LIVABLE STREETS INITIATIVE

HAMPTON ROADS
PLANNING DISTRICT COMMISSION

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BRIAN MILLER	GRAPHIC TECHNICIAN II
RACHAEL V. PATCHETT	REPROGRAPHIC SUPERVISOR

LIVABLE STREETS INITIATIVE

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Prepared by the Staff of the Hampton Roads Planning District Commission

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AUTHOR:

Robert B. Case, P.E.

ORGANIZATION NAME, ADDRESS AND TELEPHONE
Hampton Roads Planning District Commission
723 Woodlake Drive
Chesapeake, Virginia 23320
(757) 420-8300

ABSTRACT

The Hampton Roads Planning District Commission (HRPDC) staff was requested to undertake a study which evaluates the compatibility of VDOT guidelines with the concept of "livable streets." Livable streets are streets which are built (or modified) to be safe and user-friendly, for pedestrians as well as drivers, and visually pleasing to those who live along them. Some people believe that certain street guidelines, such as a 30-foot minimum pavement width, sacrifice aesthetic and pedestrian goals in order to better serve vehicular traffic. This study examines which tools used to create livable streets are compatible with VDOT guidelines, regulations, and laws and which are not. It is to be used by localities, developers, and consultants to aid them as they choose local street designs and seek approval from VDOT for these designs.

ACKNOWLEDGMENTS

This report was prepared in cooperation with the U.S. Department of Transportation, the Federal Highway Administration, the Virginia Department of Transportation, and the cities of Hampton Roads. The contents of this report reflect the views of the staff of the Hampton Roads MPO. The MPO staff 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 Hampton Roads Planning District Commission or cooperating bodies. The report does not constitute a standard, specification or regulation. FHWA or VDOT acceptance of this report as evidence of fulfillment of the objectives of this planning study does not constitute endorsement/approval of the need for any recommended improvements nor does it constitute approval of their location and design or a commitment to fund any such improvements. Additional project level environmental impact assessments and/or studies of alternatives may be necessary.

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INTRODUCTION

The staff of the Hampton Roads Planning District Commission (HRPDC) was requested to undertake a study which evaluates the compatibility of VDOT guidelines with the concept of "livable streets." Livable streets are streets which are built (or modified) to be safe and user-friendly, for pedestrians as well as drivers, and visually pleasing to those who live along them. Some people believe that certain street guidelines, such as a 30-foot minimum pavement width, sacrifice aesthetic and pedestrian goals in order to better serve vehicular traffic. This study examines which tools used to create livable streets are compatible with VDOT guidelines and which are not. It is to be used by localities, developers, and consultants to aid them as they choose local street designs and seek approval from VDOT for these designs.

This study examines various tools which are being used in the U.S. and around the world today in attempts to make streets more livable. Most of the tools examined in this study were taken from two current movements: "Neo-traditional Neighborhoods" and "Traffic Calming". Neo-traditional neighborhoods are updated versions of older neighborhood designs. They often include a grid pattern for streets, narrower street widths, and alleys behind the homes. Traffic calming includes a number of tools (e.g. speed humps and street closures) which are designed to slow and/or reduce traffic. Most of the tools in this study, whether associated with neo-traditional neighborhoods or traffic calming, can be employed for either existing *or* new streets.

The first part of the report body provides background information for each of the study's livable streets tools to aid the user in determining which, if any, of these tools they would like to consider implementing. The information includes:

- verbal description
- graphical depiction
- application
- advantages
- disadvantages
- estimated cost

Under the "Application" headings, the study relates the circumstances in which each tool has been applied and the effects which were sought from such application.

Because the primary purpose of this study is to compare livable streets tools to VDOT guidelines, the background information provided in this part of the report is not exhaustive. Therefore, this study does not specifically recommend the use of any of these tools. Recommendations would only be possible after a thorough review of research documenting the actual effects of each measure (e.g. vehicle safety, pedestrian safety, vehicle speeds, and noise levels), and such a review was not part of this Work Program task. The few research publications which were reviewed, however, indicate that some livable streets initiatives hold great promise in safety improvement

and noise reduction. For highlights from these publications documenting the safety and noise impacts of livable streets initiatives, see Appendix B.

The second and principal part of the study examines whether or not the various livable streets tools conform with the regulations, guidelines, and laws which influence VDOT design decisions (hereinafter referred to as “VDOT criteria”). Each tool is examined under various scenarios: city vs. county and new construction vs. modification of existing roadways. The purpose of this section is to:

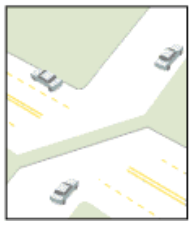
1) assist localities, developers, and consultants in determining which tools for livable streets can be approved under VDOT criteria, and the conditions under which such approvals may be granted, and

2) provide localities, developers, and consultants with information that will improve his or her ability to participate in the process of VDOT engineers determining which tools to approve.

TOOLS FOR LIVABLE STREETS

DESCRIPTION AND APPLICATION OF TOOLS FOR LIVABLE STREETS

1. Diagonal Diverters



"Raised diagonal closure of an intersection preventing through movements and a turning movement…"[1]

image source: www.bergenrecord.com
reprinted with permission of *The Record* of Hackensack, NJ

Application
"Applied to roads where a high degree of rat-running [i.e. cutting through a neighborhood] is experienced and/or where speeds are excessive. Typically applied in residential areas with a grid-type road layout."[1]

Advantages: reduces cut-thru traffic; slows traffic.

Disadvantages: can increase travel distances and emergency response times.

2. Traffic Circles

"…circle in the centre of an intersection providing one-way circular flow…"[1]

The circles considered here are for low-volume residential streets; these circles are not "roundabouts" (which are for higher volume streets).

image source: www.charmeck.nc.us

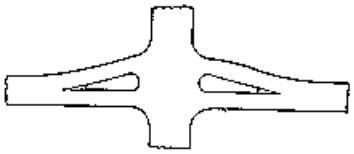
Application
"…these are used to replace multi-way stop controlled intersections with high violation rates. They are also applied where speeds through the intersection need to be reduced."[1]

Advantages: "reduces speeds, …can be visually attractive".[2]

Disadvantages
In an area where no circles currently exist, drivers will not expect to encounter a circle at an intersection; circles may increase emergency response times; they "may…require additional right of way."[2]

Estimated cost: $3,500-$15,000 each[2] (to retrofit).

3. Intersection Approach Islands



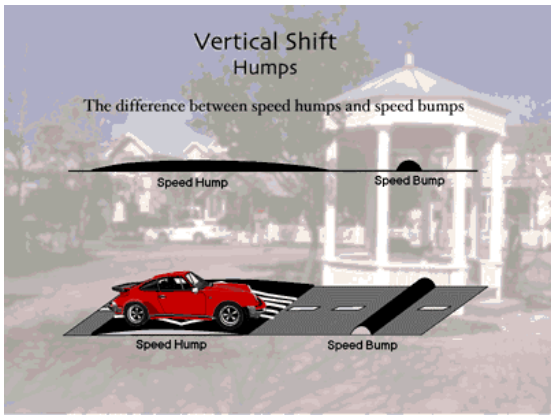
Island at the leg of an intersection which divides traffic streams.
"Commonly used features include pedestrian refuge treatments…and other more traditional forms of intersection traffic control islands."[3]

Advantages: "reduces speeds, provides refuge for pedestrians crossing roadway."[2]

Disadvantages: may require additional right-of-way.

Estimated Cost: $5,000-$15,000 each[2] (to retrofit).

