
Chapter 16 – Engineering Software

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Chapter 16 – Engineering Software

16.1 Software Utilized in the Electronic Development & Delivery of Plans

16.1.1 Overview

The Virginia Department of Transportation (VDOT) has established standards and procedures for the electronic development and delivery of Right of Way and Construction plans.

As the first step in this process, the VDOT CADD Committee adopted **MicroStation** as its standard graphics package. **MicroStation** is a drafting package developed, marketed and sold by Bentley Systems Inc. The committee adopted **GEOPAK**, by Bentley Systems Inc., as its standard road design system with modifications to meet VDOT standards, and **FALCON** as our file management system. Likewise, the Department has selected **GEOPAK Drainage** as the preferred design package for the production of **Storm Sewer Profiles**, as outlined in Chapter 9 of the [VDOT CADD Manual](#).

The utilization of one standard drafting and design package provides standards for files that can be utilized by survey, designers, and construction. In addition, VDOT's project management, construction estimating and other computerized design systems for Traffic Engineering, Right of Way/Utilities, Structure and Bridge, Environmental Quality, and Materials are being interfaced to utilize the standard files created by the drafting and design programs.

The system operates on a Personal Computer (PC) running the latest Department version of the MicroSoft Windows operating system. Specifications for these computers are available.

The adoption of a standard drafting and design package allows the Department to utilize electronic data that has been developed by consultants to complete projects that might be recalled or re-assigned. This would also apply to those projects being designed by the Department and assigned to a consultant to be completed.

In addition, the Department has developed standards for the delivery of electronic files to the private sector contractors for design and construction bidding. This process utilizes VDOT Standards for design files and our file Management system.

16.1.2 VDOT CADD Manual

The [VDOT CADD Manual](#) will include standards for all Preliminary Engineering Divisions including the addition of separate chapters for Structure and Bridge, Landscape and Hydraulics. Although the manual will be maintained by Location and Design Division, each of the Division's support groups will be responsible for setting and maintaining the standards for their respective division. The Location and Design CADD Support Group, as the manager of the Automated Engineering System, will provide support and guidance to other divisions as needed to insure that their standards blend with the AES system.

This manual will be revised by the respective support groups as needed to insure that it is up to date with VDOT standards.

The standards set forth in the [VDOT CADD Manual](#) were developed to be used in conjunction with and to meet the requirements of the policies and procedures as stated in the [VDOT Road Design Manual](#), the [VDOT Drainage Manual](#), A Policy on Geometric Design of Highways and Streets by AASHTO, [Divisional Instructional and Information Memoranda](#), and other guidelines as set forth by the Virginia Department of Transportation.

16.1.3 Software Packages

The software packages used by the Virginia Department of Transportation for electronic plan design are as follows:

MicroStation: A Computer Drafting software package. This product is marketed and distributed by Bentley Systems Inc. of Exton, Pennsylvania.

GEOPAK: An Engineering Road Design Software Package. This product is marketed and distributed by Bentley Systems Inc. of Exton, Pennsylvania.

GEOPAK Drainage: A module within the GEOPAK Design Software Package used for the design of roadway drainage systems and the production of storm sewer profiles. This product is marketed and distributed by Bentley Systems Inc. of Exton, Pennsylvania.

Falcon: An Oracle based file (document) management system. A TSA Advet product.

16.2 Hydraulic/Hydrologic Engineering Software in Use by The Department

16.2.1 Introduction and Disclaimer

The following section provides a link to the current list of all hydrologic and hydraulic engineering software in use by the Department.

It should be noted that the Department does not necessarily prefer everything that is included on the list for a given application nor does it necessarily reject software that is not included. The list is intended only to represent such hydrologic and/or hydraulic engineering software that the Department either currently uses or has at least summarily tested. It serves as a recommendation, not a requirement. If there is any question as to the application of hydrologic and/or hydraulic engineering software either on Department projects or those projects that will ultimately come under the Department's jurisdiction, an inquiry should be made to the Department's Central Office Hydraulics Section (in Richmond) to:

Mr. J. Thomas Downer, P.E.
Asst. State Hydraulics Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, Virginia 23219

Phone: (804) 225-4957
Fax: (804) 225-3686
E-mail: John.Downer@VDOT.Virginia.gov

16.2.2 Link to Appendix 16A-1

[Appendix 16A-1](#) Hydrologic/Hydraulic Engineering Microcomputer Software in Use by the Department (revised 5/2012)

16.3 VDOT Web-Based Hydrologic/Hydraulic Applications

16.3.1 Introduction and Disclaimer

The following section provides a link to a list of all the current web-based hydrologic and hydraulic applications in use by the Department. A User's Guide for all of the applications can be accessed on the Sign-In page.

VDOT assumes no responsibility for the use/misuse of these software products. The application of these software products is the sole responsibility of the user. There are no expressed or implied warranties. No user support for this software will be provided by VDOT.

