Rural Flood Prone Roadway Study

June 27, 2003

Town of
Ashland
Counties of
Charles City
Chesterfield
Goochland
Hanover
Henrico
New Kent
Powhatan
City of
Richmond

Richmond Regional Planning District Commission
2104 West Laburnum Avenue, Suite 101
Richmond, Virginia 23227
Phone: (804) 367-6001
Fax: (804) 367-4375
www.richmondregional.org

Acknowledgement

Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration and the Virginia Department of Transportation.

Disclaimer

The contents of this document reflect the views of the Richmond Regional Planning District Commission. The Commission 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 Federal Highway Administration (FHWA) or the Virginia Department of Transportation (VDOT). This report does not constitute a standard, specification, or regulation.

FHWA or VDOT acceptance of this document as evidence of fulfillment of the objectives of the rural transportation planning program 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.

Richmond Regional
Planning District Commission

Planning district commissions make government more efficient and effective through coordinated planning and program analysis. Virginia's General Assembly created planning districts in 1968 under the authority of the *Virginia Area Development Act* - revised as the *Regional Cooperation Act* in 1995 - "to promote orderly and efficient development of the physical, social and economic elements of the districts." Through planning district commissions, now 21 in number, local governments solve mutual problems which cross boundary lines and obtain expertise from professional staffs and advice on making the most of scarce taxpayer dollars through intergovernmental cooperation.

Members

Town of Ashland
Angela L. LaCombe

Charles City County
Michael L. Holmes

Chesterfield County
Edward B. Barber
Kelly E. Miller
Russell J. Gulley
John L. McHale, III
George A. Roarty
Arthur S. Warren
Renny B. Humphrey

Goochland County
Malvern R. Butler
Joseph T. Lacy, Jr.

Hanover County
John G. Dankos, Jr.
J.T. "Jack" Ward
John E. Gordon, Jr.
Robert R. Setliff

Henrico County
James B. Donati, Jr.
Richard W. Glover
David A. Kaechele
Patricia S. O'Bannon
Gregory R. Baka
Chris W. Archer
Frank J. Thornton

New Kent County
Mark S. Daniel
Rebecca M. Ringley

Powhatan County
Roy J. Harrison, Jr.
Richard W. Ayers

City of Richmond
Joseph E. Brooks
Wm. Russell Jones, III
Delores L. McQuinn
William J. Pantele
(Vacant) Citizen Representative

Staff

Paul E. Fisher
Executive Director
Jo A. Evans
Assistant Executive Director
Peter M. Sweetland
Finance and Contracts Administrator
Patricia A. Villa
Communications Coordinator
Daniel N. Lysy
Director of Transportation
Michael O. Clements
Principal Planner
Lawrence C. Hagin
Principal Planner
Jin H. Lee
Senior Planner
Bradley R. Shelton
Associate Planner
+ Principal project staff

Jacqueline S. Stewart+
Director of Planning & Info. Systems
Alan W. Gregory
Principal Planner – GIS Coordinator
Joseph M. Ndanga
Senior Planner
Christine H. Fix
Senior Planner
R. Todd Rigler+
Associate Planner
Leigh R. Medford
Planning Technician – GIS
Katherine E. Barrett
Executive Secretary
Rhonda J. Bailey
Administrative Secretary
Sharon E. Robeson
Administrative Secretary
Demetra N. Jones
Receptionist/Secretary

Table of Contents

Introduction

This study identifies roadways in the rural sections of the Richmond Regional Planning District that are prone to flooding. A flood prone roadway is defined as any public road that has a history of being covered by enough water in a manner that the road surface, markings, and edges are not visible to the operators of a motor vehicle, cyclists, or pedestrians. Such conditions could be caused by stream/river flooding, poor drainage along roadways, or normal surface runoff. Water on the roadway could be both standing and moving, and could also leave debris such as gravel, leaves, and sticks on the roadway. Duration of the flood event can vary from minutes to days.

