CERTIFICATE OF AUTHENTICITY

THIS IS TO CERTIFY THAT THE FOLLOWING ELECTRONIC RECORDS ARE TRUE AND ACCURATE REPRODUCTIONS OF THE ORIGINAL RECORDS OF JAMES CITY COUNTY GENERAL SERVICES DEPARTMENT- STORMW ATER DIVISION; WERE SCANNED IN THE REGULAR COURSE OF BUSINESS PURSUANT TO GUIDELINES ESTABLISHED BY THE LIBRARY OF VIRGINIA AND ARCHIVES; AND HA VE BEEN VERIFIED IN THE CUSTODY OF THE INDIVIDUAL LISTED BELOW.

BMPNUMBER: **WC094**

DATE VERIFIED: **December 13, 2016**

QUALITY ASSURANCE TECHNICIAN: **Charles E. Lovett II**

Charles E. Lovett II

LOCATION: WILLIAMSBURG, VIRGINIA

Stormwater Division

MEMORANDUM

DATE: December 13, 2016
TO: Virginia Correctional Enterprises Document Management Services
FROM: Charles Lovett II, Stormwater Administrative Assistant
BMP: WC094
RE: Files Approved for Scanning

NAME PDF/SCANNED FILE:	Stonehouse Glenn Section 1 and 2		
BMP ID OR GEN FILE NUMBER:	WC094	**OWNER NAME :**	STONEHOUSE OWNERS FOUNDATION
PIN:	0540100001D	**SITE ADDRESS:**	3291 NEWLAND CT
		LEGAL DESCRIPTION:	CA S-1 STONEHOUSE GLEN

MAINTENANCE AGREEMENT IN FILE:	YES	**BOOK/PAGE OR DOCUMENT NO:**	050022763	**OTHER DESCRIPTION:**	F2 - Dry ED

BOX NO:	N/A	**COMMENTS:**	Related BMPs WC091, WC092, WC094, WC095

County Record Checklist

*Directions: Please check the type of file for scanning and check the documents enclosed in the file. Remove any budget documents, contractor financial statements or any documents with account numbers.

☐ Stormwater Projects, General Site/Subdivision (from ERP) and Stream Restoration Files

Order of Contents: File Name: _____

	a.	Certification of Authenticity (placed in the file at the time of certification)
	b.	Memorandum of files approved for scanning
	c.	This checklist
☐	1.	Maintenance Agreement
☐	2.	Deeds/Easements/Agreements/Property Records
☐	3.	Record Drawings (As Builts)
☐	4.	Construction Drawings
☐	5.	Warranties
☐	6.	Project development documentation
☐	7.	Reports
☐	8.	Specifications and engineering calculations
☐	9.	Permitting (ex. wetlands permit, SWPPP)
☐	10.	Inspections
☐	11.	Correspondence
☐	12.	Misc. (ex. photos)

☐ Stormwater Stormwater Mangement Facilities (BMP) Files

Order of Contents: File Name: WC094

	a.	Certification of Authenticity (placed in the file at the time of certification)
	b.	Memorandum of files approved for scanning
	c.	This checklist
☒	1.	Maintenance Agreement
☐	2.	Deeds/Easements/Agreements/Property Records
☒	3.	Construction Certificate
☒	4.	Record Drawing (as-built plan)
☒	5.	Construction Drawings
☒	6.	Design Calculations
☒	7.	Reports
☒	8.	Correspondence
☒	9.	Inspection Records
☒	10.	Misc. (ex. photos)

050022763

COPY

COUNTY OF JAMES CITY, VIRGINIA

√S-716-03

DECLARATION OF COVENANTS

INSPECTION/MAINTENANCE OF DRAINAGE SYSTEM

THIS DECLARATION, made this 24th day of August, 2005, between Stonehouse Glen, LLC, and all successors in interest, ("COVENANTORS(S)"), owner(s) of the following property:

Street Address: 9151 Six Mount Zion Road, Toano, VA
Legal Description: P-15 Hicks Tract, Stonehouse Glen, LLC Parcel ID No. 0540100003
Project Name: Stonehouse Glen Section II
Document No. 040010274, and the County of James City, Virginia ("COUNTY").

WITNESSETH:

We, the COVENANTOR (S), with full authority to execute deeds, mortgages, other covenants, and all rights, titles and interests in the property described above, do hereby covenant with the COUNTY as follows:

1. The COVENATOR(S) shall provide maintenance for the drainage system including any runoff control facilities, conveyance systems and associated easements, hereinafter referred to as the "SYSTEM," located on and serving the above-described property to ensure that the SYSTEM is and remains in proper working condition in accordance with approved design standards, and with the law and applicable executive regulations. The SYSTEM shall not include any elements located within any Virginia Department of Transportation rights-of-way.

2. If necessary, the COVENANTOR(S) shall levy regular or special assessments against all present or subsequent owners of property served by the SYSTEM to ensure that the SYSTEM is properly maintained.

3. The COVENANTOR(S) shall provide and maintain perpetual access from public right-of-ways to the SYSTEM for the COUNTY, its agent and its contractor.

4. The COVENANTOR(S) shall grant the COUNTY, its agent and its contractor a right of entry to the SYSTEM for the purpose of inspecting, operating, installing, constructing, reconstructing, maintaining or repairing the SYSTEM.

5. If, after reasonable notice by the COUNTY, the COVENANTOR(S) shall fail to maintain the SYSTEM in accordance with approved design standards and with the law and applicable executive regulations, the COUNTY may perform all necessary repair or maintenance work, and the COUNTY may asses the COVENANTOR(S) and/or all property served by the SYSTEM for the cost of the work and any applicable penalties.

6. The COVENANTOR(S) shall indemnify and save the COUNTY harmless from any and all claims for damages to persons or property arising from the installation, construction, maintenance, repair, operation or use of the SYSTEM.

7. The COVENANTOR(S) shall promptly notify the COUNTY when the COVENANTOR(S) legally transfers any of the COVENANTOR(S)' responsibilities for the SYSTEM. The COVENANTOR(S)' shall supply the COUNTY with a copy of any document of transfer, executed by both parties.

8. The covenants contained herein shall run with the land and shall bind the COVENANTOR(S) and the COVENANTOR(S)' heirs, executors, administrators, successors and assignees, and shall bind all present and subsequent owners of property served by the SYSTEM.

9. This COVENANT shall be recorded in the County Land Records.

IN WITNESS WHEREOF, the COVENANTOR(S) have executed this DECLARATION OF COVENANTS as of first above written.

COVENANTOR(S)

Kenneth G. McDermott

ATTEST:

Print Name/Title Kenneth G. McDermott, Manager

Patricia M. Penci

COMMONWEALTH OF VIRGINIA
~~CITY~~/COUNTY OF James City

I hereby certify that on this 24th day of August, 20 05, before the subscribed, a Notary Public of the State of Virginia, and for the ~~City~~/County of James City, aforesaid personally appeared Kenneth G. McDermott and did acknowledge the aforegoing instrument to be their Act.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 24th day of August, 20 05

Patricia M. Penci
Notary Public

My Commission expires: June 30, 2006

Approved as to form:

Asst County Attorney

This Declaration of Covenants prepared by:

Patricia M. Penci
(Print Name)

Office Manager
(Title)

4029 Ironbound Road, Suite 100
(Address)

Williamsburg, VA 23188
(City) (State) (Zip)

Phone: 757-253-2975

VIRGINIA: CITY OF WILLIAMSBURG & COUNTY OF JAMES CITY
This document was admitted to record on 23 Sept 05
at 3:49 AM/PM. The taxes imposed by Virginia Code
Section 58.1-801, 58.1-802 & 58.1-814 have been paid.

STATE TAX	LOCAL TAX	ADDITIONAL TAX
$ —	$ —	$ —

TESTE: BETSY B. WOOLRIDGE, CLERK

BY: Betsy B. Woolridge Clerk

050022763

COPY

COUNTY OF JAMES CITY, VIRGINIA

S-116-03

DECLARATION OF COVENANTS

INSPECTION/MAINTENANCE OF DRAINAGE SYSTEM

THIS DECLARATION, made this 24th day of August, 2005, between Stonehouse Glen, LLC, and all successors in interest, ("COVENANTORS(S)"), owner(s) of the following property:

Street Address: 9151 Six Mount Zion Road, Toano, VA
Legal Description: P-15 Hicks Tract, Stonehouse Glen, LLC Parcel ID No. 0540100003
Project Name: Stonehouse Glen Section II
Document No. 040010274, and the County of James City, Virginia ("COUNTY").

WITNESSETH:

We, the COVENANTOR (S), with full authority to execute deeds, mortgages, other covenants, and all rights, titles and interests in the property described above, do hereby covenant with the COUNTY as follows:

1. The COVENATOR(S) shall provide maintenance for the drainage system including any runoff control facilities, conveyance systems and associated easements, hereinafter referred to as the "SYSTEM," located on and serving the above-described property to ensure that the SYSTEM is and remains in proper working condition in accordance with approved design standards, and with the law and applicable executive regulations. The SYSTEM shall not include any elements located within any Virginia Department of Transportation rights-of-way.

2. If necessary, the COVENANTOR(S) shall levy regular or special assessments against all present or subsequent owners of property served by the SYSTEM to ensure that the SYSTEM is properly maintained.

3. The COVENANTOR(S) shall provide and maintain perpetual access from public right-of-ways to the SYSTEM for the COUNTY, its agent and its contractor.

4. The COVENANTOR(S) shall grant the COUNTY, its agent and its contractor a right of entry to the SYSTEM for the purpose of inspecting, operating, installing, constructing, reconstructing, maintaining or repairing the SYSTEM.

5. If, after reasonable notice by the COUNTY, the COVENANTOR(S) shall fail to maintain the SYSTEM in accordance with approved design standards and with the law and applicable executive regulations, the COUNTY may perform all necessary repair or maintenance work, and the COUNTY may asses the COVENANTOR(S) and/or all property served by the SYSTEM for the cost of the work and any applicable penalties.

6. The COVENANTOR(S) shall indemnify and save the COUNTY harmless from any and all claims for damages to persons or property arising from the installation, construction, maintenance, repair, operation or use of the SYSTEM.

7. The COVENANTOR(S) shall promptly notify the COUNTY when the COVENANTOR(S) legally transfers any of the COVENANTOR(S)' responsibilities for the SYSTEM. The COVENANTOR(S)' shall supply the COUNTY with a copy of any document of transfer, executed by both parties.

8. The covenants contained herein shall run with the land and shall bind the COVENANTOR(S) and the COVENANTOR(S)' heirs, executors, administrators, successors and assignees, and shall bind all present and subsequent owners of property served by the SYSTEM.

9. This COVENANT shall be recorded in the County Land Records.

IN WITNESS WHEREOF, the COVENANTOR(S) have executed this DECLARATION OF COVENANTS as of first above written.

COVENANTOR(S)

Kenneth G. McDermott

ATTEST:

Print Name/Title Kenneth G. McDermott, Manager

Patricia M. Penci

COMMONWEALTH OF VIRGINIA
~~CITY~~/COUNTY OF James City

I hereby certify that on this 24th day of August, 20 05, before the subscribed, a Notary Public of the State of Virginia, and for the ~~City~~/County of James City, aforesaid personally appeared Kenneth G. McDermott and did acknowledge the aforegoing instrument to be their Act.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 24th day of August, 20 05

Patricia M. Penci
Notary Public

My Commission expires: June 30, 2006

Approved as to form:

Asst County Attorney

This Declaration of Covenants prepared by:

Patricia M. Penci
(Print Name)

Office Manager
(Title)

4029 Ironbound Road, Suite 100
(Address)

Williamsburg, VA 23188
(City) (State) (Zip)

Phone: 757-253-2975

VIRGINIA: CITY OF WILLIAMSBURG & COUNTY OF JAMES CITY
This document was admitted to record on 23 Sept. 05
at 3:49 AM/PM. The taxes imposed by Virginia Code
Section 58.1-801, 58.1-802 & 58.1-814 have been paid.

STATE TAX	LOCAL TAX	ADDITIONAL TAX
$	$	$

TESTE: BETSY B. WOOLRIDGE, CLERK

BY: Betsy B. Woolridge Clerk

James City County Environmental Division
Stormwater Management/BMP Record Drawing & Construction Certification Review
Tracking Form

Project Name: Stonehorse Glen Sec 2
County Plan No.: S-116-03
Stormwater Management Facility: Dry Pond #5
BMP Phase #: ☐ I ☑ II ☐ III

- ☐ Information Package Received. Date/By: 6/29/11 M. MASDESKI
- ☐ Completeness Check:
  - ☑ Record Drawing Date/By: 5/24/11 CA. OSBOURNE
  - ☑ Construction Certification Date/By: 6/28/11 W. WARD
  - ☑ RD/CC Standard Forms (Required for all BMPs after Feb 1st 2001Only)
  - ☑ Insp/Maint Agreement # / Date: 050022763/8/24/05
  - ☑ BMP Maintenance Plan Location: AS BUILT DRWG
  - ☐ Other:
- ☐ Standard E&SC Note on Approved Plan Requiring RD/CC or County comment in plan review
  - ☑ Yes ☐ No Location: PLAN REVIEW COMMENTS
- ☑ Assign **County BMP ID Code #**: Code: WC 094
- ☑ Preliminary Input/Log into Division's "As-Built Tracking Log"
- ☑ Add Location to GIS Map. Obtain basic site information (GPIN, Owner, Address, etc.)
- ☑ Preliminary Log into Access Database (BMP ID #, Plan No., GPIN, Project Name, etc.)
- ☑ Active Project File Review (correspondence, H&H, design computations, etc.).
- ☑ Initial As-Built File setup (File label, folder, copy plan/details/design information, etc.).
- ☑ Inspector Check of RD/CC (forward to Inspector using transmittal for cursory review).
- ☑ Pre-Inspection Drawing Review of Approved Plan (Quick look prior to Field Inspection).
- ☑ Final Inspection (FI) Performed Date: 7/29/11 (MM)
- ☑ Record Drawing (RD) Review Date:
- ☑ Construction Certification (CC) Review Date:
- ☑ Actions:
  - ☑ No comments.
  - ☐ Comments. Letter Forwarded. Date:
  - ☐ Record Drawing (RD)
  - ☐ Construction Certification (CC)
  - ☐ Construction-Related (CR)
  - ☐ Site Issues (SI)
  - ☐ Other :
- ☐ Second Submission:
- ☐ Reinspection (if necessary):
- ☑ Acceptable for SWM Purposes (RD/CC/CR/Other). Ok to proceed with bond release.
- ☑ Complete "Surety Request Form". OK ?
- ☑ Check/Clean active file of any remaining material and finish "As-Built" file.
- ☑ Add to County BMP Inventory/Inspection schedule (Phase I, II or III).
- ☑ Copy Final Inspection Report into County BMP Inspection Program file.
- ☑ Obtain Digital Photographs of BMP and save into County BMP Inventory.
- ☑ Request mylar/reproducible from As-Built plan preparer. (CD)
- ☑ Complete "As-built Tracking Log".
- ☐ Last check of BMP Access Database (County BMP Inventory).
- ☐ Add BMP to JCC Hydrology & Hydraulic database (optional).
- ☐ Add BMP to Municipal BMP list (if a County-owned facility)
- ☐ Add BMP to PRIDE BMP ratings database.

Final Sign-Off

Plan Reviewer: _____ Date: _____

*** See separate checklist, if needed.

JCreech 7/12/14

Environmental Division

JUN 29 2011

RECEIVED

James City County, Virginia
Environmental Division

Stormwater Management / BMP Facilities
Record Drawing and Construction Certification Forms

(Note: In accordance with the requirements of the Chesapeake Bay Preservation Ordinance, Chapter 23, Section 23-10(4), BMP's shall be designed and constructed in accordance with the manual entitled James City County Guidelines for Design and Construction of Stormwater Management BMP's. Erosion and sediment control policy and approved plans generally require that at the completion of the project and prior to release of surety, an "as-built" plan prepared by a registered Professional Engineer or Certified Land Surveyor must be provided for the drainage system for the project, including any Best Management Practice (BMP) facilities. In addition, for BMP facilities involving the construction of an impounding structure or dam embankment, certification is required by a Professional Engineer who has inspected the structure during its construction. Currently there are over 20 water quality type BMP's accepted by the County.)

Section 1 - Site Information:

Project Name: Stonehouse Glen Phase 2
Structure/BMP Name: BMP #5
Project Location: Stonehouse Glen S-1
BMP Location: Between and at the rear of lots 39 and 40 on Newland Court
County Plan No.: S - 116 - 03

Project Type: ☑ Residential ☐ Business ☐ Commercial ☐ Office ☐ Institutional ☐ Industrial ☐ Public ☐ Roadway ☐ Other _____

Tax Map/Parcel No.: 0540400001D
BMP ID Code (if known): _____
Zoning District:: _____
Land Use: _____
Site Area (sf or acres): _____

Brief Description of Stormwater Management/BMP Facility:
An extended-detention basin is an impoundment that temporarily stores runoff for a specified period and discharges it through a hydraulic outlet structure to a downstream conveyance system. An extended-detention basin is usually dry during non-rainfall periods.

Nearest Visible Landmark to SWM/BMP Facility: South of int. Stonehouse Glen and Newland Ct by lots 11&12

Nearest Vertical Ground Control (if known):
☑ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☐ Other
Station Number or Name: 340
Datum or Reference Elevation: NGVD(29) 123.20
Control Description: James City County Geodetic Ground Control station 340
Control Location from Subject Facility: approximately 6,600' South West from BMP

Section 2 - Stormwater Management / BMP Facility Construction Information:

PreConstruction Meeting Held for Construction of SWM/BMP Facility: ☑ Yes ☐ No ☐ Unknown
Approx. Construction Start Date for SWM/BMP Facility: _____
Facility Monitored by County Representative during Construction: ☑ Yes ☐ No ☐ Unknown
Name of Site Work Contractor Who Constructed Facility: C.A. Barrs
Name of Professional Firm Who Routinely Monitored Construction: Landmark Design Group/VHB
Date of Completion for SWM/BMP Facility: May 2011
Date of Record Drawing/Construction Certification Submittal: May 2011

(Note: Record Drawing and Construction Certifications are required within thirty (30) days of the completion of Stormwater Management and/or BMP facility construction. Record Drawings and Construction Certifications must be reviewed and approved by the James City County Environmental Division prior to final inspection, acceptance and bond or surety release.)

Section 3 - Owner / Designer / Contractor Information:

Owner/Developer: *(Note: Site Owner or Applicant responsible for development of the project.)*

Name: Stonehouse Glen, L.L.C (Ken Mcdermott, Manager)
Mailing Address: 15 Mendham Road P.O. Box 704
Gladstone, NJ 07934
Business Phone: (908) 234-2620 Fax: _____
Contact Person: Ken Mcdermott Title: Manager

Design Professional: *(Note: Professional Engineer or Certified Land Surveyor responsible for the design and preparation of plans and specifications for the Stormwater Management / BMP facility.)*

Firm Name: VHB+LandMark
Mailing Address: 351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185
Business Phone: (757) 220-0500
Fax: (757) 220-8544
Responsible Plan Preparer: Debbie Lenceski
Title: Project Manager
Plan Name: Stonehouse Glen Section II
Firm's Project No. 2002261-504.04
Plan Date: Revised July 15, 2005
Sheet No.'s Applicable to SWM/BMP Facility: C-15 / 15A / ____ / ____ / ____

BMP Contractor: *(Note: Site Work Contractor directly responsible for construction of the Stormwater Management / BMP facility.)*

Name: C.A. Barrs
Mailing Address: PO Box 1489
Yorktown, Virginia 23692
Business Phone: (757) 898-7282
Fax: (757) 898-1282
Contact Person: _____
Site Foreman/Supervisor: _____
Specialty Subcontractors & Purpose (for BMP Construction Only):

Section 4 - Professional Certifications:

Certifying Professionals: *(Note: A Registered Professional Engineer or Certified Land Surveyor is responsible for preparation of a Record Drawing, sometimes referred to as an As-Built plan, for the drainage system for the project including any Stormwater Management/BMP Facilities. A Registered Professional Engineer is responsible for the inspection, monitoring and certification of Stormwater Management / BMP facilities during its construction.)*

Record Drawing and Construction Certifications for Stormwater Management / BMP Facilities

Record Drawing Certification

Firm Name: VHB+LandMark
Mailing Address: 351 McLaws Circle, Suite 3
Williamsbug, Virginia 23185
Business Phone: (757) 220-0500
Fax: (757) 220-8544

Name: Charles R. Orsborne
Title: Senior Project Manager, CLS

Signature: _____
Date: _____

I hereby certify to the best of my knowledge and belief that this record drawing represents the actual condition of the Stormwater Management / BMP facility. The facility appears to conform with the provisions of the approved design plan, specifications and stormwater management plan, except as specifically noted.

COMMONWEALTH OF VIRGINIA
5/24/11
Charles R. Orsborne
LIC. NO. 1381
LAND SURVEYOR

_____ (Seal)

Virginia Registered Professional Engineer or Certified Land Surveyor

Construction Certification

Firm Name: ECS MID-ATLANTIC, LLC
Mailing Address: 108 INGRAM ROAD
SUITE 1, WILLIAMSBURG VA 23188
Business Phone: 757-229-6677
Fax: 757-229-9978

Name: W. LLOYD WARD, P.E.
Title: VP / BRANCH MANAGER

Signature: _____
Date: 6/28/11

I hereby certify to the best of my knowledge and belief that this Stormwater Management/BMP facility was monitored and constructed in accordance with the provisions of the approved design plan, specifications and stormwater management plan, except as specifically noted.

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
Lic. No. 034612
6/28/11
PROFESSIONAL ENGINEER

_____ (Seal)

Virginia Registered Professional Engineer

Section 5 - Record Drawing and Construction Certification Requirements and Instructions:

- ☑ PreConstruction Meeting - Provides an opportunity to review SWM / BMP facility construction, maintenance and operation plans and address any questions regarding construction and/or monitoring of the structure. The design engineer, certifying professionals (if different), Owner/Applicant, Contractor and County representative(s) are encouraged to attend the preconstruction meeting. Advanced notice to the Environmental Division is requested. Usually, this requirement can be met simultaneously with Erosion and Sediment Control preconstruction meetings held for the project.

- ☑ A fully completed ***STORMWATER MANAGEMENT / BMP FACILITIES, RECORD DRAWING and CONSTRUCTION CERTIFICATION FORM*** and ***RECORD DRAWING CHECKLIST***. All applicable sections shall be completed in their entirety and certification statements signed and sealed by the registered professional responsible for individual record drawing and/or construction certification.

- ☑ The Record Drawing shall be prepared by a Registered Professional Engineer or Certified Land Surveyor for the drainage system of the project including any Best Management Practices.

- ☑ Construction Certification. Construction of Stormwater Management / BMP facilities which contain impoundments, embankments and related engineered appurtenances including subgrade preparation, compacted soils, structural fills, liners, geosynthetics, filters, seepage controls, cutoffs, toe drains, hydraulic flow control structures, etc. shall be visually observed and monitored by a Registered Professional Engineer or his/her authorized representative. The Engineer must certify that the structure, embankment and associated appurtenances were built in accordance with the approved design plan, specifications and stormwater management plan and standard accepted construction practice and shall submit a written certification and/or drawings to the Environmental Division as required. Soil and compaction test reports, concrete test reports, inspection reports, logs and other required construction material or installation documentation may be required by the Environmental Division to substantiate the certification, if specifically requested. The Engineer shall have the authority and responsibility to make minor changes to the approved plan, in coordination with the assigned County inspector, in order to compensate for unsafe or unusual conditions encountered during construction such as those related to bedrock, soils, groundwater, topography, etc. as long as changes do not adversely affect the integrity of the structure(s). Major changes to the approved design plan or structure must be reviewed and approved by the original design professional and the James City County Environmental Division.