Most of these web-based WINDOWS software modules were created to replace older DOS-based programs that will no longer function in the latest MICROSOFT WINDOWS environments. The Department longer supports or distributes these DOS-based programs.

16.3.2 Link to Appendix 16A-2

[Appendix 16A-2](#) VDOT Web-Based Hydrologic/Hydraulic Applications (revised 5/2012)

16.3.2 Link to VDOT Web Applications Usage Agreement Form

The following is a link to the VDOT Web Applications Usage Agreement Form for External Customers (Consultant):

[VDOT Web Applications Usage Agreement Form](#)

External Customers will be required to complete and submit this form, before being issued a sign-in ID and Password.

16.3.2 Link to VDOT Web Applications Sign-In Page

The following is a link to the VDOT Web Applications Sign-In Page for External Customers (Consultant):

[VDOT Web Applications Sign-In Page \(External\)](#)

VDOT Internal Customers can access the applications through this link:

[VDOT Web Applications Sign-In Page \(Internal\)](#)

Appendix 16A-1 Hydrologic/Hydraulic Engineering Software In Use By
The Department

**HYDROLOGIC/HYDRAULIC ENGINEERING SOFTWARE IN USE
BY THE DEPARTMENT**

HYDROGRAPH/FLOOD ROUTING

(1) HEC-1

- U.S. Army Corps of Engineers' Flood Hydrograph Package
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required but is desirable and requires 132-column print capability.

Source: U.S. Army Corps of Engineers – Hydrologic Engineering Center

Internet web address:

<http://www.hec.usace.army.mil/software/legacysoftware/hec1/hec1-download.htm>

(2) HEC-HMS

- U.S. Army Corps of Engineers' Hydrologic Modeling System
- Computer requirements: WINDOWS-based. A printer is desirable.

Source: U.S. Army Corps of Engineers – Hydrologic Engineering Center

Internet web address:

<http://www.hec.usace.army.mil/software/hec-hms/download.html>

(3) WIN TR-55

- An interactive package for calculating peak flows and hydrographs using the N.R.C.S.' TR-55 procedures. Routing provisions are included.
- Computer requirements: WINDOWS-based. A printer is not required but is desirable.

Source: USDA - National Resource Conservation Service

Internet web address:

http://www.wsi.nrcs.usda.gov/products/W2Q/H&H/Tools_Models/WinTR55.html

(4) WIN TR-20

- A program for performing hydrographic analyses & flood routing using N.R.C.S.' procedures described in their "NEH-4" publication.
- Computer requirements: WINDOWS-based. A printer is not required but is desirable.

Source: USDA - National Resource Conservation Service

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Internet web address:

http://www.wsi.nrcs.usda.gov/products/W2Q/H&H/Tools_Models/WinTR20.html

(5) ROUT/HYDRO

- An interactive package that develops peak discharge, expands it into an inflow hydrograph, & routes using the storage indicator method.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required but is desirable.

Source: Muncaster Engineering
1740 Lambs Road
Charlottesville, VA 22901
Phone: (804) 978-7879
Fax: (804) 973-0249
E-mail: tmuncaster@aol.com

Note: The above software may no longer be readily available.

(6) WATERSHED MODELING

- Design and analysis of detention basins using SCS, Rational Method, and Santa Barbara Urban Hydrograph procedures.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required but is desirable.

Source: Eagle Point
4131 Westmark Drive
Dubuque, Iowa 52002
Phone: 1-800-678-6565

(7) VISUAL URBAN

- Urban Drainage Design Package which includes a module for flood routing using the storage-indicator method
- Computer requirements: WINDOWS based. A printer is not required but is desirable.

Source: The Federal Highway Administration's Internet web site.

Internet web address:

http://www.fhwa.dot.gov/engineering/hydraulics/software/softwaredetail.cfm#hy2_2_visual_urban

(8) CRITSTRM

- Actually "Critical Storm Duration", the program will determine the ordinates of a hydrograph for the storm even that will produce the largest volume of water for a given frequency using the Rational Formula as a basis for the

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calculation. This is a module of the Department's "Web-Based Hydraulics Applications".

- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

Source: V.D.O.T. – Location & Design Web Section

Internet web address for access information:

<http://www.virginiadot.org/business/locdes/notification.asp>

(9) PONDPACK

- WINDOWS based hydrologic modeling/routing program.
- Analyzes pre and post-developed watershed conditions and pond sizes
- Computes outlet rating curves with tailwater effects, pond infiltration, pond detention times, and analyzes channels
- Computes interconnected pond routing with divergent (multiple) outfalls
- Can use any rainfall duration or distribution to compute hydrographs
- Computes hydrographs for multiple events, adds them at junctions, and routes them through multiple reaches and ponds

Source: Bentley

685 Stockton Drive

Exton, PA 19341

Phone: 1-800-236-8539

PEAK DISCHARGE HYDROLOGY

(1) NSS (National Streamflow Statistics Program)

- NSS is a Windows program for estimating the magnitude and probability of peak discharges for unregulated rural and urban watersheds and for estimating other streamflow statistics for unregulated rural watersheds. NSS replaced NFF (National Flood Frequency Program) in 2004.
- Computer requirements: WINDOWS- based. A printer is not required but is desirable.