4. Speed Humps



"Carefully profiled humps creating vertical constraints on speed…"[3]

Application:
"Constructed on roads where speeds are in excess of 40 km/h [25 mph] and where speeds need to be reduced. Typical applications include approaches to intersections, mid-block on links in residential areas, access points to residential areas etc."[1]

image source: www.worldpath.net

Advantages: "reduces speeds".[2]

Disadvantages: "increases emergency response times".[2]

Estimated Cost: $2,000-$3,000 per hump[2] (to retrofit).

5. Speed Tables

"…similar to speed humps…constructed with a table or flat portion which typically doubles as a pedestrian cross walk."[3]

image source: www.charmeck.nc.us

Application
"…typically used where speeds need to be reduced and motorists need to be made aware of the presence of pedestrians."[1]

Advantages: "reduces speeds, provides improved visibility and safety for pedestrians".[2]

Disadvantages: "increases emergency response times".[2]

Estimated Cost: $2,500-$8,000 each[2] (to retrofit).

6. Curb Extensions / Chokers

"…created by curb modifications…to narrow the roadway to a minimum width."[3]

Sometimes lanes are narrowed, sometimes parking area is simply terminated (as shown here).

image source: www.multnomah.lib.or.us

Application
Chokers are "applied in areas where speed limits are violated and also where certain [large] vehicles…are prohibited."[1]

Advantages: "reduces speeds, provides parking protection, shortens pedestrian crossing distance".[2]

Disadvantages: "potential drainage problems".[2]

Estimated Cost: $7,000-$10,000 per pair[2] (to retrofit).

7. Chicanes

"Similar to a…choker, except the road is tapered from both sides, leaving a single S-bend lane."[1]

Application
"Applied mid-block on roads where speeds and through traffic need to be reduced."[1]

image source: www.bergenrecord.com, reprinted with permission of *The Record* of Hackensack, NJ

Advantages: "reduces speeds, shortens pedestrian crossing time and distance"[2]

Disadvantages: contravenes driver expectation.

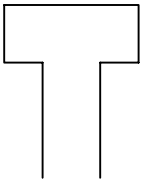
Estimated Cost: $5,000-$15,000 per set[2] (to retrofit).

8. Alleys

"…drastically altering the typical section…of the roadway environment (e.g. from a street to a driveway)…."[3]

Application: in neo-traditional neighborhoods.

9. Atypical Street Ends



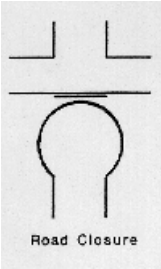
The *typical* street end built in recent years is a large circular cul-de-sac (e.g. having a pavement radius of 40 feet) with no island. An "atypical" street end is any design (other than the typical one) which is included in the AASHTO Green Book.[4] These include square-end turnarounds (at left), circular cul-de-sacs with islands in the middle, and hammerhead turnarounds.

Application: where residents desire less pavement.

Advantages
Turnarounds which use less pavement decrease the amount and contamination of runoff and are considered more aesthetically pleasing by some residents.

Disadvantages
Some atypical designs are more difficult for large vehicles (e.g. fire trucks) to negotiate.

10. Street Closure



Retrofit: Closing the street at mid-block creates two dead end streets; closing it at an intersection creates one dead-end street (as shown here). A narrow connection can be constructed at the turnaround to accommodate pedestrians and emergency vehicles.
New subdivisions: Cul-de-sacs are commonly used.

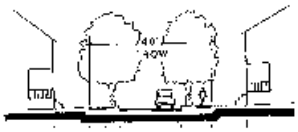
image source: www.tempe.gov

Application: where cut-thru traffic is to be eliminated.

Advantages: eliminates cut-thru traffic.

Disadvantages: can increase travel distances and transfer traffic problems to other streets.

11. Narrow Residential Curb & Gutter Streets



Definition: curb and gutter streets with less than 28' of pavement.

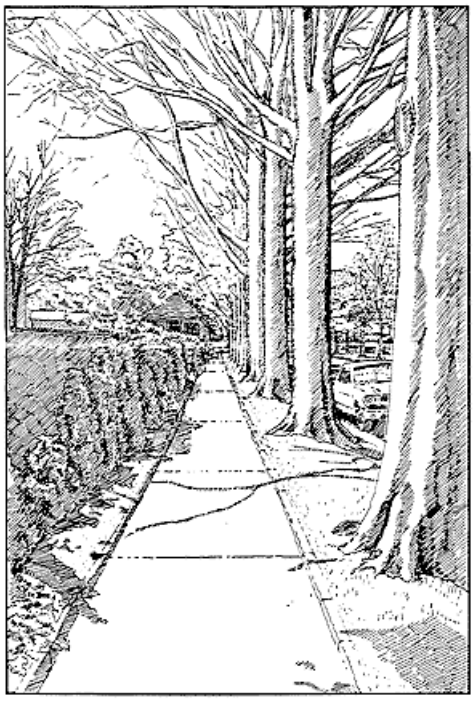
image source: www.webcom.com
copyright by Planning Commissioners Journal

Application: any neighborhood.

Advantages
Narrow streets have less pavement thereby decreasing the amount and contamination of runoff. They are considered more aesthetically pleasing by some residents and are thought to improve the social atmosphere of a neighborhood.

Disadvantages: can affect movement of large vehicles (fire, bus, etc.), particularly when combined with tight curb radii.

12. Street Trees



Trees lining the street.

(Street trees can be found between the pavement and sidewalk, between the sidewalk and right-of-way line, and on the homeowner's side of the right-of-way line.)

Catherine Johnson, Architect & Town Planner
Image used by permission of Ms. Johnson; image source: www.theatlantic.com

Application
Street trees can be included in any neighborhood, new or old, where space is provided for them.

Advantages: aesthetics, cooling, air quality.

Disadvantages
Depending on placement, trees can block the sight of motorists,[5] represent a hazard for vehicles, cause pavement and sidewalk cracking, and result in damage to utilities. Also, there is a cost associated with pruning street trees, removing limbs which fall from them in a storm, and replacing the trees after they die.

13. All-way Stop

"Erection of stop signs on all intersection approaches."[1]

Application
"Applied on streets where through traffic is to be discouraged…."[1]
It should be noted that studies indicate that the addition of stop signs actually results in higher speeds between signs.[6]

image source: http://members.aol.com/rcmoeur/signman.html

14. Buried Lines (power, phone, etc.)

Description
The placement of power, phone, cable, and other lines in the ground (instead of on power poles).

Application: where residents desire unobstructed views.

15. Lower Speed Limits

Speed limits less than 25 mph on a local road or less than 35 mph on a collector road.

Application: Lower speed limits have been applied where residents have complained of vehicle speeds. Note that: 1) lower speed limits do not necessarily result in lower vehicle speeds; 2) under certain circumstances, VDOT will designate a residential street as having $200 fines for speeding (see "Code of Virginia" under "VDOT-referenced Documents—Uses and Variances" below).

image source: http://members.aol.com/rcmoeur/signman.html

16. Tight Curb Radii

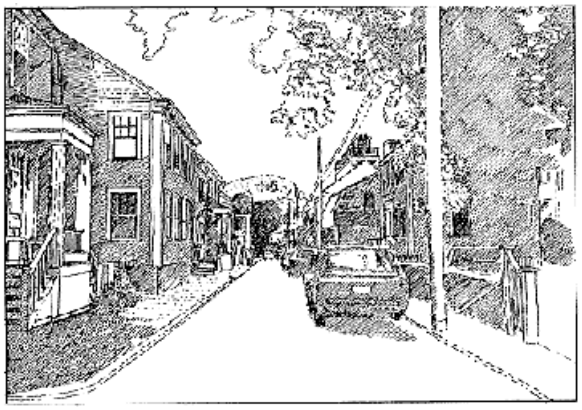
Definition: curb radii (at intersections) of less than 25 feet.