- ☑ Record Drawing and Construction Certifications are required within **thirty (30) days** of the completion of Stormwater Management / BMP facility construction. Submittals must be reviewed and accepted by James City County Environmental Division prior to final inspection, acceptance and bond/surety release.

  Dual Purpose Facilities - Completion of construction also includes an interim stage for Stormwater Management / BMP facilities which serve dual purpose as temporary sediment basins during construction and as permanent stormwater management / BMP facilities following construction, once development and stabilization are substantially complete. For these dual purpose facilities, construction certification is required once the temporary sediment basin phase of construction is complete. Final record drawing and construction certification of additional permanent components is required once permanent facility construction is complete.

  Interim Construction Certification is required for those dual purpose embankment-type facilities that are generally ten (10) feet or greater in dam height (*) and may not be converted, modified or begin function as a permanent SWM / BMP structure for a period generally ranging from six (6) to eighteen (18) months or more from issuance of a Land Disturbance permit for construction.

Interim or final record drawing and construction certifications are not required for temporary sediment basins which are designed and constructed in accordance with current minimum standards and specifications for temporary sediment basins per the Virginia Erosion and Sediment Control Handbook (VESCH); have a temporary service life of less than eighteen (18) months; and will be removed completely once associated disturbed areas are stabilized, unless a distinct hazard to the public's health, safety and welfare is determined by the Environmental Division due to the size or presence of the structure or due to evidence of improper construction.

(*Note: Dam Height as referenced above is generally defined as the vertical distance from the natural bed of the stream or waterway at the downstream toe of the embankment to the top of the embankment structure in accordance with 4VAC50-20-30, Virginia Impoundment Structure Regulations and the Virginia Dam Safety Program.)

☑ Record Drawings shall provide, at a minimum, all information as shown within these requirements and the attached **RECORD DRAWING CHECKLIST** specific to the type of SWM/BMP facility being constructed. Other additional record data may be formally requested by the James City County Environmental Division. *(Note: Refer to the current edition of the James City County Guidelines for Design and Construction of Stormwater Management BMP's manual for a complete list of acceptable BMP's. Currently there are over 20 acceptable water quality type BMP's accepted by the County.)*

☑ Record Drawings shall consist of blue/black line prints and a reproducible (mylar, sepia, diazo, etc) set of the approved stormwater management plan including applicable plan views, profiles, sections, details, maintenance plans, etc. as related to the subject SWM / BMP facility. The set shall indicate **"RECORD DRAWING "** in large text in the lower right hand corner of each sheet with record elevations, dimensions and data drawn in a clearly annotated format and/or boxed beside design values. Approved design plan values, dimensions and data shall not be removed or erased. Drawing sheet revision blocks shall be modified as required to indicate record drawing status. Elevations to the nearest 0.1' are sufficiently accurate except where higher accuracy is needed to show positive drainage. Certification statements as shown in Section 4 of the Record Drawing and Construction Certification Form, ***or similar forms thereof***, and professional signatures and seals, with dates matching that of the record drawing status in the revision or title block, are also required on all associated record drawing plans, prints or reproducibles.

☑ Submission Requirements. Initial and subsequent submissions for review shall consist of a minimum of one (1) blue/black line set for record drawings and one copy of the construction certification documents with appropriate transmittal. Under certain circumstances, it is understood that the record drawing and construction certification submissions may be performed by different professional firms. Therefore, record drawing submission may be in advance of construction certification or vice versa. Upon approval and prior to release of bond/surety, final submission shall include one (1) reproducible set of the record drawings, one (1) blue/black line set of the record drawings and one (1) copy of the construction certification. Also for current and/or future incorporation into the County BMP database and GIS system, it is requested that the record drawings also be submitted to the Environmental Division on a diskette or CD-ROM in an acceptable electronic file format such as *.dxf, *.dwg, etc. or in a standard scanned and readable format. The electronic file requirement can be discussed and coordinated with Environmental Division staff at the time of final submission.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

I. Methods and Presentation: *(Required for all Stormwater Management / BMP facilities.)*

XX 1. All constructed facilities meet approved design plans, unless otherwise shown. Record information or deviations from approved design plan shown in clearly annotated format and/or boxed beside design values.

XX 2. Elevations to the nearest 0.1' unless higher accuracy is needed to show positive drainage.

XX 3. All plan sheets labeled with "RECORD DRAWING" in large text in lower right hand corner (Approved County Plan Number and BMP ID Code can be included if known).

XX 4. All plan sheet revision blocks modified to indicate date and record drawing status.

XX 5. All plan sheets have certification statements and certifying professional's signature and seal.

II. Minimum Standards: *(Required for all Stormwater Management / BMP facilities, as applicable.)*

XX 1. All requirements of Section I (Methods and Presentation) apply to this section.

XX 2. Plan Views: Show general location, arrangement and dimensions. Location and alignment shall generally match approved design plans.

XX 3. Profile or elevations along top or berm of the facility. At a minimum, elevations are required at each end, at intervals not to exceed 50 feet and where low spots may be present. Top of embankment or berm elevations must be no less than design elevation plus any settlement allowances.

XX 4. Top widths, berm widths and embankment side slopes.

XX 5. Show length, width and depth of facility or grading, contours or spot elevations as required to verify permanent pool and design storage volumes were met or were reasonably close to the approved design. Evaluation of as-built grading, contours, spot elevations, or cross-sections, may be necessary by the professional to ensure approved design configurations, depths and volumes were closely maintained. If grading or elevations are significantly different from the approved plan, the Environmental Division shall be contacted immediately to determine whether the variation is acceptable or whether further evidence will be required. Facilities which do not closely resemble approved plan grades, elevations or configurations may require regrading by the Contractor; check volumetric computations; and/or a check hydraulic routing to ensure approved design water surface elevations, discharges or freeboard were closely maintained.

XX 6. Cross-section of the embankment through the principal spillway or outlet barrel. Must extend at least 100 ft. downstream of the pipe outlet or to recorded site property line, whichever is closer. Proper correlation is required between principal spillway (control structure) crest, emergency spillway crest, orifice and weirs and the top of the dam or facility. All elevations and dimensions must reasonably match the design plan or be sequentially relative to each other and the facility must reflect the required design storage volume(s) and/or design depth.

XX 7. Profile or elevations along the entire centerline of the emergency spillway. Emergency spillway may be steeper, but no flatter or narrower than design.

XX 8. Elevation of the principal spillway crest or outlet crest of the structure.

XX	9.	Primary control structure (riser) diameter or dimensions, height, type of material and base size. Indicate provisions for access that are present such as steps, ladders, etc.
XX	10.	Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.
XX	11.	Type and size of anti-vortex and trash rack device. Height, diameter, dimensions, bar spacings (if applicable) and elevations relative to the principal spillway crest. Indicate if lockable hatch is present or not.
NA	12.	Type, location, size and number of anti-seep collars or documentation of other methods utilized for seepage control. **May need to obtain this information during construction.**
NA	13.	Top of impervious core embankment, core trench limits and elevation of cut-off trench bottom. **May need to obtain this information during construction.**
XX	14.	Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.
XX	15.	Outlet barrel diameter, length, slope, type and thickness class of material and type of flared end sections, headwall or endwall.
XX	16.	Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.
XX	17.	BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.
XX	18.	Maintenance plan taken from approved design plan transposed onto record drawing set.
NA	19.	Fencing location and type, if applicable to facility.
XX	20.	BMP vicinity properly cleaned of stockpiles and construction debris.
XX	21.	No visual signs of erosion or channel degradation immediately downstream of facility.
XX	22.	Any other information formally requested by the Environmental Division specific to the constructed SWM/BMP facility.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

III. Group A - Wet Ponds *(Includes A-1 Small Wet Ponds; A-2 Wet Ponds; A-3 Wet Ext Det Ponds.)*

NA A1. All requirements of Section II, Minimum Standards, apply to Group A facilities.

NA A2. Principal spillway consists of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

NA A3. Sediment forebays or pretreatment devices provided at inlets to pond. Generally 4 to 6 ft. deep.

NA A4. Access for maintenance and equipment is provided to the forebay(s). Access corridors are at least 12 ft. wide, have a maximum slope of 15 percent and are adequately stabilized to withstand heavy equipment or vehicle use.

NA A5. Adequate fixed vertical sediment depth markers installed in the forebay(s) for future sediment monitoring purposes.

NA A6. Pond liner (if required) provided. Either clay liners, polyliners, bentonite liners or use of chemical soil additives based on requirements of the approved plan.

NA A7. Minimum 6 percent slope safety bench extending a minimum of 15 feet outward from normal pool edge and/or an aquatic bench extending a minimum of 10 feet inward from the normal shoreline with a maximum depth of 12 inches below the normal pool elevation, if applicable, per the approved design plans. (Note: Safety benches may be waived if pond side slopes are no steeper than 4H:1V).

NA A8. No trees are present within a zone 15 feet around the embankment toe and 25 feet from the principal spillway structure.

NA A9. Wet permanent pool, typically 3 to 6 feet deep, is provided and maintains level within facility.

NA A10. Low flow orifice has a non-clogging mechanism.

NA A11. A pond drain pipe with valve was provided.

NA A12. Pond side slopes are not steeper than 3H:1V, unless approved plan allowed for steeper slope.

NA A13. End walls above barrels (outlet pipe) greater than 48 inch in diameter are fenced to prevent a fall hazard.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

IV. Group B - Wetlands *(Includes B-1 Shallow Marsh; B-2 Ext Det Shallow Wetlands; B-3 Pond Wetland System and B-4 Pocket Wetland)*

NA B1. Same requirements as Group A Wet Ponds.

NA B2. Minimum 2:1 length to width flow path provided across the facility.

NA B3. Micropool provided at or around outlet from BMP (generally 3 to 6 ft. deep).

NA B4. Wetland type landscaping provided in accordance with approved plan. Includes correct pondscaping zones, plant species, planting arrangements, wetland beds, etc. Wetland plants include 5 to 7 emergent wetland species. Individual plants at 18 inches on center in clumps.

NA B5 Adequate wetland buffer provided (Typically 25 ft. outward from maximum design water surface elevation and 15 ft. setback to structures).

NA B6. No more than one-half (½) of the wetland surface area is planted.

NA B7. Topsoil or wetland mulch provided to support vigorous growth of wetland plants.

NA B8. Planting zones staked or flagged in field and locations subsequently established by appropriate field surveying methods for record drawing presentation.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

V. Group C - Infiltration Practices *(Includes C-1 Infiltration Trench; C-2 Infiltration Trench; C-3 Infiltration Basin; and C-4 Infiltration Basin)*

NA C1. All requirements of Section II, Minimum Standards, apply to Group C facilities as applicable.

NA C2. Facility is not located on fill slopes or on natural ground in excess of six (6) percent.

NA C3. Pretreatment devices provided prior to entry into the infiltration facility. Acceptable pretreatment devices include sediment forebays, sediment basins, sediment traps, sump pits or inlets, grass channels, plunge pools or other acceptable measures.

NA C4. Three (3) or more of the following pretreatment devices provided to protect long term integrity of structure: grass channel; grass filter strip; bottom sand layer; upper filter fabric layer; use of washed bank run gravel aggregate.

NA C5. Sides of infiltration practice lined with filter fabric.

NA C6. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

NA C7. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

NA C8. Minimum one hundred (100) foot separation horizontally from any known water supply well and minimum one hundred (100) foot separation upslope from any building.

NA C9. Minimum twenty-five (25) foot separation down gradient from any structure.

NA C10. Stormwater outfalls provided for overflow associated with larger design storms.

NA C11. No visual signs of erosion or channel degradation immediately downstream of facility.

NA C12. Facility does not currently cause any apparent surface or subsurface water problems to downgrade properties.

NA C13. Observation well provided.

NA C14. Adequate, direct access provided to the facility for future maintenance, operation and inspection.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

VI. Group D - Filtering Systems *(Includes D-1 Bioretention Cells; D-2 Surface Sand Filters; D-3 Underground Sand Filters; D-4 Perimeter Sand Filters; D-5 Organic Filters; and D-6 Pocket Sand Filters)*

NA D1. All requirements of Section II, Minimum Standards, apply to Group D facilities.

NA D2. Sediment pretreatment devices provided.

NA D3. For D-1 BMPs (Bioretention Cells), pretreatment consisting of a grass filter strip below level spreader (deflector); a gravel diaphragm; and mulch and planting soil layers were provided.

NA D4. For D-1 BMPs (Bioretention Cells), plantings consist of native plant species; vegetation provided was based on zones of hydric tolerances; trees and understory of shrubs and herbaceous materials were provided; woody vegetation is absent from inflow locations; and trees are located around facility perimeter.

NA D5. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

NA D6. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed .

NA D7. Filtering system is off-line from storm drainage conveyance system.

NA D8. Overflow outlet has adequate erosion protection.

NA D9. Deflector, diversion, flow splitter or regulator structure provided to divert the water quality volume to the filtering structure.

NA D10. Minimum four (4) inch perforated underdrain provided in a clean aggregate envelope layer beneath the facility.

NA D11. Minimum fifty (50) foot separation from any slope fifteen (15) percent or greater. Minimum one hundred (100) foot separation horizontally from any known water supply well. Minimum one hundred (100) foot separation upslope and twenty-five (25) foot separation downslope from any building.

NA D12. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

NA D13. No visual signs of erosion or channel degradation immediately downstream of facility.

NA D14. Adequate, direct access provided to the pretreatment area and/or filter bed for future maintenance.

STORMWATER MANAGEMENT / BMP FACILITIES
AS-BUILT PLAN CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

VII. Group E - Open Channel Systems *(Includes E-1 Wet Swales (Check Dams); E-2 Dry Swales; and E-3 Biofilters)*

NA E1. All requirements of Section II, Minimum Standards, apply to Group E facilities as applicable.

NA E2. Open channel system has constructed longitudinal slope of less than four (4) percent.

NA E3. No visual signs of erosion in the open channel system's soil and/or vegetative cover.

NA E4. Open channel side slopes are no steeper than 2H:1V at any location. Preferred channel sideslope is 3H:1V or flatter.

NA E5. No visual signs of ponding are present at any location in the open channel system, except at rock check dam locations for E-1 systems (Wet Swales).

NA E6. For E-2 BMPs (Dry Swales), an underdrain system was provided.

NA E7. Treated timber or rock check dams provided as pretreatment devices for the open channel system.

NA E8. Gravel diaphragm provided in areas where lateral sheet flow from impervious surfaces are directly connected to the open channel system.

NA E9. Grass cover/stabilization in the open channel system appears adaptable to the specific soils and hydric conditions for the site and along the channel system.

NA E10. Open channel system areas with grass covers higher than four (4) to six (6) inches were properly mowed.

NA E11. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

NA E12. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

NA E13. For E-3 BMPs (Biofilters), the bottom width is six (6) feet maximum at any location.

NA E14. For E-3 BMPs (Biofilters), sideslopes are 3H:1V maximum at any location.

NA E15. For E-3 BMPs (Biofilters), the constructed channel slope is less than or equal to three (3) percent at any location.

NA E16. For E-3 BMPs (Biofilters), the constructed grass channel is approximately equivalent to the constructed roadway length.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

VIII. Group F - Extended Dry Detention *(Includes F-1 Timber Walls; and F-2 Dry Extended Detention with Forebay)*

XX F1. All requirements of Section II, Minimum Standards, apply to Group F facilities.

XX F2. Basin bottom has positive slope and drainage from all basin inflow points to the riser (or outflow) location.

NA F3. Timber wall BMP used in intermittent stream only. (ie. Prohibited in perennial streams.)

NA F4. Forebay provided approximately 20 ft. upstream of the facility. Forebays generally 4 to 6 feet in depth.

XX F5. A reverse slope pipe, vertical stand pipe or mini-barrel and riser was provided to prevent clogging.

NA F6. Principal spillway and outlet barrel provided consisting of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

NA F7. Mini-barrel and riser, if used, contains a removable trash rack to reduce clogging.

XX F8. Low flow orifice, if used, has a minimum diameter of three (3) inches or two (2) inches if internal orifice control was utilized and a small, cage type external trash rack.

NA F9. Timbers properly reinforced or concrete footing provided if soil conditions were prohibitive.

NA F10. Timber wall cross members extended to a minimum depth of two (2) feet below ground elevation.

XX F11. Protection against erosion and scour from the low flow orifice and weir-flow trajectory provided.

XX F12. Stilling basin or standard outlet protection provided at principal spillway outlet.

XX F13. Adequate, direct access provided to the facility. Access corridor to facility is at least ten (10) feet wide, slope is less than twenty (20) percent and appropriate stabilization provided for equipment and vehicle use. Access extends to forebay, standpipe and timber wall, as applicable.

XX F14. No visual signs of undercutting of timber walls or clogging of the low orifice were present.

XX F15. No visual signs of erosion or channel degradation immediately downstream of facility.

XX F16. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

IX. Group G - Open Spaces *(Includes All Open Space Types G-1; G-2; and G-3)*

NA G1. All requirements of Section II, Minimum Standards, apply to Group G facilities as applicable.

NA G2. Constructed impervious areas appear to conform with locations indicated on the approved plan and appear less than sixty (60) percent impervious in accordance with the requirements of the James City County Chesapeake Bay Preservation Ordinance.

NA G3. Dedicated open space areas are in undisturbed common areas, conservation easements or are protected by other enforceable instruments that ensures perpetual protection.

NA G4. Provisions included to clearly specify how the natural vegetated areas utilized as dedicated open space will be managed and field identified (marked).

NA G5. Adequate protection measures were implemented during construction to protect the defined dedicated open space areas.

NA G6. Dedicated open space areas were not disturbed during construction (ie. cleared, grubbed or graded).

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)

X. Storm Drainage Systems (Associated with BMP's Only)

(Includes all incidental stormwater drainage conveyance systems associated with SWM/BMP facilities such as onsite or offsite storm drains, open channels, inlets, manholes, junctions, outlet protections, deflectors, etc. These facilities are external to the treatment function of, but are directly associated with drainage to and/or from a constructed SWM/BMP facility. The intent of this portion of the certification is to accurately identify the type and quantity of inflow or outflow points associated with the facility for future reference. The Professional may use his/her own discretion to determine inclusive facilities to meet the intent of this section. As a general rule, storm drainage systems would include incidental facilities to the nearest access structure upslope or downslope from the normal physical limits of the facility or 800 feet of storm drainage conveyance system length, whichever is less.)

XX SD1. All requirements of Section II, Minimum Standards, apply to Storm Drainage Systems.

XX SD2. Horizontal location of all pipe and structures relative to the SWM/BMP facility.

XX SD3. Type, top elevation and invert elevation of all access type structures (inlets, manholes, etc.).

XX SD4. Material type, size or diameter, class, invert elevations, lengths and slopes for all pipe segments.

XX SD5. Class, length, width and depth of riprap and outlet protections or dimensions of special energy dissipation structures.

XII. Other Systems

(Includes any non-typical, specialty, manufactured or innovative stormwater management/BMP practices or systems generally accepted for use as or in conjunction with other acceptable stormwater management / BMP practices. Requires evidence of prior satisfactory industry use and prior Environmental Division approval, waiver or exception .)

NA O1. All requirements of Section II, Minimum Standards, apply to this section.

NA O2. Certification criteria to be determined on a case-by-case basis by the Environmental Division specific to the proposed SWM/BMP facility.

STORMWATER MANAGEMENT / BMP FACILITIES
RECORD DRAWING CHECKLIST

XIII. References *(The James City County Record Drawing and Construction Certification Forms and Checklists for Stormwater Management / BMP facilities were developed using the following sources and references.)*

- ☐ Baltimore County, Maryland Soil Conservation District, As-Built Stormwater Management Pond Checklist.
- ☐ James City County, Virginia, Guidelines for Design and Construction of Stormwater Management BMP's (October 1999).
- ☐ James City County, Virginia, Stormwater Detention/Retention Basin Design Checklist and Erosion and Sediment Control and Stormwater Management Design Plan Checklists.
- ☐ James City County Stormwater Policy Framework, Final Report of the James City County BMP Policy Project, October 1998, The Center for Watershed Protection.
- ☐ Prince Georges County, Maryland, As-Built Requirements Retention or Detention Pond/Basin.
- ☐ Prince William County, Virginia, Stormwater Management Fact Sheet.
- ☐ Stafford County, Virginia, As-Built Plan Checklist.
- ☐ Stormwater Management Design Manual, NRCS Maryland Code No. 378, Pond Standards and Specifications.
- ☐ USEPA/Watershed Management Institute, Stormwater Management Inspection Forms.
- ☐ Virginia Impounding Structure Regulations (Dam Safety), Department of Conservation & Recreation, 1997.
- ☐ Virginia Erosion and Sediment Control Handbook, Third Edition 1992, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.
- ☐ Virginia Stormwater Management Handbook, 1999 edition, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.

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James City County, Virginia
Environmental Division

Stormwater Management / BMP Facilities
Record Drawing and Construction Certification Forms

(Note: In accordance with the requirements of the Chesapeake Bay Preservation Ordinance, Chapter 23, Section 23-10(4), BMP's shall be designed and constructed in accordance with the manual entitled James City County Guidelines for Design and Construction of Stormwater Management BMP's. Erosion and sediment control policy and approved plans generally require that at the completion of the project and prior to release of surety, an "as-built" plan prepared by a registered Professional Engineer or Certified Land Surveyor must be provided for the drainage system for the project, including any Best Management Practice (BMP) facilities. In addition, for BMP facilities involving the construction of an impounding structure or dam embankment, certification is required by a Professional Engineer who has inspected the structure during its construction. Currently there are over 20 water quality type BMP's accepted by the County.)

RECEIVED
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ENVIRONMENTAL DIVISION

Section 1 - Site Information:

Project Name: **Stonehouse Glen Section II**
Structure/BMP Name: **Bmp 5**
Project Location: Stonehouse District, James City County, Virginia
BMP Location: Stonehouse Glen (Street Name)
County Plan No.: S -116-03

Project Type: ☒ Residential ☐ Business ☐ Commercial ☐ Office ☐ Institutional ☐ Industrial ☐ Public ☐ Roadway ☐ Other _____

Tax Map/Parcel No.: 0540100003
BMP ID Code (if known): WC094
Zoning District:: Pud-R
Land Use: Residential

Site Area (sf or acres): 96.3105 Ac.