Source: U.S. Geological Survey's Internet web address:

<http://water.usgs.gov/software/NSS/>

(2) PEAKFQWIN

- A program for determining design peak discharges from stream gaging records (downloadable from USGS' Internet site) using the Log-Pearson Type III frequency distribution method in accordance with WRC Bulletin 17-B guidelines.

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- Computer requirements: WINDOWS- based. A printer is not required but is desirable.

Source: U.S. Geological Survey's Internet web address:

<http://water.usgs.gov/software/peakfq.html>

(3) EPSON

- A program that projects design peak flows based on analysis of annual gaged peak flows. Gage records are available on for most all gaging stations in Va. This is a module of the Department's "Web-Based Hydraulics Applications."
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

(4) DISCHARGE

- A program for estimating the 2, 5, 10, 25, 50, 100 and 500 yr. peak flows using the Daniel G. Anderson Method ("MAGNITUDE AND FREQUENCY OF FLOODS IN NORTHERN VIRGINIA") and the Franklin Snyder Method (A.S.C.E. Journal – Hydraulics Division - October, 1958. One hundred point rainfall curves, in the form of external data files, are supplied with the program for use with the Franklin Snyder Method. This is a module of the Department's "Web-Based Hydraulics Applications".
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

(5) REGEQUAT

- A program for determining peak discharges using the U.S. Geological Survey's Regional Regression Equations. Program considers natural, rural watersheds but can take the effects of urbanization into account using the Urban Regression Equations – both the 3 and 7-parameter versions. This is a module of the Department's "Web-Based Hydraulics Applications".
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

(6) PQTRANS

- A program for estimating the peak discharges at an ungaged location from a nearby gaging station using both the U.S.G.S. and N.R.C.S. peak discharge transfer formulae. This is a module of the Department's "Web-Based Hydraulics Applications".

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- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft “Internet Explorer” (or fully compatible web browser), and “Adobe Reader” for viewing, saving, and/or generating hardcopy printouts

(7) VIRTOC

- A program for determining peak discharges using the Rational Formula. Program has several options for calculating both overland and channel flow time. The program uses rainfall data based on “B, D, & E” factors derived from the NOAA’s “Atlas-14” publication. This is a module of the Department’s “Web-Based Hydraulics Applications.”
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft “Internet Explorer” (or fully compatible web browser), and “Adobe Reader” for viewing, saving, and/or generating hardcopy printouts

Source (3 thru 7): V.D.O.T. – Location & Design Web Section

Internet web address for access information:

<http://www.virginiadot.org/business/locdes/notification.asp>

(8) EFH-2

- Essentially a simplified version of the NRCS’ “TR-55” which is based on their “Engineering Field Handbook”, Chapter 2. It is suggested that it not be used for drainage areas greater than 200 acres or for watersheds where the urban land use does not exceed 10%.
- Computer requirements: WINDOWS- based. A printer is not required but is desirable.

Source: USDA - National Resource Conservation Service

Internet web address:

http://www.wsi.nrcs.usda.gov/products/W2Q/H&H/Tools_Models/efh2.html

OPEN CHANNEL FLOW

(1) HY-15

- A program for use in designing stable linings for open channels in accordance with the FHWA "HEC-15" publication. The program was originally developed by the FHWA but the Department has re-written as a WINDOWS application and is a module of the Departments “Web-Based Hydraulics Applications”.
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft “Internet Explorer” (or fully compatible web browser), and “Adobe Reader” for viewing, saving, and/or generating hardcopy printouts

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(2) RDDITCH

- A program for use in determining depth and velocity for the 2-yr. and 10-yr. peak flows in roadside and median ditches. Flow characteristics are calculated for Manning's "n" values of 0.03, 0.05 and 0.015. The program uses rainfall data based on "B, D, & E" factors derived from the NOAA's "Atlas-14" publication. This is a module of the Department's "Web-Based Hydraulics Applications."
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

(3) RIPRAP

- A program for designing riprap slope protection in accordance with the FHWA's "HEC-11" publication. It considers channel side slopes, bottoms, slope stability by tractive force procedures and riprap slope protection for wave action. This is a module of the Department's "Web-Based Hydraulics Applications."
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

Source (1 thru 3): V.D.O.T. – Location & Design Web Section

Internet web address for access information:

<http://www.virginiadot.org/business/locdes/notification.asp>

(4) VISUAL URBAN

- Urban Drainage Design Package which includes a module for open channel flow in prismatic and circular sections
- Computer requirements: WINDOWS based. A printer is not required but is desirable.