Types of Flooding

There are four basic types of floods that afflict Virginia: coastal flooding, urban flooding, flash flooding, and river flooding.

Coastal Flooding: Coastal flooding usually occurs with the storm surge of a hurricane or with a "Nor'easter", an intense low pressure system that moves slowly up the coast with strong onshore winds. While the hurricane season goes from June through November, Nor'easters occur from September through March and are generally considered a winter-time storm.

Urban Flooding: Urban flooding occurs in heavily paved areas and can occur anytime with a heavy rain. Paved surfaces do not allow water to be absorbed into the ground, thereby increasing the speed and amount of water runoff. Poor infiltration may be exacerbated if areas are without proper drainage or if storm drains become clogged. Streets become streams and water gathers in low-lying areas turning them into a pond. If it rains hard enough, underpasses can rapidly fill, trapping motorists, and streets can accumulate enough water to submerge cars or carry them wherever the water flows.

Flash Flooding: Flash floods occur in a short period of time, hence the name "flash." Rain falls at such a high rate that water does not have time to be absorbed into the ground. It flows downhill into ditches, lowlands, and small streams. As the heavy rain continues, ditches overflow, drains backup, and water ponds in lowlands and streams rise over their banks. Streams and creeks can become raging rivers in just hours. People are often caught off guard, especially motorists. Rainfall intensity and duration probably play the greatest role in creating flood/flash conditions. However, soil type, soil moisture content, and terrain also influence the runoff absorption rates. For the Richmond region, November through March has a higher incident of flood/flash events because of rainfall patterns and the vegetation’s reduced need for moisture. Frozen ground increases the likelihood of flash flooding as well. Finally, melting snow cover combined with heavy rain increases the likelihood of flash flooding. Snow along a roadway can also block drainage ditches and force water into the roadway.

River Flooding: River floods occur when heavy rains fall over a large area. In many cases in Virginia, it begins as widespread flash flooding of small streams. About 60 percent of Virginia's river floods begin with flash flooding from tropical systems passing over or near the state. A recent example was Hurricane Fran in September 1996. The flash flood waters in the streams and creeks flow into the larger rivers and flooding can occur for the next couple of days as the bulge of water progresses down the length of the river. River flooding also occurs as a result of successive rainstorms (as seen in the widespread and prolonged flooding in the mid-west during the summer of 1993). Rainfall from any one storm is not enough to cause a problem, but with each successive storm's passage over the basin, the river rises until eventually it overflows its banks. If it is late winter or spring, melting snow in the mountains can produce added runoff that can compound flood problems. The most recent example of this in Virginia was flooding in January 1996 with a rapid thaw of the two to four feet of snow that had fallen over the previous two weeks.

Dangers of Flooding

About 40 percent of flood-related deaths occur to people traveling in motor vehicles. Suddenly changing water depths, water currents, and road damage make crossing a flooded roadway very dangerous for both motor vehicles and pedestrians. Six inches of swiftly moving water can knock people off their feet. Two feet of water can float most cars and strong currents can easily push vehicles into deeper water. It only takes a thin layer of water to cause a moving vehicle to hydroplane. Rural areas are particularly vulnerable because roads are lightly traveled and often not closed to traffic as quickly as urban roadways during storm events.

The 1993 Fact Sheet (Appendix A) produced by the Federal Emergency Management Agency (FEMA) states that if you are in a vehicle during a flood you should turn around and go another way. While this advice may be practical in urban areas, it may be somewhat difficult in rural communities since an alternate route may not be readily identified or available. The lack of alternate routes tempts drivers into making dangerous crossings. Once the vehicle stalls in the flooded area, escaping may become difficult and in some cases, nearly impossible. Among the problems: water pressure on the outside of the vehicle prevents occupants from opening doors; the vehicle could overturn into a ditch or ravine and become inundated; and even if a person were able to get out of the vehicle, the strong current and undertow of the flood waters would likely be too much to overcome in attempting to swim to safety. Flooded roadways can also prevent emergency service vehicles from reaching their destinations.