Application: tight curb radii have been used in neo-traditional neighborhoods.

Advantages: reduced pavement area and crosswalk length.

Disadvantages: difficult turns for large vehicles, particularly when combined with narrow streets.

17. One-way Streets



Application
One-way streets have been applied "…to eliminate through traffic…"[1]

Advantages
At intersections, adequate sight distance need be maintained only in one direction, thereby allowing an increase in on-street parking. One-way streets can also reduce cut-thru traffic.

Catherine Johnson, Architect & Town Planner
Image used by permission of Ms. Johnson; image source: www.theatlantic.com

Disadvantages: can result in wrong-way driving; can increase travel distances.

18. Through Truck Restrictions

Description:
A "through truck restriction" makes it illegal for large trucks to use certain roadways unless they have a destination on that roadway.

image source: http://members.aol.com/rcmoeur/signman.html

Application: in residential areas.

Advantages
Truck restrictions reduce the noise, danger, pollution, and unsightliness of large trucks.

Disadvantages: can increase travel distances for trucks.

VDOT APPROVAL OF TOOLS FOR LIVABLE STREETS

It is desirable to get VDOT approval for livable streets designs for two reasons: 1) In the counties, VDOT maintains those roadways which are in its secondary road system;[7] and 2) VDOT repays the independent cities (and towns larger than 3,500 population) for maintenance of the localities' roadways which meet VDOT criteria. In addition to the approval of design elements of new roadways (for acceptance into the secondary system or inclusion in the mileage total for maintenance repayments[8]), this study addresses VDOT approval of modifications to existing roadways in the cities and counties. The purpose of this section is:

1) to assist localities, developers, and consultants in determining which tools for livable streets can be approved by VDOT, and the conditions under which such approvals may be granted; and
2) to provide localities, developers, and consultants with information that will improve his or her ability to participate in the process of VDOT engineers determining which tools to approve.

VDOT is flexible, to a certain degree, concerning the approval of livable streets design elements:

- Citations do not exist in VDOT-referenced documents (the documents to which VDOT refers in the decision-making process) for all of the tools examined in this study. In the absence of written policies or criteria, VDOT engineers base decisions on their own judgement.
- VDOT policy toward those tools for which citations do exist may not be "set in stone".
- Some of the citations are guidelines (i.e. not laws or recorded regulations).
- Some of the citations which are in legal documents are accompanied by allowances for variances.
- VDOT policies concerning livable streets are evolving.

The absence of a "hard line" concerning livable streets design elements has two results: 1) predicting with certainty VDOT approval or disapproval is difficult; and 2) localities can participate in the process of VDOT's approval of street designs.

VDOT refers to several documents when making determinations on design questions. Knowledge of the role of and citations found in these documents is critical in predicting the outcome of and participating in VDOT review of atypical designs such as tools for livable streets. The next two sections assist localities, developers, and consultants in gaining that knowledge. In the first section, the role of each document is covered by examining its intended use and by reviewing any allowances for variances which it may contain. In the second section, the degree to which the tools for livable streets conform with the guidelines found in these documents is addressed.

VDOT-referenced Documents—Uses and Variances

Road Design Manual

VDOT's *Road Design Manual* provides design guidelines for roadways, from urban arterial highways to rural local roads. It is to be used by engineers as a "guide", not as the "final word" on design questions. According to its preface:

> "[This manual] is intended to serve as [a]…*guide* [emphasis added] and is to be used in conjunction with specifications, standards, policy directives (State and Federal), and design policy manuals published by the American Association of State Highway and Transportation Officials [AASHTO]. It is neither a textbook nor a substitute for engineering knowledge, experiences, or judgement."[9]

A Policy on Geometric Design of Highways and Streets (AASHTO "Green Book")

This book, referenced by VDOT as quoted above, is used by engineers across the United States, and considered by some to be the "bible" of road design. Like VDOT's *Road Design Manual*, it is a guide. According to the Green Book, "the *guidance* [emphasis added] supplied by this text…is based on established practices and is supplemented by recent research."[10] Note that one would expect guidance primarily based on "established practices" to be strongly influenced by guidelines which have been used in the past, some of which are based on research and some of which are not.

The Green Book includes a policy statement which could be valuable to those trying to make residential streets safe and user-friendly, for pedestrians as well as drivers, and visually pleasing to those who live along them. According to the book, in the case of residential streets:

> "[The] overriding consideration is to foster a safe and pleasant environment whereas the convenience of the motorist is secondary."[11]

John Leonard of Georgia Tech and Jeff Davis of The Citadel have studied the relationship between traffic calming measures and national standards. Their article ("Urban Traffic Calming Measures, Conformance with AASHTO and MUTCD Guidelines") was published in Traffic Congestion and Traffic Safety in the 21st Century (New York: American Society of Civil Engineers, 1997). The table has been included in this study as Appendix C, for information only. Because VDOT has many of its own guidelines, this HRPDC study does not directly address the conformance of the eighteen tools for livable streets with AASHTO or MUTCD guidelines.

Subdivision Street Requirements

For counties, and towns with a population of less than 3,500, VDOT's *Subdivision Street Requirements* (SSR):

> "[establishes the] minimum state criteria that new subdivision streets must satisfy for acceptance and maintenance…as part of the secondary system of state highways." "[It is] a regulation [24 VAC 30-90-10 et seq.] of the Commonwealth Transportation Board, adopted under the provisions of the Commonwealth's Administrative Process Act."[12]

The *Subdivision Street Requirements* "govern the aspects of subdivision street development that set them apart from those considerations customarily applied to highway projects."[13] In other design questions, the *Road Design Manual* and other VDOT and industry publications govern.

It should be noted that VDOT's resident engineers have been given significant leeway to approve designs which vary from the SSR:

> "The department's resident engineers are authorized considerable discretionary authority in the application of the geometric standards relative to alignment and grade for streets functionally classified as "local". Such judgments should take into consideration the individual situation, but in no instance are the safety features, structural integrity, or traffic capacities prescribed by these requirements to be sacrificed."[14]

(Due to its size and importance, Table 1 has been placed on the following pages [in the middle of this discussion of "VDOT-referenced Documents"] at the centerfold of this booklet. Otherwise, it would be placed at the end of the body of this report.)

TABLE 1
Livable Streets Tools- Conformance with VDOT Criteria (30)