Source: The Federal Highway Administration's Internet web site.

Internet web address:

http://www.fhwa.dot.gov/engineering/hydraulics/software/softwaredetail.cfm#hy2_2_visual_urban

(5) QUICK-2

- A program developed by the Federal Emergency Management Agency (FEMA) to perform open channel flow calculations in irregular and prismatic (and round) channels. Water surface profile computations can also be performed but on open channels only. There is no provision for analyzing culverts or bridges.
- Computer requirements: WINDOWS-based however, a DOS version is available.

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Source: Federal Emergency Management Agency (FEMA)

Internet web address: http://www.fema.gov/plan/prevent/fhm/dl_qck22.shtm

(6) DitchSoftVA

- A WINDOWS-based application for use in designing, analyzing, and checking allowable flow velocities and depths of roadside and median ditches in accordance with Chapter 7 of the VDOT DRAINAGE MANUAL. Also allows the user to determine to test different flexible and concrete linings in accordance with the latest version of the FHWA's "HEC-25" publication. Works either as a stand-alone application or, as appropriate, in conjunction with the other modules of Ensoftec's "ENSOFT HYDRO" software suite.
- Computer requirements: Microsoft's EXCEL spreadsheet (required only to generate output using the Department's standard LD-268 form). A printer is not required but is desirable.

Source: Ensoftec, Inc.

P.O. Box 3009

Gaithersburg , MD 20885-3009

Phone: (301) 294-7066

Internet web address is: <http://www.ensoftec.com/>

PIPE FLOW/CULVERT HYDRAULICS

(1) QUICKPIPE

- A simple program for designing and/or analyzing round culvert pipes and box culverts. It doesn't consider multiple lines, elliptical, oval, or other irregular shapes, or flow overtopping the roadway.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required, but is desirable.

Note: if the above program is no longer available from the McTrans Center it may be possible to obtain it directly from the program's developer (provided the information shown below is still valid):

Charles K. Cover, P.E.

1084 Carriage Hill Parkway

Annapolis, MD 21401-6516

phone: (410) 266-0756 (after 5:00 PM EST)

(2) WinHY-8

- A package of interactive programs for the design and analysis of culverts. It handles overtopping and does flood routing.

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- Computer requirements: WINDOWS-based. A word processor capable of generating Rich Text “.rtf” files is necessary for creating reports. A printer is optional

Source : The Federal Highway Administration (FHWA)

Internet web address is:

<http://www.fhwa.dot.gov/engineering/hydraulics/software/hy8/>

(3) BCAP

- A WINDOWS-based application for use in designing/analyzing culverts where up to two changes in the grade of the flow line are necessary. The program uses the FHWA’s “HY-8” algorithms and computes a water surface profile through the culvert.
- Computer requirements: WINDOWS-based - a printer is not required but is desirable.

Source: The Nebraska Department of Roads

Internet web address is:

<http://www.dor.state.ne.us/roadway-design/downloads.htm#bcap>

(4) CS Hydraulic Tools

- A WINDOWS-based application for use in designing/analyzing ConSpan arch culverts using the FHWA’s “HDS-5” procedures. The software also includes provisions for generating hydrographs and flood routing.
- Computer requirements: WINDOWS-based - a printer is not required but is desirable.

Source: CON/SPAN Bridge Systems

Internet web address is:

<http://www.con-span.com/con-span/main.html> (under “Tech Support”)

(5) CulvertSoftVA

- A WINDOWS-based application for use in designing/analyzing culverts using the FHWA’s “HDS-5” procedures. The software also includes provisions for designing outlet protection/energy dissipators using VDOT, FHWA, & DCR procedures.
- Computer requirements: Microsoft’s EXCEL spreadsheet (Required only to generate the Department’s Standard LD-269 form and other basic reports associated with the program). A printer is not required but is desirable.

Source: Ensoftec, Inc.

P.O. Box 3009

Gaithersburg, MD 20885-3009

Phone: (301) 294-7066

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Internet web address is: <http://www.ensoftec.com/>

DROP INLET/STORM SEWER DESIGN

(1) QHEC12

- A program that will perform analysis for all drop inlet types covered in the Federal Highway Administration's HEC-12 publication.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required but is desirable.

Source: HAESTAD METHODS
37 Brookside Road
Waterbury, Connecticut 06708
Phone: 1-800-422-6555

Note: The above program may no longer be available.

(2) VDOT-HGL

- A blank spreadsheet template for performing hydraulic grade line computations in accordance with the procedures outlined in Chapter IV of the VDOT DRAINAGE MANUAL.
- Computer requirements: WINDOWS-based - a printer is not required but is desirable.

Source: Signal Hill Engineering
8540 Sandstone Way
Manassas, Virginia 22111
Phone: (703) 369-9291

Note: The above spreadsheet may no longer be available.