The National Weather Service in Wakefield, Virginia maintains historical weather data for central Virginia. The top ten largest historical flooding events for the James River in the Richmond region are listed below. It is unknown the degree to which these floods impacted rural roads, but it is recorded that flooding was wide-spread throughout the region.

Historical Flood Data

James River, Richmond, Virginia

Date	Duration	Related Event/Name	Inches of Rain	Average Rainfall per day (inches)
September 6-8 1996	3 days	"Fran"	23.8	7.93
January 19-22 1996	4 days	"The Great Melt Down"	22.0	5.5
November 4-7 1985	4 days	Election Day Flood"	30.8	7.7
June 21-24 1972	4 days	"Agnes"	36.5	9.13
August 20-22 1969	3 days	"Camille"	28.6	9.53
August 18-20 1955	3 days	"Diane"	16.9	5.63
October 15-17 1942	3 days		19.5	6.5
August 14-18 1940	4 days		23.3	5.83
April 26-27 1937	2 days		25.2	12.6
March 18-19 1936	2 days	"The Great Spring Flood"	26.5	13.25

http://www.erh.noaa.gov/er/lwx/Historic_Events/va-floods.html

The remainder of the study provides flooding data specific to the region's four rural localities: Charles City County, Goochland County, New Kent County, and Powhatan County. Locations that are routinely known to flood as well as historical data on major flash flood events is provided to comprehensively indicate roadway segments where flooding is likely or is known to have occurred. Routine flood locations were identified by the Virginia Department of Transportation and/or local officials. Historical data is provided by the National Weather Service in Wakefield, Virginia.

Charles City County

Flood Prone Roadways identified by VDOT and Local Sources

Route	603	0.5 mile west of Route 609
Route	609	south of Route 625
Route	602	1 mile north of Route 155
Route	626	1 mile south of Route 615
Route	614	@ Morris Creek
Route	613	1.5 miles south of Route 5
Route	631	@ Bradley Run
Route	618	0.25 mile south New Kent County /Charles City County Line

These sites are illustrated on the attached county map.

National Weather Service Flood Prone Areas

(Areas identified by the National Weather Service-Wakefield as having a history of, or potential for, flooding.)

Event:	Flash Flood
Begin Date:	04 Aug 2000, 05:00:00 PM EST
Begin Location:	**5 Miles North West of Charles City County**
End Date:	04 Aug 2000, 05:30:00 PM EST
End Location:	**5 Miles North West of Charles City County**
Property Damage:	$ 0.0
Crop Damage:	$ 0.0
Description:	Heavy rain caused flooding at Route 607 and Church Lane near Adkins Store.

Event:	Flash Flood
Begin Date:	01 Sep 2000, 01:50:00 PM EST
Begin Location:	**Eastern Portion of County**
End Date:	01 Sep 2000, 01:50:00 PM EST
End Location:	**Eastern Portion of County**
Property Damage:	$ 0.0
Crop Damage:	$ 0.0
Description:	Several flooded roads across eastern half of county.

Goochland County

Flood Prone Roadways identified by VDOT and Local Sources

Route	600	@ Rock Castle
Route	618	@ Bridge 0.4 miles west of 616
Route	608	@ Elk Hill
Route	608	1 mile north of Route 606
Route	608	@ Little Lickinghole Creek
Route	687	0.5 mile south of Route 608
Route	687	0.75 mile north of Route 6
Route	680	@ dead end
Route	616	@ Little Lickinghole Creek
Route	600	@ Little Lickinghole Creek
Route	613	@ Big Lickinghole Creek
Route	673	@ Big Lickinghole Creek
Route	611	@ Big Lickinghole Creek
Route	609	@ Big Lickinghole Creek
Route	607	@ Irwin
Route	603	@ Elk Island Bridge
Route	603	@ Byrd Creek
Route	667	@ Byrd Creek
Route	667	@ Little Byrd Creek
Route	610	@ Little Byrd Creek
Route	609	@ Little Byrd Creek
Route	603	@ Little Wittle Creek
Route	609	@ Mill Creek
Route	681	1 mile south of Route 605
Route	646	1 mile south of Route 250
Route	669	0.75 mile south of Route 250
Route	632	@ Beaver Dam Creek
Route	639	@ Beaver Dam Creek
Route	645	0.75 north of Route 6
Route	628	@ dead end

These sites are illustrated on the attached county map.

