including sidewalk and planting strip, is 8 feet; a 12 foot border is preferred.
- Barrier curbs. Barrier curbs are encouraged in areas of high pedestrian traffic and speeds up to 37 mph, or on discretionary basis, up to 50 mph. At higher speeds, barrier curbs do not act as barriers anyway.

The conclusion: It appears that we cannot place too much blame on the Green Book for the sorry state of urban streets.

Liability Isn't the Issue, Either

Governments used to have general immunity from tort liability, but that has changed since the 1960s, as various courts and legislatures made it possible for individuals and groups to sue in cases where government fails to exercise due care in its decisions.

Government decisions are now divided into two classes: discretionary (planning decisions) and ministerial (operational decisions). Discretionary decisions involve a choice among valid alternatives and are generally immune from tort claims. Ministerial decisions leave minimal leeway for personal judgment and are not immune.

As part of our study for NJDOT, we surveyed statutory and recent case law in 16 states. With the sole exception of local roads in Vermont, all states had replaced sovereign immunity with more limited discretionary immunity.

New Jersey has a Tort Claims Act that leaves the state almost completely immune from tort liability resulting from design-related decisions. All it takes is for the right body or person to approve a design (or the standards on which a design is based).

At the other extreme is Georgia, whose supreme court held in DOT v. Brown (1996) that the design of a roadway is an operational function, not covered by discretionary immunity: "Only the decision to build, and not where or how it is built, is immune." Between these extremes are states such as California and South Carolina, which provide design immunity but allow it to lapse as conditions change. From our 16-state survey, we don't find tort liability much of an excuse for the sorry state of urban streets. Instead, we have identified some real culprits.

Put the Blame Here

AASHTO's Green Book offers design policies and guidelines, not standards. For each design element, AASHTO typically provides a range of acceptable values, from a minimum value to a more desirable target value.

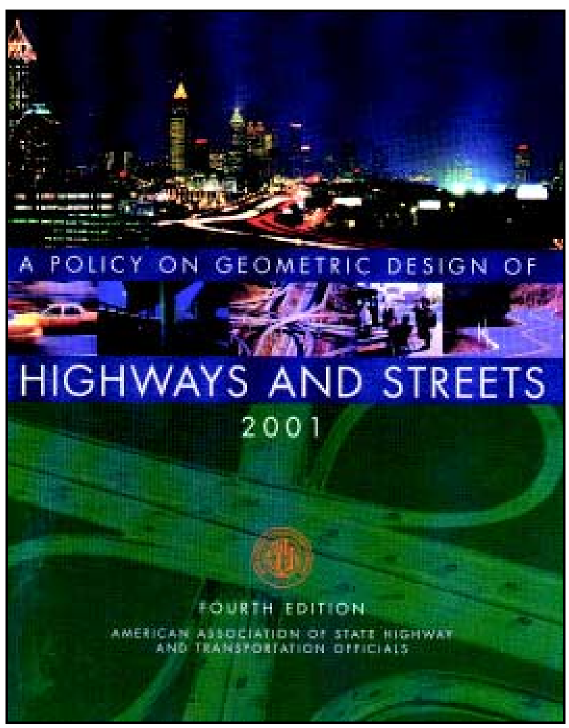

Figure A.2.7: "Green Book" applied by Maryland State Highway Administration.

For an AASHTO guideline to become a standard, it must be adopted by a responsible agency. Many states have adopted standards toward the middle or upper end of the AASHTO ranges, on the theory that if some is good, more is better. County and city engineers have then blindly adopted state standards.

As noted, Maryland's lane width standards would have encroached on trees and sidewalks in the town of Westminster. Those standards exceeded AASHTO minimums. Not only were these particular standards thrown out, but the experience convinced Bob Douglass, the Maryland State Highway Administration's deputy chief engineer, that the standards should be thrown out wholesale.

In 1998, Douglass wrote a memo banning the use of the state's highway design manual. He found that the templates were generally oversized (especially stopping sight distance and vertical curves) and stymied creativity among engineers. The agency was losing legal challenges when an element was below the state minimum value, but above the Green Book value. Now the agency relies exclusively on the Green Book.

In the Wrong Class

Another culprit is misclassification of streets. Streets and highways in this country are classified by location—urban or rural—and by function: arterial, collector, and local. There is a direct relationship between classification and design standards. Classification determines design speed, design vehicle, and cross section (lane width, shoulder width, and type and width of median).

The U.S. classification system has been criticized for ignoring distinctions among contexts and among roadway functions. An urban arterial conforms to the same basic standards whether it is a main street or a bypass.

Misclassification of streets commonly occurs for two reasons. A small town, village, or hamlet fails to meet the definition of urban. That community may end up with a main street designed to rural standards. This was true in Brooklyn, Connecticut, before the compromise described at the beginning of this article.

The simple solution to this problem is to treat any place that is built up as urban, regardless of its census designation. The Federal Highway Administration policy is simple: If it looks urban, use urban standards.

The other common case of misclassification occurs as road functions change over time. In Westminster, Maryland, East Main Street had always been part of Maryland State Route 32. It began functioning more like a local street when the State Road 140 bypass opened. Accordingly, this portion of Route 32 was removed from the Maryland state highway system after the street was reconstructed, and the city assumed responsibility for its operation and maintenance. Other examples of misclassification include Sunset Drive (State Route 986) in South Miami and Springfield Avenue (State Route 124) in Maplewood, New Jersey.

Level of Disservice

Level-of-service standards are yet another obstacle to context-sensitive design. While there is a legal imperative to provide safe roads, there is no such reason to provide free-flowing roads. Some congestion may be desirable in a downtown. After all, a downtown without traffic isn't a very exciting downtown.

Virtually all DOTs have adopted level-of-service standards. Typically, the standard for urban areas is C or D, while the standard for suburban areas is B or C. As traffic volumes increase to the point where the standard is no longer met, a road and its intersections often will be widened regardless of the effects on adjacent land uses.

The alternative is to accept congestion in areas that function as destinations. Since 1993, Florida has allowed its local governments to exempt streets through downtowns and urban redevelopment areas from level-of-service standards. The effective standard becomes level of service F. Many cities and towns have taken this option.

West Palm Beach, for example, has adopted level-of-service E as its standard and is seeking a complete exemption from level-of-service standards for much of the city. This city keeps an eye on both low volume-to-capacity ratios (less than 0.6) and high ones (greater than 0.9). A low volume-to-capacity ratio may offer an opportunity—a place where the street can be narrowed and street life encouraged by means of widened sidewalks, on-street parking, and landscaped curb extensions and islands.

Sunset Drive (SR 986) in South Miami once functioned as the city's main street, and the city wanted to reclaim the street as part of a downtown redevelopment plan. To slow traffic and reduce crossing distance, the existing four- or five-lane cross section has been narrowed to three lanes. The roadway narrowing permits wider sidewalks, additional street trees, and outdoor dining. Florida Department of Transportation (FDOT) initially opposed a decline in level of service on its road. The solution was to de-designate this last section of SR 986, turn the section over to the city, and have the lane reduction occur within the city's jurisdiction. The two eastbound travel lanes continue through the intersection with US 1 (the western boundary of the city), the inside lane ending in a trap left lane a block into the city. Roadway level of service is thus maintained at LOS E on the westbound approach, under FDOT's jurisdiction. The one westbound lane approaching US 1 has less carrying capacity than the previous configuration. But the resulting LOS F falls within the city's jurisdiction.