(3) VISUAL URBAN

- Urban Drainage Design software package that includes a module for the design analysis of drop inlets. There is also a module for normal depth calculations in round pipes.
- Computer requirements: WINDOWS-based - a printer is not required but is desirable.

Source: The Federal Highway Administration's Internet web site.

Internet web address is:

http://www.fhwa.dot.gov/engineering/hydraulics/software/softwaredetail.cfm#hy2_2_visual_urban

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(4) InletSoftVA

- A WINDOWS-based application for use in designing/analyzing all types of drop inlets in accordance procedures presented in the VDOT DRAINAGE MANUAL and the FHWA's HEC-22 publication. Works either as a stand-alone application or in conjunction with the PipeSoftVA software package shown below.
- Computer requirements: Microsoft's EXCEL spreadsheet (Required only to generate the Department's Standard LD-204 form). A printer is not required but is desirable.

(5) PipeSoftVA

- A WINDOWS-based application for use in designing/analyzing storm sewers in accordance with procedures described in the VDOT DRAINAGE MANUAL. The software will also generate a hydraulic grade line utilizing the VDOT method. Works either as a stand-alone application or in conjunction with Inletsoft software package described above.
- Computer requirements: Microsoft's EXCEL spreadsheet (Required only to generate the Department's Standard LD-229 form and other basic reports associated with the program). A printer is not required but is desirable.

(6) PipeProfilerVA

- A WINDOWS-based application that plots and/or displays storm sewer pipes and appurtenances (in plan profile view) using data files created by the "InletSoftVA" and "PipeSoftVA" program modules from the "Ensoft Hydro" hydraulic design software suite. Calculated hydraulic grade lines may be plotted and/or displayed. The program can also optionally generate separate storm sewer pipe and appurtenance summaries using the same data. The plots and summaries may be viewed and/or printed from with "PipeProfilerVA" but, to be included as part of an electronic plan assembly, must be used in conjunction with CADD software such as "AUTOCAD", "MICROSTATION", etc. Pipe and structure summaries may also be exported to an "EXCEL" spreadsheet.
- Computer requirements: CADD software such as "AUTOCAD", "MICROSTATION", etc. is required in order to import the program's output into a standard CADD file format. Microsoft "EXCEL" is also required if it is desired to export the summaries to a spreadsheet. A printer or plotter is required for hardcopy output.

Source (4 & 6): Ensoftec, Inc.

P.O. Box 3009

Gaithersburg, MD 20885-3009

Phone: (301) 294-7066

Internet web address is: <http://www.ensoftec.com>

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(7) PFLOW

- A WINDOWS-based application for use in determining flow characteristics in round pipe based on Manning's equation. This is a module of the Department's "Web-Based Hydraulics Applications.
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

(8) GEOPAK Drainage

- A module within the GEOPAK Design Software Package used primarily for the design of roadway drainage systems and the production of storm sewer profiles.
- Computer requirements: MICROSTATION CADD software. Program operates within the MICROSTATION environment.

Source: Bentley
685 Stockton Drive
Exton, PA 19341
Phone: 1-800-236-8539

WATER SURFACE PROFILES / BRIDGE HYDRAULICS

(1) HEC-2

- The U.S. Army Corps of Engineers' water surface profiles program. An ASCII text editor or word processor is required to generate or edit data input files.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer with 132 column print capability is needed.

(2) EDIT2

- The U.S. Army Corps of Engineers' program that edits and checks HEC-2 data input files for errors. An ASCII text editor is required to generate or edit data input files.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required but is desirable.

(3) PLOT2

- The U.S. Army Corps of Engineers' program that plots HEC-2 cross sections and/or generated water surface profiles either by "screen-dumping" a high resolution graphics image to a printer or plotting the image on a Hewlett-Packard Model 7475A pen plotter.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required but is desirable.

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(4) COED (Corps of Engineers' Editor)

- The U.S. Army Corps of Engineers' program for creating and editing input data sets for use with their "HEC" series of computer software
- Computer requirements: Developed for MS-DOS but will run under WINDOWS.

Source (1 thru 4): U.S. Army Corps of Engineers – Hydrologic Engineering Center

Internet web address:

<http://www.hec.usace.army.mil/software/legacysoftware/hec2/hec2-download.htm>

(5) HEC-RAS

- (Hydrologic Engineering Center - River Analysis System) - The U.S. Army Corps of Engineers new software package for the analysis of floodplains and bridged waterways. Full graphics package for viewing x-sections, profiles, rating curves, and 3-D floodplain views.
- Computer requirements: WINDOWS-based - a printer is not required but is desirable.

Source: U.S. Army Corps of Engineers – Hydrologic Engineering Center

Internet web address:

<http://www.hec.usace.army.mil/software/hec-ras/hecras-download.html>

(6) HY-7/WSPRO

- The U.S. Geological Survey's and F.H.W.A.'s water surface profiles program. An ASCII text editor or word processor is required to generate or edit data input files.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS - a printer is not required but is desirable.