Brief Description of Stormwater Management/BMP Facility: Detention Basin to function as temporary sediment basin until stabilization of all areas draining to it

Nearest Visible Landmark to SWM/BMP Facility:
Six Mount Zion Road (S.R. 600) & Fieldstone Parkway
Nearest Vertical Ground Control (if known):
☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☐ Other
Station Number or Name: 340
Datum or Reference Elevation: Va. State Plane Nad 83
Control Description: Disk in concrete on Old Stage Road (S.R. 30)
Near end of exit ramp at I-64 exit 227
Control Location from Subject Facility: Southeast 5900'+,-

Section 2 - Stormwater Management / BMP Facility Construction Information:

PreConstruction Meeting Held for Construction of SWM/BMP Facility: ☐ Yes ☐ No ☒ Unknown
Approx. Construction Start Date for SWM/BMP Facility: _____
Facility Monitored by County Representative during Construction: ☐ Yes ☐ No ☒ Unknown
Name of Site Work Contractor Who Constructed Facility: C.A Barrs
Name of Professional Firm Who Routinely Monitored Construction: Landmark Design Group

Date of Completion for SWM/BMP Facility: _July, 2006
Date of Record Drawing/Construction Certification Submittal: 08-14-06

(Note: Record Drawing and Construction Certifications are required within thirty (30) days of the completion of Stormwater Management and/or BMP facility construction. Record Drawings and Construction Certifications must be reviewed and approved by the James City County Environmental Division prior to final inspection, acceptance and bond or surety release.)

Section 3 - Owner / Designer / Contractor Information:

Owner/Developer: *(Note: Site Owner or Applicant responsible for development of the project.)*

Name: Stonehouse Glen, LLC
Mailing Address:15 Mendham Road, P.O. Box 704
Gladstone, New Jersey 07934
Business Phone: 908-234-2620_____ Fax: _____

Contact Person: Ken Mcdermott Title: Manager

Design Professional: *(Note: Professional Engineer or Certified Land Surveyor responsible for the design and preparation of plans and specifications for the Stormwater Management / BMP facility.)*

Firm Name: Landmark Design Group
Mailing Address:4029 Ironbound Road, Suite 100
Williamsburg, Va. 23188

Business Phone: 757-253-2975
Fax:757-229-0049
Responsible Plan Preparer: _James W. Brawley III, P.E.
Title: Senior Associate
Plan Name: Plan of Development Stonehouse Glen Section II
Firm's Project No. 2002261-504.04
Plan Date: 7-15-05
Sheet No.'s Applicable to SWM/BMP Facility: C-15 /C-15A

BMP Contractor: *(Note: Site Work Contractor directly responsible for construction of the Stormwater Management / BMP facility.)*

Name:C.A. Barrs
Mailing Address: 7601 George Washington Memorial Hwy. Yorktown, Va.
Business Phone: 757-898-4443
Fax: _____
Contact Person: Steve Barrs
Site Foreman/Supervisor: Scott St.Clair
Specialty Subcontractors & Purpose (for BMP Construction Only):_____

Section 4 - Professional Certifications:

Certifying Professionals: *(Note: A Registered Professional Engineer or Certified Land Surveyor is responsible for preparation of a Record Drawing, sometimes referred to as an As-Built plan, for the drainage system for the project including any Stormwater Management/BMP Facilities. A Registered Professional Engineer is responsible for the inspection, monitoring and certification of Stormwater Management / BMP facilities during its construction.)*

Record Drawing and Construction Certifications for Stormwater Management / BMP Facilities

Record Drawing Certification

Firm Name: Landmark Design Group
Mailing Address: 4029 Ironbound Road Suite 100
Williamsburg, Va. 23188

Business Phone: 757-253-2975
Fax: 757-229-0049

Name: Peter Farrell, L.S.
Title: Director of Surveys

Signature: P. L. Farrell
Date: 8-17-06

I hereby certify to the best of my knowledge and belief that this record drawing represents the actual condition of the Stormwater Management / BMP facility. The facility appears to conform with the provisions of the approved design plan, specifications and stormwater management plan, except as specifically noted.

COMMONWEALTH OF VIRGINIA
PETER FARRELL
002036
LAND SURVEYOR

_____ (Seal)

Virginia Registered Professional Engineer
or Certified Land Surveyor

Construction Certification

Firm Name: ECS Mid-Atlantic, LLC
Mailing Address: 108 Ingram Rd, Suite 1
Williamsburg, VA 23188

Business Phone: (757) 229-6677
Fax: (757) 229-9978

Name: Michael J. Galli, P.E.
Title: Vice President / Principal Engineer

Signature: Michael J. Galli
Date: 8-18-06

I hereby certify to the best of my knowledge and belief that this Stormwater Management/BMP facility was monitored and constructed in accordance with the provisions of the approved design plan, specifications and stormwater management plan, except as specifically noted.

MICHAEL J. GALLI
No. 036034
8/18/06
COMMONWEALTH OF VIRGINIA
PROFESSIONAL ENGINEER

_____ (Seal)

Virginia Registered
Professional Engineer

1/10/12

Transportation
Land Development
Environmental
Services

Vanasse Hangen Brustlin, Inc.

351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185
757 220-0500
FAX 757 220-8544

Meeting Notes

Attendees: Bill Cain
Mike Majdeski
Mike Woolson
Scott StClair
Piotr Swietuchowski
Deborah Lenceski

Date/Time: December13, 2011/ 1:00

Project No.: 33315.00

Place: Stonehouse Glen

Re: BMP review letter

Notes taken by: Deborah Lenceski

We met at Stonehouse Glen on December 13 to discuss means of addressing the comments presented in James City County's letter received October 28. These comments are reproduced below with our field discussions and decisions following in italics. The comments are addressed in the order in which we visited the ponds.

BMP # 4
WC095-Adjacent to Newland Court

Construction - Related Items:

14. Remove 12"-18" of sediment build-up from pond bottom and the area around the primary pond orifice and re-vegetate once complete.

CA Barrs will remove cat tails and excess vegetation, and then re-grade the pond bottom adding fill as necessary, to create positive drainage. Lowering the orifice instead of re-grading is acceptable as long as the new invert will be above the invert of the outfall pipe.

15. Repair erosion along left side of the access roadway resulting from concentrated runoff and inert material being buried in the gravel section. Prior to close out of the project and the release of the posted bonds, any and all foreign materials are to be removed from the stone section and replaced with stone.

Engineering and Resource Protection Division Staff clarified that the "inert material" is some large branches. CA Barrs will remove these and re-grade the entrance road. They will add a diversion rill above the D1 to reduce the flow down the steeper portion of the road.

Recommend "will" changed to "has".

WC094-Adjacent to Stonehouse Glen and Newland Court
Construction - Related Items:

11. Remove 8"-10" of sediment from throughout the pond bottom and from the area surrounding the primary pond orifice and re-vegetate the area following the remediation work.

CA Barrs will reset the low level orifice to ensure positive drainage and reseed the pond bottom. They will also reset the rip rap and install step pool in the main spill way into the pond from Stonehouse Glen.

12. Repair erosion along the BMP access roadway. Currently there is a rill that has formed along the centerline of the drive primarily due to inaccessibility of stormwater to the rip rap lined ditch along the side of the access. Prior to resubmittal, a smooth transition needs to be provided into the referenced channel to promote positive drainage into the measure.

CA Barrs will re-grade the entrance road.

13. Re-establish the access roadway at Newland Court per the approved plan. Currently a portion of the access has been covered with sod and is being maintained by the adjacent property owner and a utility box has been located in the centerline of the entrance. Prior to release of the project and associated bonds, the access must be relocated to the side of the utility and sod replaced with stone.

We discussed the adjacent homeowners' requests that the access road be resurfaced with another substance. JCC staff noted that their concern that the road area be distinguishable so that future owners can recognize the area as potentially having a separate use. Cox Communications is to have the box relocated during the first week of January.

WC091 - Adjacent to Ottaway Court
Construction - Related Items:

1. Remove sediment from inflows within the dry pond and ensure that the primary pond orifice is clear of debris and vegetation.

2. Remove all vegetation from within the pond's primary outlet protection.

3. Replace the cover on the manhole immediately upstream of the pond's outlet protection.

4. Repair erosion along the BMP access road at the bottom of the hill.

We decided that these items are maintenance items to be completed by CABarrs. Engineering and Resource Protection Division Staff noted some channel erosion in the receiving stream and decided that they were not concerned with that as part of the acceptance process.

WC092-Adjacent to Ashlock Court
Construction - Related Items:

5. Repair and re-stabilize the eroded areas along the north facing interior slopes of the pond.

CA Barrs will re-seed and place install Erosion Control Blanket matting on these slopes in accordance with Virginia Erosion and Sediment Control Handbook specifications.

6. Remove 8"-10"sediment from the pond bottom and from the area surrounding the primary pond orifice and re-vegetate the area following the remediation work.

This work will be completed after VHB completes a reassessment of the pond function.

7. Repair erosion along the right side of the outlet protection as associated with the inflow pipe and ensure the area is properly re-stabilized following the remediation work.

CA Barrs will reset the rip rap in the main spill way into the pond.

8. Repair erosion and replace rip-rap at the primary BMP outfall. Much of the outlet protection from the pond has been washed downstream into the adjacent streambed.

VHB will reassess the outfall characteristics. Engineering and Resource Protection Division Staff determined that the limits of the rip rap as it lies now will be considered the upper limits of the RPA, and any reconstruction that remains upstream of that point can be completed without additional environmental permitting. The effort will require a new field survey of the outfall receiving channel. After determining a preliminary design, VHB will reconvene with Engineering and Resource Protection Division Staff to determine the format of a plan submittal.

9. It appears from information obtained from a recent site inspection that the referenced stormwater management facility is not operating as originally intended as the downstream channel section is experiencing severe erosion and rip rap from the associated stilling basin has migrated several yards downstream. Though information provided in the record drawings appears to indicate that the associated components of the facility have been installed generally in accordance with the approved plans, information is necessary to show that the required attenuation volume has been provided with basin limits. Should it be determined that the facility has the required volume, it may be necessary to reevaluate the facility to insure full compliance with State Minimum Standard 19.

See comment number 8. VHB has reviewed the original pond analysis and has determined that the BMP has adequate storage volume and it was design in compliance with State Minimum Standard 19. VHB has also determined based on the site visits that the existing outfall condition may be a result of the storm events like Hurricane Irene that we have witnessed in August/September of 2011. The subject storm event has exceeded the design parameters and mainly contributed to failure of the outfall protection.

WC093-Adjacent to Stonehouse Glen and Fieldstone Parkway

10. James City County Engineering and Resource Protection Division has no comments to provide for this facility.

Since the county is satisfied with this pond, we did not visit this BMP.

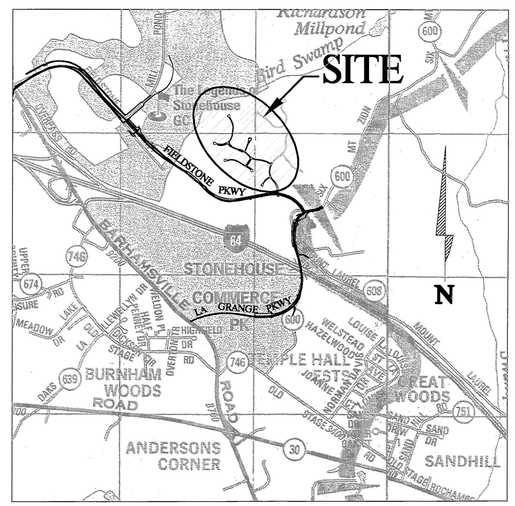
INTERIM BMP RECORD DRAWINGS
STONEHOUSE GLEN
SECTION I
STONEHOUSE GLEN, L.L.C.

JAMES CITY COUNTY, VIRGINIA

AUGUST 14, 2006

SHEET INDEX

SHEET. NO.	DESCRIPTION
R-1	COVER SHEET
R-2	POND 1
R-3	POND 2
R-4	POND 3



COPYRIGHT ADC THE MAP PEOPLE PERMITTED USE NO. 20605142

VICINITY MAP

SCALE: 1"=2,000'

STATISTICAL DATA

TAX MAP AND PARCEL:	TAX MAP (06-04) PARCEL 1-01 (PART)
ZONING:	PUD-R
PROJECT AREA:	85.4963 AC.
AREA DISTURBED:	10.0 ± AC.
F.E.M.A. PANEL NUMBER:	510201 0010B ZONE X - AREA OUTSIDE OF 500 YR. FLOOD PLAN
WATERSHED:	IT APPEARS THIS PROJECT IS SITUATED IN THE WARE CREEK WATERSHED, DRAINING TO RICHARDSON'S MILL POND, COUNTY BMP ID CODE WC 059.
OWNER\DEVELOPER:	STONEHOUSE AT WILLIAMSBURG, L.L.C. KEN MCDERMOTT, MANAGER 15 MENDHAM ROAD P. O. BOX 704 GLADSTONE, NJ 07934 (908) 234-2620
FUTURE OWNER OF WATER AND SANITARY:	JAMES CITY SERVICE AUTHORITY 101 E. MOUNTS BAY ROAD P.O. BOX 8784 WILLIAMSBURG VA, 23187 (757) 253-6805

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITIONS OF THE STORMWATER MANAGEMENT/BMP FACILITIES. THE FACILITIES APPEAR TO CONFORM WITH THE PROVISIONS OF THE APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN, EXCEPT AS SPECIFICALLY NOTED.

Peter Farrell

PETER FARRELL, L.S. 002036

SURVEY PERFORMED BY LANDMARK DESIGN GROUP 8/2006

RECEIVED AUG 21 2006 ENVIRONMENTAL DIVISION

COMMONWEALTH OF VIRGINIA 8/17/06 PETER FARRELL No. 002036 LAND SURVEYOR

4029 Ironbound Road Suite 100 Williamsburg, VA 23188 Tel: (757) 253-2975 Fax: (757) 229-0949 Email: lmdg@landmarkdg.com

5544 Greenwich Road Suite 200 Virginia Beach, VA 23462 Tel: (757) 473-2030 Fax: (757) 497-7533 Email: lmvb@landmarkdg.com

LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists

REVISIONS: No. | Date | Comment | By

DRAWING STATUS: Interoffice Review; Client for Review; Pre Approval Bidding

COUNTY APPROVAL: 1st Submittal; 2nd Submittal; 3rd Submittal; Approved

BMP RECORD DRAWINGS

COVER SHEET

STONEHOUSE GLEN SECTION I

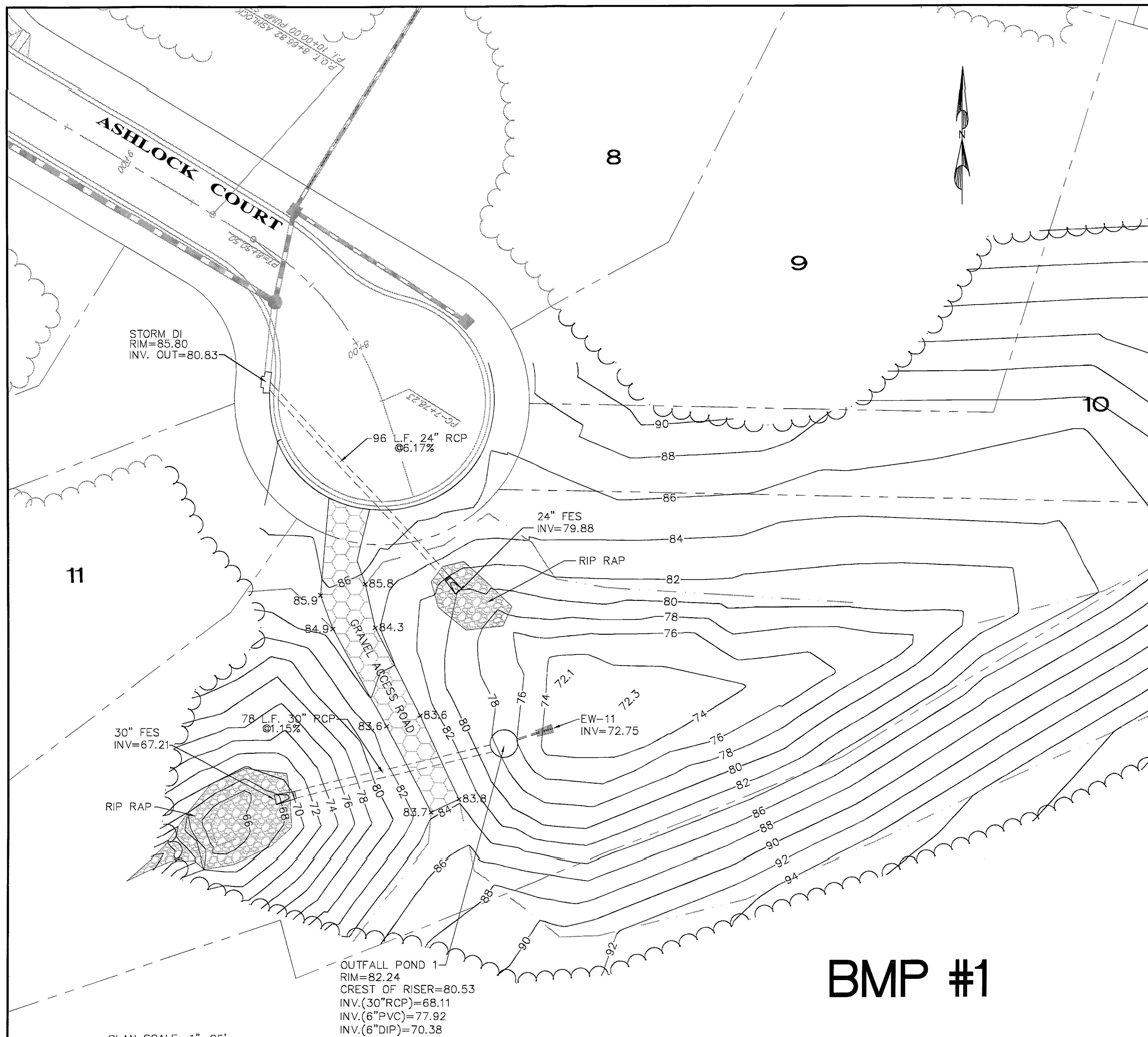
STONEHOUSE GLEN, L.L.C.

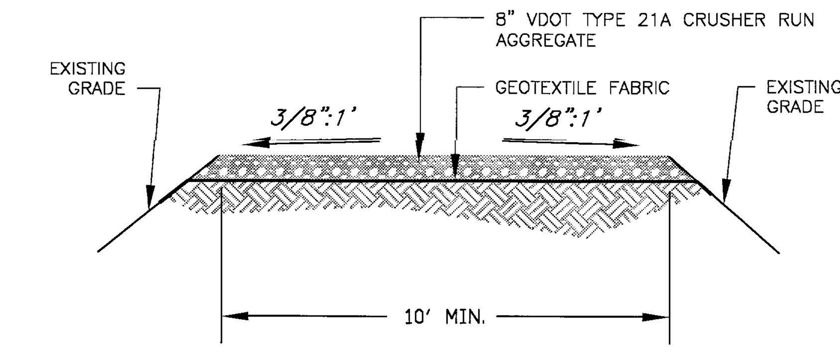
JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 8/14/06
Checked: PF	Scale: N/A
File Mgr./Drawn: CRO	CADD File name: SheetC-1.dwg
Project Number: 2002261-504.00	Dwg. File No.: 17306W
Drawing Number: R-1	

1 OF 4

JCC CASE #S-098-03





BMP ACCESS ROAD DETAIL

N.T.S.

BMP #1

TOP OF DAM: ~~83.82~~ 83.6

100 YEAR WSE: 81.81

25 YEAR WSE: 81.63

10 YEAR WSE: 81.51

2 YEAR WSE: 80.70

1 YEAR WSE: 77.54

CREST OF PRINCIPAL SPILLWAY: ~~80.64~~ 80.53

INV. 6"ø VERT. ORIFICE: ~~72.00~~ 72.75 @ EW-11

NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 6" DIAMETER DEWATERING DEVICE WITH 8" DIAMETER PERFORATED DRAINAGE TUBING, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 78.15 – SEDIMENT CLEANOUT LEVEL IS 76.14. 6" DUCTILE IRON PIPE AT ELEV. 72.00 IS TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITIONS OF THE STORMWATER MANAGEMENT/BMP FACILITIES. THE FACILITIES APPEAR TO CONFORM WITH THE PROVISIONS OF THE APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN, EXCEPT AS SPECIFICALLY NOTED.

Peter Farrell

PETER FARRELL, L.S. 002036

SURVEY PERFORMED BY LANDMARK DESIGN GROUP 8/2006

COMMONWEALTH OF VIRGINIA
8/17/06
PETER FARRELL
No. 002036
Peter Farrell
LAND SURVEYOR

BMP MAINTENANCE REQUIREMENTS

THE OWNER OR ITS DESIGNATED REPRESENTATIVE WILL INSPECT THE SWM/BMP STRUCTURES AFTER EACH SIGNIFICANT RAINFALL EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL FOR THIS STRUCTURE IS DEFINED AS ONE (1) INCH OR MORE OF GAUGED RAINFALL WITHIN A 24-HOUR PERIOD. ONCE PER YEAR, A REPRESENTATIVE OF THE COUNTY MAY JOINTLY INSPECT THE STRUCTURE.

THE BASIN SERVES A DRAINAGE AREA OF 16 ACRES ASSOCIATED WITH PROPOSED STONEHOUSE GLEN SECTION 1. PRINCIPAL STRUCTURES ASSOCIATED WITH THIS BMP CONSIST OF ONE 12-INCH LOW FLOW OUTLET, A 60-INCH PRECAST CONCRETE RISER AND A 36-INCH CLASS III RCP OUTLET. THERE IS AN EMERGENCY SPILLWAY ASSOCIATED WITH THIS BASIN. DURING THE 100-YEAR STORM EVENT, THERE IS NO FLOW THROUGH THE EMERGENCY SPILLWAY.

INSPECTION AND MAINTENANCE OF THE FACILITY WILL CONSIST OF THE FOLLOWING ADDITIONAL MEASURES:

– INSPECT FOR SEDIMENT BUILDUP BY VISUAL OBSERVATION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN THE POND STORAGE AREAS. IF THE DEPTH OF THE SEDIMENT REACHES THE DEPTH OF 2'-6" ABOVE THE BOTTOM OF THE POND, REMOVAL IS REQUIRED. AT THE SAME TIME, OR AT LEAST ONCE PER YEAR, CLEAN THE RISER BOTTOMS AND OUTLET PIPES OF ACCUMULATED SEDIMENTS. DISPOSE OF SEDIMENTS REMOVED FROM THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA.

– PERFORM MAINTENANCE MOWING OF POND GRASSES AT LEAST TWICE EACH YEAR. GRASSES SUCH AS TALL FESCUE SHOULD BE MOWED IN EARLY SUMMER AFTER EMERGENCE OF THE HEADS OF COOL SEASON GRASSES AND IN LATE FALL TO PREVENT SEEDS OF ANNUAL WEEDS FROM MATURING. MOWING OF LEGUMES CAN BE LESS FREQUENT. TREES, SHRUBS AND WOODY VEGETATION ARE NOT PERMITTED TO GROW ALONG OR ON ANY PART OF THE EMBANKMENT THAT WAS CONSTRUCTED USING ENGINEERED (COMPACTED) FILLS.

– PERFORM SOIL SAMPLING ON STABILIZED POND SOIL AREAS AT LEAST ONCE EVERY 4 YEARS. SOIL SAMPLING AND TESTING SHOULD BE PERFORMED BY A QUALIFIED SOIL TESTING LABORATORY SUCH AS VPI&SU. CONTACT THE LOCAL OFFICE OF THE VIRGINIA COOPERATIVE EXTENSION FOR FURTHER INFORMATIONS. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.