It is worth noting that several of the context-sensitive projects we studied have improved or at least maintained roadway level-of-service despite narrowed roadways. How? Through clever treatment of intersections, where most delays occur.

The Standard Cross Section

Nearly all state DOTs include typical sections—another culprit—in their road design manuals. If an area is classified as urban, and a road is functionally classified as a principal arterial, the typical section for an urban principal arterial becomes the default roadway.

Typical sections inhibit flexible and context-sensitive design in two ways. First, where right-of-way is constrained, something must be sacrificed to maintain standard travel lanes, and it is usually the sidewalk, landscape buffer, or parking lane. Also, there is a tendency to adopt a single, typical section for an entire stretch of road, even when conditions change along its length. Having a single typical

Figure A.2.8: Sunset Drive before reconstruction, South Miami, Florida.

Figure A.2.9: Sunset Drive after reconstruction, South Miami, Florida.

section is convenient for the design engineer and construction crew, but it is not good policy.

The proposed five-lane section over the length of southern Isleta Boulevard (see above) created excess capacity at the midpoint, and correspondingly higher speeds and higher costs. The hybrid design with a three-lane section in the middle will save $4.5 million on right-of-way acquisition and construction costs. The tendency to use a single typical section is also evident in the Brooklyn case study at the beginning of the article.

An even more dramatic example is found in Saratoga Springs, New York. South Broadway (US 9) changes from a four-lane, semi-rural highway with a striped median and posted speed of 55 mph to a three-lane urban road with a raised median, single northbound lane, and posted speed of 30 mph, all in a stretch of 1,800 feet.

By all accounts, the section in question would have been reconstructed as a uniform four-lane roadway with a flush median, but for two things. First, in 1999, New York State started an Environmental Initiative, with context-sensitive design at its heart. Second, the highway passes Saratoga Spa State Park, the Lincoln Baths, and the Museum of Dance. Something special, more like a gateway, was required. Ultimately, a series of roadway sections got built that make a smooth transition from the high-speed semi-rural environment to the south to the low-speed urban environment to the north (see Figure A.2.6).

The Four Rs

Roads that are being resurfaced, restored, or rehabilitated (so-called 3R projects) do not have to be upgraded to current geometric standards. Instead, states can (and some do) make them subject to special standards below those of AASHTO—

Figure A.2.10: Multiple sections heading into town on US 9, Saratoga Springs, New York.

with the blessing of the Green Book. By contrast, under state and federal policies, roads reconstructed down to their bases must be brought up to current standards.

In a constrained main street environment, there is no reason to treat 3R and reconstruction projects differently. In both cases, designers already know how a road performs based on historical accident and other data. The Maryland State Highway Administration reached this conclusion in Westminster, and now leaves existing cross sections alone unless there is a documented crash problem.

Exceptions to the Rules

The Federal Highway Administration grants design exceptions on the National Highway System, and the same is true for state or local DOTs on non-NHS roads. Between 1997 and 1999, NJDOT engineers requested and received design exceptions for 81 projects, including most major highway projects undertaken by the state.

From our review of the 81 reports, exceptions are typically requested in order to save money, not to preserve context. Here is a typical scenario: A road is being reconstructed, and a sharp curve must to be straightened to meet the standard for horizontal curvature. However, someone's house or business would be taken, some park or cemetery would be encroached on, a lot of extra asphalt would have to poured, or some other big expense would be incurred.

And so the design engineer checks crash statistics for the location in question, focusing on the types of crashes associated with substandard horizontal curves, and finds that the curve in question generates only an average number of crashes compared to state norms. Noting that substantial costs can be avoided by allowing a substandard horizontal curve, a design exception is requested and granted.

Sometimes context also is taken into account, as with a road and bridge project in an historic district of Oxford Township, New Jersey. But this is a rare occurrence.

Let's Use Common Sense

Gary Toth, one of the overseers of our research at New Jersey DOT, keeps saying that context-sensitive design is just a matter of common sense. If the designer understands the safety and mobility needs to be addressed, and then uses common sense to fit sound engineering principles into the environmental and community context, a design will emerge that represents the best of all worlds.

On 15th Avenue in Anchorage, Alaska, the first common sense decision was to divide the roadway section into three segments because traffic turns off as it heads west. Daily volumes drop from 22,000 at the eastern end of the avenue to 4,000 at the western end, implying very different cross sections. Focusing on the westernmost segment, the second common sense decision was to drop a lane, from four to three, the center lane becoming a continuous left-turn lane.

In a third common sense decision, the outer westbound lane was replaced with a five-foot sidewalk and landscape buffer between the road and sidewalk. By reducing the number of lanes, the state is also reducing the amount of snow to be cleared, and creating more storage space for it in the buffer strip. With Anchorage's low sun angle, and the sun blocked by buildings and trees, the engineers expect that three additional weeks of bare pavement a year will result from the decision to place the sidewalk on the north side of the street rather than dropping an eastbound lane and placing the sidewalk on the south side.

The final exercise of common sense was to seek several design exceptions. Some stopping and intersection sight distances, curb return radii, shoulder widths, and clearances to obstructions will remain substandard. However, the project will still improve safety and, with the design exceptions in place, cost about a third as much.

What's Next

Because AASHTO has been responsible for, or at least been blamed for, so much of what of what we don't like about urban streets in this country, it seems fitting to end on a positive note from the AASHTO Bridging document.

> *The notion of designing a "high quality" low speed road is counterintuitive to many highway engineers, yet it is in many cases the appropriate solution.... Context-sensitive design in the urban environment often involves creating a safe roadway environment [by encouraging drivers] to operate at low speeds.*

The document then offers a qualified endorsement of traffic calming, something unimaginable five years ago.

Appendix A.3

Survey of Local Governments

The TPI team surveyed local governments to assess their experiences with DOT main street projects. Questionnaires were sent to the mayors of all 566 localities in New Jersey. Upon receiving written responses, the TPI team conducted follow-up phone calls with localities that provided ambiguous responses. The additional comments are reflected in the tables below.

General Results

Survey results are summarized in Table A.3.1. One hundred forty-two (25%) localities responded to the survey. Of those, 60 (42%) have no state highways that function as main streets through their communities. This narrows the field considerably in terms of impacts of state highways on community life.

Of the 82 localities with state highways functioning as main streets, 39 (48%) report no work completed during the past five years and no work planned, further limiting the field. Of those reporting work, many have had only resurfacing projects, where the potential for conflict with local objectives is less than with reconstruction, widening, or realignment.

Of the 37 towns with recent DOT experience, 19 (51%) stated that the work generally was consistent with local objectives. Twenty-four percent stated the work was not consistent and the remaining 24 percent gave mixed reviews. In some cases, concerns arose when DOT failed to preserve or recreate main street character. These are the cases of greatest relevance to this project. In other cases, concerns arose for the opposite reason, the failure of DOT to widen roads, relieve congestion, or remove pedestrians and cyclists from the street environment to the degree desired locally. Overall the record is mixed, but with enough legitimate main street concerns to justify policy changes within DOT.