Source: The Federal Highway Administration's Internet web site.

Internet web address is:

<http://www.fhwa.dot.gov/engineering/hydraulics/software/softwaredetail.cfm#hy7>

(7) WSPROGRAPH

- A program for use in plotting water surface profiles, flood plain widths and flood plain cross sections which is intended to be used in conjunction with the U.S.G.S. and F.H.W.A.'s "WSPRO" program. WSPROGRAPH uses as its input the output (as written to disk) of the WSPRO program.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer or Hewlett-Packard compatible plotter is not required but is desirable.

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(8) HY-9

- A program developed by the FHWA for the determination of bridge related general and local scour. The program is based on their publication "SCOUR – TECHNICAL ADVISORY". Note: this program may not be fully compatible with the latest version of the FHWA's "HEC-18" publication.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS. A printer is not required but is desirable.

(9) SWITCH

- A program to convert HEC-2 data files to HY-7/WSPRO format and vice versa.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS.

Source (7 thru 9): McTrans Center
University of Florida
512 Weil Hall
P.O. Box 116585

(10) FESWMS-2DH

- (Finite Element Surface Water Modeling System) is a two dimensional stream flow model which employs finite element analysis techniques.
- Computer requirements: MS-DOS 3.1 or greater operating system, 640K RAM (minimum), a 10-MEGABYTE hard disk (minimum), a math coprocessor, a printer or a Hewlett-Packard model 7475A pen plotter is required.

Source: The Federal Highway Administration's Internet web site.

Internet web address is:

http://www.fhwa.dot.gov/engineering/hydraulics/software/softwaredetail.cfm#feswms_2dh

(11) BRRIPRAP

- A program that calculates the size of riprap necessary to protect bridge abutments based on the FHWA's "HEC-18" publication (as revised 4/93). This is a module of the Department's "Web-Based Hydraulics Applications".
- Computer requirements: Internet access, Microsoft WINDOWS, Microsoft "Internet Explorer" (or fully compatible web browser), and "Adobe Reader" for viewing, saving, and/or generating hardcopy printouts

Source: V.D.O.T. – Location & Design Web Section

Internet web address for access information:

<http://www.virginiadot.org/business/locdes/notification.asp>

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(12) GIANTP

- An interactive program used to develop an input data for pre-1995 versions of the FHWA/USGS WSPRO program.
- Computer requirements: Developed for MS-DOS but will run under WINDOWS.

Source: Mr. Gamal E. Hassan, PE

GHassan@TRCSOLUTIONS.com

(13) CHECK2

- A software package developed by the Federal Emergency Management Agency (FEMA) specifically for checking HEC-2 data sets for compliance with FEMA modeling practices. However, the package is also set up for creating/editing and processing HEC-2 data sets as well. The HEC-2 program (as well as its supporting programs) are included with the package.
- Computer requirements: WINDOWS-based. A printer with 132 column print capability is needed.

(14) CHECKRAS

- A software package developed by the Federal Emergency Management Agency (FEMA) specifically for checking HEC-RAS data sets for compliance with FEMA modeling practices. Note: this software works in conjunction with HEC-RAS so it must be installed on the user's computer.
- Computer requirements: WINDOWS-based. A printer is not required but is desirable.

(15) RASPLOT

- A software package developed by the Federal Emergency Management Agency (FEMA) specifically generating water surface profile plots in FEMA's preferred format as extracted from HEC-RAS. Note: this software works in conjunction with HEC-RAS so it must be installed on the user's computer.
- Computer requirements: WINDOWS-based. A printer is not required but is desirable.

Source (13 thru 15): Federal Emergency Management Agency (FEMA)

Internet web address: http://www.fema.gov/plan/prevent/fhm/frm_soft.shtm#1

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INTERACTIVE HYDROLOGIC/HYDRAULIC ENGINEERING PACKAGE

(1) HYDRAIN

- (Also know as POOL FUND PROJECT) An interactive package of programs that perform most hydrologic/hydraulic engineering functions. A master program supervisor and data input shells are included to facilitate using the individual programs. The package currently includes HYDRO (a program to develop peak flows, inflow hydrographs, and analyze gaging data), HYCULV & HY-8 (programs for the design and analysis of culverts), HYDRA (a program for the design and analysis of storm sewers, sanitary sewers, and combination sewers), HY-7/WSPRO (water surface profiles) and HYCHANL (a program for designing channels, ditches & linings).
- Computer requirements: Developed for MS-DOS but will run under WINDOWS.

Source: The Federal Highway Administration, though it apparently is no longer available as a download option on their web site. You might try contacting Joe Krolak either by e-mail at joseph.krolak@fhwa.dot.gov or by phone at (202) 366-4611.

MISCELLANEOUS

(1) PROJFLOTATION

- Determines hydrostatic uplift forces at the entrance of culvert pipes and the counterweight requirements necessary to offset such forces.
- Computer requirements: WINDOWS based.

