

Virginia Transportation Research Council

research report

An Examination of Practices
for Retrofitting Existing Roads
with Sidewalks in the United States

http://www.virginiadot.org/vtrc/main/online_reports/pdf/10-r4.pdf

ILONA O. KASTENHOFER
Senior Research Scientist



Standard Title Page - Report on Federally Funded Project

1. Report No.: FHWA/VTRC 10-R4		2. Government Accession No.:		3. Recipient's Catalog No.:	
4. Title and Subtitle: An Examination of Practices for Retrofitting Existing Roads with Sidewalks in the United States				5. Report Date: June 2010	
				6. Performing Organization Code:	
7. Author(s): Ilona O. Kastenhofer				8. Performing Organization Report No.: VTRC 10-R4	
9. Performing Organization and Address: Virginia Transportation Research Council 530 Edgemont Road Charlottesville, VA 22903				10. Work Unit No. (TRAIS):	
				11. Contract or Grant No.: 83999	
12. Sponsoring Agencies' Name and Address: Virginia Department of Transportation Federal Highway Administration 1401 E. Broad Street 400 North 8th Street, Room 750 Richmond, VA 23219 Richmond, VA 23219-4825				13. Type of Report and Period Covered: Final	
				14. Sponsoring Agency Code:	
15. Supplementary Notes:					
16. Abstract: <p>In Virginia, as in the United States, many roads were built without sidewalks. With steadily increasing efforts to develop a more balanced, multimodal transportation system, missing sidewalks pose a unique connectivity issue. Although the Virginia Department of Transportation's (VDOT) <i>Policy for Integrating Bicycle and Pedestrian Accommodations</i> allows for the construction of bicycle and pedestrian facilities separate from highway construction, it does not specifically address the issue of missing sidewalks. The purpose of this study was to identify and examine current practices relating to retrofitting existing roads with sidewalks in order to provide VDOT with guidance on addressing the issue of missing sidewalks in its transportation system.</p> <p>Three tasks were performed to achieve the study objectives. First, a literature review was conducted to identify material that addressed issues relating to retrofitting existing roads with sidewalks. Second, VDOT's current practices were documented and reviewed based on a survey and interviews of district staff. Third, the practices of state departments of transportation (DOTs) and selected localities were identified based on a survey of the DOT and locality representatives, the literature review, and a search of agency websites.</p> <p>With regard to the literature review, no publication focusing on the topic of missing sidewalks was found. Most of the literature was focused on accommodations for pedestrians along newly constructed roads and on operational issues for existing pedestrian facilities.</p> <p>With regard to VDOT's current practices, VDOT has no current policy to construct missing sidewalks. No VDOT district has an inventory of sidewalks or missing sidewalks or any "wish-list" for sidewalk connections. Further, there is no prioritization method should more requests for sidewalk connections be received than is possible to accommodate. Although VDOT has completed a limited number of projects to provide missing sidewalks, there is no dedicated funding source to address future requests.</p> <p>Most state DOTs are similar to VDOT in not having a program to construct missing sidewalks. Experiences of localities across the United States show successful sidewalk retrofit programs, which focus on targeted areas with high pedestrian activity.</p> <p>The study recommends that VDOT develop guidelines for identifying, prioritizing, and constructing missing sidewalks. Such guidelines are expected to provide guidance relating to identifying high-priority targeted areas for constructing missing sidewalks, prioritizing needed projects, and identifying funding options.</p>					
17 Key Words: Sidewalks, pedestrian accommodations, construction of sidewalks, missing sidewalks, sidewalk retrofit			18. Distribution Statement: No restrictions. This document is available to the public through NTIS, Springfield, VA 22161.		
19. Security Classif. (of this report): Unclassified		20. Security Classif. (of this page): Unclassified		21. No. of Pages: 32	22. Price:

FINAL REPORT

**AN EXAMINATION OF PRACTICES FOR RETROFITTING EXISTING ROADS
WITH SIDEWALKS IN THE UNITED STATES**

**Ilona O. Kastenhofer
Senior Research Scientist**

Virginia Transportation Research Council
(A partnership of the Virginia Department of Transportation
and the University of Virginia since 1948)

In Cooperation with the U.S. Department of Transportation
Federal Highway Administration

Charlottesville, Virginia

June 2010
VTRC 10-R4

DISCLAIMER

The contents of this report reflect the views of the author, who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Virginia Department of Transportation, the Commonwealth Transportation Board, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation. Any inclusion of manufacturer names, trade names, or trademarks is for identification purposes only and is not to be considered an endorsement.

Copyright 2010 by the Commonwealth of Virginia.
All rights reserved.

ABSTRACT

In Virginia, as in the United States, many roads were built without sidewalks. With steadily increasing efforts to develop a more balanced, multimodal transportation system, missing sidewalks pose a unique connectivity issue. Although the Virginia Department of Transportation's (VDOT) *Policy for Integrating Bicycle and Pedestrian Accommodations* allows for the construction of bicycle and pedestrian facilities separate from highway construction, it does not specifically address the issue of missing sidewalks. The purpose of this study was to identify and examine current practices relating to retrofitting existing roads with sidewalks in order to provide VDOT with guidance on addressing the issue of missing sidewalks in its transportation system.

Three tasks were performed to achieve the study objectives. First, a literature review was conducted to identify material that addressed issues relating to retrofitting existing roads with sidewalks. Second, VDOT's current practices were documented and reviewed based on a survey and interviews of district staff. Third, the practices of state departments of transportation (DOTs) and selected localities were identified based on a survey of the DOT and locality representatives, the literature review, and a search of agency websites.

With regard to the literature review, no publication focusing on the topic of missing sidewalks was found. Most of the literature was focused on accommodations for pedestrians along newly constructed roads and on operational issues for existing pedestrian facilities.

With regard to VDOT's current practices, VDOT has no current policy to construct missing sidewalks. No VDOT district has an inventory of sidewalks or missing sidewalks or any "wish-list" for sidewalk connections. Further, there is no prioritization method should more requests for sidewalk connections be received than is possible to accommodate. Although VDOT has completed a limited number of projects to provide missing sidewalks, there is no dedicated funding source to address future requests.

Most state DOTs are similar to VDOT in not having a program to construct missing sidewalks. Experiences of localities across the United States show successful sidewalk retrofit programs, which focus on targeted areas with high pedestrian activity.

The study recommends that VDOT develop guidelines for identifying, prioritizing, and constructing missing sidewalks. Such guidelines are expected to provide guidance relating to identifying high-priority targeted areas for constructing missing sidewalks, prioritizing needed projects, and identifying funding options.

FINAL REPORT

AN EXAMINATION OF PRACTICES FOR RETROFITTING EXISTING ROADS WITH SIDEWALKS IN THE UNITED STATES

Ilona O. Kastenhofer
Senior Research Scientist

INTRODUCTION

In the United States, many roads were built without sidewalks. With steadily increasing efforts to develop a more balanced, multimodal transportation system, missing sidewalks pose a unique connectivity issue for pedestrians. National attention to pedestrian issues has increased in the last two decades. For example, funding for pedestrian and bicycle facilities and programs under the Federal-Aid Highway Program increased from \$22.9 million in 1992 to \$541 million in 2008.¹ (The Federal Highway Administration's [FHWA] financial database "is not set up to separate walking projects from bicycling projects."²)

The Bicycle & Pedestrian Program of the FHWA's Office of Human and Natural Environment promotes bicycle and pedestrian transportation use, safety, and accessibility. Each state has a bicycle and pedestrian coordinator in its state department of transportation (DOT) to promote and facilitate the increased use of nonmotorized transportation, including developing facilities for the use of pedestrians and bicyclists and public educational, promotional, and safety programs for using such facilities. The FHWA Bicycle & Pedestrian Program issues guidance and is responsible for overseeing that requirements in legislation are understood and met by the states and other implementing agencies.³ It is important to note that policies and organizational arrangements almost always address bicycle and pedestrian issues together. In most cases, bicycle and pedestrian issues have combined responsibility in federal, state, and local offices.⁴