	Count	Percentage
All surveys	142	100%
No state route	60	42%
State route	82	58%
State Routes	82	100%
No work	39	48%
Planned work	6	7%
Recent work	37	45%
Recent work	37	100%
Positive	19	51%
Mixed	9	24%
Negative	9	24%

Table A.3.1: Summary of Mayors Survey.

Specific Concerns

To illustrate how conflicts arise between communities and DOT, specific concerns reported in the mayor's survey are broken down by type in Table A.3.2. Included are 18 projects already completed as well as four projects in planning. Of the concerns reported, just over a third involve roadway design elements. In no case did localities have an issue with DOT geometric design standards. Where DOT actions most often conflicted with local objectives was in the failure to calm traffic, provide for pedestrians or cyclists, or beautify the street.

Town	Route	Locality's issue	State's position	Type of Concern (Design Element/ Other)
Bound Brook	28	Requested left-turn lane 6-inch curbs	No left turn lane 4-inch curbs	DE DE
Bridgeton	49	Requested reconstruction	Repave only	Other
Bridgewater	28	Overnight work hours	—	Other
Burlington	130	Requested trees & urban design elements		No trees
or urban design elements		Other		
Chester East Amwell	206 179	Requested additional turn lane Thought that bypass built in 70's negated need for wider road through town Requested pedestrian amenities Thought new, open road invites speeding, does not preserve community character nor control traffic. Asked that drainage issues be addressed Requested traffic calming elements Old historic wall destroyed during	No turn lane Built wider road None built Must build to standards Not addressed None included Wall since rebuilt	DE DE Other DE Other DE Other
Elmer	40	construction Requested reconstruction	Repave only, will reconstruct soon	Other
Fredon	(planned) 94	Drainage problems remain since two locations continue to hold water and	—	Other
Lambertville	29	regularly form ice in the winter Wants 25 mph posted instead of 35	—	Other
	(planned)	and 40 mph		
Mannington Maple Shade	45 73	Reconstruction time too long Requested widened road	— No widening	Other DE
Marlboro	9	Requested drainage issues be addressed Requested 6-foot high anti-pedestrian	Insufficient resources No fence	Other Other
Middlesex	28	fence Access to businesses limited during	—	Other
Morristown	124	construction Requested additional sidewalks Requested new drainage to coordinate with the project's next phase Requested trees	None built No additional drainage No trees	Other Other Other
Netcong	46/183 (planned)	Requested sidewalk ramps Wants to calm traffic and improve pedestrian conditions in area around to-	No ramps —	Other DE
Princeton Borough	27, 206	be-removed traffic circle Timing of work hurt businesses, night-	—	Other
Randolph	10	time work kept residents awake Requested retention of existing grass median Requested preserving woodlands and sound buffering along roadside	Installed concrete median Eliminated some woodlands to widen shoulder	DE Other
Ridgefield	1/9, 46, 63, 93	Requested cycle and pedestrian facilities Did not see need for cycling facilities Disagreed with on-street parking	No cycle or pedestrian facilities Prohibited parking	Other Other DE
Rockaway	46	prohibition Requested widened road	No widening	DE
Burrough Seaside Park	35	Concerned with pedestrian safety	—	Other
Vineland	(planned) 47 (planned)	Concerned with pedestrian safety crossing widened road Concerned for cyclists on new cycle	— —	DE DE
Woodbury	45	lanes at freeway ramps Concerned with resurfacing around manholes	—	Other

Figure A.3.2: Table of specific issues.

Appendix A.4

Main Street Visual Preference Survey

The recommended policies and practices apply to main streets. But what is a main street? To zero in on the salient attributes of these special roadways, the TPI team developed a *Main Street Visual Preference Survey*. It consists of 50 centerline images of diverse roadways running through villages, towns, cities, and suburbs throughout the United States. It was distributed to the Technical Review Committee (TRC), and these experts were asked to:

1. Rate each street as a good or bad example of a main street (either actualized or potential), and
2. List the attribute(s) that makes the particular street a good or bad example.

The results confirmed our suspicion that main streets are distinguished not so much by geometric design elements as by roadside conditions and relative scale. Results also suggest that main streets appear in many different contexts, not just as traditional urban shopping streets.

Below are some of the best and worst examples of main streets, according to the TRC.

Good Examples

West Chester, Pennsylvania

Albany, New York

Bad Examples

Colorado Springs, Colorado

Berkeley, California

Attributes of Best and Worst

The most common descriptions of the highly rated images were:

- Street and buildings in correct proportions and scale,
- Low speed and volume,
- Pedestrian presence and pedestrian orientation,
- Interesting visually, good lighting, nice tree canopy,
- Vibrant commercial, buildings close to street,
- On-street parking available, and
- Nice gateway feature.

The most common descriptions of poorly rated images were:

- Too wide, too much asphalt,
- High speed,
- No pedestrians,
- Minimal streetscaping,
- Low density, no commercial/retail density, too many curb cuts,
- Typical auto-oriented suburban arterial, and
- Looks rural.

Quantifying "Main Streetness"

At some point, DOT will need to classify its urban highways with respect to context (main street or other), as it presently classifies them with respect to function (principal arterial, minor arterial, etc.). This will be necessary to implement the main street policies recommended herein, such as the use of Main Street Overlays. To assist DOT with this task, the TPI study team analyzed the ratings of street scenes by the TRC. First, a content analysis was performed on each slide, and the salient attributes of the streets and contexts were quantified. Then, average scores assigned the slides by the TRC were modeled in terms of these attributes using multiple regression analysis, with the attributes serving as independent variables.

Twenty-two attributes were quantified and tested for their explanatory power:

(1) Number of pedestrians visible.

(2) Number of travel lanes.

(3) On-street parking—1 if yes, 0 is no.

(4) Curb extensions—1 if yes, 0 if no.

(5) Marked crosswalks visible—1 if yes, 0 if no.

(6) Commercial uses abut—1 if yes, 0 if no.

(7) Mixed uses abut—1 if yes, 0 if no.

(8) Percent visible street frontage with trees.

(9) Percent visible street frontage with active uses (pedestrian generating uses).

(10) Sidewalk width in feet.

(11) Building setback in feet.

(12) Ratio of building height to width from building face to building face.

(13) Number of moving vehicles visible.

(14) Textured pavement visible—1 if yes, 0 if no.

(15) Median—1 if yes, 0 if no.

(16) Median width in feet.

(17) Travel lane width in feet.

(18) Uniform building heights—1 if yes, 0 if no.

(19) Buffer strip width in feet.

(20) Primarily historic buildings visible—1 if yes, 0 if no.

(21) Primarily small-scale buildings visible—1 if yes, 0 if no.

(22) One-way street—1 if yes, 0 if no.

Five attributes proved statistically significant in our "best-fit" regression equation: sidewalk width, percentage of frontage with active uses, percentage of frontage with street trees, building setback from the street, and number of travel lanes. All have the expected relationships to "main streetness"—the first four variables are positively related to slide scores, the fifth is negatively related. The variables collectively explain 79 percent of the variance in slide scores. All but one of these variables—number of travel lanes—measure some aspect of context, as opposed to an attribute of the street itself. Dropping this one variable, the resulting best-fit equation still explains 73 percent of the variance in slide scores. The equation takes the form:

SCORE = 2.22 + 0.0149*TREES + 0.0132*ACTIVE USES + 0.125*SIDEWALK – 0.0258*SETBACK

This equation, or a similar one estimated from a visual preference survey involving more and different respondents, could be used by DOT to identify urban highways as potential main streets. It would only be necessary to establish a threshold score for qualification as a main street, substitute values for individual highway segments into the equation, and see if the segments reach the qualifying level.