Source: V.D.O.T. - Hydraulics Section

Internet web address for ordering information:

<http://www.virginiadot.org/business/locdes/notification.asp>

(2) FISHXING

- Assists in designing and analyzing highway culvert pipes to facilitate the passage of various fish species.
- Computer requirements: WINDOWS based.

Source: Internet web address: <http://www.stream.fs.fed.us/fishxing/>

(3) HYPERCALC

- English to SI metric (and vice-versa) converter particularly geared to hydraulic engineering.
- Computer requirements: WINDOWS based.

Appendix 16A-1

Source: The Federal Highway Administration's Internet web site.

Internet web address is:

<http://www.fhwa.dot.gov/engineering/hydraulics/software/hyper.cfm>

DISCLAIMER

It should be noted that the Department does not necessarily prefer everything that is included on the above list for a given application nor does it necessarily reject software that is not included. The list is intended only to represent such hydrologic and/or hydraulic engineering software that the Department either currently uses or has at least summarily tested. It serves as a recommendation, not a requirement. If there is any question as to the application of hydrologic and/or hydraulic engineering software either on Department projects or those projects that will ultimately come under the Department's jurisdiction, an inquiry should be made to the Department's Central Office Hydraulics Section (in Richmond) to:

Mr. J. Thomas Downer, P.E.
Asst. State Hydraulics Engineer
Virginia Department of Transportation
1401 East Broad Street
Richmond, Virginia 23219

Phone: (804) 225-4957
Fax: (804) 225-3686
E-mail: John.Downer@VDOT.Virginia.gov

WEB-BASED HYDRAULIC/HYDROLOGIC APPLICATIONS IN USE BY THE DEPARTMENT

PEAK DISCHARGE HYDROLOGY

DISCHAR

This module is intended for use in computing peak discharges (2, 5, 10, 25, 50, 100 and 500 yr.) for watersheds of 200 acres or more. The module uses Daniel G. Anderson's method and Franklin F. Snyder's method. Anderson's method was developed from test sites up to 570 square miles in northern Virginia. This method applies to an area of 200 acres or more. Anderson's method, entitled *Effects of Urban Development on Floods in Northern Virginia*, was published in 1968. A copy of the original study can be obtained from the U.S. Geological Survey by contacting:

U.S. Geological Survey
U.S. Books & Reports Sales
Federal Center
Box 25425
Denver, Colorado 80225
Phone: (303) 236-7476

Snyder's method was published in the October 1958 in the A.S.C.E. *Journal of the Hydraulics Division*. Refer to that publication for detailed explanation of this method. Application of the Snyder Method would be as indicated in Chapter VI of the VDOT DRAINAGE MANUAL.

EPSON - LOG PEARSON TYPE III FREQUENCY CALCULATIONS

This module is based on “*Guidelines for Determining Flood Flow Frequency, Bulletin 17B*” from the US Department of the Interior. It is used as an alternative Log-Pearson type III analysis to **LP3SHELL**.

This module provides a statistical analysis of stream gauge records in order to establish the discharge - frequency relationship. While this module will function with minimum of four (4) annual gauge flows, it is recognized that approximately twenty years of continuous records is required to establish a reliable gauge rating. Further, the reliability of the discharge - frequency relationship is restricted to approximately 2.5 times the length of record.

LP3SHELL – LOG-PEARSON TYPE III FREQUENCY ANALYSIS (SHELL TO HYDRO.EXE)

This module provides for an interactive data entry/editing for use with the HYDRO program, part of the Hydrain Package of software, Log-Pearson type III option.

The usage of and data creation for the HYDRO.EXE program for Log-Pearson Type II frequency calculations is addressed in the FHWA's publication “*User's Manual for Hydrain Integrated Drainage Design Computer System: Version 6.1*” in volume II, “HYDRO.”

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PQTRANS – PEAK DISCHARGE TRANSFER

This module allows the user to employ peak discharges from a site, for which they are known (i.e. gauging records, etc.), and utilize them as a basis for estimating peak discharges at another site, on the same or similar nearby watershed. This is done by prorating the known discharges using two nationally recognized formulas developed for this purpose:

- 1) USGS (U.S. Geological Survey) Transfer Formula. As presented in the FHWA's publication "*User's Manual for Hydrain Integrated Drainage Design Computer System: Version 6.1*" in Volume II, "HYDRO."
- 2) NRCS (National Resource Conservation Service) Transfer Formula from their *NEH-4* publication

REGEQUAT – REGRESSION EQUATIONS CALCULATION

REGEQUAT was developed on the Regional Regression Equations presented in the U.S. Geological Survey's publication "*Methods for Estimating the Magnitude and Frequency of Peak Discharges of Rural, Unregulated Streams in Virginia*" (Water-Resources Investigations Report 94-4148).

The program considers natural, rural watersheds but can take the effects of urbanization into account using the 3 and 7-parameter Urban Regression Equations.