– IN STABILIZED POND AREAS, IF VEGETATION COVERS LESS THAN 40% OF SOIL SURFACES, LIME, FERTILIZE AND SEED IN ACCORDANCE WITH RECOMMENDATIONS FOR NEW SEEDLINGS. IF VEGETATION COVERS MORE THAN 40% BUT LESS THAN 70% OF SOIL SURFACES, LIME, FERTILIZE AND OVER SEED IN ACCORDANCE WITH CURRENT SEEDING RECOMMENDATIONS OR REQUIREMENTS OF THE VESCH.

– PERFORM QUARTERLY INSPECTIONS OF THE RISER SECTION FOR THE OBSERVANCE OF COLLECTED TRASH AND DEBRIS. IMMEDIATELY REMOVE ANY TRASH OR DEBRIS THAT PREVENTS THE MOVEMENT OF WATER. REMOVE ANY TRASH AND LITTER DOWNSTREAM AND AT STORM DRAIN OR CHANNEL INFLOW LOCATIONS TO MAINTAIN THE INTEGRITY OF THE STRUCTURE AND PROVIDE AN ATTRACTIVE APPEARANCE.

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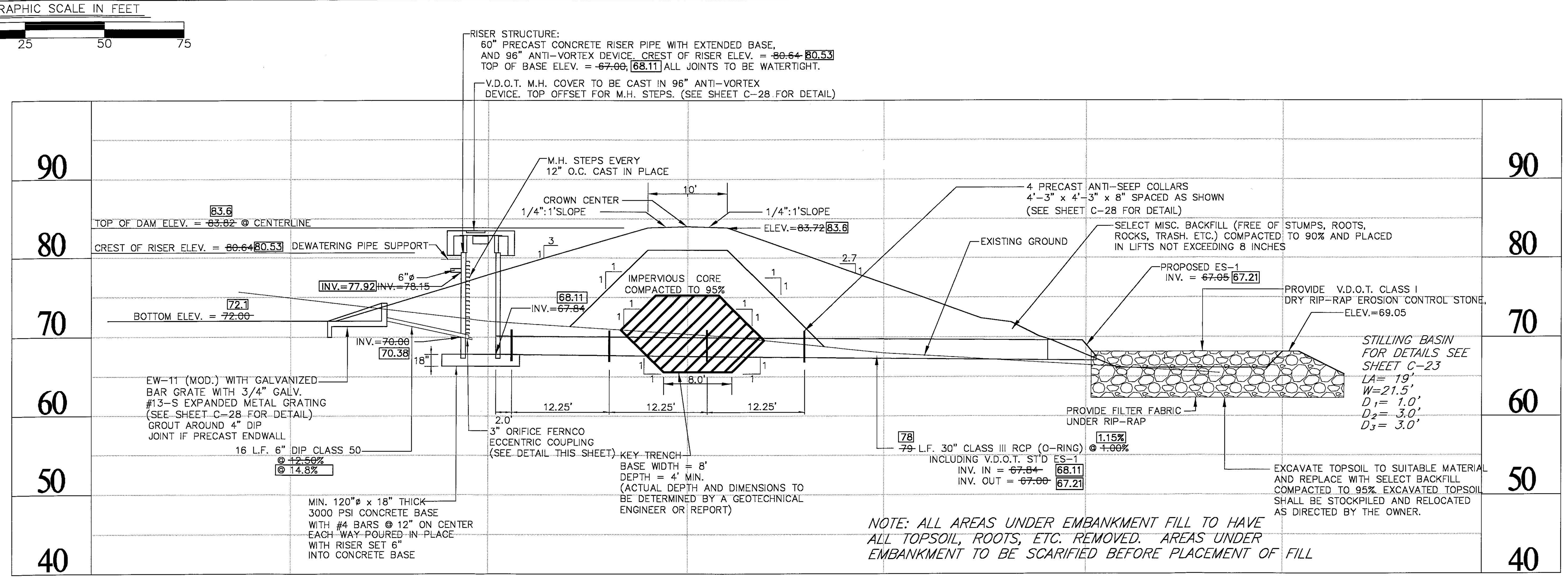
– PERFORM QUARTERLY INSPECTIONS OF THE GRADED SIDE SLOPES OF THE FACILITY FOR SIGNS OF ANIMAL/RODENT BURROWS OR SLOPE EROSION. IMMEDIATELY PERFORM NECESSARY REPAIRS, REFILLING OR RESEEDING.

– PERFORM ANNUAL OBSERVATIONS OF PERIMETER AREAS SURROUNDING THE FACILITY TO ENSURE CHANGES IN LAND USE, TOPOGRAPHY OR ACCESS HAVE NOT OCCURRED AND DO NOT AFFECT THE OPERATION, MAINTENANCE, ACCESS OR SAFETY FEATURES AS PROVIDED. APPROPRIATE ACTION IS REQUIRED TO ENSURE ADEQUACY AND TO PROVIDE A CLEAR, SAFE PASSAGE FOR MAINTENANCE VEHICLES TO THE ENGINEERED EMBANKMENT AND PRINCIPAL FLOW CONTROL STRUCTURES.

RECORD KEEPING. THE OWNER OR DESIGNATED REPRESENTATIVE SHALL KEEP REASONABLE, ACCURATE WRITTEN RECORDS OF INSPECTIONS PERFORMED FOR THE STRUCTURE. RECORDS SHALL DOCUMENT ROUTINE MAINTENANCE AND/OR REPAIRS PERFORMED. COPIES SHALL BE PROVIDED TO THE COUNTY UPON REQUEST.

THE FACILITY SHALL NOT ACCEPT ADDITIONAL DRAINAGE OR BE MODIFIED IN ANY WAY WITHOUT PRIOR CONSENT OR APPROVAL BY THE ENVIRONMENTAL DIVISION OF JAMES CITY COUNTY.

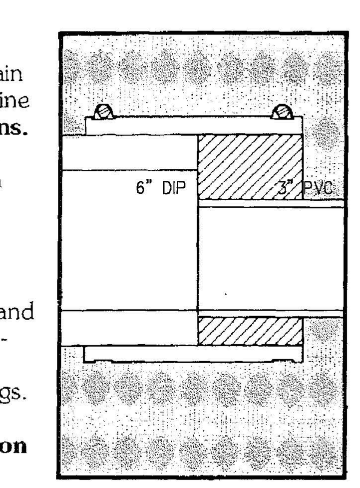


BMP #1 SECTION

N.T.S.

FERNCO ECCENTRIC COUPLINGS help maintain an even, continuous flowline in **critical grade conditions.** They're easy to install and available to fit all common sewer pipe size combinations. Made of tough, flexible elastomeric PVC, Eccentric Couplings seal reliably against infiltration and exfiltration. Eccentric bushings fit one end of Fernco Standard Flexible Couplings.

Available for all common sewer pipe materials.



Clay to Clay Clay to CI/Plastic Clay to A-C/Ductile Concrete to Concrete	Concrete to CI/Plastic A-C/Ductile to CI/Plastic A-C/Ductile to A-C/Ductile CI/Plastic to CI/Plastic
When ordering, please provide size and piping materials to be connected.	

INTERIM BMP RECORD DRAWINGS

BMP PLAN + DETAILS

STONEHOUSE GLEN
SECTION I
STONEHOUSE GLEN, L.L.C.
JAMES CITY COUNTY VIRGINIA

LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists
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Fax (757) 229-0049
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5544 Greenwich Road
Suite 200
Virginia Beach, VA 23462
Tel. (757) 473-2000
Fax (757) 497-7933
Email: lmdg@landmarkdg.com

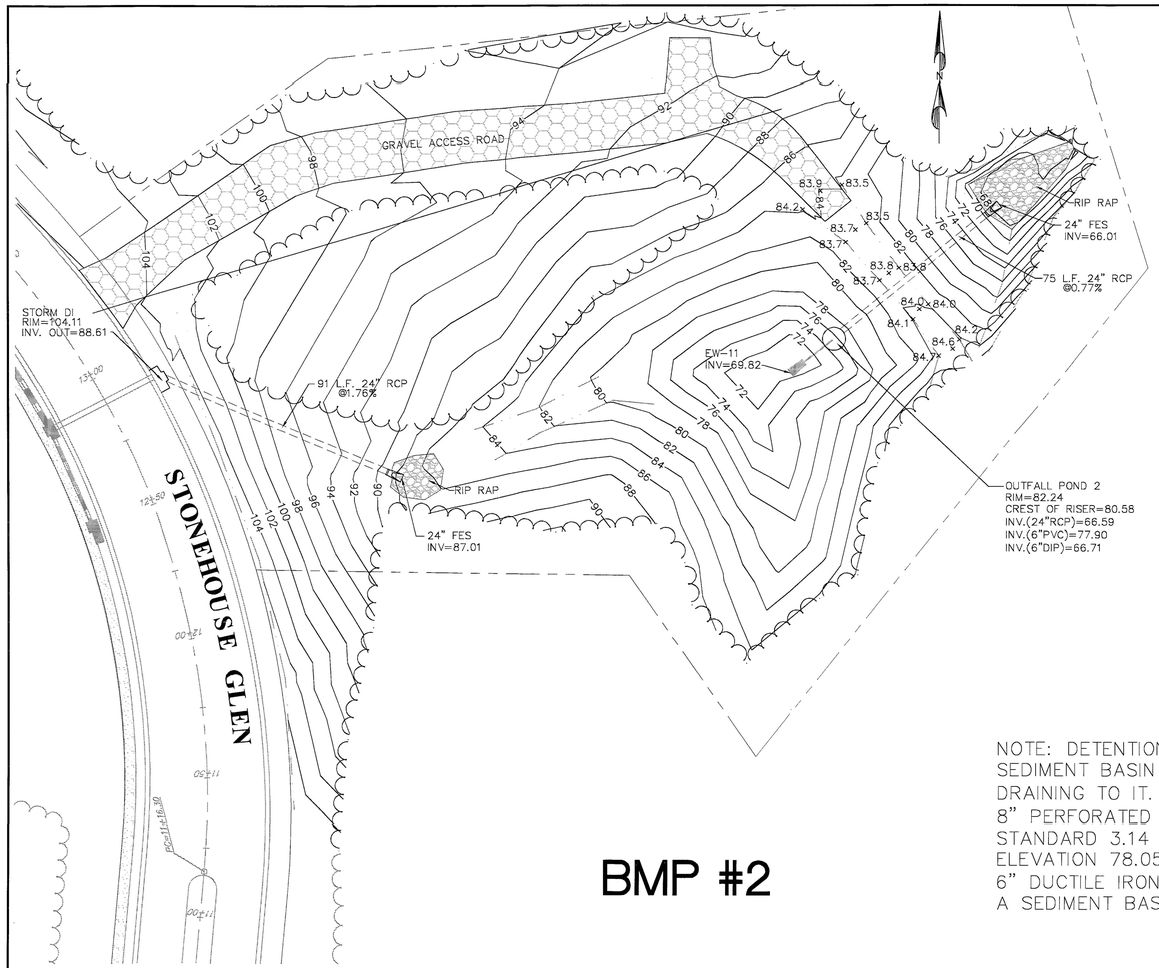
REVISIONS: No. | Date | Comment | By

DRAWING STATUS: Interoffice Review / Client for Review / Pre Approval Bidding

COUNTY APPROVAL: 1st Submittal / 2nd Submittal / 3rd Submittal / Approved

Designed: LMDG	Date: 8/14/06
Checked: PF	Scale: as noted
File Mgr./Drawn: CRO	CADD File name: C-16
Project Number: 2002261-504.00	Dwg. File No.: 17305W
Drawing Number R-2	2 OF 4

JCC CASE #S-098-03



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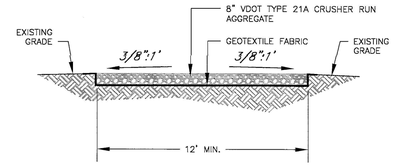

BMP ACCESS ROAD DETAIL

N.T.S.

BMP #2

TOP OF DAM: ~~83.55~~ 83.9

100 YEAR WSE: 81.35

25 YEAR WSE: 81.06

10 YEAR WSE: 80.89

2 YEAR WSE: 78.12

1 YEAR WSE: 75.98

CREST OF PRINCIPAL SPILLWAY: ~~80.55~~ 80.58

INV. 6"ø VERT. ORIFICE: ~~68.00~~ *@ EW-11* 69.82

NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 6" DIAMETER DEWATERING DEVICE WITH 8" PERFORATED DRAINAGE TUBING, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 78.05– SEDIMENT CLEANOUT LEVEL IS 75.80. 6" DUCTILE IRON PIPE TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.

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Peter Farrell

PETER FARRELL, L.S. 002036

SURVEY PERFORMED BY LANDMARK DESIGN GROUP
8/2006

COMMONWEALTH OF VIRGINIA
8/17/06
PETER FARRELL
No. 002036
LAND SURVEYOR

BMP MAINTENANCE REQUIREMENTS

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THE BASIN SERVES A DRAINAGE AREA OF 3.2 ACRES ASSOCIATED WITH PROPOSED STONEHOUSE GLEN SECTION 1. PRINCIPAL STRUCTURES ASSOCIATED WITH THIS BMP CONSIST OF ONE 3–INCH LOW FLOW OUTLET, A 36–INCH PRECAST CONCRETE RISER AND A 24–INCH CLASS III RCP OUTLET. THERE IS NO EMERGENCY SPILLWAY ASSOCIATED WITH THIS BASIN.

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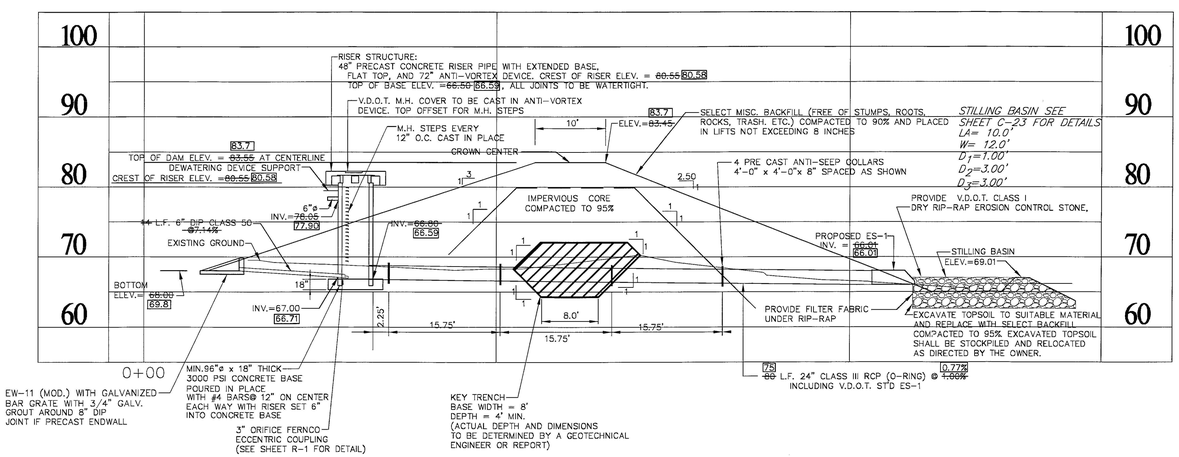


NOTE: ALL AREAS UNDER EMBANKMENT FILL TO HAVE ALL TOPSOIL, ROOTS, ETC. REMOVED. AREAS UNDER EMBANKMENT TO BE SCARIFIED BEFORE PLACEMENT OF FILL

BMP #2
STONEHOUSE GLEN

GRAPHIC SCALE

0 5 10 20 40

(IN FEET)
1 inch = 10 ft.

4029 Ironbound Road
Suite 100
Williamsburg, VA 23188
Ph: (757) 220-9232
Fax (757) 229-0649
Email: lmdg@landmarkdg.com

9544 Greenwich Road
Suite 200
Virginia Beach, VA 23462
Ph: (757) 467-7812
Fax: (757) 467-7813
Email: lmdg@landmarkdg.com

LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists

REVISIONS:

No.	Date	Comment	By

DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

INTERIM BMP RECORD DRAWINGS

BMP PLAN + DETAILS

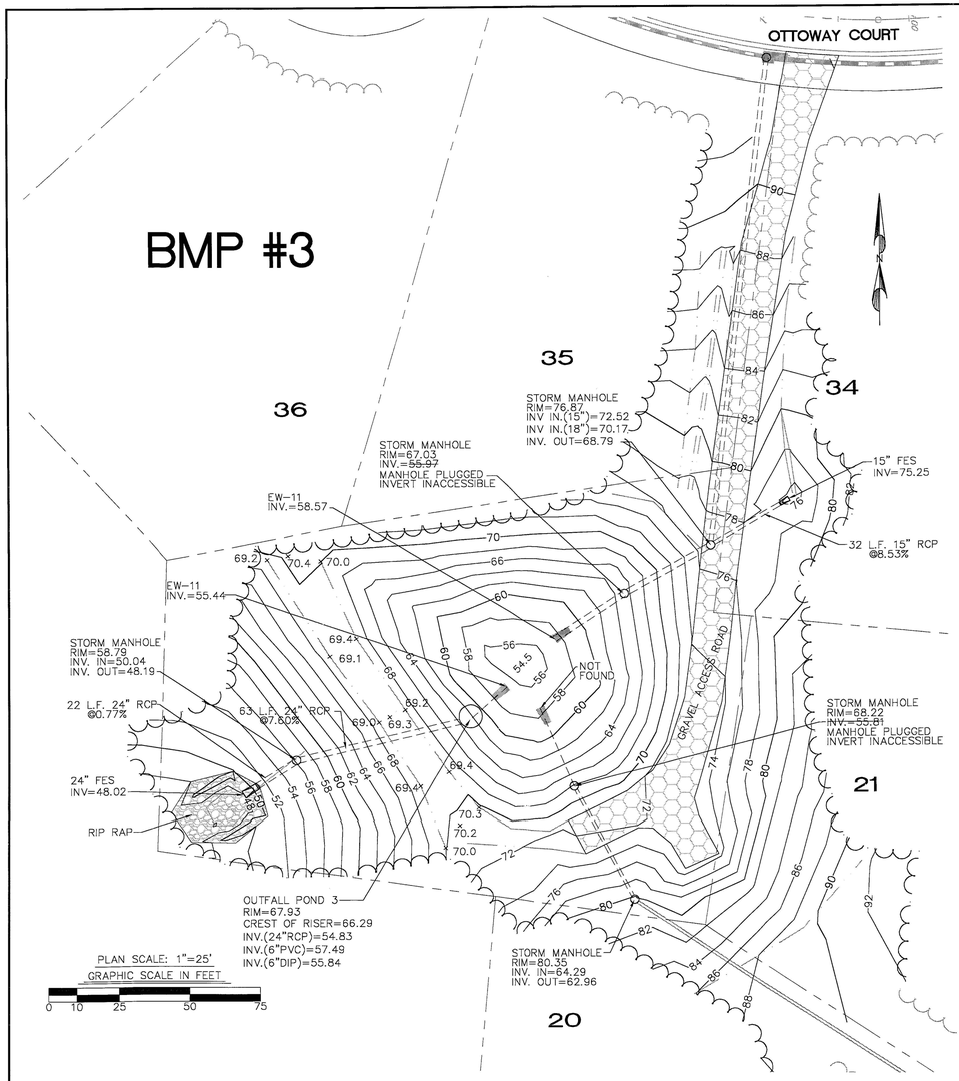
STONEHOUSE GLEN
SECTION I
STONEHOUSE GLEN, L.L.C.

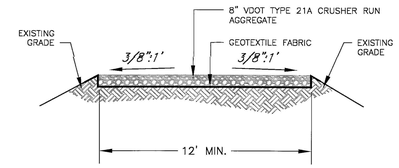
JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 8/14/06
Checked: PF	Scale: as noted
File Mgr./Drawn: CRO	CADD File name: C-16A
Project Number: 2002261-504.00	Dwg. File No.: 17304W

Drawing Number R-3
3 OF 4

JCC CASE #S-098-03





BMP ACCESS ROAD DETAIL
N.T.S.

BMP #3

TOP OF DAM: ~~69.50~~ 69.3

100 YEAR WSE: 67.45

25 YEAR WSE: 67.22

10 YEAR WSE: 67.12

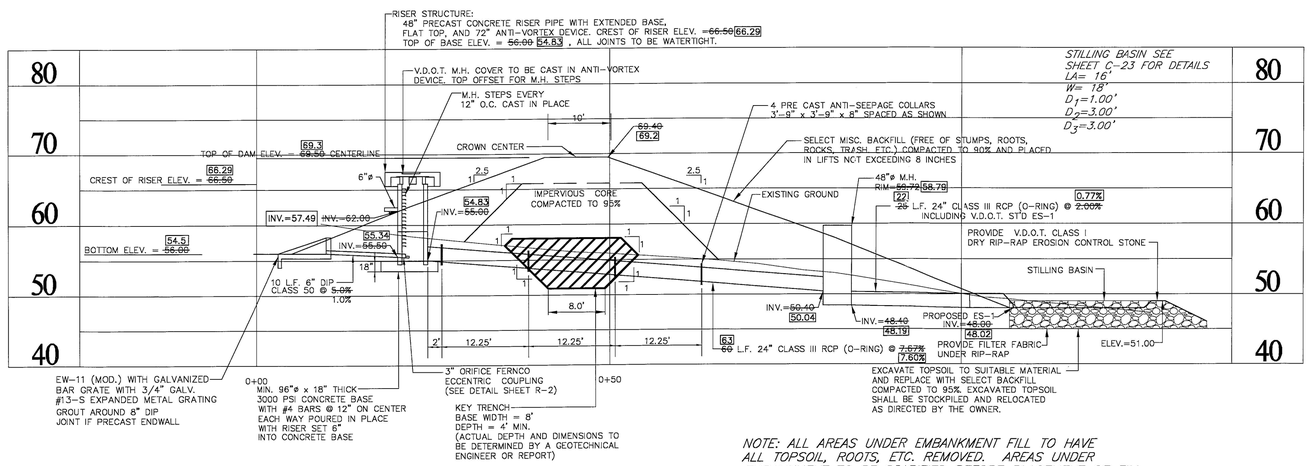
2 YEAR WSE: 65.56

1 YEAR WSE: 63.51

CREST OF PRINCIPAL SPILLWAY: ~~66.50~~ 66.29

INV. 6"ø VERT. ORIFICE: ~~56.00~~ 55.44

NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY1 SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 6" DIAMETER DEWATERING DEVICE WITH 8" DIAMETER PERFORATED DRAINAGE TUBING, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 62.00– SEDIMENT CLEANOUT LEVEL IS 60.00. 6" DUCTILE IRON PIPE TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.



NOTE: ALL AREAS UNDER EMBANKMENT FILL TO HAVE ALL TOPSOIL, ROOTS, ETC. REMOVED. AREAS UNDER EMBANKMENT TO BE SCARIFIED BEFORE PLACEMENT OF FILL

BMP #3 SECTION

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITIONS OF THE STORMWATER MANAGEMENT/BMP FACILITIES. THE FACILITIES APPEAR TO CONFORM WITH THE PROVISIONS OF THE APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN, EXCEPT AS SPECIFICALLY NOTED.