Discussion

Beyond the ratings and attributes, this survey generated two important ideas from the TRC. First, placing too much emphasis on traditional main streets would be a mistake. A traditional main street has historic character, is narrow, and is lined by small shops. New Jersey has few of these. There are certainly more state highways running through New Jersey's communities with few (if any) historic buildings, wider cross-sections, and mixed land uses. These routes may warrant special treatment, too.

The other important idea relates to the potential for retrofits. As stated in the questionnaire, the TPI team was looking not only for good examples of existing main streets, but also for streets that might be redesigned to function as main streets. From the survey results, context is all-important. It appears that streets with pedestrian-generating uses, small building setbacks, and similar attributes could be made to function as main streets if the paved widths were narrowed, sidewalks widened, medians added, trees planted, and other design changes were made.

Appendix A.5

Relevant Federal Laws and State Initiatives

by Michael King, Trefor Williams, and Reid Ewing

Adapted from "States Flexing Main Street Design," paper presented at the 2001 Annual Meeting, Transportation Research Board, Washington, D.C.

Design standards tailored to community objectives would not be possible without recent changes in federal and state laws and policies.

Relevant Federal Initiatives

Beginning with the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and continuing with the National Highway System Act (NHS Act) of 1995 and Transportation Equity Act for the 21st Century Act (TEA-21) of 1998, the US Highway Code now allows, and even encourages, a certain amount of flexibility in highway design—except on the Interstate Highway System. Without federal historic preservation and environment protection laws, less impetus would exist at the state and local levels to exercise flexibility.

Transportation Laws

The specific laws providing flexibility in road design can be found in Section 109, Title 23 of the United States Code. ISTEA changed the law to allow the adoption of individual state standards for highways other than those on the National Highway System (NHS).

> (o) COMPLIANCE WITH STATE LAWS FOR NON-NHS PROJECTS—Projects (other than highway projects on the National Highway System) shall be designed, constructed, operated, and maintained in accordance with State laws, regulations, directives, safety standards, design standards, and construction standards.

The NHS Act added the provision that even highways on the NHS (except Interstate highways) can be designed to minimize adverse community impacts. Also, they can be designed giving due consideration to the needs of pedestrians and cyclists.

> (c) DESIGN CRITERIA FOR NATIONAL HIGHWAY SYSTEM—
>
> (1) IN GENERAL—A design for new construction, reconstruction, resurfacing (except for maintenance resurfacing), restoration, or rehabilitation of a highway on the National Highway System (other than a highway also on the Interstate System) may take into account, in addition to the criteria described in subsection (a)—
>
> > (A) the constructed and natural environment of the area;
> >
> > (B) the environmental, scenic, *aesthetic, historic, community*, and preservation impacts of the activity; and
> >
> > (C) access for other *modes* of transportation. [emphases added]

TEA-21 changed highway planning requirements. TEA-21's reference to "planned future traffic" permits designing for volumes according to a plan, as opposed to merely accepting more traffic as inevitable. The reference to the "needs of each locality" suggests coordinating highway projects with local objectives and local plans.

> (a) IN GENERAL—The Secretary shall ensure that the plans and specifications for each proposed highway project under this chapter provide for a facility that will—
>
>> (1) adequately serve the existing and *planned future traffic* of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and
>>
>> (2) be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (1) and to conform to the particular *needs of each locality*. [emphases added]

In addition to the flexibility provided in Section 109 of Title 23, Section 402 calls for each state to positively address speeding and attendant crashes. The language could be used to justify setting design speeds as low as posted speeds on main streets.

> (a) Each State shall have a highway safety program…designed to reduce traffic accidents and deaths, injuries, and property damage resulting therefrom. Such programs shall be in accordance with uniform guidelines [which] shall include programs
>
>> (1) to reduce injuries and deaths resulting from motor vehicles being driven in *excess of posted speed limits*. [emphasis added]

Historic Preservation Laws

Should a roadway project affect a property that is listed on or determined eligible for the National Register of Historic Places, the National Historic Preservation Act (NHPA) of 1966, as amended, requires an assessment of the magnitude of the effect. The NHPA then calls on the lead government agency to adopt measures to avoid, minimize, or mitigate any negative impact. Protected historic transportation resources include sites of significant events (e.g., road from Selma to Montgomery, Alabama), segments of important trading or travel routes (e.g., Route 66), and grand boulevards from the "City Beautiful" period (e.g., Lake Shore Drive in Chicago).

If there is an available avoidance alternative that is both reasonable and feasible, which solves the transportation problem and avoids the negative effect on the resource, Section 4(f) of the Department of Transportation Act of 1966 requires the selection of that alternative. If no avoidance alternative is available, the project must incorporate all possible design changes to minimize or mitigate harm to the affected property.

Innovative street designs may run afoul of historic preservation guidelines and standards if they substantially change the appearance or character of an historic resource, or if they substantially affect the relationship between the street and historic buildings along it. In New York State, for example, the State Historic Preservation Office (SHPO) has rejected curb extensions as inconsistent with the wide, straight streets of the pre-automobile era.

For an SHPO to have legal standing to intervene in such cases, its objections must be based on National Register documents describing why the resource is historic. Then, there must be a finding of sufficient negative impact to justify stopping a project or requiring major redesign or use of alternatives.

Environmental Laws

The National Environmental Policy Act (NEPA) of 1969, as amended, requires the lead government agency to prepare of an Environmental Impact Statement (EIS) or an Environmental Assessment (EA) when a federal action will have or could have a significant impact on the environment. Federal actions subject to this requirement include highway projects funded in part by FHWA. EISs, and to a lesser degree EAs, require consideration of alternatives to proposed actions; assessment of social, economic, and environmental impacts of proposed actions and alternatives; and a plan to mitigate adverse impacts of proposed actions.

Under FHWA regulations, certain types of federally funded highway projects normally require a full EIS, such as construction of multilane road on a new alignment. Other types normally qualify for categorical exclusions from the EIS/EA requirements, such as 3R (resurfacing, restoration, and rehabilitation) projects. And then there are the intermediate projects that may or may not significantly affect the environment. They normally receive an intermediate level of scrutiny via EAs. Whatever the mechanism, NEPA has been used to challenge and modify many federal highway projects, including some involving main streets. An example from our case studies is Isleta Boulevard in Albuquerque (see Appendix A.2).

Federal Technical Assistance Initiatives

Since passage of ISTEA, FHWA has generally supported flexibility in highway design and has sponsored various initiatives toward this end. The federal push effectively began in 1997 with the publication of *Flexibility in Highway Design*. This book encourages highway designers to look for flexibility within the existing guidelines by:

- ❑ Going to the lower end of geometric ranges in American Association of State Highway and Transportation Officials' (AASHTO's) *A Policy on Geometric Design of Highways and Streets* (the Green Book),
- ❑ Lowering design speeds,
- ❑ Reclassifying highways to a lower functional class,
- ❑ Maintaining highway geometry by undertaking 3R-type work,
- ❑ Using design exceptions where environmental consequences are great, and
- ❑ Developing alternative geometric standards for non-NHS roads, especially scenic roads.