In recent years, Virginia has been increasing its focus on serving non-motorized users. In 2004, the Virginia Department of Transportation (VDOT) issued a *Policy for Integrating Bicycle and Pedestrian Accommodations* to improve related practices.⁵ The policy states: "The Virginia Department of Transportation (VDOT) will initiate all highway construction projects with the presumption that the project shall accommodate bicycling and walking." The policy defines *accommodation* as "any facility, design feature, operational change, or maintenance activity that improves the environment in which bicyclists and pedestrians travel." Prior to this policy, the provision of non-motorized accommodations had to be justified with each new highway construction project, and stand-alone non-motorized projects were rarely considered.⁶ The policy also states: "Bicycle and pedestrian accommodations can be developed through projects that are independent of highway construction, either within the highway right-of-way or on an independent right-of-way." Prior to this policy, a justification for building sidewalks was required; the current policy presumes walking and biking accommodations.⁶ The policy focuses on pedestrian accommodations as a part of new projects. The policy does not address retrofitting existing roads with sidewalks.

In addition to VDOT's policy requirements, Section 33.1-23.03 of the *Code of Virginia*⁷ requires quantifiable measures to be included in the Statewide Transportation Plan. One of these measures is "job and housing access to transit and pedestrian facilities." However, there are no applicable pedestrian data available. According to a staff member of VDOT's Transportation & Mobility Planning Division (TMPD), in the absence of specific pedestrian data, census-based commute-to-work data are being used for reporting purposes.

VDOT has undertaken several initiatives to improve accommodations and safety for pedestrians. It developed the *Bike and Pedestrian Implementation Guide for Locality Involvement*.⁶ In addition, funding within the federally funded Highway Safety Improvement Program (HSIP) was increased.⁸ With the recently increased funding, VDOT funded 7 of the 23 bicycle and pedestrian applications for FY 2007-2008. At the cost of \$2.4 million, 4 signalized crossings (\$1 million), 1 retrofit sidewalk project (\$0.9 million), and 2 shared use path projects (\$0.5 million) were approved.⁸ It is important to note that the HSIP is limited to improvements justified from the safety perspective; pedestrian accommodations needed for improved mobility/connectivity, such as missing sidewalks, are not eligible for funding.

Another initiative was the development of the Instructional and Informational Memorandum on Context Sensitive Solutions.⁹ VDOT's TMPD also held the first of a series of Walkable Community Workshops to encourage safer and more inclusive facility planning and design. A persistent theme in these workshops is the idea of "complete streets," where all users are accommodated: motorists, cyclists, transit users, and pedestrians, including disabled citizens.¹⁰

With steadily increasing efforts to develop a more balanced, multimodal transportation system, the lack of pedestrian accommodations, i.e., sidewalks, along existing roads poses connectivity problems for pedestrians. As is easily observed, many miles of roadway in Virginia, as well as in the United States, were built without sidewalks, although it is important to note that a large portion of the road network is rural, where sidewalks may rarely be needed.

A July 16, 2007, article in *The Washington Post* is an example of missing sidewalks receiving media attention. The article reported that "A survey of 840 miles of roads in Loudoun [County, Virginia] found that only 14 percent had sidewalks, according to a bicycle and pedestrian mobility plan county supervisors adopted in 2003."¹¹

Even though funding for retrofit pedestrian projects has received increased attention in recent years, most of VDOT's efforts have focused on ensuring pedestrian accommodations as part of new roadway construction projects, which culminated in the previously mentioned *Policy for Integrating Bicycle and Pedestrian Accommodations*,⁵ which presumes that bicycle and pedestrian accommodations will be provided with newly built roads—not providing such accommodations requires justification. Although the policy allows for the construction of bicycle and pedestrian facilities separate from highway construction, it does not specifically address the issue of missing sidewalks.

PURPOSE AND SCOPE

The purpose of this study was to identify and examine the sidewalk retrofit practices of U.S. state DOTs and selected U.S. localities, with particular attention to the practices of VDOT, in order to provide VDOT with guidance on addressing the issue of missing sidewalks in its transportation system.

The specific objectives of the study were as follows:

1. Identify the literature related to retrofitting sidewalks.
2. Document and review VDOT's current practices with regard to retrofitting sidewalks.
3. Document and review the practices of state DOTs and selected localities with regard to retrofitting sidewalks.

The scope of the study was limited to missing sidewalks for increased connectivity. Identifying and examining all potential missing pedestrian accommodations were beyond the scope of this study, as was the effect of missing sidewalks on the safety of pedestrians. Sidewalk retrofit practices examined included (but were not limited to) identifying missing sidewalks, prioritizing and funding retrofit sidewalk projects, and dealing with constraints for retrofit sidewalk design. The terms *missing sidewalks*, *non-existent sidewalks*, and *retrofit sidewalk projects* all relate to the specific condition when roads were originally built without sidewalks.

METHODOLOGY

Overview

Three tasks were performed to achieve the objectives of this study:

1. A literature search was conducted to identify material that addressed issues relating to retrofitting existing roads with sidewalks.
2. VDOT's current practices were documented and reviewed based on a survey and interviews of district staff.
3. The practices of state DOTs and selected localities were identified based on a survey of the DOT and locality representatives, the literature review, and a search of agency websites. Examples of successful sidewalk retrofit programs were of particular interest. A sidewalk retrofit program was defined as successful if it was supported with a dedicated, steady, annual budget and was based on a well-developed prioritization method.

Review of the Literature

Related literature was sought by using the Transportation Research Information Service, searching the publications of the Transportation Research Board (TRB), conducting an Internet search, and having conversations with practitioners, with the Internet being the main source of information. Websites of state and local agencies were reviewed to collect information about their sidewalk retrofit practices.

Review of VDOT's Current Practices

The questionnaire shown in Appendix A was emailed to the bicycle and pedestrian coordinator in each of VDOT's nine districts. As may be seen, time-consuming data collection was not the intention of the survey. The questions related to sidewalk inventories, funding for sidewalks, sidewalk project prioritization, and design issues.

In VDOT's seven rural districts (Bristol, Culpeper, Fredericksburg, Lynchburg, Richmond, Salem, and Staunton), the district transportation planners also have the role of bicycle and pedestrian planning. In VDOT's two urban districts (Northern Virginia [NOVA] and Hampton Roads), a staff member is dedicated to bicycle and pedestrian issues. Neither district has dedicated ownership of pedestrian issues only. All responses were followed-up by telephone.

Input was also sought from VDOT's TMPD, which also handles multimodal issues and transportation planning activities and in which the state bicycle and pedestrian coordinator is housed.

Surveys of State DOTs

The questionnaire shown in Appendix A was also sent to the bicycle and pedestrian coordinator of each of the 50 state DOTs. Extra efforts were made through follow-up telephone calls and e-mails to acquire survey responses from the 3 states that are similar to Virginia in that they own and operate both their primary and secondary highway systems and have a similar climate: Delaware, North Carolina, and West Virginia. (Alaska is also responsible for the secondary system, but climatic conditions for pedestrians are very different there.) States responsible for their secondary road systems also function as the highway section of local (mostly county and small town) departments of public work and therefore are responsible for sidewalks along local roads. This is not the case with the 45 state DOTs that own and operate only the primary and interstate highways in their state.

Survey of Localities

The questionnaire shown in Appendix A was also sent to 60 localities within and outside Virginia. The list of responding localities is provided in Appendix C. Localities outside

Virginia (counties, cities, boroughs, or towns) to be surveyed were chosen if they had information on their website that indicated the potential existence of a program that focused on providing missing sidewalks. This constituted an intentional selection of localities with pedestrian-focused programs; i.e., the selection of these localities was not random. Localities within Virginia received the survey from the bicycle and pedestrian coordinator of each of the nine VDOT districts.