Peter Farrell

PETER FARRELL, L.S. 002036

SURVEY PERFORMED BY LANDMARK DESIGN GROUP
8/2006

COMMONWEALTH OF VIRGINIA
8/17/06
PETER FARRELL
PETER FARRELL
No. 002036
LAND SURVEYOR

BMP MAINTENANCE REQUIREMENTS

THE OWNER OR ITS DESIGNATED REPRESENTATIVE WILL INSPECT THE SWM/BMP STRUCTURES AFTER EACH SIGNIFICANT RAINFALL EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL FOR THIS STRUCTURE IS DEFINED AS ONE (1) INCH OR MORE OF GAUGED RAINFALL WITHIN A 24-HOUR PERIOD. ONCE PER YEAR, A REPRESENTATIVE OF THE COUNTY MAY JOINTLY INSPECT THE STRUCTURE.

THE BASIN SERVES A DRAINAGE AREA OF 3.2 ACRES ASSOCIATED WITH PROPOSED STONEHOUSE GLEN SECTION 1. PRINCIPAL STRUCTURES ASSOCIATED WITH THIS BMP CONSIST OF ONE 3-INCH LOW FLOW OUTLET, A 36-INCH PRECAST CONCRETE RISER AND A 24-INCH CLASS III RCP OUTLET. THERE IS NO EMERGENCY SPILLWAY ASSOCIATED WITH THIS BASIN.

INSPECTION AND MAINTENANCE OF THE FACILITY WILL CONSIST OF THE FOLLOWING ADDITIONAL MEASURES:

– INSPECT FOR SEDIMENT BUILDUP BY VISUAL OBSERVATION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN THE POND STORAGE AREAS. IF THE DEPTH OF THE SEDIMENT REACHES THE DEPTH OF 2'-6" ABOVE THE BOTTOM OF THE POND, REMOVAL IS REQUIRED. AT THE SAME TIME, OR AT LEAST ONCE PER YEAR, CLEAN THE RISER BOTTOMS AND OUTLET PIPES OF ACCUMULATED SEDIMENTS. DISPOSE OF SEDIMENTS REMOVED FROM THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA.

– PERFORM MAINTENANCE MOWING OF POND GRASSES AT LEAST TWICE EACH YEAR. GRASSES SUCH AS TALL FESCUE SHOULD BE MOWED IN EARLY SUMMER AFTER EMERGENCE OF THE HEADS OF COOL SEASON GRASSES AND IN LATE FALL TO PREVENT SEEDS OF ANNUAL WEEDS FROM MATURING. MOWING OF LEGUMES CAN BE LESS FREQUENT. TREES, SHRUBS AND WOODY VEGETATION ARE NOT PERMITTED TO GROW ALONG OR ON ANY PART OF THE EMBANKMENT THAT WAS CONSTRUCTED USING ENGINEERED (COMPACTED) FILLS.

– PERFORM SOIL SAMPLING ON STABILIZED POND SOIL AREAS AT LEAST ONCE EVERY 4 YEARS. SOIL SAMPLING AND TESTING SHOULD BE PERFORMED BY A QUALIFIED SOIL TESTING LABORATORY SUCH AS VPI&SU. CONTACT THE LOCAL OFFICE OF THE VIRGINIA COOPERATIVE EXTENSION FOR FURTHER INFORMATIONS. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.

– IN STABILIZED POND AREAS, IF VEGETATION COVERS LESS THAN 40% OF SOIL SURFACES, LIME, FERTILIZE AND SEED IN ACCORDANCE WITH RECOMMENDATIONS FOR NEW SEEDLINGS. IF VEGETATION COVERS MORE THAN 40% BUT LESS THAN 70% OF SOIL SURFACES, LIME, FERTILIZE AND OVER SEED IN ACCORDANCE WITH CURRENT SEEDING RECOMMENDATIONS OR REQUIREMENTS OF THE VESCH.

– PERFORM QUARTERLY INSPECTIONS OF THE RISER SECTION FOR THE OBSERVANCE OF COLLECTED TRASH AND DEBRIS. IMMEDIATELY REMOVE ANY TRASH OR DEBRIS THAT PREVENTS THE MOVEMENT OF WATER. REMOVE ANY TRASH AND LITTER DOWNSTREAM AND AT STORM DRAIN OR CHANNEL INFLOW LOCATIONS TO MAINTAIN THE INTEGRITY OF THE STRUCTURE AND PROVIDE AN ATTRACTIVE APPEARANCE.

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– PERFORM QUARTERLY INSPECTIONS OF THE GRADED SIDE SLOPES OF THE FACILITY FOR SIGNS OF ANIMAL/RODENT BURROWS OR SLOPE EROSION. IMMEDIATELY PERFORM NECESSARY REPAIRS, REFILLING OR RESEEDING.

– PERFORM ANNUAL OBSERVATIONS OF PERIMETER AREAS SURROUNDING THE FACILITY TO ENSURE CHANGES IN LAND USE, TOPOGRAPHY OR ACCESS HAVE NOT OCCURRED AND DO NOT AFFECT THE OPERATION, MAINTENANCE, ACCESS OR SAFETY FEATURES AS PROVIDED. APPROPRIATE ACTION IS REQUIRED TO ENSURE ADEQUACY AND TO PROVIDE A CLEAR, SAFE PASSAGE FOR MAINTENANCE VEHICLES TO THE ENGINEERED EMBANKMENT AND PRINCIPAL FLOW CONTROL STRUCTURES.

RECORD KEEPING. THE OWNER OR DESIGNATED REPRESENTATIVE SHALL KEEP REASONABLE, ACCURATE WRITTEN RECORDS OF INSPECTIONS PERFORMED FOR THE STRUCTURE. RECORDS SHALL DOCUMENT ROUTINE MAINTENANCE AND/OR REPAIRS PERFORMED. COPIES SHALL BE PROVIDED TO THE COUNTY UPON REQUEST.

THE FACILITY SHALL NOT ACCEPT ADDITIONAL DRAINAGE OR BE MODIFIED IN ANY WAY WITHOUT PRIOR CONSENT OR APPROVAL BY THE ENVIRONMENTAL DIVISION OF JAMES CITY COUNTY.

GRAPHIC SCALE
0 5 10 20 40
(IN FEET)
1 inch = 10 ft.

4029 Ironbound Road
Suite 100
Williamsburg, VA 23188
Tel: (757) 253-0040
Fax: (757) 229-2075
Email: lmdg@landmarkdg.com

5544 Greenwich Road
Suite 200
Virginia Beach, VA 23462
Tel: (757) 473-3000
Fax: (757) 473-3020
Email: lmdg@landmarkdg.com

LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists

REVISIONS:			
No.	Date	Comment	By

DRAWING STATUS
- Interdiffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

INTERIM BMP RECORD DRAWINGS

BMP PLAN + DETAILS

STONEHOUSE GLEN
SECTION I
STONEHOUSE GLEN, L.L.C.

JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 8/14/06
Checked: PF	Scale: as noted
File Mgr./Drawn: CRO	CADD File name: C-16B
Project Number: 2002261-504.00	Dwg. File No.: 17303W

Drawing Number
R-4
4 OF 4

JCC CASE #S-098-03

FINAL BMP RECORD DRAWINGS
STONEHOUSE GLEN

SECTION II

STONEHOUSE GLEN, L.L.C.

JAMES CITY COUNTY, VIRGINIA

MAY 20, 2011

VHB

Vanasse Hangen Brustlin, Inc.

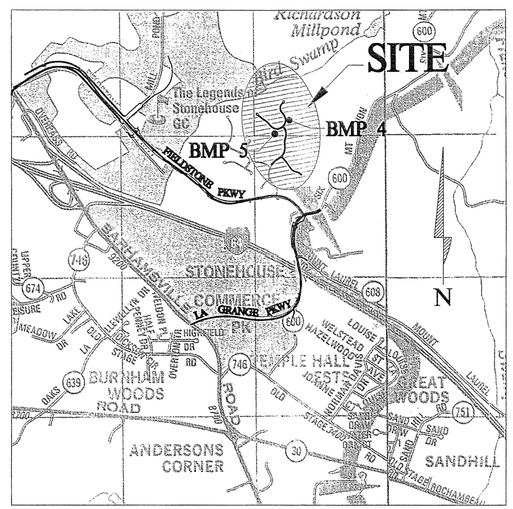
Transportation
Land Development
Environmental Services

351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757 220 0500 • FAX 757 220 8544

Environmental Division
JUN 29 2011
RECEIVED

SHEET INDEX

SHEET. NO.	DESCRIPTION
R-1	COVER SHEET
R-2	POND 4
R-3	POND 5



COPYRIGHT ADC THE MAP PEOPLE PERMITTED USE NO. 20605142

VICINITY MAP

SCALE: 1"=2,000'

STATISTICAL DATA

TAX PARCEL ID:	0540100003
ZONING:	PUD-R
PROJECT AREA:	96.3105 AC.
AREA DISTURBED:	9.26 ± AC.
F.E.M.A. PANEL NUMBER:	510201 0010B ZONE X - AREA OUTSIDE OF 500 YR. FLOOD PLAN
WATERSHED:	IT APPEARS THIS PROJECT IS SITUATED IN THE WARE CREEK WATERSHED, DRAINING TO RICHARDSON'S MILL POND, COUNTY BMP ID CODE WC 059.
OWNER\DEVELOPER:	STONEHOUSE GLEN, L.L.C. KEN MCDERMOTT, MANAGER 15 MENDHAM ROAD P. O. BOX 704 GLADSTONE, NJ 07934 (908) 234-2620
FUTURE OWNER OF WATER AND SANITARY:	JAMES CITY SERVICE AUTHORITY 101 E. MOUNTS BAY ROAD P.O. BOX 8784 WILLIAMSBURG VA, 23187 (757) 253-6805

GENERAL NOTES

1. MERIDIAN SOURCE: VIRGINIA STATE PLANE COORDINATE SYSTEM – SOUTH ZONE (NAD 83)
2. ELEVATIONS HEREON ARE IN FEET AND ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29)
3. THIS SURVEY DOES NOT IMPLY IN ANY WAY THAT:
   (1) INSPECTIONS WERE MADE DURING THE CONSTRUCTION
   (2) TO THE QUALITY OF THE WORK, OR
   (3) TO ANY ELEMENT OR STRUCTURE NOT VISIBLE OR DEPICTED ON THE SURVEY.
4. RECORD INFORMATION SHOWN ON THIS PLAN ARE BASED UPON AN ACTUAL ON-THE-GROUND INSTRUMENT SURVEY PERFORMED BY VHB, INC. DURING JANUARY AND MAY OF 2011.
5. HORIZONTAL AND VERTICAL DATUM BASED ON JAMES CITY COUNTY GEODETIC CONTROL NETWORK MONUMENT #340.

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITIONS OF THE STORMWATER MANAGEMENT/BMP FACILITIES. THE FACILITIES APPEAR TO CONFORM WITH THE PROVISIONS OF THE APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN, EXCEPT AS SPECIFICALLY NOTED.

Charles R. Orsborne, L.S. LIC. NO. 1381

SURVEY PERFORMED BY VHB, INC.
JANUARY 2011, MAY 2011

No.	Revision	Date	Appvd.

Designed by | Drawn by | Checked by
CAD checked by | Approved by
Scale 1"=20' | Date May 20, 2011

Project Title
Stonehouse Glen
Section II
Stonehouse Glen, LLC.
James City County, Virginia

Issued for
James City County
Environmental Division
JCC Case#: S-116-03

Drawing Title
Final Record Drawings

COMMONWEALTH OF VIRGINIA
Charles R. Orsborne
LIC. NO. 1381
5/24/11
LAND SURVEYOR

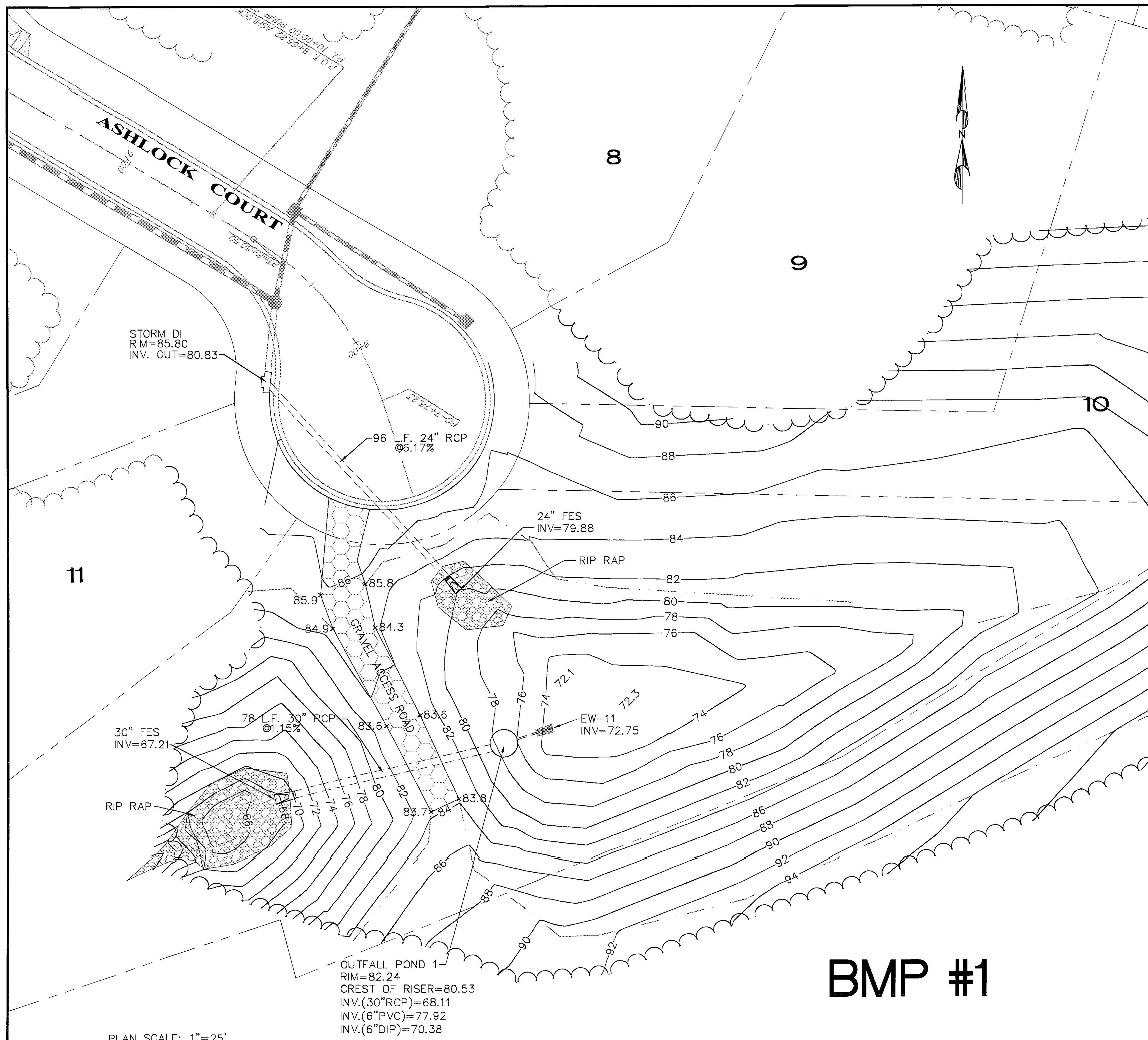
FOR RECORD DRAWING INFORMATION ONLY

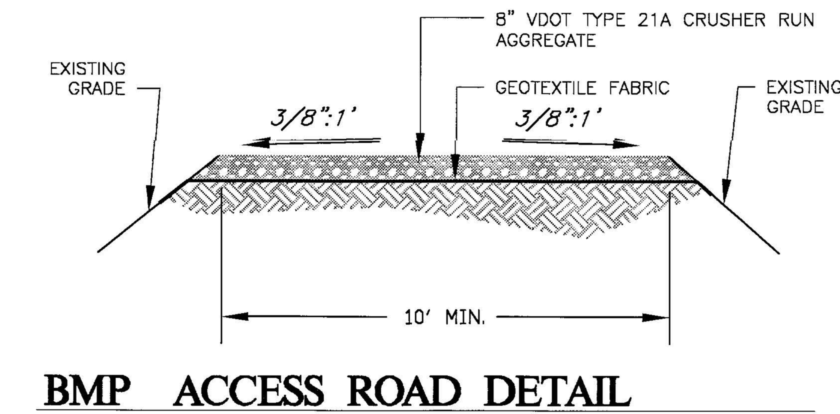
Drawing Number
R-1

Sheet 1 of 3

Project Number
33315.00

T:\PROJECTS\2002261-504.00 STONEHOUSE GLEN PH 1&2 BMP REC\DWG\DWG\R-1.DWG





BMP ACCESS ROAD DETAIL
N.T.S.

BMP #1
TOP OF DAM: ~~83.82~~ 83.6

100 YEAR WSE: 81.81

25 YEAR WSE: 81.63

10 YEAR WSE: 81.51

2 YEAR WSE: 80.70

1 YEAR WSE: 77.54

CREST OF PRINCIPAL SPILLWAY: ~~80.64~~ 80.53

INV. 6"ø VERT. ORIFICE: ~~72.00~~ 72.75 @ EW-11

NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 6" DIAMETER DEWATERING DEVICE WITH 8" DIAMETER PERFORATED DRAINAGE TUBING, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 78.15 – SEDIMENT CLEANOUT LEVEL IS 76.14. 6" DUCTILE IRON PIPE AT ELEV. 72.00 IS TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.

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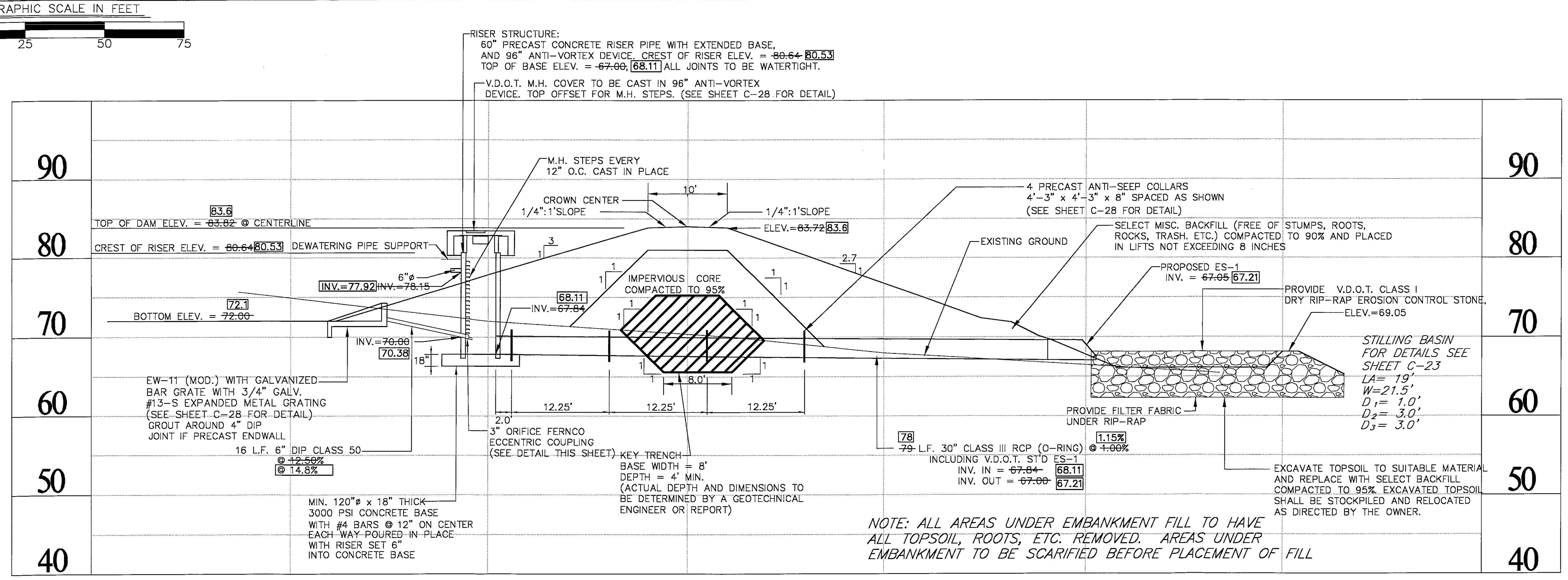
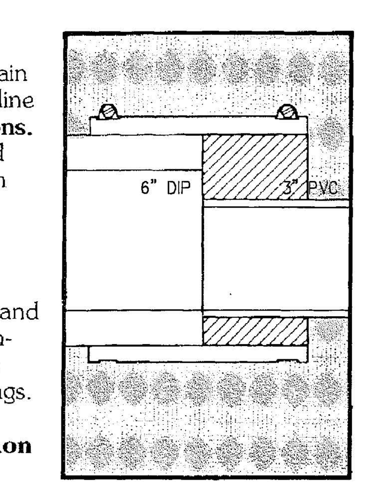


BMP #1 SECTION
N.T.S.

FERNCO ECCENTRIC COUPLINGS help maintain an even, continuous flowline in **critical grade conditions.** They're easy to install and available to fit all common sewer pipe size combinations. Made of tough, flexible elastomeric PVC, Eccentric Couplings seal reliably against infiltration and exfiltration. Eccentric bushings fit one end of Fernco Standard Flexible Couplings.

Available for all common sewer pipe materials.



Clay to Clay Clay to CI/Plastic Clay to A-C/Ductile Concrete to Concrete	Concrete to CI/Plastic A-C/Ductile to CI/Plastic A-C/Ductile to A-C/Ductile CI/Plastic to CI/Plastic
When ordering, please provide size and piping materials to be connected.	