National Weather Service Flash Flood/Flood Prone Areas

(Areas identified by the National Weather Service-Wakefield as having a history of, or potential for, flooding.)

Event:	Flash Flood
Begin Date:	27 Jun 1995, 1000 EST
Begin Location:	**Western Portion of County**

End Date: 27 Jun 1995, 1500 EST
End Location: Not Known
Property Damage: $ 35.0K
Crop Damage: $ 177.0K
Description: Very heavy rainfall caused by slow moving thunderstorms caused small streams and creeks to overflow their banks and lead to the closure of Virginia Route 6 and more than a dozen secondary roads. The rain damaged more than 4,500 acres of crop and pasture land, of which 350 acres were destroyed.

New Kent County

Flood Prone Roadways identified by VDOT and Local Sources

Route	638	@ Cattail Swamp Pond Creek
Route	606	@ County Line Bridge
Route	607	@ dead end
Route	614	@ White House
Route	606	@ Tunstall
Route	624	@ dead end
Route	625	@ dead end
Route	33	0.25 mile west of West Point
Route	636	@ Plum Point
Route	1002	Intersection with Route 627
Route	627	@ Chickahominy Shores
Route	618	south of Interstate 64
Route	615	Between Routes 106 and 60

These sites are illustrated on the attached county map.

National Weather Service Flash Flood/Flood Prone Areas

Areas identified by the National Weather Service-Wakefield as having a history of, or potential for, flooding.

Event	Urban/Small Stream Flood
Begin Date:	08 Sep 1996, 07:45:00 PM EST
Begin Location:	**Quinton**
End Date:	08 Sep 1996, 07:45:00 PM EST
End Location:	**Wrights Corner**
Property Damage:	$ 0.0
Crop Damage:	$ 0.0
Description:	Local police reported Highway 665 was closed due to high water.

Event:	Flash Flood
Begin Date:	04 Aug 2000, 05:45:00 PM EST
Begin Location:	**Lanexa**
End Date:	04 Aug 2000, 06:15:00 PM EST
End Location:	**Lanexa**
Property Damage:	$ 0.0
Crop Damage:	$ 0.0
Description:	Heavy rain caused flooding on Carter Road in Lanexa.

Event:	Flash Flood
Begin Date:	01 Jun 2001, 05:40:00 PM EST
Begin Location:	**4 Miles North of Quinton**
End Date:	01 Jun 2001, 05:40:00 PM EST
End Location:	**4 Miles North of Quinton**
Property Damage:	$ 0.0
Crop Damage:	$ 0.0
Description:	Five inches of rainfall and high water reported by spotter.

Powhatan County

Flood Prone Roadways identified by VDOT and Local Sources

Route	603	@ Rocky Ford Creek
Route	603	@ Skippers Creek
Route	604	@ Butterwood Creek
Route	603	@ Butterwood Creek
Route	614	@ Jones Creek
Route	711	Between Routes 659 and 617
Route	711	West of Route 652
Route	652	@ dead end
Route	669	@ boat landing

These sites are illustrated on the attached county map.