The websites of responding localities were also searched for information about their pedestrian retrofit program. Information about prioritizing retrofit sidewalk improvements was of particular interest.

RESULTS

Literature Review

Although there a large body of research on pedestrian issues, no literature specifically relating to the lack of sidewalks along existing roads was identified.

The literature search revealed a significant level of research focusing on providing safe movements for pedestrians, improving walking conditions for transit users, and various other related issues. Most of this attention was focused on accommodations for pedestrians along newly constructed roads and on operational issues for existing pedestrian facilities. This research interest is also demonstrated by the research agenda of TRB's Pedestrians Committee. For example, its Research Circular E-C084 presents the top 16 pedestrian research problem statements, which are prioritized from a list of approximately 80 such statements.¹²

The Virginia Transportation Research Council (VTRC) has published several reports relating to nonmotorized modes. In 2008, Natarajan et al. developed a methodology for the selection, evaluation, and prioritization of bicycle and pedestrian safety projects in Virginia for inclusion in the HSIP.¹³ The methodology provides "a direct linkage between the selection criteria and conditions at the site that might be hazardous to non-motorized travel." The study focused only on safety criteria. In 2006, Grimes et al. investigated alternative transportation funding source available to Virginia localities.¹⁴ Several of the funding sources can potentially be used for providing or improving pedestrian accommodations. A summary table of funding sources from the report is provided in Appendix B. However, as the report states:

These alternatives are usually special programs with a unique emphasis, such as conservation, alternative modes, hazard elimination, and economic development. Generally, these funds are awarded on a competitive basis and have accompanying restrictions on their use.

Thus, these funds are not pedestrian focused and are competitive. Several other reports addressed specific pedestrian crossing issues.¹⁵⁻²⁰ Two additional studies addressed legal issues for non-motorized users.^{21,22}

VDOT's Current Sidewalk Retrofit Practices

Standards and Regulations Governing VDOT's Sidewalk Design Practices

As discussed in the “Introduction” section, in 2004, VDOT instituted the *Policy for Integrating Bicycle and Pedestrian Accommodations*, which presumes that bicycle and pedestrian accommodations will be provided with newly built roads, i.e., *not providing* such accommodations requires justification.⁵

As with other states, sidewalk design in Virginia is governed by Title II of the Americans with Disabilities Act (ADA), which became effective January 26, 1992. The United States Access Board, an independent federal agency devoted to accessibility for people with disabilities, developed ADA Standard for Accessible Design.²³ The Access Board also published revised draft accessibility guidelines for public rights of way,²⁴ which were recommended as a best practice by FHWA.²⁵

Based on FHWA's recommendation, VDOT's Location & Design Division issued an Instructional and Information Memorandum, IIM-LD-55, on December 12, 2007, and updated it on July 29, 2009.²⁶ This memorandum governs VDOT's current sidewalk design practices,²⁶ along with VDOT's road design standards.²⁷ Although VDOT's standard sidewalk width is 5 ft, constructing a 4-ft-wide sidewalk (the minimum required width) is a possibility based on a design waiver, which the VDOT district location and design engineer has the authority to approve or deny.²⁶ In addition:

New sidewalks less than 60" (1525 mm) wide must provide a pedestrian passing area, minimum 60"x 60" (1525 mm x 1525 mm) at reasonable intervals not to exceed 200' (61 m). These passing areas can be provided at entrances or street intersections.²⁶

IIM-LD-55 focuses on pedestrian accommodation as part of new highway construction projects. For technical assistance relating to alteration projects (Title II of the ADA requires conformance to new construction requirements to “the maximum extent feasible”), VDOT relies on the recommendations of a subcommittee of the Public Rights-of-Way Access Advisory Committee—a committee formed by the United States Access Board and composed of representatives from disability organizations, public works departments, transportation and traffic engineering groups, the design and civil engineering professions, government agencies, and standards-setting bodies chartered by the United States Access Board. These recommendations were published as *Special Report: Accessible Public Rights-of-Way Planning and Design for Alterations*.²⁸ The recommendations cover, as an example, whether gaps in existing sidewalks may be closed by constructing connecting segments that match existing sidewalk widths but fall short of the guidance provided in the ADA Access Guidelines or the Public Rights-of-Way Access Advisory Committee. The case of VDOT's 4-ft-wide sidewalks is an example. According to a staff member of the United States Access Board:

This is possible in an alteration/addition if providing a 5- or 4-foot wide sidewalk is “technically infeasible” (not just cost prohibitive). (Sidewalks of less than 3 feet in width cannot be considered usable.) Interpretations of “maximum extent feasible” and “technically infeasible” must be made on a case by case basis by the jurisdiction and are rebuttable.²⁹

Thus, constructing a sidewalk as narrow as 3 ft is permissible, but only in alteration or addition projects when a 4-ft or wider sidewalk is *both* technically infeasible and cost prohibitive.

Survey and Interview Results

Survey responses were received from all nine VDOT districts. The results provided here were based on these survey responses; telephone interviews with seven of the nine district coordinators; and follow-up e-mails with two coordinators, which was their choice of communication. The results were categorized as follows: sidewalk inventory, funding for missing sidewalks and prioritizing sidewalk projects, and design issues relating to sidewalk construction. The complete survey responses can be obtained from the author upon request.

Sidewalk Inventory

VDOT does not have a statewide inventory system focusing on the presence or absence of pedestrian accommodations along roadways. In the absence of such a system, there are no statewide data available that could be used for the systematic analysis of existing accommodations for pedestrians.

None of the districts has an inventory of sidewalks or missing sidewalks. Three survey respondents indicated that some of VDOT's highway inventory systems may allow for entering sidewalk data, but they did not know if this has been done. One respondent stated that VDOT's TMPD has a database (Statewide Planning System) where sidewalk information can be added. The two urban district respondents stated that some of the urban or urbanized localities had some inventory. All survey respondents indicated a shared understanding that VDOT relies on localities to identify and prioritize sidewalk needs along roads; i.e., VDOT is not actively involved in identifying and prioritizing sidewalk needs along roads. A geographical information system (GIS) was viewed by all respondents as the best way to store inventory data.

The districts do not have "wish-lists" (a list of requests) for missing segments of sidewalks to be constructed. Respondents of four of the nine districts knew of specific requests to construct missing sidewalk links for connectivity. The requests came from citizens in three districts and from developers in one district (Richmond District). Lists of requests are not kept.

Survey respondents were asked to estimate the percentage of roads missing sidewalks (where sidewalks are non-existent) on one or both sides of the roads. In the absence of data, the answers were based on their familiarity with the road network. Estimates for the seven rural districts ranged between 80 and 99 percent. With regard to the two urban districts, the estimate for the NOVA District was 70 to 75 percent of roads in (non-incorporated) urban areas and 85 to 90 percent of roads in suburban areas. Both estimates relate to the VDOT system. The estimate for the Hampton Roads District was more than 90 percent for the VDOT system, which is mostly rural. An estimate of 30 percent was also provided for the cities (incorporated urban areas that are not part of the VDOT system).

Funding for Missing Sidewalks and Prioritizing Sidewalk Projects

None of the nine districts had dedicated, steady, annual funding to construct missing sidewalks when they were not part of a highway construction project. Sidewalk segments that were constructed used various funding sources, such as Transportation Enhancement funds, VDOT secondary/primary funds, urban funds, Hazard Elimination Program funds, Congestion Mitigation and Air Quality (CMAQ) Improvement Program funds, Safe Routes to School funds, county funds, revenue sharing funds, and developer contributions. The district coordinators did not recall using any of these funds more frequently than the others. Specific information is not available since related data are not kept. In addition, none of these funds is solely dedicated to pedestrian improvements; i.e., there is significant competition for these funds, particularly for highway capacity improvements.