COMMONWEALTH OF VIRGINIA
8/17/06
PETER FARRELL
No. 002036
LAND SURVEYOR

LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists
4029 Ironbound Road
Suite 100
Williamsburg, VA 23188
Tel. (757) 253-2975
Fax (757) 229-0049
Email: lmdg@landmarkdg.com
5544 Greenwich Road
Suite 200
Virginia Beach, VA 23462
Tel. (757) 473-2000
Fax (757) 497-7933
Email: lmdg@landmarkdg.com

REVISIONS:

No.	Date	Comment	By

DRAWING STATUS: Interoffice Review, Client for Review, Pre Approval Bidding

COUNTY APPROVAL: 1st Submittal, 2nd Submittal, 3rd Submittal, Approved

INTERIM BMP RECORD DRAWINGS

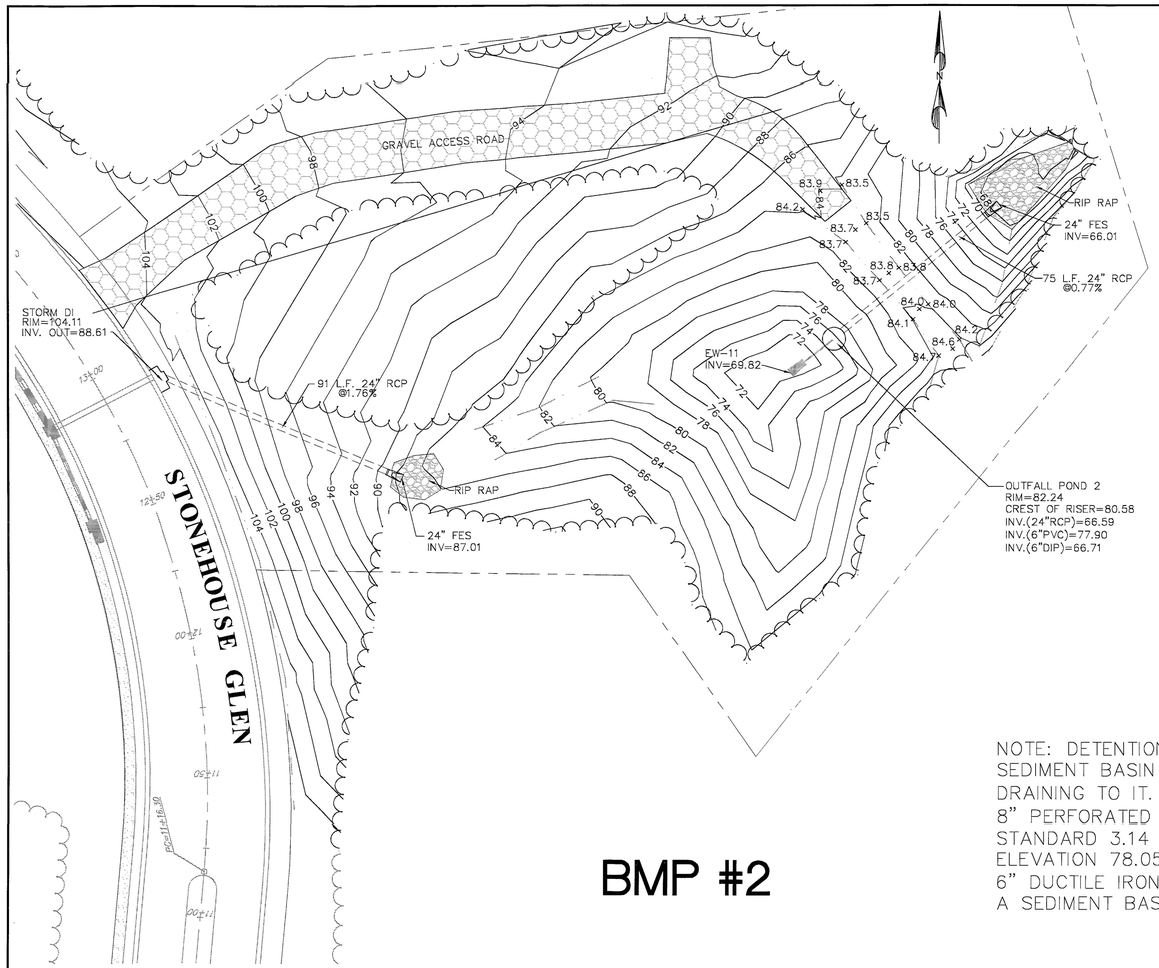
BMP PLAN + DETAILS

STONEHOUSE GLEN
SECTION I
STONEHOUSE GLEN, L.L.C.

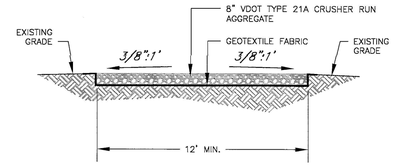
JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 8/14/06
Checked: PF	Scale: as noted
File Mgr./Drawn: CRO	CADD File name: C-16
Project Number: 2002261-504.00	Dwg. File No.: 17305W
Drawing Number: R-2	2 OF 4

JCC CASE #S-098-03



BMP #2



BMP ACCESS ROAD DETAIL

N.T.S.

BMP #2

TOP OF DAM: ~~83.55~~ 83.9

100 YEAR WSE: 81.35

25 YEAR WSE: 81.06

10 YEAR WSE: 80.89

2 YEAR WSE: 78.12

1 YEAR WSE: 75.98

CREST OF PRINCIPAL SPILLWAY: ~~80.55~~ 80.58

INV. 6"ø VERT. ORIFICE: ~~68.00~~ *@ EW-11* 69.82

NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 6" DIAMETER DEWATERING DEVICE WITH 8" PERFORATED DRAINAGE TUBING, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 78.05– SEDIMENT CLEANOUT LEVEL IS 75.80. 6" DUCTILE IRON PIPE TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.

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8/2006

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– PERFORM ANNUAL OBSERVATIONS OF PERIMETER AREAS SURROUNDING THE FACILITY TO ENSURE CHANGES IN LAND USE, TOPOGRAPHY OR ACCESS HAVE NOT OCCURRED AND DO NOT AFFECT THE OPERATION, MAINTENANCE, ACCESS OR SAFETY FEATURES AS PROVIDED. APPROPRIATE ACTION IS REQUIRED TO ENSURE ADEQUACY AND TO PROVIDE A CLEAR, SAFE PASSAGE FOR MAINTENANCE VEHICLES TO THE ENGINEERED EMBANKMENT AND PRINCIPAL FLOW CONTROL STRUCTURES.

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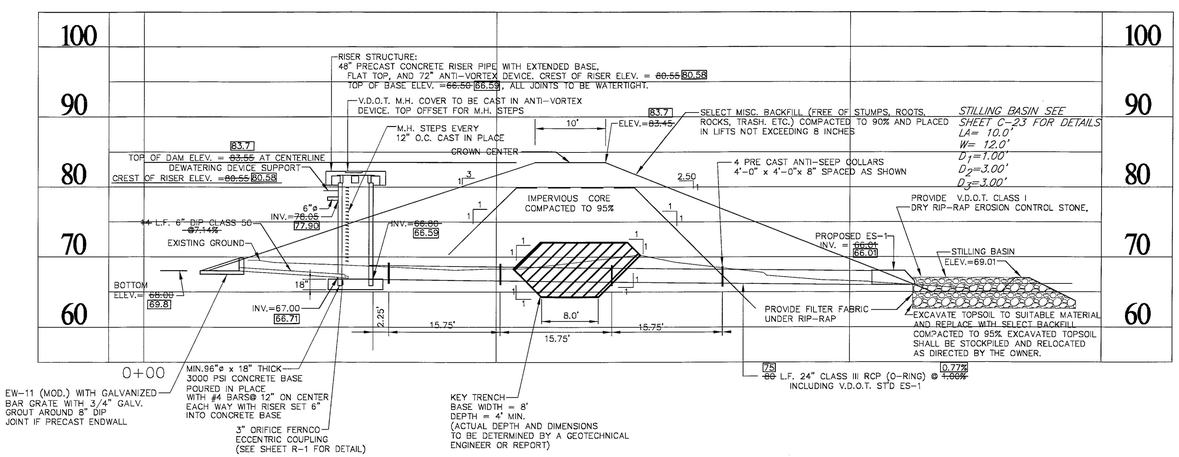

NOTE: ALL AREAS UNDER EMBANKMENT FILL TO HAVE ALL TOPSOIL, ROOTS, ETC. REMOVED. AREAS UNDER EMBANKMENT TO BE SCARIFIED BEFORE PLACEMENT OF FILL

BMP #2
STONEHOUSE GLEN

GRAPHIC SCALE

0 5 10 20 40

(IN FEET)
1 inch = 10 ft.

4029 Ironbound Road
Suite 100
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Email: lmdg@landmarkdg.com

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Fax: (757) 467-7813
Email: lmdg@landmarkdg.com

LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists

REVISIONS:

No.	Date	Comment	By

DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

INTERIM BMP RECORD DRAWINGS

BMP PLAN + DETAILS

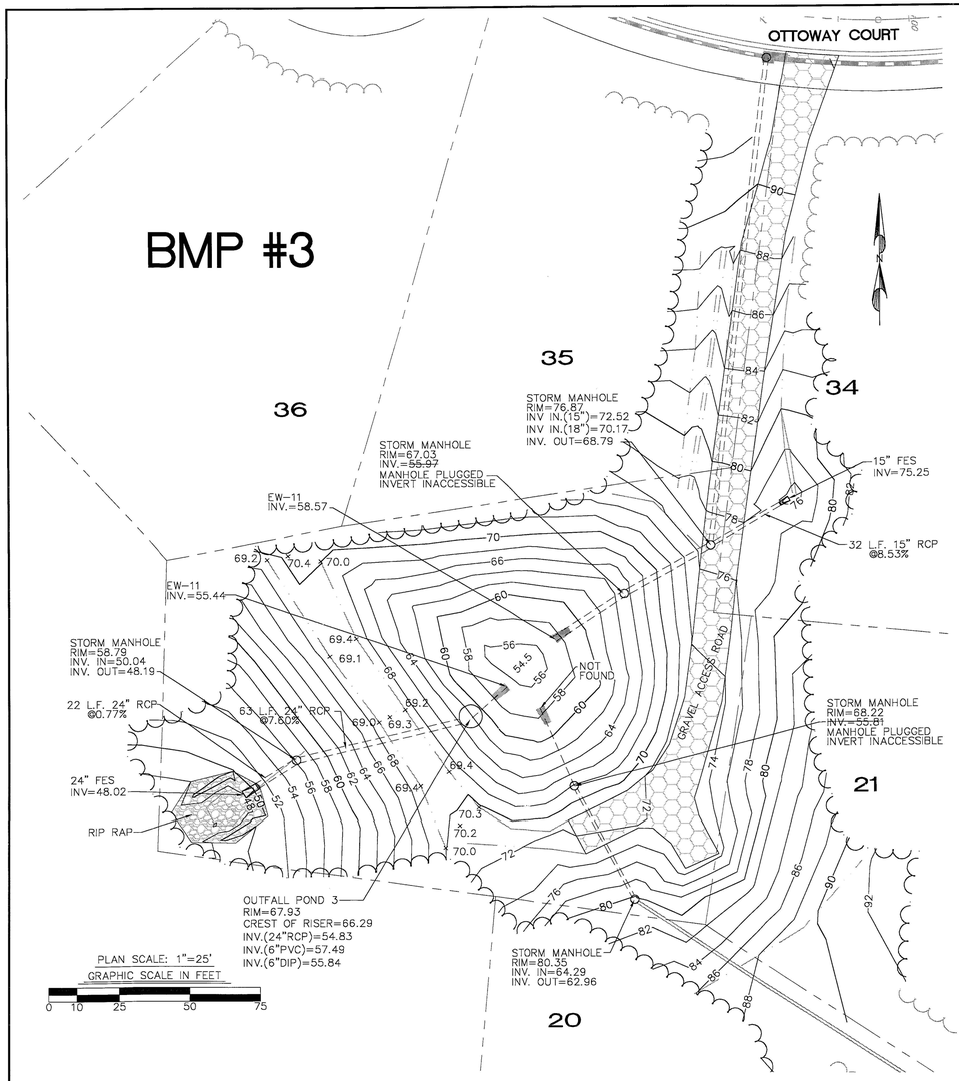
STONEHOUSE GLEN
SECTION I
STONEHOUSE GLEN, L.L.C.

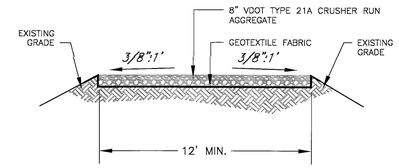
JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 8/14/06
Checked: PF	Scale: as noted
File Mgr./Drawn: CRO	CADD File name: C-16A
Project Number: 2002261-504.00	Dwg. File No.: 17304W

Drawing Number R-3
3 OF 4

JCC CASE #S-098-03





BMP ACCESS ROAD DETAIL
N.T.S.

BMP #3

TOP OF DAM: ~~69.50~~ 69.3

100 YEAR WSE: 67.45

25 YEAR WSE: 67.22

10 YEAR WSE: 67.12

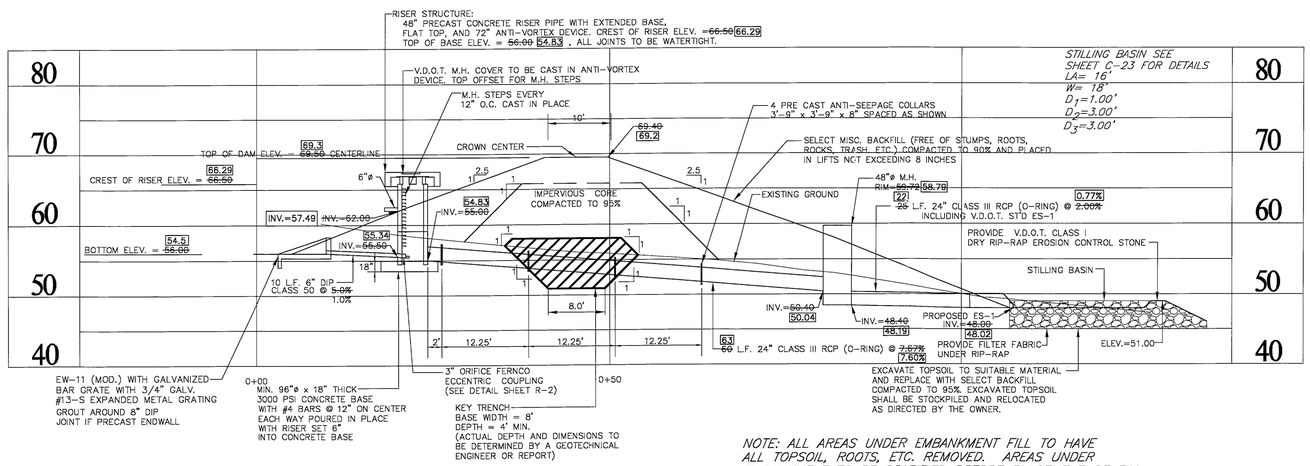
2 YEAR WSE: 65.56

1 YEAR WSE: 63.51

CREST OF PRINCIPAL SPILLWAY: ~~66.50~~ 66.29

INV. 6"ø VERT. ORIFICE: ~~56.00~~ 55.44

NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY1 SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 6" DIAMETER DEWATERING DEVICE WITH 8" DIAMETER PERFORATED DRAINAGE TUBING, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 62.00– SEDIMENT CLEANOUT LEVEL IS 60.00. 6" DUCTILE IRON PIPE TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.



NOTE: ALL AREAS UNDER EMBANKMENT FILL TO HAVE ALL TOPSOIL, ROOTS, ETC. REMOVED. AREAS UNDER EMBANKMENT TO BE SCARIFIED BEFORE PLACEMENT OF FILL

BMP #3 SECTION

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITIONS OF THE STORMWATER MANAGEMENT/BMP FACILITIES. THE FACILITIES APPEAR TO CONFORM WITH THE PROVISIONS OF THE APPROVED DESIGN PLAN, SPECIFICATIONS AND STORMWATER MANAGEMENT PLAN, EXCEPT AS SPECIFICALLY NOTED.

Peter Farrell

PETER FARRELL, L.S. 002036

SURVEY PERFORMED BY LANDMARK DESIGN GROUP
8/2006

COMMONWEALTH OF VIRGINIA
8/17/06
PETER FARRELL
PETER FARRELL
No. 002036
LAND SURVEYOR

BMP MAINTENANCE REQUIREMENTS

THE OWNER OR ITS DESIGNATED REPRESENTATIVE WILL INSPECT THE SWM/BMP STRUCTURES AFTER EACH SIGNIFICANT RAINFALL EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL FOR THIS STRUCTURE IS DEFINED AS ONE (1) INCH OR MORE OF GAUGED RAINFALL WITHIN A 24-HOUR PERIOD. ONCE PER YEAR, A REPRESENTATIVE OF THE COUNTY MAY JOINTLY INSPECT THE STRUCTURE.

THE BASIN SERVES A DRAINAGE AREA OF 3.2 ACRES ASSOCIATED WITH PROPOSED STONEHOUSE GLEN SECTION 1. PRINCIPAL STRUCTURES ASSOCIATED WITH THIS BMP CONSIST OF ONE 3-INCH LOW FLOW OUTLET, A 36-INCH PRECAST CONCRETE RISER AND A 24-INCH CLASS III RCP OUTLET. THERE IS NO EMERGENCY SPILLWAY ASSOCIATED WITH THIS BASIN.

INSPECTION AND MAINTENANCE OF THE FACILITY WILL CONSIST OF THE FOLLOWING ADDITIONAL MEASURES:

– INSPECT FOR SEDIMENT BUILDUP BY VISUAL OBSERVATION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN THE POND STORAGE AREAS. IF THE DEPTH OF THE SEDIMENT REACHES THE DEPTH OF 2'-6" ABOVE THE BOTTOM OF THE POND, REMOVAL IS REQUIRED. AT THE SAME TIME, OR AT LEAST ONCE PER YEAR, CLEAN THE RISER BOTTOMS AND OUTLET PIPES OF ACCUMULATED SEDIMENTS. DISPOSE OF SEDIMENTS REMOVED FROM THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA.

– PERFORM MAINTENANCE MOWING OF POND GRASSES AT LEAST TWICE EACH YEAR. GRASSES SUCH AS TALL FESCUE SHOULD BE MOWED IN EARLY SUMMER AFTER EMERGENCE OF THE HEADS OF COOL SEASON GRASSES AND IN LATE FALL TO PREVENT SEEDS OF ANNUAL WEEDS FROM MATURING. MOWING OF LEGUMES CAN BE LESS FREQUENT. TREES, SHRUBS AND WOODY VEGETATION ARE NOT PERMITTED TO GROW ALONG OR ON ANY PART OF THE EMBANKMENT THAT WAS CONSTRUCTED USING ENGINEERED (COMPACTED) FILLS.

– PERFORM SOIL SAMPLING ON STABILIZED POND SOIL AREAS AT LEAST ONCE EVERY 4 YEARS. SOIL SAMPLING AND TESTING SHOULD BE PERFORMED BY A QUALIFIED SOIL TESTING LABORATORY SUCH AS VPI&SU. CONTACT THE LOCAL OFFICE OF THE VIRGINIA COOPERATIVE EXTENSION FOR FURTHER INFORMATIONS. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.

– IN STABILIZED POND AREAS, IF VEGETATION COVERS LESS THAN 40% OF SOIL SURFACES, LIME, FERTILIZE AND SEED IN ACCORDANCE WITH RECOMMENDATIONS FOR NEW SEEDLINGS. IF VEGETATION COVERS MORE THAN 40% BUT LESS THAN 70% OF SOIL SURFACES, LIME, FERTILIZE AND OVER SEED IN ACCORDANCE WITH CURRENT SEEDING RECOMMENDATIONS OR REQUIREMENTS OF THE VESCH.

– PERFORM QUARTERLY INSPECTIONS OF THE RISER SECTION FOR THE OBSERVANCE OF COLLECTED TRASH AND DEBRIS. IMMEDIATELY REMOVE ANY TRASH OR DEBRIS THAT PREVENTS THE MOVEMENT OF WATER. REMOVE ANY TRASH AND LITTER DOWNSTREAM AND AT STORM DRAIN OR CHANNEL INFLOW LOCATIONS TO MAINTAIN THE INTEGRITY OF THE STRUCTURE AND PROVIDE AN ATTRACTIVE APPEARANCE.

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BMP PLAN + DETAILS

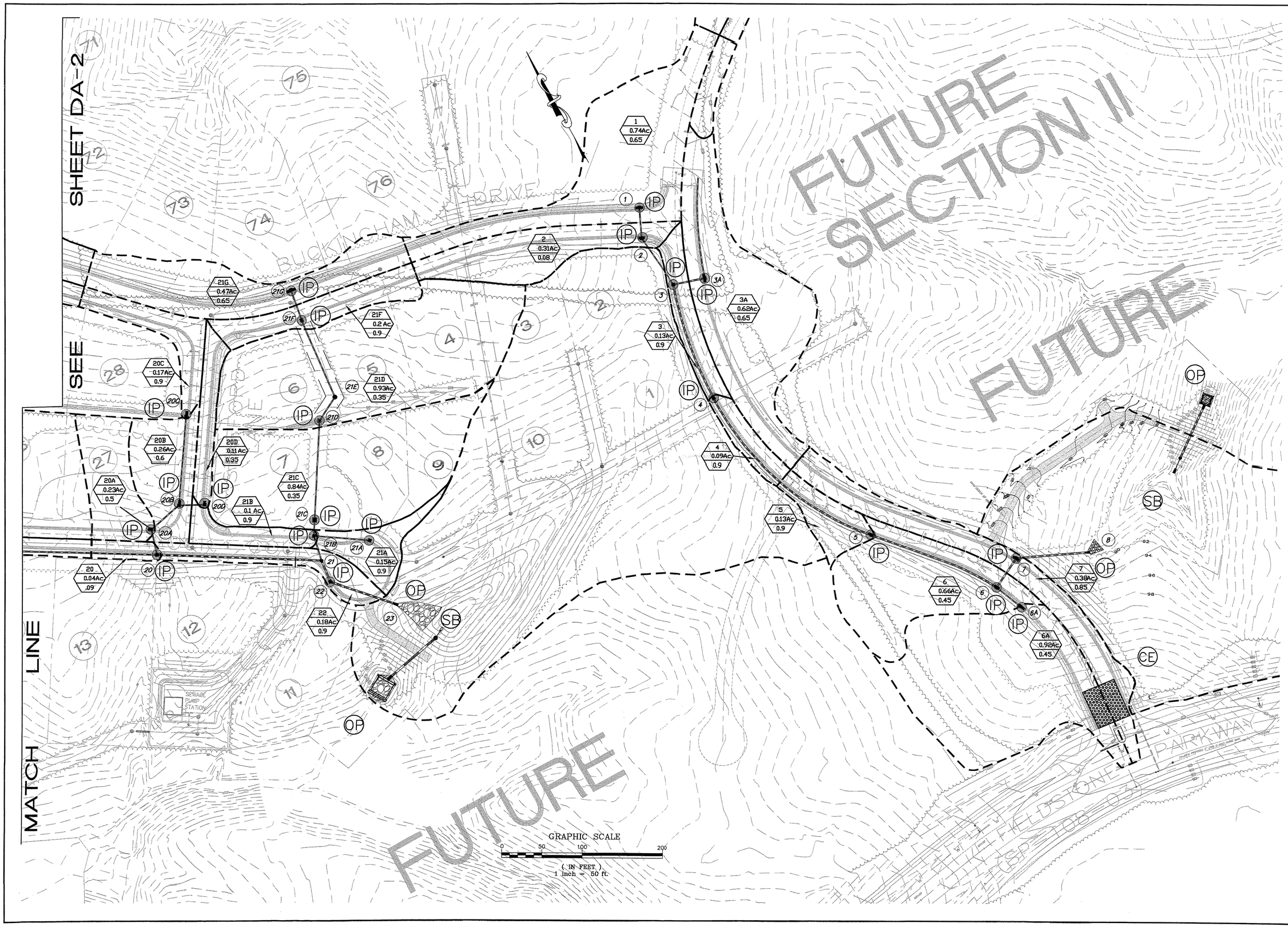
STONEHOUSE GLEN
SECTION I
STONEHOUSE GLEN, L.L.C.

JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 8/14/06
Checked: PF	Scale: as noted
File Mgr./Drawn: CRO	CADD File name: C-16B
Project Number: 2002261-504.00	Dwg. File No.: 17303W

Drawing Number
R-4
4 OF 4

JCC CASE #S-098-03



COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024305
PROFESSIONAL ENGINEER

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- 2nd Submittal
- 3rd Submittal
- Approved

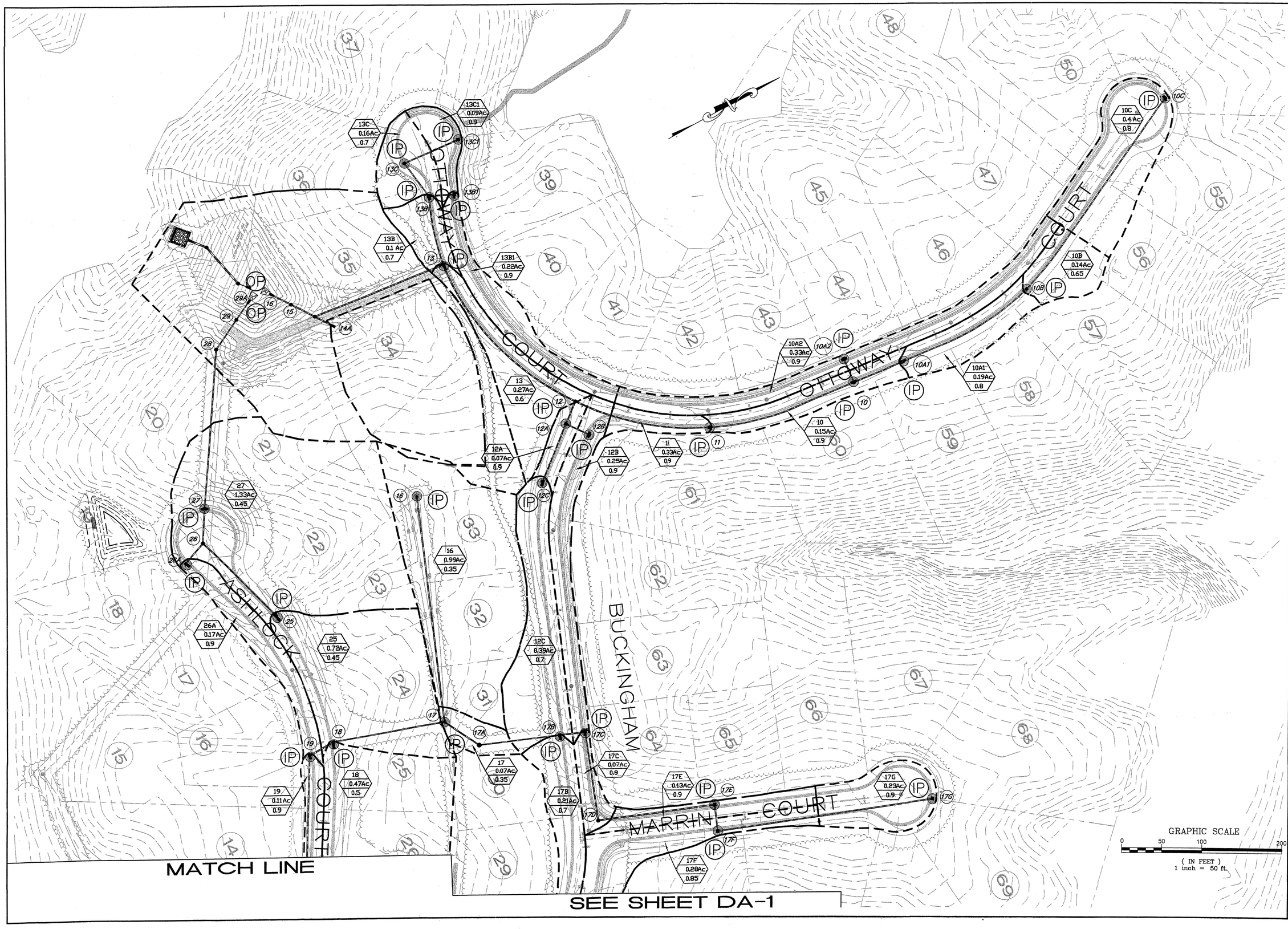
DRAINAGE AREA MAP
STONEHOUSE GLEN
SECTION I
STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 10/27/04
Checked: CRO	Scale: 1"=50'
File Mgr./Drawn: RMJ	CADD File name: DA-1.dwg
Project Number: 2002261-504.04	Dwg. File No.: 14777W

Drawing Number DA-1

1 OF 2



COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024305
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No.	Date	Comment	By

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DRAINAGE AREA MAP
STONEHOUSE GLEN
SECTION I
STONEHOUSE AT WILLIAMSBURG, L.L.C.
JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 10/27/04
Checked: CRO	Scale: 1"=50'
File Mgr./Drawn: RMJ	CADD File name: DA-2.dwg
Project Number: 2002261-50404	Dwg. File No.: 14776W
Drawing Number: DA-2 2 OF 2	

Supporting Engineering Documents
For
Stonehouse Glen Subdivision
Section I

MAY 2005
RECEIVED
PLANNING DEPARTMENT

James City County, Virginia

October 28, 2003
Revised February 10, 2004
Revised May 20, 2004
Revised November 1, 2004
Revised February 23, 2005
Revised April 18, 2005
Revised May 11, 2005

COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024305
04-18-05
PROFESSIONAL ENGINEER

Prepared for:
Mr. Ken McDermott, Manager
Stonehouse at Williamsburg, L.L.C.
15 Mendham Road
P.O. Box 704
Gladstone, New Jersey 07934
(908) 234-2620

LANDMARK DESIGN GROUP

LMDG Project No.
2002261-504.04

Supporting Engineering Documents

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1. Erosion and Sediment Control and Stormwater Management Design Plan Checklist

2. Project Description / Existing Site Conditions / Adjacent Area Description

3. Erosion and Sediment Control Narrative, Calculations and Drainage Area Maps

4. Stormwater Management Narrative and Calculations, including Channel Adequacy

5. Drainage Calculations
   a. Storm Drain Design
   b. Ditch Calculations
   c. Hydraulic Gradeline Calculation

6. Road Pavement Calculations

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7

8

9

10

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W122503-TPM

James City County, Virginia
Environmental Division

Erosion and Sediment Control and Stormwater Management Design Plan Checklists

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IV.	Calculations	4
Stormwater Management Design Plan		
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II.	Stormwater Conveyance Systems	7
III.	Stormwater Management / BMP Facilities	8
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GENERAL INFORMATION

Project Name: Stonehouse Glen
Owner / Applicant: Stonehouse @ Williamsburg, LLC
Plan Preparer: LandMark Design Group Email: ronnieo@landmarkdg.com
Project Location: Stonehouse
Tax Map / Parcel: 0640 100001
County Plan No. (if known): _____
County BMP Type: Flow Attenuation (-)

Other information submitted in addition to this checklist (Check all that apply):

- ☑ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ☑ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ☑ Erosion & Sediment Control Plan Design Report.
- ☑ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ☑ Stormwater Management Design Report.
- ☐ Other, List: _____

Issue Date
March 1, 2001

JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

EROSION AND SEDIMENT CONTROL PLAN CHECKLIST

I. *GENERAL:*

Yes	No	N/A	
☑	☐	☐	*FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH).
☑	☐	☐	*LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project.
☐	☐	☑	*VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site.

II. *SITE PLAN:*

Yes	No	N/A	
☑	☐	☐	*VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site.
☑	☐	☐	*INDICATE NORTH* direction in relation to the site.
☑	☐	☐	*LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities.
☑	☐	☐	*DISTURBED AREA ESTIMATES* in acres or square feet for the project.
☑	☐	☐	*EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval.
☑	☐	☐	*FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required).
☑	☐	☐	*EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat.
☑	☐	☐	*EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas.

Yes	No	N/A	
☑	☐	☐	*EXISTING SITE FEATURES* including roads, buildings, homes, utilities, streams, fences, structures and other important surface features of the site.
☑	☐	☐	*SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia.
☐	☐	☐	*ENVIRONMENTAL INVENTORY* in accordance with Section 23-10(2) of the Chesapeake Bay Preservation Ordinance of James City County. Inventory generally includes: tidal shores and wetlands, non-tidal wetlands, resource protection area, hydric soils and slopes steeper than 25 percent. For wetlands, provide a copy of issued permits or satisfactory evidence that appropriate permits are being pursued for the entire project. Wetland limits shown on BMP Plan Sheet
☐	☐	☑	*100-YEAR FLOODPLAIN LIMITS* or any special flood hazard areas or flood zones based on appropriate Federal Management Agency Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs) of James City County, Virginia.
☑	☐	☐	*DRAINAGE AREAS* for offsite and onsite areas, existing or proposed as applicable. Include drainage divides and directional labels for all subareas at points of interest and size (in acres), weighted runoff coefficient or curve number and times of concentration for each subarea.
☐	☐	☑	*CRITICAL EROSION AREAS* which require special consideration or unique erosion and sediment control measures. Refer to the VESCH, Chapter 6 for criteria.
☑	☐	☐	*DEVELOPMENT PLAN* for the site showing all improvements such as buildings, structures, parking areas, access roadways, above and below ground utilities, stormwater management and drainage facilities, trails or sidewalks, proposed vegetation and landscaping, amenities, etc.
☑	☐	☐	*LOCATION OF PRACTICES* proposed for erosion and sediment control, tree protection and temporary stormwater management due to land disturbance activities at the site. Use standard abbreviations, labels and symbols consistent for plan views based on minimum standards and specifications in Chapter 3 of the VESCH.
☑	☐	☐	*TEMPORARY STOCKPILE AREAS* or staging and equipment storage areas as required for onsite or offsite construction activities or indicate that none are anticipated for this project.
☐	☐	☑	*OFFSITE LAND DISTURBING AREAS* including borrow sites, waste areas, utility extensions, etc. and required erosion and sediment controls. If none are anticipated for the project, then indicate on the plans by general or erosion and sediment control notes.
☑	☐	☐	*DETAILS* or alternately, appropriate reference to current minimum standards and specifications of the VESCH for each measure proposed for the project. Non-modified, standard duplicated details (silt fence, diversion dikes, etc.) may be referenced to the current version of the VESCH. Specific dimensional or modified standards (basins, traps, outlet protections, check dams, etc.) require presentation on detail sheets. Schedules or tables may be used for multiple site measures such as sediment traps, basins, channels, slope drains, etc. Any modification to standard details should be clearly defined, explained and illustrated.

Yes	No	N/A	
☑	☐	☐	*MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project.
☐	☐	☑	*TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project.
☑	☐	☐	*CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor.
☐	☐	☑	*PHASING PLAN* if required for larger project sites that are to be developed in stages or phases.
☑	☐	☐	*STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes dated May 5, 1999.
☑	☐	☐	*PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications.

III. *NARRATIVE:*

Yes	No	N/A	
☑	☐	☐	*PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed.
☑	☐	☐	*EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site.
☑	☐	☐	*ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity.
☐	☐	☑	*OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented.
☑	☐	☐	*SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable.
☐	☐	☑	*CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.)

Yes No N/A

☑ ☐ ☐ *PROPOSED EROSION & SEDIMENT CONTROL MEASURES* inclusive to the specific erosion and sediment control plan as proposed for the land disturbing activity. Measures should be consistent with those proposed on the site drawings. Address general use, installation, limitations, sequencing and maintenance requirements for each control measure.

☑ ☐ ☐ *STABILIZATION MEASURES* required for the site, either temporary or permanent, and during and following construction including temporary and permanent seeding and mulching, paving, stone, soil stabilization blankets and matting, sodding, landscaping or special stabilization techniques to be utilized at the site.

☑ ☐ ☐ *STORMWATER MANAGEMENT CONSIDERATIONS* for the site, either of temporary or permanent nature, and strategies, sequences and measures required for control. May reference the stormwater management plan for the site, if prepared, for permanent stormwater management facilities and control of drainage once the site is stabilized.

IV. *CALCULATIONS:*

Yes No N/A

☑ ☐ ☐ *CALCULATIONS AND COMPUTATIONS* associated with hydrology, hydraulics and design of proposed temporary and permanent erosion and sediment control measures including: sediment traps and basins, diversions, stormwater conveyance channels, culverts, slope drains, outlet protections, etc. Computations are not required on the construction plan and may be attached in a supplemental erosion and sediment control plan design report, if presented in a clear and organized format.

☑ ☐ ☐ *TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET* submitted for each basin along with schematic or sketch cross-section showing applicable design and construction data, storage volumes (wet-dry), dimensions and elevations. Peak design runoff to be based on the 2- or 25-year design storm event based on maximum disturbed site conditions (existing, interim or proposed conditions) in accordance with Minimum Standard 3.14 of the VESCH.

JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST

I. *GENERAL:*

Yes	No	N/A	
☑	☐	☐	*FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH).
☐	☐	☑	*WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only.
☐	☐	☑	*VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site.
☑	☐	☐	*PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications.
☐	☐	☑	*WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only).
☐	☐	☑	*PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet.
☑	☐	☐	*INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project.
☐	☐	☑	*FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable.
☑	☐	☐	*DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map.

Yes	No	N/A	
☑	☐	☐	*SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins.
☑	☐	☐	*STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations.
☑	☐	☐	*TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided.
☑	☐	☐	*MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities.
☑	☐	☐	*STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information.
☐	☐	☐	*PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.)
☑	☐	☐	North arrow and plan legend.
☑	☐	☐	Property lines.
☑	☐	☐	Adjacent property information.
☑	☐	☐	Existing site features and existing impervious cover areas.
☑	☐	☐	Impervious cover tabulations.
☑	☐	☐	Existing drainage facilities (natural or manmade).
☑	☐	☐	Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.).
☑	☐	☐	Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography.
☑	☐	☐	Existing and proposed easement locations.

See existing site conditions narrative also.

Yes	No	N/A	
☑	☐	☐	Proposed site improvements and proposed impervious cover areas.
☑	☐	☐	Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information.
☑	☐	☐	Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.).
☑	☐	☐	Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.).
☑	☐	☐	Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations.
☐	☐	☑	Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties.
☐	☑	☐	Test boring locations with reference surface elevations (if known).
☑	☐	☐	Risers, barrels, underdrains, overflows and outlet protections.
☑	☐	☐	Emergency spillway level section and outlet channel.
☑	☐	☐	Existing and proposed site utilities and protection measures.
☑	☐	☐	Erosion and sediment control measures (for site or BMP).
☑	☐	☐	Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities.

II. *STORMWATER CONVEYANCE SYSTEMS:*

Yes	No	N/A	
☑	☐	☐	*PLAN VIEWS*
			☑ ☐ ☐ Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule.
			☑ ☐ ☐ Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled.
			☑ ☐ ☐ All structure numbers labeled.
			☑ ☐ ☐ Adequate horizontal clearance from other site utilities or structures.
☑	☐	☐	*PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas.
☑	☐	☐	*DETAILS*
			☑ ☐ ☐ Typical storm drain bedding details or reference note.
			☑ ☐ ☐ Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.).
			☑ ☐ ☐ Inlet shaping detail or applicable reference note.
			☑ ☐ ☐ Step detail or applicable reference note (if depth 4 ft. or more).
			☑ ☐ ☐ Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included.
			☑ ☐ ☐ Outlet protections at all pipe outfalls.

Yes No N/A

☐ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

- ☑ ☐ ☐ Storm Sewer Design computations based on 10-year design event.
- ☑ ☐ ☐ Hydraulic Grade Line computations based on 10-year design event.
- ☑ ☐ ☐ Inlet computations based on current VDOT procedure for spread, ponding depth and grate size required.
- ☐ ☐ ☑ Culvert Headwater computations. Design based on 10-year design storm event and check only for 100-year storm event.
- ☐ ☐ ☑ Open Channel computations based on 2-year design event for velocity and 10-year design event for capacity.
- ☑ ☐ ☐ Standard outlet protection or special energy dissipators.
- ☐ ☑ ☐ Pipe thickness design computations, as required, for selected pipe type (live load, minimum cover, maximum height of cover, etc.).
- ☐ ☐ ☑ Adequate channel computations for receiving channels (based on field measured channel section data).

III. *STORMWATER MANAGEMENT / BMP FACILITIES:*

Yes No N/A

☑ ☐ ☐ *HYDROLOGY* - An SCS based methodology is required for the design of stormwater management/BMP facilities with watersheds exceeding 20 acres. Under 20 acres, other generally accepted methodologies such as the modified rational, critical storm are allowable. Refer to Chapter 5 of the VESCH or Chapter 5 of the VSMH.

- ☑ ☐ ☐ Runoff Curve Number or Coefficient determinations: predeveloped and ultimate development land use scenarios.
- ☑ ☐ ☐ Time of concentration: predeveloped and ultimate development indicating overland, shallow concentrated, and channel flow components (200 ft. maximum length for overland flow).
- ☑ ☐ ☐ Hydrograph generation (tabular or graphical): pre- and postdevelopment conditions for the ~~1-~~, 2-, 10-, and 100-year design storm events.

For 2yr only - Pre-Dev.

☑ ☐ ☐ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

- ☐ ☐ ☑ Screening and layout consistent with Section 24-98(d) of the Chapter 24 Zoning ordinance (landscaping, screening, visibility, etc.).
- ☐ ☐ ☑ Basic considerations for safety and unauthorized entry.
- ☑ ☐ ☐ Proper length to width ratio (Typically 2H:1V).
- ☐ ☐ ☑ Facilities with deep pools (4 feet or more in depth) provided with two benches. Fifteen (15) ft. safety bench outward from normal pool at maximum 6 percent slope and aquatic bench inward from normal shoreline below normal pool. Narrower widths may be considered on a case-by-case basis.
- ☐ ☐ ☑ Pond buffer minimum 25 feet outward from maximum design WSEL. Additional setbacks may be required to permanent structures.
- ☑ ☐ ☐ No trees, shrubs or woody plants within 15 feet of embankment toe or 25 feet from principal spillway structure.

Yes	No	N/A	
☐	☐	☑	Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation.

Yes	No	N/A	
☑	☐	☐	*HYDRAULIC COMPUTATIONS*
☑	☐	☐	Elevation- or Stage- Storage curve and/or tabular data.
☐	☐	☑	Weir / Orifice Control - Extended Detention.
☐	☐	☑	Weir / Orifice Control - riser 1-year control for channel protection.
☐	☐	☑	Weir / Orifice Control - riser 2-year control for quantity (if required).
☐	☐	☑	Weir / Orifice Control - riser 10-year control for quantity (if required).
☑	☐	☐	Inlet / Outlet (barrel) control - (All Storms).
☑	☐	☐	Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions.
☑	☐	☐	Emergency spillway capacity and depth of flow.
☑	☐	☐	Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions.
☐	☐	☑	Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria.
☑	☐	☐	*POND or RESERVOIR ROUTING*
☑	☐	☐	Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation.
☑	☐	☐	Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass).
☐	☐	☐	*MISCELLANEOUS COMPUTATIONS*
☐	☐	☑	Water quality volume for permanent pool based on selected BMP treatment volume (WQv).
☐	☐	☑	Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations.
☐	☐	☑	Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria.
☐	☐	☑	Pond drain computations (within 24 hours).
☑	☐	☐	Anti-seep collar design (concrete preferred) or match material type.
☑	☐	☐	Filter diaphragm design (or alternative method of controlling seepage).

Yes	No	N/A	
☐	☐	☑	Riser / base structure flotation analyses. FS = 1.25 minimum.
☐	☐	☑	Downstream danger reach study and/or emergency action plan (if conditions warrant).
☐	☐	☑	Upstream backwater analyses onto offsite adjacent property (if conditions warrant).
☐	☐	☑	100 year floodplain impacts (if conditions warrant).

Yes	No	N/A	
☐	☐	☐	*GEOTECHNICAL REQUIREMENTS*
☐	☑	☐	Geotechnical Report with recommendations specific to BMP facility type selected. Report prepared by a registered professional engineer. Requires submission, review and approval prior to issuance of Land Disturbance Permit.
☐	☑	☐	Initial Feasibility Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).
☐	☑	☐	Concept Design Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).
☐	☑	☐	Minimum Boring locations: borrow area, pool area, principal control structure, top of facility near one abutment and emergency spillway if provided.
☐	☑	☐	Boring logs with Unified Soil Classification (ASTM D2487), soils descriptions and depths to bedrock and the seasonal water table indicated.
☑	☐	☐	Standard County Record Drawing/Construction Certification note provided on plan. *Note: It is understood that preparation of record drawings and construction certifications as required for project facilities may not necessarily be performed by the plan preparer. These components may be performed by others.*
See C-26			
☐	☐	☐	*PRINCIPAL SPILLWAY PROFILE AND ASSOCIATED DETAILS*
☐	☐	☐	*EXISTING GROUND AND PROPOSED GRADE*
☑	☐	☐	Embankment or excavation side slopes labeled (3H:1V maximum).
☑	☐	☐	Minimum top width labeled (per VESCH or VSMH requirements).
☑	☐	☐	Removal of unsuitable material under proposed facility (per Geotechnical Report requirements).

Yes	No	N/A	
☐	☐	☐	*CORE TRENCH*
☑	☐	☐	Material (per plan or Geotechnical Report).
☐	☐	☐	Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
☑	☐	☐	Side slopes (1:1 maximum steepness)
☑	☐	☐	Depth (4' minimum or greater as dictated by Geotechnical Report).
☐	☐	☐	*PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*
☑	☐	☐	Durable, watertight, resistant material (concrete preferred).
☑	☐	☐	Riser diameter is at least 1.25 times larger than barrel diameter.
☑	☐	☐	All pertinent dimensions and elevations shown.
☑	☐	☐	Control orifice or weir dimensions and elevations shown.
☐	☐	☑	Trash rack - removable - for each release.
☑	☐	☐	Anti-vortex device, baffle or plate.
☑	☐	☐	Riser base structure with dimensions and embedment specifications (concrete preferred).
☑	☐	☐	Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
☑	☐	☐	Low flow orifice with trash rack device.
☐	☐	☐	*PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*
☑	☐	☐	Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
☑	☐	☐	Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
☑	☐	☐	Pipe inverts, length, size, class and slope shown.
☑	☐	☐	Flared end section or endwall provided on barrel outlet.
☐	☐	☐	*SEEPAGE CONTROL*
☐	☐	☑	Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water).
☑	☐	☐	*ANTI-SEEP COLLARS*
☑	☐	☐	Anti-seep collar, concrete preferred.
☑	☐	☐	Size - 15 percent increase in length of saturation using outside pipe diameter.
☑	☐	☐	Spacing and location on barrel (located at least 2 feet from a pipe joint).

☐ ☐ ☐ *FILTER DIAPHRAGMS*

☐ ☐ ☑ Design based on latest NRCS design methods and certified by a professional engineer.

Yes No N/A

☑ ☐ ☐ *ELEVATION AND DIMENSIONAL DESIGN DATA*

- ☑ ☐ ☐ Top of facility - construction height and settled height (10 percent settlement).
- ☑ ☐ ☐ Crest of principal control structure spillway at least one (1) foot below crest of emergency spillway, if provided.
- ☑ ☐ ☐ Minimum freeboard of one (1) foot above the 100-year design high water elevation for facilities <u>with</u> an emergency spillway.
- ☐ ☐ ☑ Minimum freeboard of two (2) feet above the 100-year design high water elevation for facilities <u>without</u> an emergency spillway or in accordance with the SCS National Engineering Handbook (prior approval required).
- ☐ ☐ ☑ Basin Sediment Clean-Out elevation (permanent mode). Typically 10 to 25 percent of water quality volume.

☐ ☐ ☐ *CROSS SECTION THROUGH FACILITY*

- ☐ ☐ ☑ Existing Ground.
- ☑ ☐ ☐ Proposed grade.
- ☑ ☐ ☐ Top of facility - constructed and settled.
- ☑ ☐ ☐ Location of emergency spillway with side slopes labeled (emergency spillway in cut).
- ☑ ☐ ☐ Bottom of core trench (4' minimum).
- ☐ ☑ ☐ Location of each soil boring.
- ☑ ☐ ☐ Barrel location.
- ☐ ☐ ☑ Existing and proposed utility location/protection.