Five states (Connecticut, Kentucky, Maryland, Minnesota, and Utah) are participating in a joint FHWA/AASHTO project to train engineers in context-sensitive design (CSD) under National Cooperative Highway Research Program (NCHRP) project 15-19. This is a mostly process-oriented initiative dealing with community involvement, "scope creep," and project management. The initiative began in 1998 with a final report due in 2001. Maryland and Minnesota have emerged as leaders, spurred on by their respective governors' efforts to control sprawl and promote "livability." Lessons learned from this NCHRP project and other state CSD training programs will be incorporated into an upcoming CSD training manual.

Under NCHRP project 20-17, the AASHTO Subcommittee on Design is trying to bridge a perceived gap between *Flexibility in Highway Design* and the AASHTO Green Book. Their guidance document is in final draft, and an advance copy was reviewed for this report. This "bridging" document delves into issues of process, geometric design, roadside safety, and tort liability. Most notably it questions some long held beliefs about design speed, traffic calming, stopping sight distance, and roadside clearance. For example, it states that the "…concept of a wide, object-free clear zone has little meaning in the urban environment…" This quote is illustrative of the direction that AASHTO is taking in the new era of context sensitivity.

TEA-21 instructed FHWA to work with professional groups such as AASHTO and the Institute of Transportation Engineers to ensure that pedestrians are fully integrated into the transportation system. This led to an NCHRP grant (project 20-07, task 105) to produce a pedestrian facility design guide. The draft guide has been submitted to AASHTO for its review, balloting, and publication, hopefully by 2002.

Some proposed guidelines currently under discussion include:

- Posted speed = design speed,
- Ten to eleven foot lane widths unless there is heavy cycle, truck, or bus traffic,
- Sixty-foot maximum unprotected pedestrian crossing distance,
- Use of *effective* turning radii at intersections,
- No *free-flow* right turns, and
- No *roll-type* curbs.

Relevant State Initiatives

Turning from the national to the state role, we find a significant number of state transportation agencies re-examining and changing the way they design and build roads. For the purposes of this study, we surveyed the three states adjoining New Jersey, states in the region with good examples of flexible highway design, states identified in various NCHRP and FHWA reports as leaders in flexible design, and other states known to have progressive DOTs. Six states (Colorado, Idaho, Maine, Rhode Island, South Carolina, Vermont) were identified in *Flexibility in Highway Design* as in the process of revising their roadway design standards pursuant to ISTEA. Three went ahead and did it. Most New England states have scenic or historic preservation laws that affect reconstruction and 3R work. Other states have incorporated flexible policies into their design manuals or practices. Relevant state initiatives are summarized below.

New Standards Adopted and Applicable to Main Streets	
Connecticut	New standards apply to intersection sight distance, design year projections, parking lane width, and allowable grade on non-NHS routes.
Idaho	New standards apply to design speed and design year projections on non-NHS routes
Vermont	New standards apply to design speed, level of service, travel lane width, stopping sight distance, horizontal curve, and allowable grade on non-NHS routes. New standards adopted for rural roads.
Maine	New standards apply to level of service, cross section, and guardrails on secondary roads.
State Standards Discarded in Favor of AASHTO Guidelines	
Maryland	State now relies solely on Green Book.
Policies Adopted and Applicable to Main Streets	
Delaware	New manual establishes guidelines for traffic calming on state roads.
Oregon	Special Transportation Area designation allows for alternate performance standards.
Washington	Livable Communities Initiative establishes performance measures by which projects in towns will be judged.
Scenic/Historic Laws Applied to Main Streets	
Connecticut	Scenic Byway Program limits cross-section width of highway projects on scenic roads.
Rhode Island	Scenic Roadways Board limits projects that would affect the characteristics of a scenic road.
Other	
Maine	Sensible Transportation Policy Act limits new highway capacity in communities.
Maryland	Thinking Beyond the Pavement initiative changes agency approach to planning and design.
New York	Environment Initiative incorporates CSD into design process.

Table A.5.1: Overview of state standards and policies.

Connecticut

The state of Connecticut has passed two laws authorizing and directing the state Department of Transportation (ConnDOT) to design roads more appropriate to local conditions. In 1998, the Connecticut General Assembly passed *An Act Concerning Alternative Design Standards for Roads & Bridges* that instructed ConnDOT to:

> *…establish alternative design standards for bridges,…roads and streets [and in doing so] solicit and consider the views of chief elected officials…, the Connecticut Trust for Historic Preservation, regional councils of governments, the Connecticut Council on the Arts, the Federal Highway Administration, and the Rural Development Council.*

At the time, ConnDOT was in the process of updating its design manual. This act forced the completion by a specific date. The revised standards generally are within Green Book values, but deviate in a few instances.

Since 1989, Connecticut has been designating state routes as scenic if they, among other criteria, abut "land on which is located an historic building or structure" as designated in the national or state historic places registry. While only two roads have thus far received designation, the Merritt Parkway and State Route 169, the program is of interest for its stand on pavement width. When a designated scenic road is to be *improved* or *maintained*, ConnDOT can only extend the width of the pavement 12 inches beyond the existing shoulder. This means that the footprint of the road must essentially remain intact, and that horizontal curves may not be straightened nor lanes widened unless the existing shoulder is narrowed.

State Route 169 was designated scenic in 1991, 190 years after being incorporated as the Norwich and Woodstock Turnpike. The designated portion is 32 miles long and travels through many small towns in the eastern part of the state including Brooklyn with its two historic districts, and Woodstock, with its town commons. According to the law "any alteration of a scenic road shall maintain the character of such road…if practical." Coupled with the restriction on road widening, the de facto standard for this road precludes any large-scale improvement in level of service or upgrade of functional class.

Delaware

The state of Delaware is one of only five states that operate and maintain local streets normally under county or city control. All told, 88 percent of the streets and highways in Delaware are under state control. Accordingly, the state Department of Transportation (DelDOT) has taken an active role in developing policies to make roadways from minor arterial on down the functional hierarchy more context sensitive.

DelDOT has adopted new "skinny" subdivision street standards and a *Traffic Calming Design Manual*, the first of its kind in the nation. The manual has been taken through the rule making process and incorporated into the state *Road Design Manual*. It is viewed as consistent with and supportive of the Statewide Long-Range Transportation Plan, whose goal is to maintain and improve mobility and access, while preserving communities and improving the quality of life. Traffic calming is a means toward the latter ends.

The manual does not mandate traffic calming. Rather, if traffic calming is initiated by residents, local officials, or others, the Department will follow the guidelines contained therein with rare exceptions. Even with standardization of traffic calming in Delaware, design flexibility will remain. The manual sets forth guidelines, rather than rigid standards. The Department reserves the right to deviate from these guidelines in special cases.

Florida

Design standards for roadway construction used by the Florida Department of Transportation (FDOT) generally exceed Green Book values. Yet, FDOT is still concerned about community livability. Toward that end, a new policy directive, *Transportation Design for Livable Communities*, is being incorporated into the roadway design manual.