VIRTOC – VIRGINIA RATIONAL METHOD AND TIME OF CONCENTRATION

This module determines peak discharges using the Rational Formula. The program has several options for calculating both overland and channel flow time. The program utilizes NOAA ATLAS-14 Rainfall Precipitation Frequency Data for every county, and most cities, within the State.

This module was designed to be a user-friendly tool that allows the user to quickly and accurately calculate the peak flow for a given watershed. The VIRTOC module is designed to collect input and present output in English units. It allows the user to make choices in determining the variables used in the Rational formula. The user may enter all of the required variables or choose to calculate the Rational runoff coefficient, time of concentration or intensity. The format also allows the user to make changes in previous input values and recalculate the peak flow without leaving the program.

The user is advised that the use of VIRTOC is constrained by the assumptions of the Rational method and thus the program should not be used for watersheds over 200 ac in size.

OPEN CHANNEL FLOW

RDDITCH - FLOW IN MEDIAN AND SIDE DITCHES

This module was developed for use in determining the average velocity and depth of flow in highway roadside and median ditches. It is particularly useful in ascertaining locations where some sort of ditch lining (i.e. EC-2, EC-3, or paving) is needed. This module can handle multiple reaches of ditch and multiple cross sections (or stations) per reach. Either triangular or trapezoidal shapes can be considered and ditch side slopes and/or bottom width may vary from cross section to cross section. Depth and velocity of flow are calculated for the 2 yr. (50%) and 10 yr. (10%) peak flows for the following Manning's "n" values:

- 0.03 (assumed for natural, earth linings)
- 0.05 (assumed for protective linings, i.e. EC-2, EC-3, etc.)
- 0.015 (assumed for paved linings).

RIPRAP – BASED ON PROCEDURES PRESENTED IN FHWA'S "HEC-11" AND "HIGHWAYS IN THE RIVER ENVIRONMENT" PUBLICATIONS

This module is used for designing rip rap slope protection in accordance with the FHWA's *HEC-11* publication. It considers channel side slopes, bottoms, and slope stability by tractive force procedures and rip-rap slope protection for wave action.

The Rip-Rap module is really three (3) separate modules in one: Channel Rip-Rap Design, Wave Action Rip-Rap Design, and Tractive Force. These modules sections will be additionally segmented by these options.

HY-15 – DESIGN OF CHANNELS WITH FLEXIBLE LININGS

Originally developed by SIMONS, LI & ASSOCIATES, INC., this module analyzes flexible and concrete linings for trapezoidal or triangular channels in straight reaches. The module uses the design procedures of *Hydraulic Engineering Circular No. 15 (1988)*. The Manning's "n" value and normal depth calculated may be different from values obtained by use of charts and tables. Manning's "n" varies with the depth and is more accurately calculated by this process. The user has the option to have the module calculate the maximum Discharge (Q) for a given lining

IRCHANL – IRREGULAR CHANNEL, STAGE-DISCHARGE

This module performs normal depth calculations in irregular shaped (natural) channels using the Manning's equation.

PIPE FLOW/CULVERT HYDRAULICS

PFLOW – PIPE FLOW (IN CIRCULAR PIPES)

This module will determine normal depth, discharge, and velocity in circular pipes. Both English and SI metric versions are available. This module function performs similar to the "Field's Wheel". It will calculate Velocity and:

- "Q" for a given Depth
- Depth for a given "Q"
- Friction Slope for a given Diameter
- Diameter for a given Friction Slope

BRIDGE HYDRAULICS

BRRIPRAP – SIZING RIPRAP FOR BRIDGE ABUTMENTS

This module is used to calculate the size of riprap necessary to protect bridge abutments. This module was developed using equations and procedures described in the Federal Highway Administration's publication entitled "*Bridge Scour and Stream Instability Countermeasures*" as revised in March 2001. The publication is more popularly known as "*Hydraulic Engineering Circular (HEC) No. 23*". It is publication # FHWA NHI 01-003 and can be obtained at the following web address:

<http://www.fhwa.dot.gov/engineering/hydraulics/pubs/hec/hec23.pdf>

HYDROGRAPH/FLOOD ROUTING

CRITSTRM – CRITICAL STORM DURATION (UTILIZING THE RATIONAL METHOD)

Actually "Critical Storm Duration", the module will determine the storm duration that will produce the largest volume of water for a given frequency using the Rational Formula as a basis for the calculation. The module has been modified from the original equations to incorporate the NOAA Atlas 14 rainfall data, using the B, D & E coefficients.

The need for and the process of determining the Critical Storm Duration is describe in chapter 6 (Hydrology), section 6.4.5.1.4 of the [VDOT Drainage Manual](#).

DISCLAIMER

NOTE: Most of these web-based WINDOWS software modules were created to replace older DOS-based programs that will no longer function in the latest MICROSOFT WINDOWS environments. The Department longer supports or distributes these DOS-based programs.