Survey respondents were asked the amount they would recommend for spending yearly on constructing missing sidewalk segments in their district. Four respondents suggested \$1 million per year, one suggested \$200,000, two expressed the need to have dedicated funding without suggesting a specific amount, and two did not know. Additional comments included the following. Two of the respondents expressed the need for a process to identify priorities and recommended levels of improvements, based on which yearly funding levels could be recommended. Two of the respondents who recommended dedicated funding added that funding would need to continue for many years to make significant improvements on a system level and that full connectivity would cost millions per year. The respondent from the NOVA District was strongly in favor of dedicated funding for constructing missing sidewalks, basing the recommended yearly funding level on an inclusive process that identifies priorities. Considering additional improvements, such as crossings and other safety improvements, was strongly recommended as a component when building a missing sidewalk. Once a retrofit sidewalk project is approved, the most frequently encountered problem is insufficient right of way being available to meet VDOT's current sidewalk standards.²⁶ Three of the respondents expressed that the need to acquire additional right of way often results in significantly increased project cost estimates, which represent major funding challenges. All nine respondents said that the demand and necessity exist for retrofit sidewalk projects but expressed concerns regarding funding shortages for transportation projects in general.

None of the districts has a formal method to prioritize missing sidewalks. Safety, connectivity, and local support were most frequently mentioned when potential criteria for prioritization were discussed. Other criteria mentioned were demand and access to public transportation.

Design Issues Relating to Sidewalk Construction

The last question on the survey (see Appendix A) was:

Occasionally the need for a sidewalk is obvious but meeting design criteria is prohibitively expensive. Have you experienced this problem and how did you deal with it?

The four most urbanized districts (NOVA, Hampton Roads, Richmond, and Fredericksburg) had encountered this problem, with limited right of way being the most frequent factor. Alternative actions suggested included breaking the project into phases if funding the entire project was not feasible, providing a wider shoulder, and resorting to a flat area behind the curb. VDOT's previously discussed design waiver process was viewed as a last resort. It was used in cases when local support for the project was very strong, but meeting design criteria was cost-prohibitive.

State DOT Practices

Of the 50 state DOTs who received the study questionnaire, 29 responded. The responding states are indicated in Figure 1 and listed in Appendix C. Their responses are reported here along with the pertinent information found in the literature search and on the websites of the DOTs. The complete survey responses can be obtained from the author upon request. The results were categorized as follows: sidewalk inventory, funding for missing sidewalks and prioritizing sidewalk projects, and design issues relating to sidewalk construction.

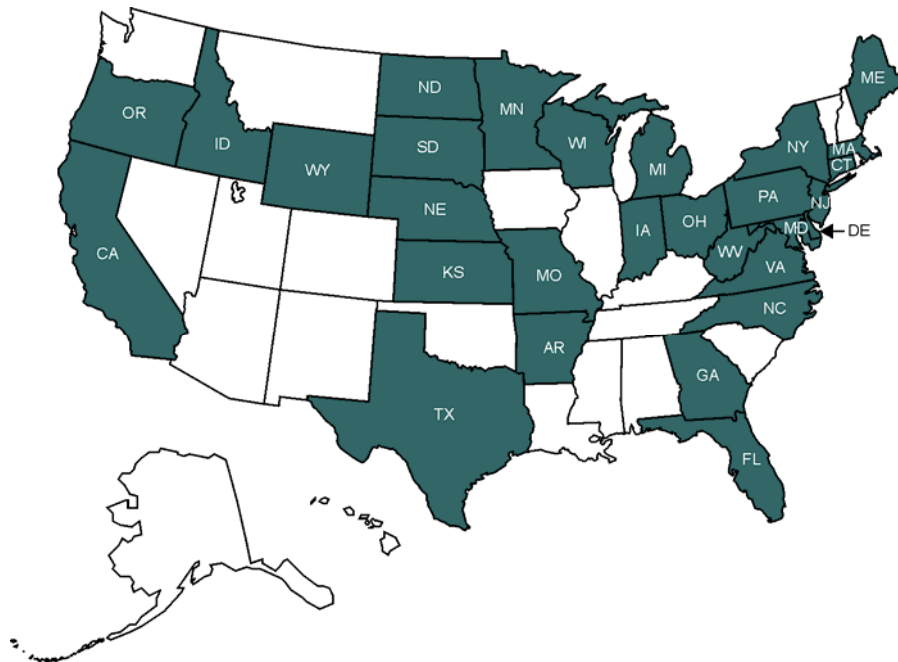


Figure 1. States Responding to Survey

Sidewalk Inventory

Except for Maryland, all responding state DOTs lacked data on existing sidewalks. The only way these state DOTs learn of the desire for sidewalk facilities is when they are identified by localities. The Maryland State Highway Administration (SHA) maintains a statewide sidewalk inventory of both existing and missing sidewalks along its urban roads.³⁰ (In Maryland, the state does not maintain the secondary road system. In Virginia, where the state maintains most of the secondary roads, the state-maintained mileage is 57,728, of which 9,940 miles are urban and 47,788 miles are rural.³¹ In contrast, the Maryland SHA maintains 5,150 miles of roads, of which 2,051 miles are urban and 3,099 miles are rural.³¹ Sidewalks exist along 22

percent of Maryland's urban state highways.³⁰) Maryland is also the only state that reported having a sidewalk retrofit program. According to Schneider et al., all state-owned roadways in Maryland were inventoried as a part of Maryland's Twenty-Year Bicycle and Pedestrian Access Master Plan to identify gaps in sidewalks and justify new sidewalk projects.³⁰ The inventory is updated every year by recording any new sidewalks constructed through various highway improvement programs, including local public efforts and developer actions.

When asked to estimate either a percentage or a mileage of missing sidewalks in their jurisdiction, 79 percent of responding DOTs did not provide an estimate. Six DOTs provided percentage estimates, which were in the range of 50 to 93 percent. Most of their estimates were not based on specific data but rather on their familiarity with their system.

None of the 29 responding state DOTs maintains a wish-list of requests for constructing missing sidewalks. They do consider retrofit sidewalk improvements based on requests from localities.

Funding for Missing Sidewalks and Prioritizing Sidewalk Projects

The most frequently used funding sources by state DOTs for constructing missing sidewalks were Transportation Enhancements, Safe Routes to School Program, Surface Transportation Program, and CMAQ funds. Other funds mentioned were bonds, scenic byway funds, Hazard Elimination Safety, and Highway Safety Program funds. None of the funds is dedicated to pedestrian improvements, with the exception of the previously mentioned Maryland sidewalk retrofit program and the National Safe Routes to School planning and infrastructure programs. New Jersey reported spending \$10 million per year on pedestrian safety improvements, including missing sidewalks and other pedestrian improvements.³² The first major effort was initiated by the North Jersey Transportation Planning Authority and the metropolitan planning organization for northern New Jersey. They developed a tool for assessing and prioritizing pedestrian needs. The New Jersey DOT responded by developing an analytical framework to identify pedestrian priorities through their Statewide Bike/Pedestrian Master Plan.

Of the responding state DOTs, 76 percent did not provide a recommended amount per year for constructing missing sidewalks. Five respondents suggested amounts as follows: \$2 million (Wisconsin), \$4 million (Maryland) \$5 million (Florida), \$5-10 million (Indiana) and \$100 million (Georgia.) The Georgia representative assumed the need to construct 2,500 miles of sidewalks, which he proposed to construct over a 25-year period. The New York representative recommended "that approximately \$50 million be spent on pedestrian transportation infrastructure (not just sidewalks, but pedestrian signals, street crossings, high visibility crosswalk markings, refuge island and medians, traffic calming and operational measures that improve pedestrian safe access and safety) on a statewide basis." He added that "[s]idewalks can never be a sole consideration when assessing pedestrian access and safety."