What makes the directive interesting are the specific treatments called for, or at least allowed, on urban sections of the State Highway System (SHS) and off the SHS. While not constituting a standard, this addition to the design manual could further the cause of flexibility and CSD.

Maine

In 1994 the Maine state legislature passed the Sensible Transportation Policy Act, which directs the state Department of Transportation to give preference to alternatives that will not increase a highway's capacity through a community. The law applies to *significant* projects, those that add capacity, and projects of *substantial* community interest.

General Techniques	SHS-urban	Non-SHS
Landscaping	Allowable	Allowable
Sidewalks Or Wider Sidewalks	Yes	Allowable
Street Furniture	Allowable	Allowable
Bike Lanes	Allowable	Allowable
Alternate Paving	Allowable	Allowable
Pedestrian Signals, Mid-block Crossings, Median Refuge Areas	Yes	Allowable
Techniques To Reduce Speed And/Or Volume		
Speed Humps	No	Allowable
On-street Parking	Allowable	Allowable
Curb Extensions	Allowable	Allowable
Street Narrowings (Chokers)	Allowable	Allowable
"Compact" Intersections	Yes	Yes
Roundabouts	Allowable	Allowable
Chicanes	Allowable	Allowable
Street Closing Or Route Relocation	Allowable	Allowable
Techniques To Support Shift Between Modes		
"Pedestrian-friendly" Crosswalk Design	Yes	Allowable
Mid-block Pedestrian Signals	Allowable	Allowable
Illuminated Pedestrian Crossings At Intersection	Allowable	Allowable
Bike Lanes/Shoulders	Yes	Yes
Area-wide Techniques		
Traffic Calming	Allowable	Allowable
20 Mph Posted Speed	No	Allowable
Limit Lanes	Allowable	Allowable
Avoid Traffic Signals	Yes	Yes
Greenway Corridors	Yes	Yes

Table A.5.2: Techniques applicable to main streets in Florida

Maryland

Maryland's "Thinking Beyond the Pavement" initiative is an outgrowth of the governor's Smart Growth program. The initiative is part of a larger NCHRP project (see NCHRP 15-19 above). A series of stakeholder charrettes, internal awareness training sessions, and implementation workshops were held in 1999. Action teams were then established to investigate further and produce "how-to change" reports.

While Maryland has no statute or rule mandating it, the Maryland State Highway Administration (MSHA) has emerged as a leader in flexible highway design. In 1998, MSHA's Deputy Chief Engineer wrote a memo declaring that the state's highway design manual was no longer to be used. He had found that the templates in the manual were generally oversized (especially stopping sight distance and vertical curves) and stymied creativity among engineers. The agency was losing legal challenges when an element was below the state standard, but above the Green Book minimum. Now the agency relies exclusively on the Green Book, and MSHA design engineers reportedly enjoy the challenge of designing roads rather than applying templates. As more national experience and research become available, MSHA plans to experiment with designs below AASHTO minimums in traffic-calmed settings.

Along with the change in geometric standards, policies have been reworked. MSHA no longer differentiates between reconstruction and 3R work on existing roads, and has a policy of leaving cross-sections alone unless there is a documented crash problem that could be fixed through reconstruction.

New York

In response to the Governor's 1999 Environmental Initiative (EI), the New York State Department of Transportation (NYSDOT) has sought to establish an environmental ethic within the department, advance state and federal environmental policies, and strengthen relationships with environmental agencies and the public.

As with most DOTs, strict regulatory compliance had long been a part of the culture at the NYS-DOT. While this reactive approach did reduce unnecessary environmental damage, and at times gained grudging regulatory agency cooperation, it was not a satisfying way of doing the people's work.

Under the EI, environmental enhancements are provided as part of capital projects, including:

- ❑ Street ambience enhancements (benches, paving, period lighting),
- ❑ Landscape and streetscape plantings
- ❑ Bikeways, paths, routes and greenways,
- ❑ Improved pedestrian facilities and crossings, and
- ❑ Wetland restoration.

Design manuals and procedures are being updated to incorporate this and other initiatives. The Design Division is conducting staff workshops on CSD, and has instituted an Excellence in Engineering Award to celebrate projects that exemplify CSD.

Oregon

In 1999, as a complement to its highway design manual, the Oregon Department of Transportation (ODOT) and the Oregon Department of Land Conservation and Development published *Main Street…When a Highway Runs Through It…*. In doing so, these agencies sought to bring a "peaceful coexistence to the dual personas of downtown and highway." The following unconventional performance measures were proposed to assess how well a highway project supported downtown or main street functions:

- ❑ Target (lower) speeds met,
- ❑ Smooth traffic flow (less delay at intersections), and

- Improved comfort in crossing the highway (less pedestrian delay, less turning delay, reduction in crash frequency and severity).

Perhaps the most significant Oregon innovation is the Special Transportation Area (STA) designation. Established in the *Oregon Highway Plan*, this designation allows ODOT and local governments to jointly recognize special roadways where the interests of local residents and businesses are weighed against the interests of through traffic. With STA designation comes greater flexibility in roadway geometrics and performance standards, both of which can be tailored to a particular street.

STA-designated main streets may include:

- Signals synchronized for low speed,
- Conversion to *urban* cross-section (with curb & gutter),
- On-street (parallel) parking with curb extensions,
- Four to three lane conversions (up to 18,000 ADT),
- Shared vehicle/bicycle lanes at speeds of 25 mph or less,
- Medians or refuge islands (minimum eight feet wide),
- Modern roundabouts,
- Intersections aligned at 90 degrees,
- Tightened or extended corners,
- Marked (high-visibility) crosswalks, and
- Gateway treatments at transitions from open highway to downtown.

STA-designated main streets typically exclude:

- Free right-turn lanes,
- Left-turn stacking lanes,
- Speed-change lanes, and
- Large corner radii.

A significant flaw in the STA program is that historic towns with established main streets do not derive much benefit from the designation, and the process is a significant bureaucratic burden. Meanwhile, suburban communities have sought STA designation for streets that are clearly not main streets. For example, one town attempted to designate a freeway interchange and others have designated suburban strips.

Rhode Island

The *Scenic Roadways Design Standards and Scenic Roadways Design Policy*, proposed in 1996, established new standards for design speed, lane width, sidewalk and border widths, and bridges on scenic routes in Rhode Island. The first test case was Ministerial Road in South Kingston, where it was found that the new standards would not preserve the road as desired. Consequently, the new standards were never officially adopted.

However, long before the effort to develop new design standards, the Rhode Island Scenic Roadways Board was established to:

> *...create & preserve rustic and scenic highways for vehicle, bicycle and pedestrian travel... [and to protect and preserve culture & trees, et. al. by] establishing protective standards of scenic highway design, speed, maintenance...*

Regarding construction, repair, or alteration of scenic roadways, the Board has adopted rules limiting changes in grade, vegetation (trees), curb lines, or and anything else that affects the scenic qualities of a road. The state Department of Transportation or municipalities may nominate any road over which they have control for scenic designation. Six highways have been designated so far, with a seventh to be voted on soon. None of the first six are main streets, but the seventh, State Route 114, runs through the heart of Bristol's downtown Historic District as Hope Street.

Hope Street is characterized by unbroken *allees* of mature Linden trees growing in large green buffer zones. It has sidewalks set far back from the curb, and several historic buildings and stone walls along it. The broad right-of-way is part of the town plan laid out in 1680.