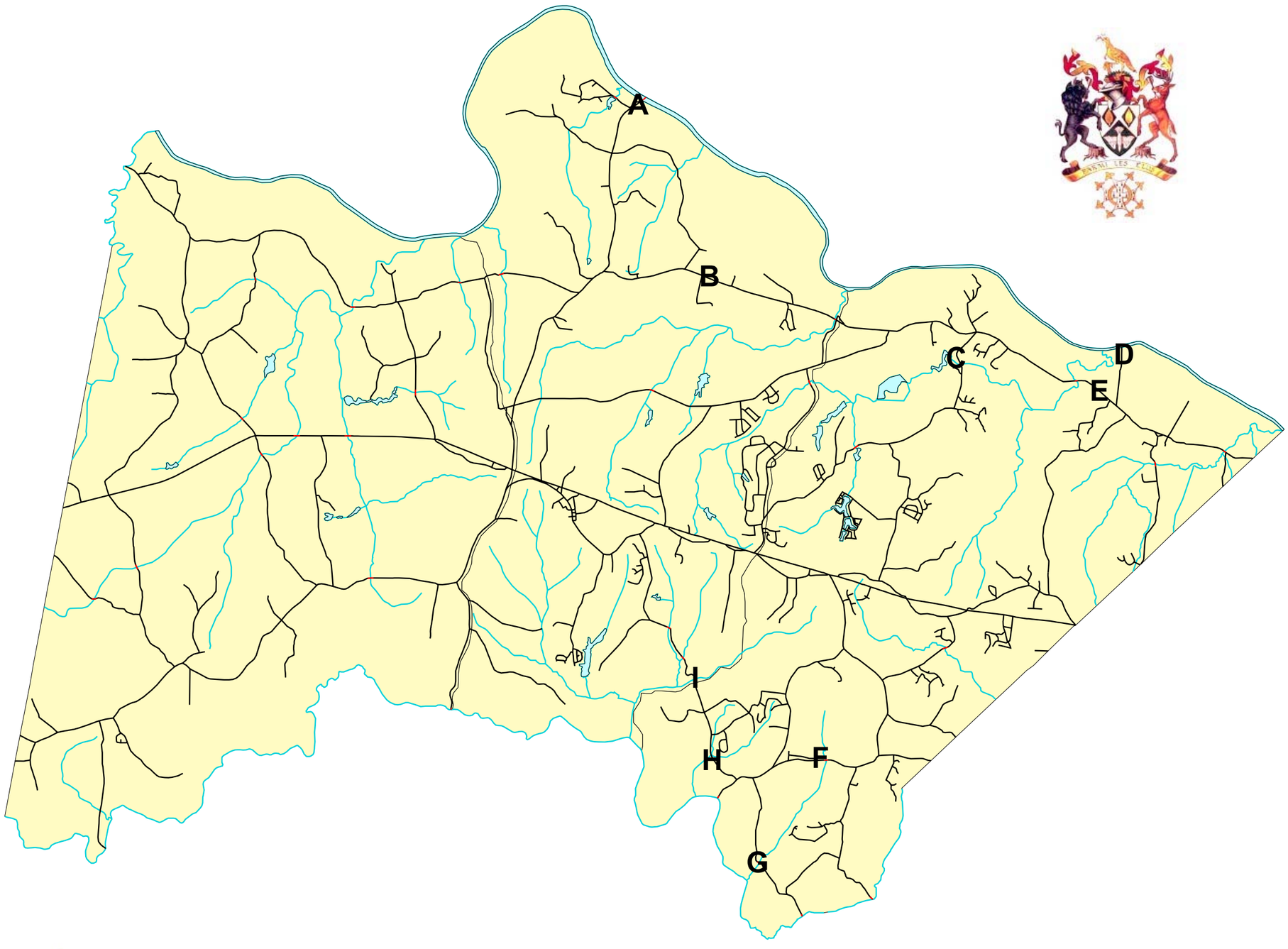
National Weather Service Flash Flood/Flood Prone Areas

Areas identified by the National Weather Service-Wakefield as having a history of, or potential for, flooding.