Of the responding state DOTs, 17 percent had a prioritization method for constructing missing sidewalks. For example, the New Jersey DOT's method uses a barrier analysis and a Pedestrian Compatibility Index, which approximates pedestrian demand in nearby census tracts.

Based on these two dimensions, the locations that have severe pedestrian barriers with high values for the Pedestrian Compatibility Index are the highest priority areas.³²

Design Issues Relating to Sidewalk Construction

Of the responding DOTs, 34 percent did not experience problems with design issues relating to building missing sidewalks because they do not build such sidewalks. The other respondents (66 percent) reported having various design problems. Most respondents did not identify the type of problems encountered, since the question asked only whether they experienced such problems and how they dealt with them. The following problems were, however, mentioned: no sufficient right of way (3 respondents), difficulty in meeting ADA requirements (2 respondents), drainage complexities (2 respondents), utility conflicts (1 respondent), physical objects in the way (1 respondent), existing bridge too narrow (1 respondent), and land owner opposition (1 respondent).

Actions taken to solve problems included redesign to reduced design criteria (5 respondents; 4 of the 5 respondents expressed strong commitment to at least the minimum design standards); make efforts to tie the pedestrian project to a road improvement project (3 respondents); ask the locality, where the project is built, for funds (3 respondents); break the project into segments and pursue the project segment by segment (2 respondents); delay the project (2 respondents); cancel the project (2 respondents); reduce aesthetic provisions (1 respondent); seek more funds (1 respondent); pave the shoulder (1 respondent); request a developer to complete the project (1 respondent); and build sidewalk on just one side of the road (1 respondent).

Selected Locality Practices

Of the 60 localities that were emailed a survey questionnaire, 47 responded (see Appendix A), for a response rate of 78%. A list of responding localities is provided in Appendix D. The survey results and the results of the search of the websites of these localities were categorized as follows: sidewalk inventory, funding for missing sidewalks and prioritizing sidewalk projects, and design issues relating to sidewalk construction. The complete survey responses can be obtained from the author upon request.

Sidewalk Inventory

Of the 47 responding localities, 29 (62%) reported having a partial or complete inventory of missing sidewalks. The collected data on pedestrian facilities showed different levels of detail and sophistication, from a simple to a detailed database and from visual to global information system (GIS) identification.

Twelve localities (26%) that do not have a full inventory do have sidewalk retrofit programs based on field surveys for targeted areas to determine candidate locations for retrofit sidewalks. Twenty-five (53%) of the localities identify targeted areas for a sidewalk inventory, such as village centers, vicinity of transit stops, dense commercial areas, senior centers, municipal facilities, multi-family housing, schools, and recreation areas. The inventories

typically include roadway type; walking conditions; street characteristics; comments from town officials and residents; and locations of pedestrian generators, bus routes, and shelters.

Three examples of a comprehensive inventory are as follows.

1. *The City of Bloomington, Indiana, developed a sidewalk inventory to identify missing sidewalk segments and to prioritize sidewalk improvement projects through the Alternative Transportation and Greenways System Plan (ATGSP).*³³ The inventory contains such data as condition, width, and ADA compliance. The location and condition of sidewalks have been identified and incorporated into a GIS. The city maintains and updates annually the GIS sidewalk inventory.³⁴
2. *The City of Denver, Colorado, developed a sidewalk inventory through a comprehensive survey of city streets and other missing links along with a GIS map, showing missing/attached/detached sidewalks.* The inventory is documented in the Pedestrian Master Plan.³⁵ The advisory team identified missing sidewalks, the lack of curb ramps or ramps that comply with the ADA, sidewalks that have obstacles within the sidewalk system, sidewalks with multiple curb cuts, and sidewalks without adequate buffers from nearby traffic. The advisory team in cooperation with citizens identified 140 locations that needed pedestrian improvements, including missing sidewalks and other needed pedestrian accommodations.
3. *The City of Sandpoint, Idaho, developed a sidewalk inventory (spreadsheets and GIS maps) of sidewalks, curbs, curb ramps, and their condition.*³⁶ While inspecting the streets, they recorded the presence of sidewalks, curbs, curb ramps, the width and condition of the sidewalks, and existing or potential pedestrian demand. They formed a pedestrian advisory committee of local residents and 40 volunteers. The citizens were involved in developing the inventory and the prioritization process. The inventory also includes the committee's comments, such as where they walked, where they saw other people walking, locations without sidewalks, and locations where they would like to be able to walk.

Of the responding localities, 57 percent did not provide an estimate of missing sidewalk connections. Fifteen of the 20 localities (75%) that did provide estimates did so in the absence of complete data, as they had only a partial inventory. Fifteen of the estimates (75%) provided were above 50 percent, ranging from 50 percent to 95 percent. Two respondents commented that the absence of a sidewalk did not equal a need for a sidewalk. For example, sidewalks might or might not be needed along rural roads. Sidewalks are rarely needed in sparsely populated rural areas. However, sidewalks might be needed along rural roads in suburban areas.

Of the 47 responding localities, only 40 percent had wish-lists of desired sidewalks. They use various sources to identify projects for their wish-list, for example, the combination of citizen request and input by staff of the locality. The most frequently used databases were GIS and Excel.

Funding for Missing Sidewalks and Prioritizing Sidewalk Projects

Survey respondents reported almost 30 different types of funds they have used for constructing missing sidewalks, with only two dedicated to this purpose. With all other funds, there is significant competition. The most frequently used funding sources were the same as for the state DOTs, i.e., Transportation Enhancements, Safe Routes to School Program, Surface Transportation Program, and CMAQ funds. Most respondents said that constructing missing sidewalks is greatly under-funded in their jurisdiction. Of the responding localities, 57 percent recommended that an annual amount of funding be spent on constructing missing sidewalk segments. The amount recommended ranged from \$50,000 to \$1 million per year.

Forty-one of the responding localities, particularly cities, had well-developed prioritization methods. Even though prioritization methods have similar components, the methods are all different as they are tailored to the needs of the jurisdiction or organization. Criteria selected by localities for prioritizing missing sidewalk projects vary widely. Most methods list the components in priority order, which differs a great deal between methods. Examples for top priority components include connectivity, proximity to schools, parks and bus stops, pedestrian attraction, vehicle volumes, utility of future sidewalk, and street type and land use. Often-used criteria relate to connectivity, proximity to activity areas, safety, public comments, land use, and traffic conditions on the road. The output of the prioritization process is generally a list of projects, a GIS map, or both.

Design Issues Relating to Sidewalk Construction

Of the 47 responding localities, 19 percent did not experience problems with design issues relating to building missing sidewalks, because they do not build such sidewalks. Fifteen percent of the respondents reported that the few projects they had were completed without experiencing design problems; 66 percent of the respondents had various design problems. Most respondents did not identify the type of problem encountered, since the question asked whether they experienced such problems and how they dealt with them. The following problems were, however, mentioned: no sufficient right of way (5 respondents), utility conflicts (4 respondents), difficulty meeting ADA requirements (1 respondent), drainage complexities (1 respondent), interchange as a barrier (1 respondent), and absence of a comprehensive design manual.

Actions taken to solve problems included seek more funds (12 respondents), redesign to reduced design criteria (9 respondents), delay the project (4 respondents), break the project into segments and pursue the project segment by segment (2 respondents), cancel the project (2), pave the shoulder (2), request a developer to complete the project (1), build the project with in-house forces instead of contracting (1 respondent), require the property owner to build the project (1 respondent), and build sidewalk on just one side of the road (1 respondent).

SUMMARY OF FINDINGS

Literature Review

- In the course of the literature search, no publication was found focusing on the topic of missing sidewalks. Most of the literature is focused on accommodations for pedestrians along newly constructed roads and on operational issues for existing pedestrian facilities.

