
Chapter 1 - Introduction

TABLE OF CONTENTS

CHAPTER 1 - INTRODUCTION	1-1
1.1 Background	1-1
1.2 Overview	1-2
1.2.1 Purpose	1-2
1.2.2 Manual Layout/Chapter Templates.....	1-2
1.3 Drainage Design Memoranda	1-4
1.4 References	1-5
1.5 User Instructions	1-6
1.6 Revisions and Updates	1-7
1.7 Acknowledgements	1-8

List of Tables

Table 1-1. Chapter Template and Contents.....	1-3
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List of Appendices

Appendix 1A-1 Definitions and Abbreviations	
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Chapter 1 - Introduction

1.1 Background

The Virginia Department of Transportation (VDOT) has developed the 2001 VDOT Drainage Manual to provide designers a valuable reference and tool for the drainage design of Virginia's roadways and to document VDOT's policies and procedures for standard roadway drainage design.

This **fifth** edition of the VDOT Drainage Manual constitutes a major technical update and compilation of the existing VDOT Drainage Manual, the AASHTO Model Drainage Manual, and other resources and has been prepared in electronic format to be made available on the Internet at the VDOT website. VDOT's Hydraulics Section prepared this edition of the manual.

The objectives of the manual are to:

- Provide concise technical information for drainage designers
- Establish VDOT's policies and procedures for drainage design
- Provide an educational tool for aspiring drainage designers and instructors
- Provide in electronic format, available on the World Wide Web for viewing and downloading
- Provide guidelines to enhance the quality of drainage design submittals to VDOT

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1.2 Overview

1.2.1 Purpose

This manual is intended as an operational handbook for use in hydrologic and hydraulic analysis. Design concepts, policies and procedures, criteria, and examples are condensed and written for use by the designer. Where appropriate, relevant hydraulic design publications are referenced. While it is essential that the user of this manual is familiar with the methods of analysis and design of highway drainage for VDOT, the text provides detailed instructions and criteria for the development of analysis and design in most cases. An exception to this rule is the case where another source document expounds upon the method in great detail. In this case, the manual directs the user to the source document or provides a brief synopsis of the subject.

This manual is intended for use in the development of VDOT highway drainage design projects by Department staff, consultants, and Virginia’s municipalities. Educational organizations may use the manual as instructional text in design application. The manual gives the designer a basic working knowledge of hydrology and hydraulics, illustrated with example problems. Basic design elements are included so that the designer can design highway drainage with minimal assistance. However, this manual cannot provide guidance on complex hydrologic or hydraulic problems and is no substitute for experience, formal training, or engineering judgment.

The Department recognizes the difficulty in accurately defining or predicting the dynamic properties of nature. There are numerous methods of analysis available and it is recommended that as many method(s) as may be appropriate be employed in the solution of a problem. Further, all hydraulic designs must give consideration to economic, aesthetic, and environmental aspects of the given design.

Complete documentation of all analyses is essential and must be perpetually maintained. The rapid development of technology in the fields of hydrology and hydraulics necessitates a periodic review and, if necessary, update of all analyses prior to construction of the facility. All analysis completed more than three years before construction must be reviewed prior to construction.

1.2.2 Manual Layout/Chapter Templates

Typical section headings for the main hydraulic chapters are identified in Table 1-1, which indicates the typical contents of the chapter sections.

The Design Concepts section for each technical chapter is generally based on the AASHTO Model Drainage Manual. As such, the material is included for theoretical background and may not conform exactly to VDOT methodology, terminology, or nomenclature. When practical, the text is revised to be consistent with VDOT methodology and policy.

Table 1-1. Chapter Template and Contents

Sections	Contents
Introduction	Objectives
Policy	Define Course of Action for VDOT, State, Federal and Local Policy
Design Criteria	Specify Standards by which Policy is Carried Out
Design Concepts	Design Considerations/ Guidelines Theory and Equations Requirements Figures <u>Necessary</u> to Support Procedures or Examples
Design Procedures & Examples	Step-by-Step Procedures Specific Design Considerations Specific Software Solutions Figures <u>Necessary</u> to Support Procedures or Examples
References	Sources of Information / Bibliography
Appendices	All Figures, Forms and Design Aids <u>Not Necessary</u> to be in Concepts or Procedures Drainage Design Memoranda Definitions Checklists Symbology and Nomenclature

1.3 Drainage Design Memoranda

Drainage Design Memoranda contain instructional and informational guidance related specifically to drainage design. The instructions and information contained in these memoranda are subject to relatively frequent changes and have therefore intentionally be excluded from the main body of text in this manual. These memoranda are all contained in Chapter 15. All Technical Supplements, Hydraulic Design Advisories, and Drainage Manual Errata Sheets published prior to issuance of this manual are now included in the manual and are hereby voided.*

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1.4 References

The manual provides references at points where the designer may need more detailed source material. The reference section at the end of each chapter includes these source documents, as well as a listing of those documents, which are recommended additions to the designer's library of references.