Event:	Flash Flood
Begin Date:	03 Sep 2000, 12:05:00 AM EST
Begin Location:	**Powhatan County**
End Date:	03 Sep 2000, 01:30:00 AM EST
End Location:	**Powhatan County**
Property Damage:	$ 0.0
Crop Damage:	$ 0.0
Description:	Slow-moving thunderstorms dumped heavy rain over portions of the eastern Virginia piedmont region, causing flooding of the intersection at routes 522 and 60 near Powhatan County.

Flood Prone Roadways

Powhatan County



- (A) Route 669 @ Boat Landing
- (B) Route 711 - Between routes 659 and 617
- (C) Route 614 @ Jones Creek
- (D) Route 652 @ dead end
- (E) Route 711 - 0.25 mile west of Route 652
- (F) Route 604 @ Butterwood Creek
- (G) Route 603 @ Butterwood Creek
- (H) Route 603 @ Skippers Creek
- (I) Route 603 @ Rocky Ford Creek

Richmond Regional Planning District Commission

1 0 1 2 3 4 5 Miles

N W E S

A — Flood Prone Areas (Identified by VDOT and local sources)

Water

Roads

Bridges

Prepared by: Richmond Regional Planning District Commission, June 2003
Source: VDOT County Series, 1999

Conclusions

Low lying terrain and heavy rains in the Richmond region will contribute to roadway flooding. However, steps can be taken to document incidents and mitigate flood problems. Below are conclusions and recommendations made as a result of this study.

Conclusion #1: There is little written documentation on flooded roadways in the Richmond region, and often the knowledge is distributed among the employees of several state and local organizations.

Recommendation: A central and structured reporting and inventory system would provide better documentation on problem areas.

- ✓ By maintaining an inventory of flood prone roadways, officials will have documentation to help evaluate possible solutions to mitigate the impact of flooded roadways in the future. While some flooding from streams and runoff can be expected, standing water in roadways indicates improper drainage that should be remedied if the problem is reoccurring.

- ✓ While the blockage of regular traffic is mostly an inconvenience, emergency service personnel should have easy access to written documentation on flood prone roadways so that they can research alternate routes before emergencies occur. In some heavily affected areas, evacuation plans could be developed for larger flood events.

- ✓ Education on floods, flash floods, and vehicle safety should be increased through existing safety programs. At particular problem areas, where there is a high threat to life, warning signs could be considered to indicate the roadway should not be crossed, if flooded.

Conclusion #2: Road construction and inadequate drainage is a major factor in rural roadway flooding.

Recommendation: New road and bridge construction should follow basic guidelines to reduce the impact of flooding. Within subdivisions, roads should approach homes and businesses in the direction away from the floodplain. Any attempt to put roadways (and structures) out of flood prone areas is beneficial. Bridges should generally be constructed perpendicular to streams with adequate dimensions to accommodate high water flow. New construction should not disrupt natural drainage patterns. Steep slopes along new roads and bridges are prone to erosion and soil slump; thus, they should be avoided or vegetated appropriately (Morris, 1997).

Conclusion #3: Inadequate funding for equipment and labor is a major contributor to rural roadway flooding.

Recommendation: Funding for equipment and an adequate labor force to maintain drainage ditches along roadways should be made available. Where possible, VDOT should utilize the state and local incarcerated population or volunteer resources.

Bibliography

Federal Emergency Management Agency. (1993). *Fact Sheet: Floods and Flash Floods.* Washington, DC: U.S. Government Printing Office.

Fifth Planning District Commission. (1999). *Rural Flood Prone Roadway Study.* Roanoke, VA.

Morris, Marya. *Subdivision Design in Flood Hazard Areas*. Federal Emergency Management Agency, American Planning Association Planning Advisory Service Report Number 473. American Planning Association, Chicago, 1997.

Watson, Barbara McNaught. (2002). *Virginia Floods.* National Weather Service. Retrieved June 3, 2003, from http://www.erh.noaa.gov/er/lwx/Historic_Events/vafloods.html.

Appendix A