	Counties		Independent Cities & Larger Towns (2)			
	Rural and Urban Local Roadways		Collector Roads and Local Streets			
	Construction of New Roadways	Modification of Existing Roadways	Construction of New Roadways	Modification of Roadways Constructed in or after 1996 to Certain Standards of the Subdivision Street Requirements (13)	Modification of Existing Grandfathered Roadways (4)	Modification of Other Roadways (29)
Goal:	Addition to Secondary System	Continuance in Secondary System	Receipt of maintenance payments from VDOT			
Document: (main regulation/guide/law)	Subdivision Street Requirements, VDOT, 1996 (1)	Road Design Manual, VDOT, 2003 and Subdivision Street Requirements, VDOT, 1996, whichever is more lenient. (25)	Code of Virginia, 1950, section 33.1-41.1, second paragraph, parts a, b, and c, or part g, whichever is more lenient. (26) (3)	not subject to VDOT regulation (13)(5)	not subject to VDOT regulation (4)(5)	Code of Virginia, 1950, section 33.1-41.1, second paragraph, parts a, b, and c. (3)
Tools						
1. Diagonal Diverters	No (minimum radius = 95') (31)	No (minimum radius = 95') (31)	Yes (no minimum radius)	Yes (see top of column)	Yes (see top of column)	Yes (no minimum radius)
2. Traffic Circles	Yes (9)	Yes (in "Calming Guide") (6)(9)	Yes (no minimum radius)	Yes (see top of column)	Yes (see top of column)	Yes (no minimum radius)
3. Intersection Approach Islands (17)	Yes (12)	Yes (in "Calming Guide") (6)(12)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
4. Speed Humps	Yes (12)	Yes (in "Calming Guide") (6)(12)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
5. Speed Tables	Yes (12)	Yes (in "Calming Guide") (6)(12)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
6. Curb Extensions / Chokers	Yes (18)(10)	Yes (18)(10)(6)	Yes (minimum width: 18'-40')(15)	Yes (see top of column)	Yes (see top of column)	No (min. pavement width: 30')
7. Chicanes	No (minimum radius = 95') (8)	No (min. radius = 95') (8)(6)	Yes (no minimum radius)	Yes (see top of column)	Yes (see top of column)	Yes (no minimum radius)
8. Alleys	Yes (14)	n.a.	Yes (14)	n.a.	n.a.	n.a.
9. Atypical Street Ends (20)	Yes (16)	Yes (16)	Yes (16)	Yes (see top of column)	Yes (see top of column)	Yes (16)
10. Street Closures	Yes (12)	Yes (12)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
11. Narrow Curb & Gutter Streets (21)	Yes (27)	Yes (22)	Yes (27)	Yes (see top of column)	Yes (see top of column)	No (min. pavement width: 30')
12. Street Trees	See VDOT landscape manual.	See VDOT landscape manual.	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
13. All-way Stops	Yes (if warranted) (23)	Yes (if warranted) (23)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
14. Buried Lines (power, phone, etc.)	Yes	Yes	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
15. Lower Speed Limits (24)	Yes (19)	Yes (19)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
16. Tight Curb Radii (less than 25')	Yes (7)(10)(11)	Yes (7)(10)(11)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
17. One-way Streets	Yes (12)	Yes (12)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)
18. Through Truck Restrictions	Yes (28)	Yes (28)	Yes (no mention in Code)	Yes (see top of column)	Yes (see top of column)	Yes (no mention in Code)

TABLE 1 Notes

(1) The purpose of these regulations is to "govern the aspects of subdivision street development that set them apart from those considerations customarily applied to highway projects. However, in all other matters regarding the design and construction of these streets, the relevant requirements of the standards, design manual, specifications, pavement design guide and associated instructions shall govern." (SSR (15), p. 4)

(2) "Larger towns": towns having a population of 3,500 or greater.

(3) See second paragraph of section 33.1-41.1 of the Virginia Code, 1997 Cumulative Supplement.

(4) Regarding the second paragraph of Virginia Code section 33.1-41.1, existing roadways which meet the criteria in parts d, e, or f (e.g. streets "established prior to July 1, 1950") are grandfathered and therefore not subject to the requirements of parts a, b, and c (e.g. 30' pavement).

(5) Exception: All maintenance payments are "subject to the approval of the Commonwealth Transportation Board" (Code of Va. 33.1-41.1).

(6) This tool is one of the approved tools included in VDOT's Residential Traffic Calming Guide, Pilot Program, Dec. 1997.

(7) There is no guidance published by VDOT for the curb radii at the intersection of residential streets. Guidance can be found in the AASHTO Green Book (A Policy on Geometric Design of Highways and Streets, 2001) in Chapter 5 "Local Roads and Streets (Urban Streets)", under "Intersection Design " (p. 404).

(8) This tool is one of the approved tools included in VDOT's Residential Traffic Calming Guide, Pilot Program, Dec. 1997, but its application is "limited to divided highways" (according to the Guide).

(9) There is no existing VDOT prohibition of traffic circles.

(10) According to 24 VAC 30-90-90 (of Subdivision Street Requirements), entrances to new subdivisions "shall comply with applicable commercial entrance requirements of the department's Permit Manual and Minimum Entrance Standards [30' min. width]."

(11) According to Minimum Standards of Entrances to State Highways (VDOT, 1989, p. 27), the minimum radius on the curb return of an entrance shall be 12.5', although the "desirable minimum" is 25'.

(12) There is no written VDOT guideline which would prohibit the use of this tool.

(13) According to Virginia Code section 33.1-41.1(g): "a street functionally classified as a local street and constructed on or after January 1, 1996, which at the time of approval by the city or town met the criteria for pavement width and right-of-way or the then-current edition of the subdivision street requirements manual" is eligible for maintenance payments (apparently regardless of modifications made subsequent to the stated approval). (5)

(14) Subject to minimum pavement width of 18' and minimum right of way of 40' ("shoulder & ditch roadway"; see 24 VAC 30-90-380 in SSR (15).

(15) SSR: VDOT's Subdivision Street Requirements (1996), comprised of regulation 24 VAC 30-90-10 through 24 VAC 30-90-380.

(16) According to 24 VAC 30-90-240 (SSR (15), pg. 22), "various types of turnaround designs may be approved." AASHTO Green Book (A Policy on Geometric Design of Highways and Streets) is referenced. Guidance can be found

TABLE 1 Notes

in Chapter 5 "Local Roads and Streets (Urban Streets)", under "Cul-De-Sacs and Turnarounds" (p. 398 in 2001 edition).

(17) Channelization and pedestrian refuge islands on approach legs of intersections.

(18) Curb Extensions/Chokers are not addressed in SSR or Road Design Manual but may be subject to the SSR (15) minimum pavement widths of 28'-40'. (27)

(19) According to Virginia Code (46.2-1300):
"The governing body of any county, city, or town…may by ordinance authorize its chief administrative officer to:...Increase or decrease the speed limit within its boundaries, provided such increase or decrease in speed shall be based upon an engineering and traffic investigation…."

(20) See "Description and Application" section of this report for description of this tool.

(21) Residential streets with less than 28 feet of hard surface between curb faces.

(22) Guidance in VDOT's Road Design Manual is as follows: In the "urbanized" area, standard GS-8 (p. A-11) allows for a 10 foot minimum width of lane (no minimum street width is given). In the designated "rural" areas, "Rural Local Road" standard GS-4 (p. A-7) allows for the use of the "Urban Local Street" standard GS-8 for "incorporated towns or other built-up areas". GS-4's minimum pavement widths (18-24 ft.) are apparently for shoulder and ditch roads. The SSR (15) does address street widths and therefore controls in this case, both rural and urban. It allows for widths as low as 22 feet in certain conditions (27).

(23) There is no existing VDOT prohibition of multi-way stops, but warrants for such stops are listed in the industry standard Manual on Uniform Traffic Control Devices (ATSSA/ITE/AASHTO, 2001) in section 2B.07.

(24) Definition: speed limits < 25 mph on a local road or < 35 mph on a collector road.

(25) Because VDOT's Subdivision Street Requirements is for "streets to be added to the secondary system", modifications to existing roadways would apparently not be limited by its requirements. In cases where the Subdivision Street Requirements are more lenient than those of the Road Design Manual, however, it appears that VDOT would not prohibit modifications (to existing roadways) which meet the SSR requirements for new roadways.

(26) Roadways need meet only one of the seven subsections (a thru g) of section 33.1-41.1 in order to qualify for maintenance payments. (3)

(27) Although standard min. pavement widths (with curb & gutter) range from 28-40 ft. (24 VAC 30-90-380, SSR (15), p. 31), reductions in pavement width down to 22 feet may be approved by the VDOT resident engineer (24 VAC 30-90-130, SSR (15), p. 13). According to that section, "Any such reduction must be specifically requested in writing by the governing body and include its commitment to require the provision of sufficient off-street parking…."