The following documents are an integral part of VDOT roadway and drainage design:

VDOT Reference Documents (all latest editions)

- VDOT Road and Bridge Standards, Volume I and II
- VDOT Road and Bridge Specifications
- VDOT Instructional and Informational Memoranda
- VDOT Road Design Manual
- Virginia Stormwater Management Regulations (VR 215.02.00)
- Virginia Erosion and Sediment Control Regulations (VR 625.02.00)
- Virginia Erosion and Sediment Control Handbook
- Virginia Stormwater Management Handbook, Volumes I and II
- VDOT Survey Instruction Manual

Compliance with the following applicable laws and agencies' regulations and policies are required:

- Virginia Department of Transportation
- Virginia Stormwater Management Regulations
- Virginia Erosion and Sediment Control Regulations
- State Drainage Law
- FHWA Federal Aid Policy Guide
- Federal Emergency Management Agency
- Environmental Protection Agency Regulation
- National Pollution Discharge Elimination System (NPDES)
- Department of Environmental Quality

1.5 User Instructions

This manual is divided into 15 chapters, each dealing with a major category of hydrologic or hydraulic analysis. Each chapter is further divided according to specific elements of the subject. Departmental policy and design criteria are presented in each chapter as they relate to the specific subject matter.

The downloaded electronic version of the Drainage Manual and its revisions will be considered the official reference document in agreements with consultants. The manual can be downloaded from VDOT's website at the following location:

<http://www.virginiadot.org/business/locdes/hydra-drainage-manual.asp>.^{*} The authors of this manual have strived to maintain the accuracy and reliability of the information and procedures presented herein. The execution of an engineering design; however, involves the judgment of the designer, and only he or she can ascertain whether a technique or item of information can be applied to a given situation. Therefore, neither the Department nor any contributor accepts responsibility for any real or alleged error, loss, damage, or injury resulting from use of the material contained herein.

References to specific computer programs, AASHTO guidelines, manual, and regulations are included in this manual. It is expected that the designer will be knowledgeable in the use of the referenced items. This manual cannot incorporate computer program user manuals or remain current with these programs and the latest drainage-related Federal regulations. The designers should keep themselves up-to-date by contacting either their local, State, or Federal hydrology/hydraulic departments.

This manual is published in U. S. Customary (English) units. In most cases all units, equations, tables, and figures are given in English units. In a few instances, some existing metric information was not converted to English units. The metric units are given so that the material could still be included in the manual. In most cases, computer software is available that allows the use of English units that can be used to obtain the required information.

Information in this Manual may be supplemented and/or revised by drainage related Location and Design Instructional and Informational Memorandums (IIM's) and Hydraulic Design Advisories (HDA's). Information in these IIM's or HDA's shall supersede that noted in this Manual unless otherwise approved by the State Hydraulics Engineer. Where language in various sections of this Manual conflict, the more stringent language shall dictate unless otherwise approved by the State Hydraulics Engineer.

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1.6 Revisions and Updates

VDOT plans to issue updates and revisions to this manual which will be found at the VDOT website. Updates and revisions would normally be anticipated no more than twice a year. Users of the manual should review the VDOT website periodically and prior to beginning design or preparing a plan submittal, to determine the date of the most recent updates. Users that cannot access the information on the Internet may phone the VDOT Hydraulics Section in the nearest district office or **Central Office*** in Richmond, Virginia at (804) 786-6016. When revisions are available, the user will be notified via either a **Hydraulic Design Advisory (HDA)** or the **Errata Sheet file** on the VDOT website at the location where the manual may be viewed and/or downloaded. These files also briefly describe each revision. All revised material (where possible) will be shaded so the user will be able to recognize it as having been changed. The shaded material within any given chapter will remain shaded until the next revision, at which time all previous shading in that chapter will be removed.

* Rev 9/09

1.7 Acknowledgements

The Department gratefully acknowledges the following for their contribution towards the preparation of this Manual:

- American Association of State Highway and Transportation Officials (AASHTO Model Drainage Manual, Highway Drainage Guidelines, and other publications)
 - Executive Committee
 - Hydrology and Hydraulics Technical Committee*
- Federal Highway Administration
- Federal Emergency Management Agency
- United States Geological Survey
- United States Army Corps of Engineers
- Virginia Department of Transportation –
 - Mr. Stephen Kindy, P.E., State Hydraulics Engineer
 - Mr. Roy Mills, Former State Hydraulics Engineer and Member AASHTO Hydrology and Hydraulics Technical Committee
 - Mr. John Dewell, Assistant State Hydraulics Engineer
 - Mr. David LeGrande, Former Assistant State Hydraulics Engineer
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* Rev 9/09

Appendix 1A-1 Definitions and Abbreviations

Abbreviations:

AASHTO	American Association of State Highway and Transportation Officials
BMP	Best Management Practice*
DCR	(Virginia) Department of Conservation and Recreation
DDM	Drainage Design Memorandum
DEQ	(Virginia) Department of Environmental Quality
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
I&IM	Instructional and Informational Memorandum
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service (formally known as the Soil Conservation Service or SCS)
RDM	Road Design Manual
SCS	Soil Conservation Service (former name of the National Resource Conservation Service)
USCOE/USACE	United States Corps of Engineers
USGS	United States Geological Survey
VDOT	Virginia Department of Transportation or the Department
VSMR	Virginia Stormwater Management Regulations

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