Vermont

Over the past ten years, the Vermont Agency of Transportation (VAOT) has undertaken three related flexible design initiatives. Two were procedural: establishment of a Project Definition Team to settle conflicts in the planning, scoping, and project development, before projects are engineered; and reorganization of the agency to a project manager-based system. The third initiative was the development of new design standards for non-NHS routes. Vermont's new design standards were an outgrowth of the long-range planning process required by ISTEA. As part of that process, VAOT found that roads built using the AASHTO Green Book guidelines were sometimes out of context and inconsistent with community values; many projects required design exceptions or were scuttled due to community opposition.

In response, the Vermont Legislature ordered VAOT to develop standards more appropriate to Vermont. The new standards relate to design speed, LOS, travel lane width, clear zone, stopping sight distance, horizontal curvature, and grade. Because Vermont is the only state to largely rewrite its design standards pursuant to ISTEA, it is instructive to consider the timeline. It took five years to get agreement on sub-AASHTO standards.

Two items of note have followed Vermont's new roadway standards. The first is an intergovernmental agreement with FHWA giving VAOT the power to grant its own design exceptions on all highways except Interstates. While state standards for NHS routes are within Green Book guidelines, having the authority to grant design exceptions has caused VAOT to be particularly flexible and responsive.

The second concerns the classification of urban and rural roadways. The Green Book adopts the census definition of "urban place." Many towns in Vermont have smaller populations, but are nonetheless built up. VAOT has taken the position that a road's classification should be based on the surrounding built form, not population or population density. By changing the classification from rural to urban, the agency has greater flexibility with design elements such as roadside clearance, curbs, and shoulder width.

Washington

The current Washington State Transportation Plan calls for "Livable Communities." What that entails is not defined. To address this shortcoming, the Washington State Transportation Commission recently asked a statewide working group to draft recommendations. The group consisted of representatives from the Washington Department of Transportation (WSDOT), environmental advocates, mayors, the National Highway Traffic Safety Administration, transit agencies, and others.

The group arrived at a series of strategies to achieve livability, some of which affect main street design:

- ❑ Preserve existing corridors, both urban & rural,
- ❑ Be flexible in design standards and procedures,
- ❑ Define community values during planning and design,
- ❑ Enhance scenic views, neighborhoods, and historic districts, and
- ❑ Provide focal points along roadways—such as plazas.

To ensure that these strategies are carried out by WSDOT, the working group recommended that the agency:

- ❑ Survey communities every two years to assess their level of satisfaction with projects,
- ❑ Start project outreach and coordination four to six years prior to construction, and

- ❑ Seek alternative funding sources for livable community projects.

The last point is especially pertinent, for funding always influences an agency's ability to respond to community needs. WSDOT wants its livability initiative to be successful, yet strategic and appropriate. To that end the Livable Communities Initiative will provide early notification about projects to communities, help them develop a livable community plan, and work with them to find additional funding for amenities.

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Appendix A.6

Summary of Design Exceptions 1997-1999

For this project, the TPI team reviewed eighty-one design exception reports filed between 1997 and 1999. Of the eighty-one, fifty reports were found to have given some consideration to community, historical, or environmental factors.

- Several projects required design exceptions to keep 3R projects from becoming full reconstruction projects, with greater attendant community impacts.
- Several projects in village or suburban settings required design exceptions, in part, to lessen community, historic, or environmental impacts.
- Several bridge replacement projects required design exceptions, in part, to lessen community, historic, or environmental impacts.

This record is less impressive than it at first appears. Of the eighty-one design exceptions, eighty appear to be driven primarily by cost savings. In only one case, involving historic preservation in Oxford, New Jersey, was the driving force context savings. In other cases, community, historic, or environmental factors appeared to be somewhat incidental to the design exception.

The 3R projects involved an odd catch-22. The typical 3R project fails to qualify for a programmatic design exception, and therefore requires lane widening, shoulder widening, or some other improvement in cross section or alignment to meet current design standards. With such an improvement, the project is automatically reclassified as a full reconstruction project. So the design engineer seeks one or more regular design exceptions to keep the 3R project what it was always intended to be, a 3R project.

CSDE	Number of Projects
Shoulder Width	20
Vertical Curve SSD	16
Superelevation	13
Horizontal Curve Radius	12
Vertical Clearance	7
Auxiliary Lane Length	6
Travel Lane Width	5
Bridge Width	4
Horizontal Curve SSD	3
Intersection Sight Distance	2
Grade	1
Cross Slope	0

Table A.6.1: Type and frequency of design exceptions.

The bridge projects involve such substantial outlays in most cases that construction costs overwhelm all other factors. In fact, bridges themselves seldom have direct impacts on the communities they serve, as they span water, other highways, rail lines, etc. It is only through their relationship to adjacent highways, and the need for smooth transitions from one to the other, that bridges may have such an impact. In the typical case, a substandard shoulder or lane width is approved on a bridge to avoid the expense of widening to the full width of the adjacent roadway.

For the fifty projects giving some consideration to community, historic, or environmental factors, Table A.6.1 shows the type and frequency of design exceptions approved. The table after that provides details on each project requiring design exceptions.

Note the preponderance of cases with one of four Controlling Substandard Design Elements (CSDEs): vertical stopping sight distance, horizontal curve radius, shoulder width, or superelevation. These particular design elements are ordinarily not a problem on main streets, with the possible exception of substandard width of shoulders which, arguably, should not be required on main streets anyway. That these particular CSDEs are so overrepresented in design exception cases, and other CSDEs such as substandard lane width are so under-represented, indicates that design exceptions are either not required or not sought very often in main street projects.

Washington Avenue Bridge	Somerset	No	Bridge Replacement	Rural Minor Collector	Shoulder Width	X	X	X		Historic District, SHPO involve-ment
Mountain	Somerset	No	Bridge Replacement	Rural Undivided Local Road	Shoulder Width	X	X	X		Consider-ation of historic structures
Route 29 at Parkside Av.	Mercer	Yes	Reconstruction	Urban Freeway	Vertical SSD, Horizontal SSD, Superelevation, Horizontal Curve Radius, Vertical Clearance, Auxiliary Lane Length	X	X			
Greentree Road, Sec. 2	Glouchester	No	Reconstruction		Superelevation	X	X			
Rt 183 Sec 1B	Sussex	No	Reconstruction	Urban Undivided Principal Arterial	Curve Radius, Intersection Sight Distance	X	X		X	
Route 47 (Section 9)	Gloucester	No	Reconstruction	Rural Principal Arterial	Shoulder Width	X	X	X	X	Design exception to minimize impact on building eligible for National Register for Historic Places
Route 47 Section 5D & 6B	Cumberland & Cape May	No	Resurfacing	Rural	Shoulder Width, Horizontal Curve Radius	X			X	
Maple Ave. Bridge over NJ Transit	Camden	No	Reconstruction	Minor Urban Arterial	Vertical Clearance over RR	X	X			
Kinnaman Avenue Bridge	Warren	No	Bridge Replacement	Undivided Rural Major Collector	Sag VCCrest VC	X	X	X	X	
Sussex County Bridge J-05	Sussex	No	Bridge Replacement	Undivided Rural Road	Vertical SSD	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