(28) Restriction of trucks is governed by VDOT's Guidelines for Considering Request for Restricting Through Trucks on Secondary Highways.

(29) Roads which do not fall under the criteria of the preceding two columns of the table.

(30) A table result of “yes” does not mean that VDOT will necessarily approve the tool, or that the tool is safe, or effective, or allowed under all pertinent design criteria. It simply means that the tool does not clearly violate written VDOT criteria.

(31) The construction of a diagonal diverter adds tight curves to the two affected roadways; these curves have substandard radii.

VDOT-referenced Documents—Uses and Variances (cont'd)

Code of Virginia

The Code of Virginia is the law of the Commonwealth. Section 33.1-41.1 lists criteria for payments to cities (and towns with a population of 3,500 or greater) for maintenance of highways, from arterial highways to local streets. The main portion of this section is reprinted in Appendix A of this study. The assessment of the conformance of the livable streets tools with this section is shown in the last four columns of this study's conformance table (found on page 15).

It should be noted that Section 33.1-41.1 includes wording allowing VDOT (and the Commonwealth Transportation Board which oversees VDOT) to make determinations which are either more lenient or more stringent than the citations contained in the section. The allowance for waiving some of the guidelines follows:

> "However, the Commissioner [of VDOT] may waive the requirements as to hard-surface pavement or right-of-way width for highways where the width modification is at the request of the local governing body and is to protect the quality of the affected local government's drinking water supply or…to accommodate some other special circumstance where such action would not compromise the health, safety, or welfare of the public. The modification is subject to such conditions as the Commissioner may prescribe."[15]

Yet this same section appears to give the Commonwealth Transportation Board (CTB) the power to deny payments which otherwise would be granted:

> "The Commonwealth Transportation Commissioner, *subject to the approval of the Commonwealth Transportation Board* [emphasis added], shall make payments for maintenance…."[15]

"Watch for Children" Sign Program

Pursuant to a 1997 General Assembly amendment to the Code of Virginia regarding the installation and maintenance of "signs alerting motorists that children may be at play nearby", VDOT implemented procedures effective July 1, 1997, that allow counties to request "Watch for Children" signs. This is one of five elements combined under VDOT's Residential Traffic Management Program. The other four elements (Maximum Speed Limits in Certain Residence Districts, Traffic Calming Guide for Local Residential Streets, Control of Residential Cut-Through Traffic, Restricting Through Trucks on Secondary Highways) are discussed below.

Maximum Speed Limits in Certain Residence Districts

Pursuant to a 1999 General Assembly amendment to the Code of Virginia regarding the "maximum speed limits in certain residence districts; penalty", VDOT implemented

procedures on June 17, 1999, that allow local governing bodies to request signs on local residential streets, collector streets, and minor arterials with a posted speed limit of 35 mph or less advising motorists of a maximum punishment of $200 for exceeding the speed limit.

Traffic Calming Guide for Local Residential Streets

This program, an element of VDOT's Residential Traffic Management Program, addresses speeding on existing residential streets. Under the program, several steps must be taken in order to implement traffic calming devices for a given roadway:

- The Board of Supervisors must forward to VDOT a resolution requesting the initiation of a traffic calming project.
- The Board of Supervisors must forward to VDOT traffic volumes and speed data.
- The Board of Supervisors must forward to VDOT a petition signed by at least 75 percent of the households in the area.
- The average speed must be at least 5 mph higher than the speed limit.
- The speed limit must not exceed 25 mph.
- A traffic calming plan "should be developed by a group that includes representatives from the petition area, impacted area, homeowner associations, the board of supervisors, local transportation/planning staff, police, fire, rescue, VDOT, and others as appropriate."[16]
- The final traffic calming plan must be approved by VDOT and the Board of Supervisors.

Three items concerning how VDOT's traffic calming guide impact the implementation of the livable streets tools included in this study follow:

1) Some livable streets tools are not traffic calming devices (e.g. street trees) and therefore are not affected by final traffic calming guide.
2) As a guide, VDOT's Traffic Calming Guide is not a portion of either the Code of Virginia or the Virginia Administrative Code.
3) The guide includes information about seven traffic calming devices which "have been effective in slowing traffic in neighborhoods", yet it does not state that only these seven devices would be considered for calming traffic.

Because of the last item above, this HRPDC report's assessment of how each livable streets tool conforms with VDOT guidelines (as shown on Table 1 and as described in the "Tool's Conformance with VDOT Criteria" section below) is not affected by whether or not a discussion of that tool is included in the traffic calming program guide.

Control of Residential Cut-Through Traffic

This cut-through policy, an element of VDOT's Residential Traffic Management Program, was adopted by the Commonwealth Transportation Board (CTB) in 1988 and amended in 1996. "The purpose of these procedures is to provide clear guidelines for

studying the issues of residential cut-through traffic and implementing the recommended remedial measures."[17] Like the traffic calming program, the cut-through policy requires that requests for solutions be made by the county or town government.

Guidelines for Considering Request for Restricting Through Trucks on Secondary Highways

These guidelines, an element of VDOT's Residential Traffic Management Program, were adopted by the CTB in 1986 and amended in 1988. They list in detail the requirements necessary to restrict trucks, as provided in Section 46.2-809 of the Code of Virginia, as follows:

> "The Commonwealth Transportation Board in response to a formal request by a local governing body…may…prohibit or restrict the use by through traffic of any part of a secondary highway if a reasonable alternate route is provided. Such restriction may apply to any truck...except a pickup or panel truck…"[18]

Tools' Conformance with VDOT Criteria

Table 1 (centerfold) is the primary instrument provided by this study to assist localities in predicting the outcome of and participating in VDOT review of tools for livable streets. The table and its associated explanatory notes present the results of the HRPDC staff's comparison of the tools for livable streets to the criteria found in the main documents which give VDOT authority and guidance as it manages the design, construction, and maintenance of Virginia highways.

The table is used by 1) looking in the first column to find the appropriate row for the livable streets tool of interest, 2) locating the appropriate column heading for the situation (city vs. county, new construction vs. modification of existing roadway) in which the tool is to be applied, and 3) reading the conformance result in the table cell at the row/column intersection. Most of the results ("yes", "no") are accompanied by footnotes referencing the reasons for which the tool does or does not conform with VDOT guidelines.

It is important to note several items:

- First, due to the fact mentioned above that VDOT engineers use judgement (in addition to written criteria) in making decisions, a table result of "yes" does not mean that VDOT will necessarily approve the tool. It simply means that the tool does not clearly violate written VDOT criteria.

- Secondly, due to the fact mentioned above that this study deals only with VDOT criteria (and not with AASHTO guidelines and current research literature), a table result of "yes" does not mean that the tool is safe, or effective, or allowed under all pertinent design criteria. It simply means that the tool does not clearly violate written VDOT criteria.

- Thirdly, perhaps the most valuable information provided by the table can be found in the table's footnotes.