Survey of VDOT Districts

- VDOT does not have a statewide sidewalk inventory system of existing or missing sidewalks.
- No VDOT district has a sidewalk inventory system of existing or missing sidewalks.
- No VDOT district has a wish-list for replacing missing segments of sidewalks.
- The few sidewalk segments constructed in recent years in VDOT districts were funded from various funding sources. No source was used any more frequently than any other. No VDOT district has a dedicated “steady” source of funding for missing sidewalk projects.
- Based on survey respondents’ estimates (according to their familiarity with their road networks since data were not available), 80 to 99 percent of rural and suburban roads are missing sidewalks on at least one side of the road, with the exception of Northern Virginia, where the estimate was 70 to 75 percent of VDOT roads in urban areas and 85 to 90 percent of roads in suburban areas.
- Seven of the nine VDOT districts recommended that an annual amount of funding be spent on constructing missing sidewalk segments. The amount recommended ranged from \$200,000 to \$1 million. Two of the seven also stated that funding would need to continue for many years to make significant improvements on a system level and that full connectivity would probably cost millions per year in their respective district.
- No VDOT district has a prioritization method with regard to projects for missing sidewalks.
- The four most urbanized VDOT districts (NOVA, Hampton Roads, Richmond, and Fredericksburg) have each encountered cases when constructing a missing sidewalk to the standard 5-ft-width design criterion was prohibitively expensive. In most cases, the cause was limited right of way. Alternative actions included providing a wider shoulder or a flat area behind the curb and breaking the project into phases to be constructed over a longer period of time. VDOT’s design waiver process was viewed as a last resort to be used in cases where some accommodation was critically needed and meeting design criteria was cost-prohibitive.

Survey of State DOTs

- Of the 29 responding states, no state DOT had a full or partial inventory of existing or missing sidewalks; the Maryland SHA maintains a statewide sidewalk inventory of existing and missing sidewalks along its urban roads.
- None of the responding states has a wish-list for constructing missing segments of sidewalks.
- Of the responding states, missing sidewalk segments constructed in recent years were funded from various funding sources. No source was used any more frequently than any other. Of the responding states, only Maryland has a dedicated “steady” source of funding for missing sidewalk projects. New Jersey reported spending \$10 million per year on pedestrian safety improvements, which includes missing sidewalks and other improvements.
- The North Carolina, Delaware, and West Virginia DOTs, which are similar to VDOT in that they own the state’s secondary system, are similar to VDOT in that they do not have a program to construct missing sidewalks.
- Six DOTs provided estimates for the proportion of their highway system without sidewalks on at least one side of the road (according to their familiarity with their road networks since data were not available). The estimates ranged from 50 to 93 percent. Twenty-three DOTs (79 percent of responding DOTs) did not provide an estimate. Of the responding state DOTs, 24 (76 percent) did not provide a recommended amount per year for constructing missing sidewalks. Four respondents suggested \$2 to \$10 million/year, and one suggested \$100 million.
- Of the responding states, 17 percent have a prioritization method with regard to projects for missing sidewalks.
- Of the responding states, 66 percent have encountered cases when constructing a missing sidewalk to the design criterion was prohibitively expensive. In most cases, the cause was insufficient right of way. Alternative actions included tying the pedestrian project to a road improvement project, asking the locality (where the project is built) for funds, breaking the project into segments, delaying the project, and canceling the project.

Survey of Localities

- Of the 47 responding localities, 62 percent had a partial or full inventory of existing or missing sidewalks. However, there were many examples from localities of inventories for a smaller targeted area, e.g., village centers, vicinity of transit stops, dense commercial areas, senior centers, municipal facilities, multi-family housing, schools, and recreation areas. Comments from local officials and residents are often added to these inventories.
- Of the responding localities, 40 percent have a wish-list for replacing missing segments of sidewalks.

- Of the responding localities, missing sidewalk segments constructed in recent years were funded from various funding sources. Survey respondents reported 30 different types of funds they have used for constructing missing sidewalks, with only two dedicated to this purpose..
- Seventy-five percent of the respondents indicated that 50% or more of their roads lacked sidewalks.
- Of the responding localities, 57 percent recommended that an annual amount of funding be spent on constructing missing sidewalk segments. The amount recommended ranged from \$50,000 to \$1 million per year.
- Of the responding localities, 87 percent have a prioritization method with regard to projects for missing sidewalks.
- Of the responding localities, 66 percent have encountered cases when constructing a missing sidewalk to the design criterion was prohibitively expensive. In most cases, the causes were not having sufficient right of way and utility conflicts. Alternative actions included seeking more funds, reducing design criteria, and delaying the project

CONCLUSIONS

- *Since VDOT has no statewide or district level inventory of missing sidewalks or a wish-list of projects for retrofitting missing sidewalks, the magnitude of the unmet demand is not known.*
- *A full inventory of sidewalk availability is not likely necessary since a large portion of the road network is rural where sidewalks may be rarely needed.*
- *That seven of the nine VDOT district respondents recommended steady, yearly, dedicated funding to construct missing sidewalks suggests that the absence of sidewalks is an issue to be addressed. Full connectivity would probably cost millions per year in their respective districts.*
- *VDOT district bicycle and pedestrian coordinators believe that the demand and necessity exist for retrofit sidewalk projects but have concerns regarding funding shortages for transportation projects in general. They expressed the need to address the issue of missing sidewalks on a statewide level, in close collaboration with localities.*
- *Experiences of selected localities across the United States show successful sidewalk retrofit programs, which focus on targeted areas with high pedestrian activity.*
- *Although funding constraints may preclude a large number of retrofit sidewalk projects, systematic, well-developed prioritization processes support identifying and implementing the most effective, high-priority sidewalk projects.*

- *Even though prioritization methods of localities, where they do exist, have similar components, the methods are all different as they are tailored to the needs of the jurisdiction or organization. Typical similar components include connectivity and proximity to activity areas. Safety and citizen requests are examples of frequently considered features in the methods. Most methods list the components in priority order, which differs a great deal between methods.*
- *Since constructing a missing sidewalk to the standard 5-ft width is at times prohibitively expensive in Virginia, alternative actions such as providing a wider shoulder or a flat area behind the curb and breaking the project into phases to be constructed over a longer period of time may be in order.*
- *Since VDOT's design waiver process is viewed as a last resort to be used in cases where some accommodation was critically needed and meeting design criteria was cost-prohibitive, meeting current standards should be the goal for any new segments.*

RECOMMENDATION

1. *VDOT's Transportation Mobility & Planning Division should collaborate with VDOT districts and localities to develop guidelines for identifying, prioritizing, funding, and constructing missing sidewalks along existing roads. Since localities have varying needs, the guidelines should incorporate flexibility relating to localities' choices of targeted areas and prioritization components.*

BENEFITS AND IMPLEMENTATION PROSPECTS

The absence of inventories and other quantitative data makes it impossible to estimate quantitatively the potential benefits and costs of implementing the recommendation. However, implementing the recommendation would provide a helpful tool for pursuing retrofit sidewalk projects.

Further progress on addressing the topic of non-existent sidewalks along existing roads would require relevant facts and quantification to explore related issues, such as the following:

- quantifying benefits of constructing missing sidewalks
- performing cost/benefit analyses of constructing missing sidewalks versus other mobility improvements
- developing methods to determine the mileage and locations of needed sidewalks

- calculating the amount of money spent on constructing missing sidewalks versus the amount that would be needed.

ACKNOWLEDGMENTS

The author is grateful for the support, information, and comments provided by staff of VDOT's Transportation & Mobility Planning Division, including Marsha Fiol, Director, and Jakob Helmboldt, State Bicycle and Pedestrian Coordinator, and by VDOT's district bicycle and pedestrian coordinators. George Rogerson of VDOT's Location & Design Division and Lois Thibault of the United States Access Board also provided helpful information. The report's final version benefited from Linda Evans' skillful editing.