Project	County	NHS	Project Type	Highway Class	CSDEs	Cost	Land Use	Hist	Env	Notes
Sussex County Bridge O-08	Sussex	No	Bridge Replacement	Local Rural Road	Vertical SSD, Horizontal Curve Radius, Intersection Sight Distance	X	X	X		
Maple Grange Road Bridge	Sussex	No	Bridge Replacement	Rural	Lane Width, Shoulder Width, Superelevation	X			X	
Route 563, Green Bank Road Bridge	Sussex	No	Bridge Replacement	Rural Major Collector	Bridge Width, Lane Width, Shoulder Width	X		X		
Route 206 & 15 Ross's Corner Road	Sussex	Yes	Reconstruction	Undivided Rural Principal Arterial	Bridge Width, Vertical SSD, Shoulder Width	X	X		X	
Belford Project	Monmouth	No	Bridge Replacement	Urban	Vertical SSD	X	X		X	
Tuckahoe Road (CR 631)	Cape May	No	Resurfacing	Rural	Lane Width, Shoulder Width	X	X			
Ocean Heights Av. (CR 559 Alt.) Phase 1	Atlantic	No	Resurfacing	Urban Minor Arterial	Shoulder Width, Vertical SSD	X	X		X	
Ocean Heights Av. (CR 559 Alt) Phase 2	Atlantic	No	Resurfacing	Urban Minor Arterial	Shoulder Width	X	X			
Zion Road (CR 615)	Atlantic	No	Resurfacing	Rural	Shoulder Width	X	X		X	
Straight St. Bridge	Passaic	No	Bridge Replacement	Urban	Horizontal Curve Radius	X	X	X		
Route 7, Section 1AG	Essex/ Hudson	No	Bridge Replacement	Urban Principal Arterial	Superelevation, Vertical SSD, Shoulder Width	X	X	X		
Old Texas Road Bridge	Middlesex	No	Bridge Replacement	Minor Arterial	Superelevation	X			X	
Ocean Drive, Ocean City	Cape May/ Atlantic	No	Bridge Replacement	Minor Urban Arterial	Horizontal Curve Radius	X			X	
Mt. Pleasant Place Bridge	Essex	No	Bridge Replacement	Urban Local Road	Bridge Width, Vertical SSD	X	X			
Route 88 @ Clifton Ave.	Ocean	No	Reconstruction	Urban Minor Arterial	Lane Width	X	X			Widths minimized to reduce impacts on new brick pavement
Route 15, Section 4C	Sussex	No	Reconstruction	Rural Principal Arterial	Horizontal Curve Radius, Grade, Vertical SSD	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

Route 1&9 (27) Ridge-field Circle Elimination	Bergen	Yes	New Construction/ Reconstruction	Urban	Horizontal Curve Radius, Shoulder Width	X	X			CBD area.
Route 31 Sections 6B & 7E	Hunterdon	Yes	New Construction/ Reconstruction	Rural Principal Arterial	Horizontal SSD	X	X		X	
Black River Road Bridge	Somerset	No	Bridge Replacement	Rural	Superelevation	X	X	X	X	
Route 71 @ Wall Street	Monmouth	No	Reconstruction	Urban Minor Arterial	Shoulder Width	X	X			
Route 202, Bernards-ville	Somerset	No	Reconstruction	Urban Minor Arterial	Vertical SSD, Superelevation	X	X			Design exceptions avoided need to reconstruct driveways
Route 166 Boroughs of Beech-wood & S. Tom's River	Ocean	No	Resurfacing	Urban	Shoulder Width, Lane Width	X	X			Tom's River CBD area Design exceptions avoided need for extensive reconstruc-tion and removal of existing trees
Route 124 Section 1 Boroughs of Madison & Chatham	Morris	No	Resurfacing	Urban	Horizontal Curve Radius, Vertical SSD, Vertical Clearance, Bridge Width	X	X			Design exceptions to minimize impacts on Madison CBD
Route 23 Section 7D & Route 94 Section 8C	Sussex	No	Reconstruction	Rural Principal Arterial	Vertical SSD, Superelevation	X	X			
U.S. Route 202/206	Somerset	No	Reconstruction	Rural	Curve Radius at Jughandle, Auxiliary Lane Length	X		X		
Route 9, Sec 25K & 1F, Borough of Sayreville	Middlesex	No	Bridge Replacement	Urban Principal Arterial	Horizontal Curve Radius	X	X			
Interstate 95/Route 31 Interchange	Mercer	Yes	Reconstruction	Interstate/ Urban Principal Arterial	Vertical SSD, Auxiliary Lane Length	X	X	X	X	

Table A.6.2: Details on Design Exception Cases 1997-1999

Project	County	NHS	Project Type	Highway Class	CSDEs	Cost	Land Use	Hist	Env	Notes
Vincentown-Retreat Road	Burlington	No	Bridge Replacement	Rural	Superelevation	X	X		X	To provide conforming super-elevation would increase impervious cover, making Pinelands permit more difficult to obtain
Route 41, Section 1A and 2A	Gloucester	No	Reconstruction	Urban Minor Arterial	Shoulder Width, Vertical Clearance	X	X		X	
Route 35, Section 12T, Perth Amboy	Middlesex	Yes	Reconstruction/ Bridge Replacement	Urban Principal Arterial	Vertical SSD	X	X			
Route 9, Section 23E	Monmouth	Yes	Reconstruction	Urban Principal Arterial	Curve Radius, Vertical SSD	X	X			
I-80 Sec 20	Bergen	Yes	Rehabilitation	Freeway Principal Arterial	Shoulder Width, Vertical Clearance	X	X			
Route 10 Section 4L	Morris	Yes	Reconstruction	Minor Arterial	Superelevation, Vertical SSD	X	X			Super-elevation design exception required to minimize impact on strip mall driveway
Route 47 Section 1C, Rte 9 KP 11.005 to KP 11.716	Cape May	No	Reconstruction	Rural Principal Arterial/ Rural Minor Arterial	Shoulder Width, Vertical Clearance, Superelevation	X	X			
Route 28, Section 3	Somerset	No	Reconstruction	Urban Principal Arterial	Shoulder Width, Auxiliary Lane Length, Curve Radius	X	X			
Route 9&70 Tri City Plaza	Ocean	No	Reconstruction	Urban Principal Arterial	Auxiliary Lane Length	X	X			
Route 4 Sec 2AE, Rte 17 Section 2P&3G	Bergen	Yes	Reconstruction	Urban Principal Arterial	Horizontal Curve Radius, Horizontal SSD, Auxiliary Lane Length, Superelevation	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

Project	County	NHS	Project Type	Highway Class	CSDEs	Cost	Use	Hist	Env	Notes
Route U.S. 1, Section 6T, Route US 130, Section 16B, Route 171, Section 1B	Middlesex	Yes	Reconstruction	Urban Principal Arterial	Vertical Clearance, Shoulder Width	X	X			
Route 17 Section 3H, 5AE	Bergen	Yes	Reconstruction	Urban Principal Arterial	Horizontal Curve Radius, Superelevation	X	X			
Route 17(3)	Bergen	Yes	Reconstruction	Urban Principal Arterial	Horizontal Curve Radius	X	X			

Table A.6.2: Details on Design Exception Cases 1997-1999

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