ENDNOTES

[1] G. Schermers and M. Theyse, "Traffic Calming: An Overview of Research, Proposed Guidelines and Warrants", in Annual Transportation Convention, 1995, Traffic Engineering and Safety I, 1A (Pretoria, South Africa: University of Pretoria, 1995), pp. 10-12.
[2] VDOT, Traffic Calming Guide for Residential Streets (Richmond: VDOT, October 2002), p. 8-10.
[3] John D. Leonard II and W. Jeffrey Davis, "Urban Traffic Calming Measures, Conformance with AASHTO and MUTCD Guidelines", in Traffic Congestion and Traffic Safety in the 21st Century (New York: American Society of Civil Engineers, 1997), pp. 15,16.
[4] American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets (Washington: AASHTO, 2001), p. 398.
[5] Situations in which trees could block sight include vehicles exiting driveways and children darting into street.
[6] VDOT, Northern Virginia District, *Multi-way Stops in Residential Communities* (7/7/95).
[7] For proposed modifications to secondary roadways, the issue of VDOT funding of the modification exists. Reportedly, VDOT approval of a modification and VDOT approval of funding for that modification are two separate issues. The issue of the funding of modifications is not addressed in this document.
[8] The maximum amount which VDOT will pay a locality for maintenance in one year is calculated (by functional class) by multiplying the total lane-mileage of conforming streets by a VDOT-established rate.
[9] VDOT, Road Design Manual (Richmond: VDOT, 1998), preface.
[10] AASHTO, A Policy on Geometric Design of Highways and Streets (Washington: AASHTO, 2001), p. xli.
[11] AASHTO, A Policy on Geometric Design of Highways and Streets, p. 394.
[12] VDOT, Subdivision Street Requirements (Richmond: VDOT, 1996), foreword.
[13] VDOT, Subdivision Street Requirements, p. 4.
[14] VDOT, Subdivision Street Requirements, p. 7.
[15] Code of Virginia, section 33.1-41.1.
[16] VDOT, Traffic Calming Guide for Local Residential Streets (Richmond: VDOT, October 2002), p. 4.
[17] VDOT, Control of Residential Cut-through Traffic (Richmond: VDOT, 1996), second page.
[18] VDOT, Guidelines for Considering Request for Restricting Through Trucks on Secondary Highways (Richmond: VDOT, 1988), first page.

APPENDIX A

VIRGINIA CODE
(1997 CUMULATIVE SUPPLEMENT)
э 33.1-41.1, SECOND PARAGRAPH

VIRGINIA CODE
(1997 CUMULATIVE SUPPLEMENT)
ə 33.1-41.1, SECOND PARAGRAPH

"No payments shall be made by the Commissioner to any such city or town unless the portion of the highway for which such payment is made either

(a) has
  i. an unrestricted right-of-way at least fifty feet wide and
  ii. a hard-surface width of at least thirty feet; or
(b) has
  i. an unrestricted right-of-way at least eighty feet wide,
  ii. a hard-surface width of at least twenty-four feet, and
  iii. approved engineering plans for the ultimate construction of an additional hard-surface width of at least twenty-four feet within the same right-of-way; or
(c)
  i. is a cul-de-sac,
  ii. has an unrestricted right-of-way at least forty feet wide, and
  iii. has a turnaround that meets applicable standards set by the Department of Transportation; or
(d) either
  i. has been paved and has constituted part of the primary or secondary system of state highways prior to annexation or incorporation or
  ii. has constituted part of the secondary system of state highways prior to annexation or incorporation and is paved to a minimum width of sixteen feet subsequent to such annexation or incorporation and with the further exception of streets or portions thereof which have previously been maintained under the provisions of ə33.1-79 or ə33.1-82; or
(e) was eligible for and receiving such payments under the laws of the Commonwealth in effect on June 30, 1985; or
(f) is a street established prior to July 1, 1950, which has an unrestricted right-of-way width of not less than thirty feet and a hard-surface width of not less than sixteen feet; or
(g) is a street functionally classified as a local street and constructed on or after January 1, 1996, which at the time of approval by the city or town met the criteria for pavement width and right-of-way of the then-current edition of the subdivision street requirements manual for secondary roads of the Department of Transportation (24 VAC 30-90-10 et seq.).

APPENDIX B

SAFETY AND NOISE IMPACTS OF LIVABLE STREETS INITIATIVES

(NOTE: The documents quoted in this appendix are available for review in the HRPDC transportation library.)

SAFETY AND NOISE IMPACTS OF LIVABLE STREETS INITIATIVES

As documented below, livable streets initiatives have been found to significantly increase safety and reduce noise.

Safety Benefits of Traffic Calming

- Sany R. Zein, et al. (Washington: Transportation Research Board, 1997).

"From all the available international and Greater Vancouver area studies, the reduction in collisions for the different traffic calming devices was reviewed…. It was found that all the various measures [speed limit reductions, refuges, stop signs, speed humps, narrowings, chicanes, traffic circles] are effective in reducing collision frequency, with the magnitude of the frequency reduction varying from 30 to 82 percent." (p. 13)

"Traffic Safety Effects from Traffic Calming" in *Proceedings of Road Safety and Traffic Environment in Europe, in Gothenburg, Sweden, September 26-28, 1990*: pp. 133-148

- Werner Brilon and Harald Blanke (Linkoping, Sweden: Swedish Road and Traffic Research Institute, 1990).

"In all areas with traffic calming measures, the number of persons injured in an accident decreased significantly." (p. 143)

"The Effects of Traffic Calming Measures on Vehicle and Traffic Noise"

- Phil Abbott, Marie Taylor, and Roger Layfield; *Traffic Engineering and Control*, v. 38, no. 9.

"After the introduction of humps…in Slough [United Kingdom]…, light vehicle noise levels were reduced substantially, these reductions being attributable to the change in vehicle speeds." (p. 452)

"Following the installation of a range of calming measures on rural trunk roads in Craven Arms, Thorney and Hayton, where there were about 15 to 20 per cent commercial vehicles, substantial reductions in both vehicle and traffic noise levels were recorded." "The results from public opinion surveys in these trunk-road villages showed that, despite significant reductions in the measured changes in…noise levels, many residents were dissatisfied with the effects of the schemes on the local noise climate." (p. 453)

APPENDIX C

CONFORMANCE OF CERTAIN TRAFFIC CALMING MEASURES WITH AASHTO AND MUTCD GUIDELINES

The table in this appendix summarizes the relationship between ten traffic calming measures and the guidelines found in AASHTO's Green Book (A Policy on Geometric Design of Highways and Streets) and the MUTCD (Manual on Uniform Traffic Control Devices) published by the Federal Highway Administration. The table is taken from the article "Urban Traffic Calming Measures, Conformance with AASHTO and MUTCD Guidelines" by John D. Leonard II of Georgia Tech and W. Jeffrey Davis of the Citadel.[1]

[1] John D. Leonard II and W. Jeffrey Davis, "Urban Traffic Calming Measures, Conformance with AASHTO and MUTCD Guidelines", in Traffic Congestion and Traffic Safety in the 21st Century (New York: American Society of Civil Engineers, 1997), p. 19.

Traffic Calming Measures [for urban local streets]- Conformance and Operational Issues