REFERENCES

1. Federal Highway Administration, Office of Human and Natural Environment. *Federal-Aid Highway Program Funding for Pedestrian and Bicycle Facilities and Programs*. <http://www.fhwa.dot.gov/environment/bikeped/bipedfund.htm>. Accessed September 9, 2009.
2. Rousseau, G. Email to I. Kastenhofer, September 4, 2009.
3. Federal Highway Administration, Office of Human and Natural Environment. Bicycle & Pedestrian Program. <http://www.fhwa.dot.gov/environment/bikeped/>. Accessed January 22, 2009.
4. Pedestrian and Bicycle Information Center. State DOT Bicycle and Pedestrian Coordinator Contact Information. University of North Carolina Highway Safety Research Center, Chapel Hill, N.C. <http://www.walkinginfo.org/assistance/contacts.cfm>. Accessed September 9, 2009.
5. Virginia Department of Transportation, Transportation & Mobility Planning Division. *Policy for Integrating Bicycle and Pedestrian Accommodations*. Richmond, 2004.
6. Virginia Department of Transportation. *Bike and Pedestrian Implementation Guide for Locality Involvement*. Richmond, 2006.
7. *Code of Virginia*, § 33.1-23.03. Board to develop and update Statewide Transportation Plan. Richmond. <http://leg1.state.va.us/cgi-bin/legp504.exe?000+coh+33.1-23.03+500786>. Accessed August 10, 2009.

8. Virginia Department of Transportation, Traffic Engineering Division. *Commonwealth of Virginia FY 2008-09 Annual Report, Highway Safety Improvement Program*. Richmond, 2008.
9. Virginia Department of Transportation. Location & Design Division. *Context Sensitive Solutions*. Instructional and Informational Memorandum: IIM-LD-235. Richmond, 2006.
10. Helmbolt, J. Email to I. Kastenhofer, September 8, 2009.
11. Chandler, M.A. Without a Car, Suburbanites Tread a Peril: Loudoun Residents Blaze Their Own Risky Trails Where Sidewalks and Bike Paths Are Lacking. *The Washington Post*, July 16, 2007, p. B1.
12. Transportation Research Board, Pedestrians Committee. *Pedestrians: Research Program Statements*. Transportation Research Circular E-C084. Transportation Research Board of the National Academies, Washington, D.C., 2006.
13. Natarajan, S., Demetsky, M.J., and Lantz, K.E. *Framework for Selection and Evaluation of Bicycle and Pedestrian Safety Projects in Virginia*. VTRC 08-R8. Virginia Transportation Research Council, Charlottesville, 2008.
14. Grimes, M.C., Mattingly, K.M., and Miller, J.S. *Alternative Transportation Funding Sources Available to Virginia Localities*. VTRC 06-R17. Virginia Transportation Research Council, Charlottesville, 2006.
15. Arnold, E.D. *Development of Guidelines for In-roadway Warning Lights*. VTRC 05-R10. Virginia Transportation Research Council, Charlottesville, 2006.
16. Dougald, L.E. *Development of Guidelines for the Installation of Marked Crosswalks*. VTRC 05-R18. Virginia Transportation Research Council, Charlottesville, 2004.
17. Arnold, E.D., and Dougald, L.E. *Evaluation of the Cross Alert System on the Virginia Capital Trail in James City County*. VTRC 08-R23. Virginia Transportation Research Council, Charlottesville, 2008.
18. Diefenderfer, B.K., and Galal, K.A. *Forensic Investigation of Brick Paver Crosswalks at Court Square in Charlottesville, Virginia*. VTRC 07-R18. Virginia Transportation Research Council, Charlottesville, 2007.
19. Arnold, E.D., and Dougald, L.E. *Guidelines for the Retrofit Installation of Accessible Pedestrian Signals by the Virginia Department of Transportation: Phase I Report*. VTRC 03-TAR3. Virginia Transportation Research Council, Charlottesville, 2003.
20. Arnold, E.D., and Dougald, L.E. *Guidelines for the Retrofit Installation of Accessible Pedestrian Signals by the Virginia Department of Transportation: Phase II Report*. VTRC 05-R5. Virginia Transportation Research Council, Charlottesville, 2005.

21. Stoke, C.B., and Sullivan, A.M. *Safe Walking in the Commonwealth: An Analysis of the Issues and Proposed Clarifications of the Code of Virginia*. VTRC 96-R13. Virginia Transportation Research Council, Charlottesville, 1995.
22. Hartman, S.E., Kweon, Y.-J., Lynn, C., and Roettig, H. *Safe Travel for Virginia's Non-motorized Road Users: A Comprehensive Review of Pedestrian and Bicycle Laws in Virginia and the United States*. VTRC 08-R5. Virginia Transportation Research Council, Charlottesville, 2007.
23. U.S. Department of Justice. *Excerpt from 28 CFR Part 36: ADA Standards for Accessible Design, Revised as of July 1, 1994*. <http://www.ada.gov/adastd94.pdf> Accessed September 9, 2009.
24. U.S. Access Board. *Revised Draft Guidelines for Accessible Public Rights-of-Way, November 23, 2005*. <http://www.access-board.gov/prowac/index.htm>. Accessed September 9, 2009.
25. Federal Highway Administration, Office of Civil Rights, *Public Rights-of-Way Access Advisory, January 23, 2006*. <http://www.fhwa.dot.gov/environment/bikeped/prwaa.htm>. Accessed September 9, 2009.
26. Virginia Department of Transportation, Location & Design Division. *Curb Ramps and Sidewalks*. Instructional and Information Memorandum: IIM-LD-55.11. Richmond, 2007.
27. Virginia Department of Transportation, Location & Design Division. *Road Design Manual*. Richmond, 2005.
28. Public Rights-of-Way Advisory Committee of the United States Access Board, Subcommittee on Technical Assistance. *Special Report: Accessible Public Rights-of-Way Planning and Design for Alterations*. Otak, Inc., 2007. <http://www.access-board.gov/PROWAC/alterations/guide.htm>. Accessed April 24, 2009.
29. Thibault, L. Email to I. Kastenhofer, April 27, 2009.
30. Schneider, R., Patton, R., Toole, J., and Raborn, C. *Pedestrian and Bicycle Data Collection in United States Communities: Quantifying Use, Surveying Users, and Documenting Facility Extent*. Federal Highway Administration, Washington, D.C., 2005.
31. Transportation Bureau of Statistics. *State Highway Agency-Owned Public Roads: 2007*. Federal Highway Administration, Washington, D.C., 2007.
32. Swords, A.R., Goldman, L.M., Feldman, W., Ehrlich, T.F., and Bird, W.J., Jr. Analytical Framework for Prioritizing Bicycle and Pedestrian Investments: New Jersey's Statewide Master Plan Update, Phase 2. In *Transportation Research Record: Journal of the Transportation Research Board*, No. 1878. Transportation Research Board of the National Academies, Washington, D.C., 2004, pp. 27-35.

33. City of Bloomington. *Bloomington Alternative Transportation and Greenways System Plan*. Bloomington, Ind., 2001. http://bloomington.in.gov/egov/docs/1144866433_802205.pdf. Accessed April 4, 2007.
34. City of Bloomington. *Unified Planning Work Program. City of Bloomington, IN, 2006*. Bloomington, Ind., 2006. http://bloomington.in.gov/egov/docs/1151347709_851457.pdf. Accessed April 4, 2007.
35. City of Denver. *Pedestrian Master Plan, City of Denver, CO, 2004*. Denver, Col., 2004. <http://www.denvergov.org/PedestrianMasterPlan/tabid/395511/Default.aspx>. Accessed January 27, 2007.
36. City of Sandpoint. *Comprehensive Plan, City of Sandpoint, ID, 2006*. Sandpoint, Id., 2004. <http://www.cityofsandpoint.com/compplan.asp>. Accessed March 25, 2007.