TRAFFIC CALMING TREATMENTS	DESIGN SPEED	HORIZONTAL ALIGNMENT	LANE WIDTHS	MEDIANS	INTERSECTIONS	TRAFFIC CONTROL DEVICES	ROADWAY CAPACITY [2]	IMPLEMENTATION STATUS
1. INTERSECTION DIVERTER	Substandard for roadway segment	Centerline R ≈ 15m less than min.	Similar to typ. roadway segment	Typical design used to form diverter	Functions like intersection w/o conflicts	Some changes to criteria needed	Reduction in segment vol. capacity	***Needs to be further addressed in criteria*** [3]
2. ROUNDABOUT	If considered an intersection des. speed N/A	Substandard curvature for road segment	Typ. ≥ 4.5 m adequate for one-way cir.	Center island typical median design	Additional design criteria are needed	Some changes to criteria are needed	HCM does not address this type operation	***Needs to be further addressed in criteria*** [3]
3. CHANNELIZATION	Current road design criteria applicable	Standard road design applicable	Curb setbacks reqmt's appear problematic	Mid-block applications, non-typical	Current road design criteria applicable	Current applications OK	Shy distance creates some vol. reduction	Widely utilized on National level
4. SPEED HUMP	4m long profile OK for 30 km/h	No change in alignment [1]	No lane width reduction [1]	Not applicable [1]	Not used in` intersection areas	Mods. similar to Denmark Needed	Negligible reduction in vol. capacity	Frequently used for speed control at Local level
5. SPEED TABLE	Ramp & break point design OK for 30 km/h	No change in alignment [1]	No lane width reduction	Some changes to criteria needed	Channelization needed along radius returns	Current applications OK	Negligible reduction in vol. capacity	Currently used in heavily trafficked pedestrian areas
6. STREET NARROWING	Clear Zone Areas can be problematic	Substandard transition typ.< 6.7:1	1-lane ≈ 4m 2-lane ≈ 5.5m ∴ substandard	Curb setbacks reqmt's appear problematic	Can be used for turn movement restrictions	Some changes to criteria needed	Shy distance will reduce vol. capacity	***Needs to be further addressed in criteria*** [3]
6. ANGLE POINTS/ CHICANES	Adequate design speed promotes poor operation	Substandard transition & curvature typ.	Alignment creates effective width reduction	Not applicable to this treatment	Not used in intersection areas	Modifications to criteria needed	Alignment will reduce vol. capacity	***Needs to be further addressed in criteria*** [3]
8. DRIVEWAY LINK [5]	Reduction of design speed problematic	Dramatic align. changes non-typical	Significant width reduction non-typical	Not applicable to this treatment	Non-symmetrical intx. approach problematic	Modifications to criteria need	Typ. Section will reduce vol. capacity	***Needs to be further addressed in criteria*** [3]
9. GATEWAYS	Clear Zone Areas can be problematic	Current design criteria applicable	Curb setbacks reqmt's appear problematic	Center island typical median design	Current road design criteria applicable	Current applications OK	No anticipated reduction in vol. capacity	Easily applied with current criteria
10. STREET CLOSURE	Cul-de-sac based on design vehicle	Cul-de-sac can be constrained by avail. ROW	Typically no lane width reduction	Not applicable to this treatment	Not used in intersection areas	Current applications OK	Reduced network circulation	Widely utilized on National level

NOTES:
1. Unless used in combination with other traffic calming treatments.
2. Excess capacity typically exists within the design of most urban local streets.
3. Improved design criteria needed prior to the use of this traffic calming treatment on a wide spread basis.
4. Problem areas are graphically highlighted (bold).
5. Alleyways have served this functional purpose in the past.

W. Jeffrey Davis, PE
jdavis@trec.ce.gatech.edu
Georgia Institute of Technology
School of Civil & Environmental Engineering

APPENDIX D

VDOT GEOMETRIC DESIGN TABLES FOR LOCAL ROADWAYS

The first table ("24 VAC 30-90-380") in this appendix is taken from VDOT's Subdivision Street Requirements (1996, p. 31). The second and third Tables ("GS-4" and "GS-8") are taken from VDOT's Road Design Manual (www.VirginiaDOT.org).

24 VAC 30-90-380 TABLE 1 - GEOMETRIC DESIGN GUIDE FOR SUBDIVISON STREETS FUNCTIONALLY CLASSIFIED AS LOCAL

ENGLISH MEASUREMENTS ALL UNITS ARE IN FEET, MPH, OR DEGREES			HORIZONTAL & VERTICAL CONTROL Maximum Cut or Fill Slope = 2:1						ROADWAY SECTION CRITERIA							
									SHOULDER & DITCH ROADWAYS				CURB AND GUTTER ROADWAYS			
													RESIDENTIAL		NON-RESIDENTIAL	
									SLOPE OF DITCH AND MINIMUM WIDTH SHALL BE BASED ON SLOPES OF 3:1 TO PROVIDE A WIDTH OF 4 FEET OR MORE.				MINIMUM ROADWAY (c-c) AND RIGHT-OF-WAY (ROW) WIDTHS SHALL BE BASED ON THE LENGTH OF STREET AND SPECIAL REQUIREMENTS REGARDING OFF-STREET PARKING, SEE 24 VAC 30-90-130 D.3.g. AND 24 VAC 30-90-280			
PROJECTED TRAFFIC VOLUME	TERRAIN	DESIGN SPEED	CURVE DATA			SUGGESTED % GRADE	SIGHT DISTANCE MINIMUM		PAVEMENT WIDTH	RIGHT OF WAY	SHOULDER WIDTH (MINIMUM)		LENGTH UNDER 0.5 MILES	LENGTH 0.5 MILES OR MORE	LENGTH NOT A FACTOR	
(ADT)		(MPH) (MIN.)	RADIUS (MIN.)	DEG. MAX	SUPER-ELEVATION		STOPPING	@ INTER-SECTIONS	(MINIMUM)	WIDTH (MIN.)	FILL W/ GR	CUT OR FILL W/O GR	PARKING ALLOWED		PARKING RESTRICTED	PARKING ALLOWED
	LEVEL		120	48°		7										
UP TO 250	ROLLING	20	120	48°	NONE	10	125	200	18	40	7	4	cc = 28	cc = 30	cc = 24	cc = 30
	MOUNTAINOUS		95	60°		16							ROW = 40	ROW = 40	ROW = 40	ROW = 40
	LEVEL		120	48°		7										
251-400	ROLLING	20	120	48°	NONE	10	125	200	20	50	7	4	cc = 28	cc = 30	cc = 24	cc = 30
	MOUNTAINOUS		95	60°		16							ROW = 40	ROW = 40	ROW = 40	ROW = 40
	LEVEL					7			22							
401-1000	ROLLING	25	180	32°	NONE	10	150	250	22	50	7	4	cc = 36	cc = 36	N/A	cc = 38
	MOUNTAINOUS					16			20				ROW = 44	ROW = 44		ROW = 46
	LEVEL					7			22							
1001-2000	ROLLING	30	300	19°	NONE	10	200	300	22	50	9	6	cc = 36	cc = 36	N/A	cc = 38
	MOUNTAINOUS					14			20				ROW = 44	ROW = 44		ROW = 46
	LEVEL					7										
2001-4000	ROLLING	30	300	19°	NONE	10	200	300	22	50	9	6	cc = 38	cc = 38	N/A	cc = 40
	MOUNTAINOUS					14							ROW = 46	ROW = 46		ROW = 48
	LEVEL	40	535	10.5°	RATE =	7	275	400								
OVER 4000	ROLLING	40	535	10.5°	STD.	9	275	400	24	50	9	6	cc = 40	cc = 40	N/A	cc = 40
	MOUNTAINOUS	30	250	23°	CROWN	14	200	300					ROW = 48	ROW = 48		ROW = 48

GEOMETRIC DESIGN STANDARDS FOR RURAL LOCAL ROAD SYSTEM (GS-4)

TRAFFIC VOLUME	TERRAIN	MIN. DESIGN SPEED (MPH)	MAXIMUM DEGREE OF CURVATURE	(9) STOPPING SIGHT DISTANCE		MINIMUM PASSING SIGHT DISTANCE	(2) MIN. WIDTH OF SURFACING OR PAVEMENT	(3)(4)(5) MIN. WIDTH OF GRADED SHOULDERS		(6) WIDTH OF DITCH (FRONT SLOPE)	(7) RECOMMENDED SLOPE	(8) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS
				DES.	MIN.			FILL W/GR	CUT & FILL			
(1) DHV OVER 400	LEVEL	50	7°30'	475'	400'	1800'	24'	11'	8'	6''	CS-4, 4A OR 4C	APPROACH ROADWAY WIDTH
	ROLLING	40	12°	325'	275'	1500'					CS-3, 3A OR 3B	
	MOUNTAINOUS	30	22°	200'	200'	1100'				4'		
(1) DHV 400 TO 200	LEVEL	50	7°30'	475'	400'	1800'	24'	9'	8'	6''	CS-4, 4A OR 4C	
	ROLLING	40	12°	325'	275'	1500'	22'				CS-3, 3A OR 3B	
	MOUNTAINOUS	30	22°	200'	200'	1100'				4'		
(1) DHV 200 TO 100	LEVEL	50	7°30'	475'	400'	1800'	22'	9'	6'	6'	CS-4, 4A OR 4C	3' PLUS PAVEMENT WIDTH PLUS 3'
	ROLLING	40	12°	325'	275'	1500'					CS-3, 3A OR 3B	
	MOUNTAINOUS	30	22°	200'	200'	1100'	20'			4'		
CURRENT ADT 400 TO DHV 100	LEVEL	50	7°30'	475'	400'	1800'	22'	7'	4'	6'	CS-4, 4A OR 4C	
	ROLLING	40	12°	325'	275'	1500'					CS-3, 3A OR 3B	
	MOUNTAINOUS	30	22°	200'	200'	1100'	20'			4'		
CURRENT ADT 400 TO ADT 250	LEVEL	40	12°	325'	275'	1500'	20'	7'	2'	6'	CS-1	2' PLUS PAVEMENT WIDTH PLUS 2'
	ROLLING	30	22°	200'	200'	1100'				4'		
	MOUNTAINOUS	20	110'R	125'	125'	800'						
CURRENT ADT 250 TO 50	LEVEL	30	22°	200'	200'	1100'	18'	7'	2'	4'	CS-1	
	ROLLING	30	22°									
	MOUNTAINOUS	20	110'R	125'	125'	800'						
CURRENT ADT UNDER 50	LEVEL	30	22°	200'	200'	1100'	18'	7'	2'	4'	CS-1	
	ROLLING	20	110'R	125'	125'	800'						
	MOUNTAINOUS	20	110'R									

GENERAL NOTES

Low design speeds are generally applicable to roads with winding alignment in rolling or mountainous terrain where environmental conditions dictate.

High design speeds are generally applicable to roads in level terrain or where other environmental conditions are favorable.

Intermediate design speeds would be appropriate where terrain and other environmental conditions are a combination of those described for low and high speed.

Standard TC-5R superelevation based on 0.08 ft./ft. maximum is to be used.

In incorporated towns or other built-up areas, Urban Standard GS-8 may be used.

RELATIONSHIP OF MAXIMUM GRADES TO DESIGN SPEEDS

TYPE OF TERRAIN	DESIGN SPEED (MPH)				
	20	30	40	50	60
	GRADES (PERCENT)				
LEVEL	--	7	7	6	5
ROLLING	11	10	9	8	6
MOUNTAINOUS	16	14	12	10	--

FOOTNOTES

(1) Use current DHV/ADT for restoration type projects. Use design year DHV/ADT for new construction.

(2) Lane width to be 12' at all interchange locations.

(3) In mountainous terrain or sections with heavy earthwork, the graded width of shoulder in cuts may be decreased 2', but in no case shall the shoulder width be less than 2'.

(4) Minimum shoulder slope shall be 1":1' on low side and same slope as pavement on high side.

(5) Provide 4' wide paved shoulders when design year ADT exceeds 2000 VPD, with 5% or more truck and bus usage. All shoulders not being paved will have the mainline pavement structure extended 1' on the same slope into the shoulder to eliminate raveling at the pavement edge.

(6) Ditch slopes to be 4:1 - 6' width, 3:1 - 4' width.

(7) Additional or modified slope criteria to be applied where shown on typical sections.

(8) Vertical clearance at roadway underpasses for new and reconstructed bridges is 16'-6" desirable and 14'-6" minimum (1' additional clearance required for non-vehicular overpasses).

(9) For intersection sight distance requirements see Appendix C, Table C-1-5.

FIGURE A - 1 - 4

GEOMETRIC DESIGN STANDARDS FOR URBAN LOCAL STREET SYSTEM (GS-8)

	MIN. DESIGN SPEED (MPH)	MINIMUM RADIUS OF CURVATURE		(1) MAX. PERCENT OF GRADE	(11) STOPPING SIGHT DISTANCE	(2) MIN. WIDTH OF LANE	(3) STANDARD CURB & GUTTER	(4) BUFFER STRIP WIDTH	(5) MINIMUM SIDEWALK WIDTH	(6) SLOPES	(9) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS
		U	ULS								
STREETS WITH CURB & GUTTER	30	300' R	250' R	15	200'	10'	CG-6	(10)	4'	2:1	SAME AS CURB TO CURB OF APPROACHES
	20	130°R	90' R		125'						
	MIN. DESIGN SPEED (MPH)	MINIMUM RADIUS OF CURVATURE		(1) MAX. PERCENT OF GRADE	MINIMUM STOPPING SIGHT DISTANCE	(2) MIN. WIDTH OF LANE	(7) MIN. WIDTH GRADED SHOULDERS		(8) WIDTH OF DITCH (FRONT) SLOPE	(6) SLOPES	(9)(10) NEW AND RECONSTRUCTED MINIMUM BRIDGE WIDTHS
		U	ULS				FILL W/GR.	CUT & FILL			
STREETS WITH SHOULDER DESIGN	30	300' R	250' R	15	200'	10'	7'	4'	4'	3:1	4' + PAVEMENT WIDTH + 4'
	20	130' R	90' R		125'						

GENERAL NOTES

Design Speeds is not a major factor for local streets. For consistency in design elements, design speeds ranging from 20 to 30 mph may be used, depending on available right of way, terrain, adjacent development and other area controls.

In the typical street grid, the closely spaced intersections usually limit vehicular speeds, making the effect of a design speed of less significance.

Design speeds exceeding 30 mph in residential areas may require longer sight distances and increased curve radii, which would be contrary to the basic function of a local street.

Standard TC-5U (Urban) superelevation based on 0.04 ft./ft. maximum.

Standard TC-5ULS (Urban Low Speed) superelevation based on 0.0208 ft./ft. maximum may be used with a design speed of 45 mph or less (45 mph = 7° maximum).

A minimum 30' width of surfacing or a minimum 30' curb to curb is to be used within incorporated cities or towns to qualify for maintenance payments.

FOOTNOTES

(1) Grades in commercial and industrial areas should be less than 8 percent; desirably, less than 5 percent.

(2) Where feasible, lanes should be 11' wide and in industrial areas should be 12' wide; however, where available or attainable right of way imposes severe limitations, 9' lanes can be used in residential areas and 11' lanes can be used in industrial areas.

(3) Or equivalent City or Town design.

(4) The minimum buffer strip width with no sidewalk or sidewalk space is to be 5'.

(5) A width of 8' or more may be needed in commercial areas.

(6) 3:1 and flatter slopes may be used when the right of way is behind the sidewalk (or sidewalk space) in residential or other areas where slopes will be maintained by the property owner.

(7) When Design year ADT exceeds 2000VPD, with greater than 5% total truck and bus usage:
Provide 4' wide paved shoulders when the graded shoulder is 5' wide or greater or provide 3' wide paved shoulders when the graded shoulder is 4' wide. All shoulders not being paved will have the mainline pavement structure extended 1', on the same slope, into the shoulder to eliminate raveling at the pavement edge.

(8) Ditch slopes to be 3:1 - 4' width.

(9) Vertical clearance at roadway underpasses for new and reconstructed bridges is to be 16'-6" desirable and 14'-6" minimum (1' additional clearance required for non-vehicular overpasses).

(10) If a buffer strip is used between the back of curb and sidewalk, it should be 2' minimum.

(11) For intersection sight distance requirements see Appendix C, Table C-1-5.

FIGURE A - 1 - 8