APPENDIX A
SURVEY INSTRUMENT

Questionnaire of Missing Sidewalk Segments

The Virginia Transportation Research Council is undertaking a research project to identify and examine challenges relating to constructing missing sidewalks along existing roads and to provide VDOT with recommendations to improve related VDOT practices. Your answers to this questionnaire will greatly contribute to making the best possible recommendations at the completion of this project. Please answer the following questions based on available information. Time consuming data collection is not the intention of this questionnaire. It is recognized that most jurisdictions/organizations have limited data relating to missing sidewalks.

Please e-mail your answers to Ilona Kastenhofer, project manager, at ilona.kastenhofer@vdot.virginia.gov. If you have any questions while answering the questionnaire, do feel free to contact her at 434-293-1981 or through e-mail. Also, please provide contact information for possible follow-up questions. Your participation is truly appreciated.

Missing Sidewalk Inventory

1. Do you have an inventory of specific locations where sidewalks exist along roads in your jurisdiction?
2. Do you have an inventory of specific locations where sidewalks are missing along existing roads in your jurisdiction?
3. Do you have a “wish-list” for missing segments of sidewalks to be constructed?
4. If you have a wish-list, how were the missing segments identified? (For example: through citizen requests or staff collected information about missing sidewalks in specific areas, etc.)
5. If you have a wish-list, what type of data base did you use? (For example: excel spreadsheet, access database, GIS, etc.)

Funding

6. How do you fund the construction of missing segments of sidewalks (when they are not part of a highway construction project)? (For example: Transportation Enhancement, VDOT Secondary/Primary funds, Hazard Elimination Program, CMAQ, etc.)
7. If you have funding, is it steady (e.g. is it provided year after year, or is it provided only occasionally)?
8. If you have steady funding, how much is it per year?
9. For urban and suburban areas: Can you provide a rough estimate of what percentage (or range of percentage) of your road network (or your mileage) is missing sidewalks on either side of the roads?
10. In your opinion, what is the amount you would recommend for spending yearly on constructing missing sidewalk segments in your district or locality?

Prioritizing

11. How do you prioritize missing sidewalk projects?

Design

12. Occasionally the need for a sidewalk is obvious but meeting design criteria is prohibitively expensive. Have you experienced this problem and how did you deal with it?

THANK YOU!

APPENDIX B

SUMMARY OF FUNDING SOURCES AND PROGRAMS

Table B1. Summary of Funding Sources and Programs

Alternative Use of Highway Allocations, Administered by VDOT	
Bicycle and Pedestrian Accommodation Policy	Allows bike lanes to be built with funds otherwise used for road construction (not additional fund source)
Rural Addition Program	Used to upgrade substandard subdivision streets to state standards (not additional fund source)
Rural Rustic Roads Program	Flexible cost-effective alternative for paving unpaved roads (not additional fund source)
PPTA of 1995	Allows private sector to design, construct, and operate transportation systems, including toll facilities (other than TPOF funds, not additional fund source except what private sector offers)
Funding Source or Program Administered by VDOT	
Transportation Enhancement Funds	Used for bicycle/pedestrian facilities, historic preservation, and aesthetic improvements
Access Programs	Includes recreational, industrial, and airport access road funds to provide access to qualifying facilities
Route 58 Corridor Development Program	Used for enhancing economic development potential of corridor
Highway Safety Improvement Program (HSIP)	Used for improving highway safety
Safe Routes to School	Eligible projects include infrastructure improvements such as sidewalks, bike lanes, and traffic calming, and public involvement, such as education and outreach.
Special Transportation Districts	Regional entities created by state law
Revenue Sharing	Matching funds available to localities
Congestion Mitigation and Air Quality (CMAQ) Improvement Program	Used to reduce emissions and promote clean air, available only in MPO areas that do not meet EPA's National Ambient Air Quality Standards
Transportation Partnership Opportunity Fund	Grants that Governor can award to facilitate economic development and use of PPTA (see above)
Rural Transportation Planning Assistance Program	Provides funding and guidance to rural PDCs in accomplishing rural planning tasks requested by localities
Rural Transportation Planning Grants.	Provides funding through competitive grant program for worthwhile rural transportation planning proposals.
Programs Administered by Localities in Virginia	
Local transportation districts	Used for special taxing of land and funding transportation improvements.
Pro-Rata Reimbursement Provisions in Subdivision Ordinance	Provides for reimbursement of road improvement costs between initial and subsequent developer
Community Development Authorities	Additional transportation funding mechanism
Road Impact Fees	Fee that particular localities can charge developers
Proffers	Cash and improvements offered by developers to persuade acceptance of rezoning application
General Funds	Can be used for transportation, including contributions to VDOT for project or improvement
Tax Increment Financing	Used to enhance economic potential of blighted areas
Local Bonding Authority	Bonds have been used by some localities to construct roads
Coal and Gas Severance Tax	Local government taxes on extraction of gas and coal, used for road improvements

Local Gas Tax	Authorized for levy by some localities
Programs Administered by Department of Rail and Public Transportation	
Industrial Access Railroad Tracks	Similar to access programs administered by VDOT
Rail Enhancement Fund	Used for retention, maintenance, improvement, and development of railways
Programs administered by U.S. Department of Transportation	
Transportation and Community System Preservation Program	Used to assist with planning and implementation of transportation improvements with environmental and community benefits
Scenic Byways Program	Used to fund recognition, preservation, and improvement of designated scenic byways
Public Lands Highway Program	Used to provide and improve access to and within federal lands.
Appalachian Regional Commission	Federally funded local and state partnership for economic development and transportation network improvements in Appalachian regions
Programs administered by Virginia Department of Conservation and Recreation	
Recreational Trails Program	Used to develop and maintain trails for motorized and non-motorized recreation

Source: Grimes, M.C., Mattingly, K.M., and Miller, J.S., *Alternative Transportation Funding Sources Available to Virginia Localities*, VTRC 06-R17, Virginia Transportation Research Council, Charlottesville, 2006.

APPENDIX C

STATE DEPARTMENTS OF TRANSPORTATION RESPONDING TO THE SURVEY

Arkansas, California, Connecticut, Delaware, Florida, Georgia, Idaho, Indiana, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Dakota, Texas, Virginia, West Virginia, Wisconsin, and Wyoming

APPENDIX D

LOCALITIES RESPONDING TO THE SURVEY

Albemarle County, Virginia; Alexandria, Virginia; Altavista, Virginia; Amherst, Virginia; Appomattox County, Virginia; Atlanta Regional Commission, Georgia; Bath County, Virginia; Bloomington, Indiana; Bridgewater, Virginia; Broadway, Virginia; Buena Vista, Virginia; Chapel Hill, North Carolina; Charlotte, North Carolina; Columbia, Missouri; Culpeper, Virginia; Danville, Virginia; Davidson County, Tennessee; Denver, Colorado; Duluth-Superior, Metropolitan Interstate Council, Texas; Edinburgh, Virginia; Fort Collins, Colorado; Franklin County, Massachusetts; Grottoes, Virginia; Harrisonburg, Virginia; Herndon, Virginia; Highland County, Virginia; Hillsborough County, Florida; Houston-Galveston Area Council, Texas; Kane County, Illinois; Louisa, Virginia; Luray, Virginia; Marin County, California; Mineral, Virginia; Nelson County, Virginia; Oakland, California; Prince Edward County, Virginia; Prince William County, Virginia; Raleigh, North Carolina; Sacramento County, California; San Diego, California; Sandpoint, Idaho; Staunton, Virginia; St. Mary's County, Maryland; St. Petersburg, Florida; Timberville, Virginia; and Warrenton, Virginia.