☐ ☐ ☐ *EMERGENCY SPILLWAY PROFILE*

- ☑ ☐ ☐ Existing ground.
- ☐ ☐ ☑ Inlet, level (control) and outlet sections per SCS.
- ☑ ☐ ☐ Spillway and crest elevations.

☐ ☐ ☑ *PRETREATMENT DEVICES* of adequate depth and properly designed using required pretreatment volumes for the selected County BMP facility type. Including, but not limited to: sediment forebays, sediment basins, sumps, grass channels, gravel diaphragms, plunge pools, chamber separators, manufactured systems or other acceptable methods.

Yes	No	N/A	
☑	☐	☐	*CONSTRUCTION SPECIFICATIONS and NOTES*
☑	☐	☐	Anticipated sequence of construction for BMP (consistent with erosion and sediment control plan).
☐	☑	☐	Provisions to control base stream or storm flow conditions encountered during construction.
☑	☐	☐	Site and subgrade preparation requirements.
☑	☐	☐	Embankment, fill and backfill material soil and placement (lift) thickness requirements.
☑	☐	☐	Compaction ~~and soil moisture~~ content requirements.
☐	☐	☑	Geosynthetics for drainage, filtration, moisture barrier, separation, and reinforcement purposes.
☐	☐	☑	Clay or synthetic (PVC or HDPE) pond liners.
☐	☐	☑	Storm drain, underdrain and pipe conduit requirements.
☐	☐	☑	Minimum depth of pipe cover for temporary (construction) and final cover conditions.
☐	☐	☑	Permanent shutoff valve and pond drain.
☑	☐	☐	Concrete requirements for structural components.
☑	☐	☐	Riprap and slope protection.
☑	☐	☐	Access or maintenance road surface, base, subbase.
☑	☐	☐	Temporary and permanent stabilization measures.
☐	☐	☑	Temporary or permanent safety fencing.
☐	☐	☑	BMP Landscaping (deep, shallow, fringe, perimeter,etc.)
☐	☐	☑	Dust and traffic control (if warranted).
☐	☐	☐	Construction monitoring and certification by professional.
☐	☐	☐	Other: _____
☐	☐	☐	Other: _____.
☐	☐	☐	*MAINTENANCE PROVISIONS*
Contractor unknown	☑	☐	Entity responsible for maintenance identified..
To be provided.	☑	☐	Maintenance Plan which outlines the long-term schedule for inspection/maintenance of the facility and forebays
☑	☐	☐	Maintenance access from public right-of-way or publicly traveled road.
☐	☐	☑	Maintenance easement provided encompassing high water pool and buffer, principal and emergency spillways, outlet structures, forebays, embankment area and possible sediment-removal stockpile areas.
☐	☐	☑	Minimum 6 foot wide public safety shelf (landing) or alternative fencing.

IV. *OUTLET PROTECTIONS:*

Yes	No	N/A	
☑	☐	☐	Sized for maximum design release (generally 10-year storm).
☑	☐	☐	Flared end section or endwall.
☑	☐	☐	Dimensions.
☑	☐	☐	Rock or riprap size, quantity and placement thickness.
☐	☑	☐	Slope at 0 percent (Level Grade).
☐	☐	☑	Geotextiles (nonwoven).
☐	☐	☑	Special energy dissipators are required for design discharge velocities that exceed eighteen (18) feet per second; or if use of standard outlet protection would result in velocities exceeding permissible channel velocities; or if space restricts or limits their use.

V. *ADDITIONAL COMMENTS OR INFORMATION SPECIFIC TO THE PLAN:*

Plan Preparer: LandMark Design Group

Date: 10/29/03

SWMProg/BMP/Checklist/ChkList

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Stonehouse Glen Subdivision

October 28, 2003

PROJECT DESCRIPTION:

Section 1 of the Stonehouse Glen Subdivision proposes the construction of 76 single-family detached residential homesites, two park areas totaling 2 acres of land, a pump station site and a stormwater management facility designed for flow attenuation only. To effect this plan, disturbance to approximately 9 acres of land will be required for construction of proposed public streets, on-site public utilities and the pump station, the stormwater management facility and other erosion and sediment control devices.

EXISTING SITE CONDITIONS:

Existing topography is characterized by relatively narrow ridgetops with intervening ravine systems. Elevations range from approximately 50 feet above MSL to approximately 115 feet above MSL. The existing land use is vacant. The existing cover is forested with a combination of mixed deciduous and evergreen species; the majority of the site has been repeatedly timbered over the past 50+ years. Surface drainage flows generally from the south to the north through a series of ravines which coalesce at Bird Swamp, and thereafter, flows enter the Ware Creek and ultimately the York River.

ADJACENT AREA DESCRIPTION:

Adjacent on-site areas (Land Bays 19, 20 and 22) are characterized by the same topographic features and drainage patterns, with surface drainage flowing along the same path as described above. All land east, west, north and south of the subject site is undeveloped, wooded and characterized by ridgetops dissected by ravines. The floodplain of Bird Swamp is broad with a braided channel; all other ravine systems are restricted in width and depth and with fairly direct flow lines. Substantial undisturbed land separates the proposed land disturbance activities associated with the subject project and the receiving waters; concentrated flow is being purposefully limited across the project with the majority of post-development flow being directed to the many ravine systems, well below erosive velocities. Potential impacts to receiving waters are expected to be negligible given structural E&S practices and the sequence of construction proposed.

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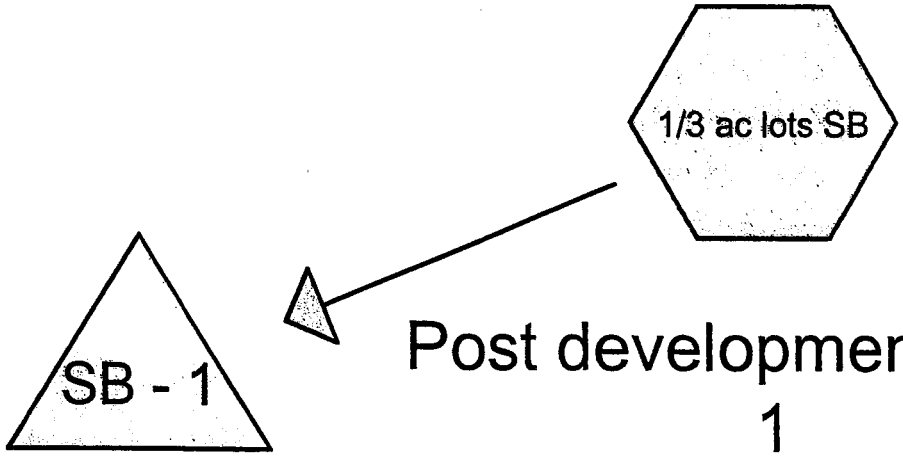
STONEHOUSE GLEN
SEDIMENT AND EROSION CONTROL NARRATIVE

The erosion and sediment control plan utilizes various methods to contain sediment and minimize erosion. The methods include silt fence, diversion dikes, temporary drains, sediment traps, sediment basins, inlet protection, etc.

Where the upslope drainage area is within the allowable parameters for silt fence, it is used. Other areas, exceeding these limits, utilize sediment traps and sediment basins below construction areas. Sediment traps and sediment basins are used in four different locations. The permanent detention basins are to function as temporary sediment basins during construction, until areas draining to them are stabilized.

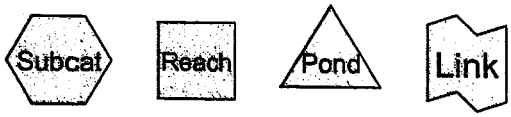
Sediment trap #1 on Lot 19 will collect runoff for the road construction at the east end of Ashlock Court. The runoff from the wooded area above the sediment trap will be diverted with diversion dikes through a temporary pipe system. The temporary pipe will be filled with flowable fill after stabilization.

Three permanent detention basins will function as temporary sediment basins until all areas draining to them are stabilized. The design and construction for all erosion and sediment control measures can be found on Sheets C-16, C-16A, C-16B, C-24, C-25 and C-26.



Post development to SB 1

Sediment Basin #1



Drainage Diagram for bmp 1 temp sed basin Revised
Prepared by Landmark Design Group 10/27/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONEHOUSE GLEN SECTION I

Basin # BMP#1 Location SOUTH EAST ASLOCK COURT

Total area draining to basin: 11.05 acres.

Basin Volume Design

Wet Storage:

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 11.05 acres = 740.4 cu. yds.

2. Available basin volume = 743.2 cu. yds. at elevation 78.15. (From storage - elevation curve)

3. Excavate _____ cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 11.05 acres = 364.7 cu. yds.

5. Elevation corresponding to cleanout level = 76.14.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 2 ft. (Min. = 1.0 ft.)

Dry Storage:

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 11.05 acres = 740.4 cu. yds.

8. Total available basin volume at crest of riser* = 1486.3 cu. yds. at elevation 80.64 (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 6 in.

10. Diameter of flexible tubing = 8 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 80.64

Top of Dam = 83.82

Design High Water = 81.57 (25 yr) 81.82 (100 yr)

Upstream Toe of Dam = 67.00

Basin Shape

12. Length of Flow / Effective Width — L / We = _____

If > 2, baffles are not required _____

If < 2, baffles are required YES

Runoff

13. Q_2 = 20.80 cfs (From Chapter 5)

14. Q_{25} = 51.61 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 51.61 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = N/A ft. (Using Q_2)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 1.0' ft. (Using Q_{25})

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter (D_r) = 60 in. Actual head (h) = ____ ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 84 ft.

Head (H) on barrel through embankment = 13.80 ft.

(From Plate 3.14-7).

19. Barrel diameter = 30" in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 96" inches.

Height = 24 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = N/A cfs.

22. Bottom width (b) = N/A ft.; the slope of the exit channel (s) = ____ ft./foot; and the minimum length of the exit channel (x) = ____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 8.64 ft.

Slope of upstream face of embankment (Z) = 3 :1.

Slope of principal spillway barrel (S_b) = 1.0 %

Length of barrel in saturated zone (L_s) = 62 ft.

24. Number of collars required = 4 dimensions = 4'X4'

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = 83.82

Design High Water = 81.57 (25 year)

Emergency Spillway Crest = N.A.

Principal Spillway Crest = 80.64

Dewatering Orifice Invert = 78.15

Cleanout Elevation = 76.14

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = 72.00

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

LENGTH OF PIPE IN SATURATED ZONE

BMP # 1

CREST OF RISER = 80.64
BOTTOM OF POND = 72.00

$$L_S = Y(z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 8.64'$

$Z = 3:1$ SLOPE

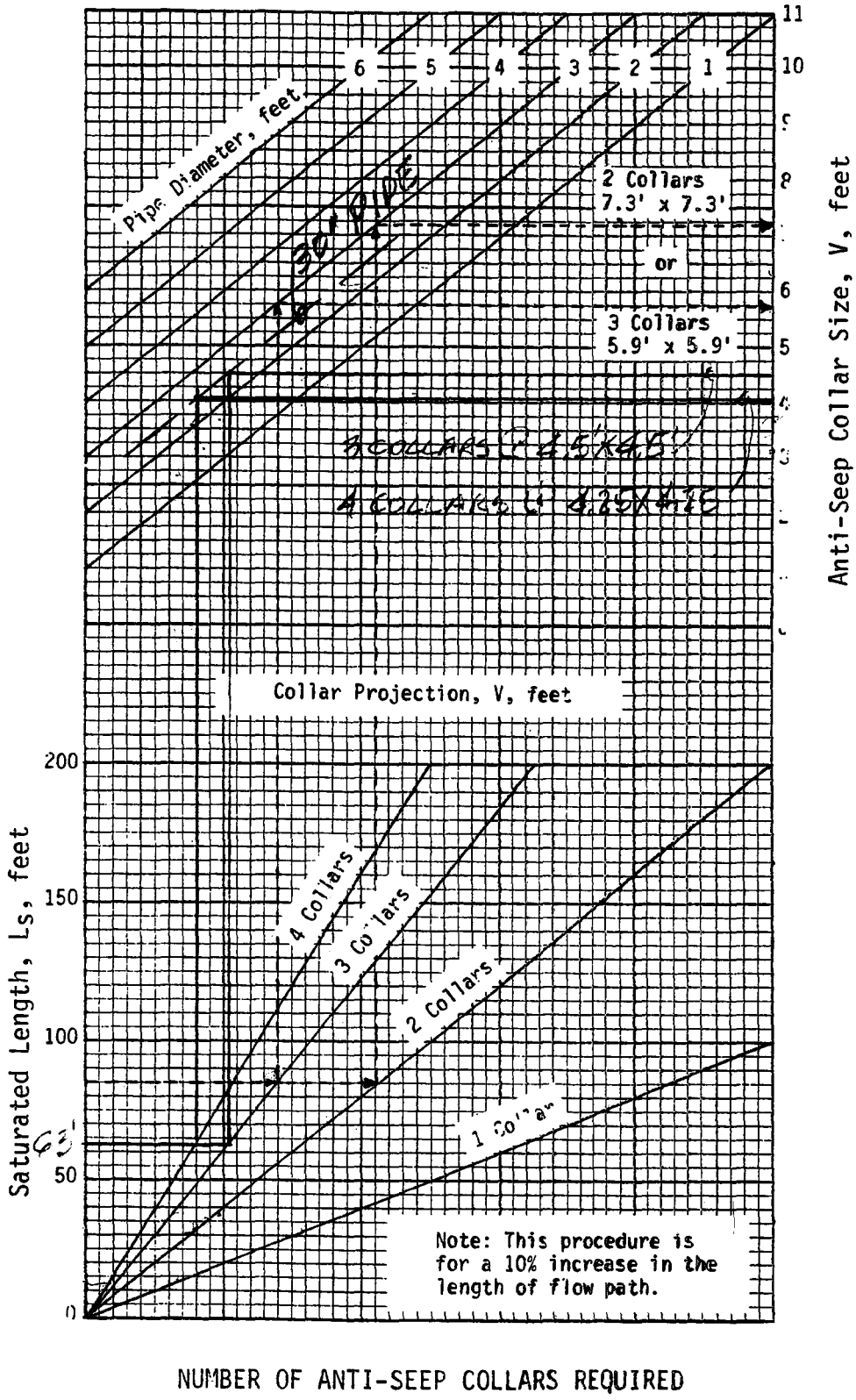
$S = 1.0\%$

$$L_S = 8.64(3+4)\left(1+\frac{0.01}{0.25-0.01}\right)$$

$L_S = 8.64 \times 7 \times 1.0417$

$L_S = 63.0'$

USE 4 COLLARS 4.25' X 4.25'



NUMBER OF ANTI-SEEP COLLARS REQUIRED

Source: USDA-SCS

BMP # 1

Plate 3.14-12

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1/3 ac lots SB: Post development to SB 1 Runoff Area=11.050 ac Runoff Depth=1.70"
Tc=20.0 min CN=81 Runoff=20.80 cfs 1.565 af

Pond SB - 1: Sediment Basin #1 Peak Elev=80.52' Storage=38,954 cf Inflow=20.80 cfs 1.565 af
Outflow=1.40 cfs 1.022 af

Total Runoff Area = 11.050 ac Runoff Volume = 1.565 af Average Runoff Depth = 1.70"

Subcatchment 1/3 ac lots SB: Post development to SB 1

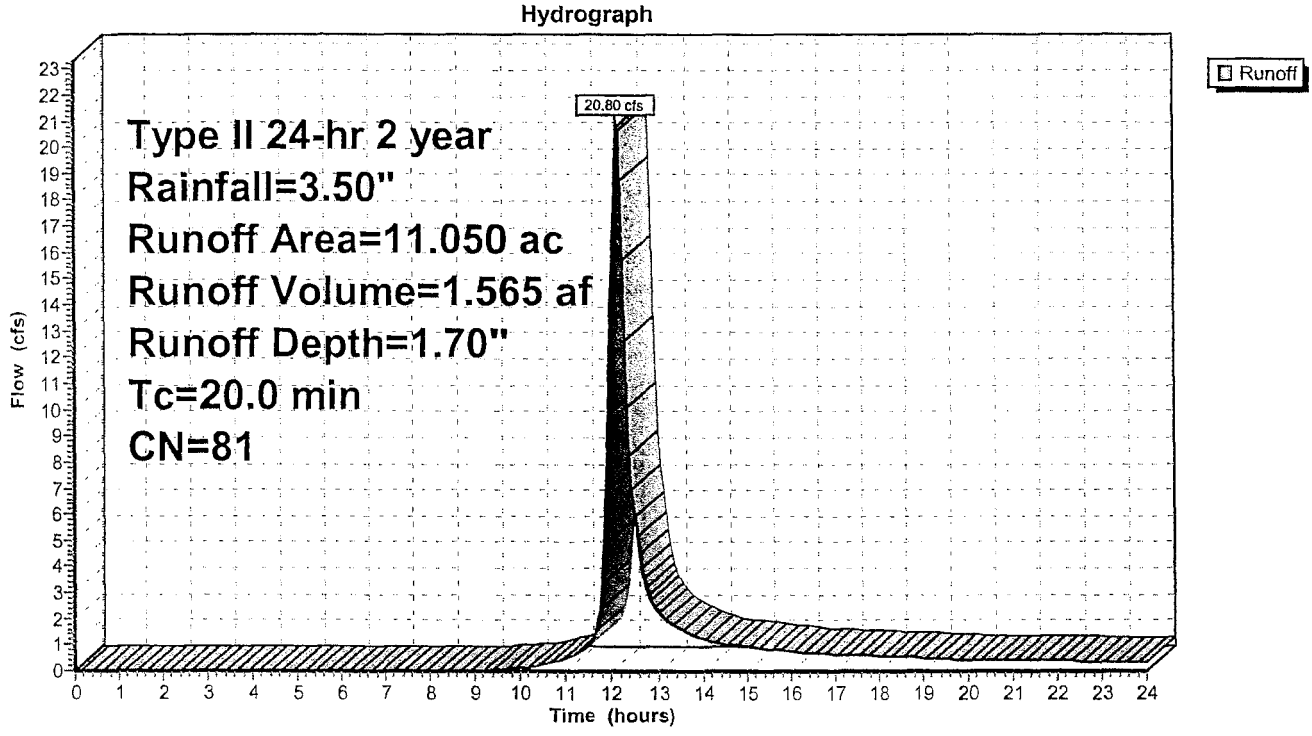
Runoff = 20.80 cfs @ 12.13 hrs, Volume= 1.565 af, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 year Rainfall=3.50"

Area (ac)	CN	Description
11.050	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1/3 ac lots SB: Post development to SB 1



Hydrograph for Subcatchment 1/3 ac lots SB: Post development to SB 1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	13.00	2.70	1.09	2.27
0.25	0.01	0.00	0.00	13.25	2.75	1.13	1.86
0.50	0.02	0.00	0.00	13.50	2.80	1.16	1.62
0.75	0.03	0.00	0.00	13.75	2.84	1.19	1.42
1.00	0.04	0.00	0.00	14.00	2.87	1.21	1.27
1.25	0.05	0.00	0.00	14.25	2.90	1.24	1.13
1.50	0.06	0.00	0.00	14.50	2.93	1.26	1.06
1.75	0.07	0.00	0.00	14.75	2.96	1.28	1.01
2.00	0.08	0.00	0.00	15.00	2.99	1.30	0.96
2.25	0.09	0.00	0.00	15.25	3.01	1.32	0.91
2.50	0.10	0.00	0.00	15.50	3.04	1.34	0.86
2.75	0.11	0.00	0.00	15.75	3.06	1.36	0.81
3.00	0.12	0.00	0.00	16.00	3.08	1.38	0.76
3.25	0.13	0.00	0.00	16.25	3.10	1.39	0.71
3.50	0.14	0.00	0.00	16.50	3.12	1.41	0.68
3.75	0.16	0.00	0.00	16.75	3.14	1.42	0.67
4.00	0.17	0.00	0.00	17.00	3.16	1.43	0.65
4.25	0.18	0.00	0.00	17.25	3.17	1.45	0.63
4.50	0.19	0.00	0.00	17.50	3.19	1.46	0.61
4.75	0.21	0.00	0.00	17.75	3.21	1.47	0.59
5.00	0.22	0.00	0.00	18.00	3.22	1.49	0.58
5.25	0.23	0.00	0.00	18.25	3.24	1.50	0.56
5.50	0.25	0.00	0.00	18.50	3.25	1.51	0.54
5.75	0.26	0.00	0.00	18.75	3.27	1.52	0.52
6.00	0.28	0.00	0.00	19.00	3.28	1.53	0.50
6.25	0.30	0.00	0.00	19.25	3.30	1.54	0.48
6.50	0.31	0.00	0.00	19.50	3.31	1.55	0.47
6.75	0.33	0.00	0.00	19.75	3.32	1.56	0.45
7.00	0.35	0.00	0.00	20.00	3.33	1.57	0.43
7.25	0.36	0.00	0.00	20.25	3.34	1.58	0.41
7.50	0.38	0.00	0.00	20.50	3.35	1.59	0.40
7.75	0.40	0.00	0.00	20.75	3.37	1.60	0.40
8.00	0.42	0.00	0.00	21.00	3.38	1.61	0.39
8.25	0.44	0.00	0.00	21.25	3.39	1.62	0.39
8.50	0.46	0.00	0.00	21.50	3.40	1.63	0.39
8.75	0.49	0.00	0.00	21.75	3.41	1.64	0.38
9.00	0.51	0.00	0.01	22.00	3.42	1.64	0.38
9.25	0.54	0.00	0.04	22.25	3.43	1.65	0.38
9.50	0.57	0.00	0.07	22.50	3.44	1.66	0.37
9.75	0.60	0.01	0.10	22.75	3.45	1.67	0.37
10.00	0.63	0.01	0.14	23.00	3.46	1.68	0.37
10.25	0.67	0.02	0.19	23.25	3.47	1.68	0.36
10.50	0.71	0.02	0.26	23.50	3.48	1.69	0.36
10.75	0.76	0.03	0.35	23.75	3.49	1.70	0.36
11.00	0.82	0.05	0.48	24.00	**3.50**	**1.71**	0.35
11.25	0.90	0.07	0.66				
11.50	0.99	0.09	0.99				
11.75	1.35	0.24	2.37				
12.00	2.32	0.82	**13.74**				
12.25	2.47	0.92	**15.72**				
12.50	2.57	0.99	5.96				
12.75	2.64	1.05	3.21				

Pond SB - 1: Sediment Basin #1

Inflow Area = 11.050 ac, Inflow Depth = 1.70" for 2 year event
Inflow = 20.80 cfs @ 12.13 hrs, Volume= 1.565 af
Outflow = 1.40 cfs @ 13.79 hrs, Volume= 1.022 af, Atten= 93%, Lag= 99.5 min
Primary = 1.40 cfs @ 13.79 hrs, Volume= 1.022 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 80.52' @ 13.79 hrs Surf.Area= 9,467 sf Storage= 38,954 cf
Plug-Flow detention time= 301.0 min calculated for 1.022 af (65% of inflow)
Center-of-Mass det. time= 192.5 min (1,034.2 - 841.7)

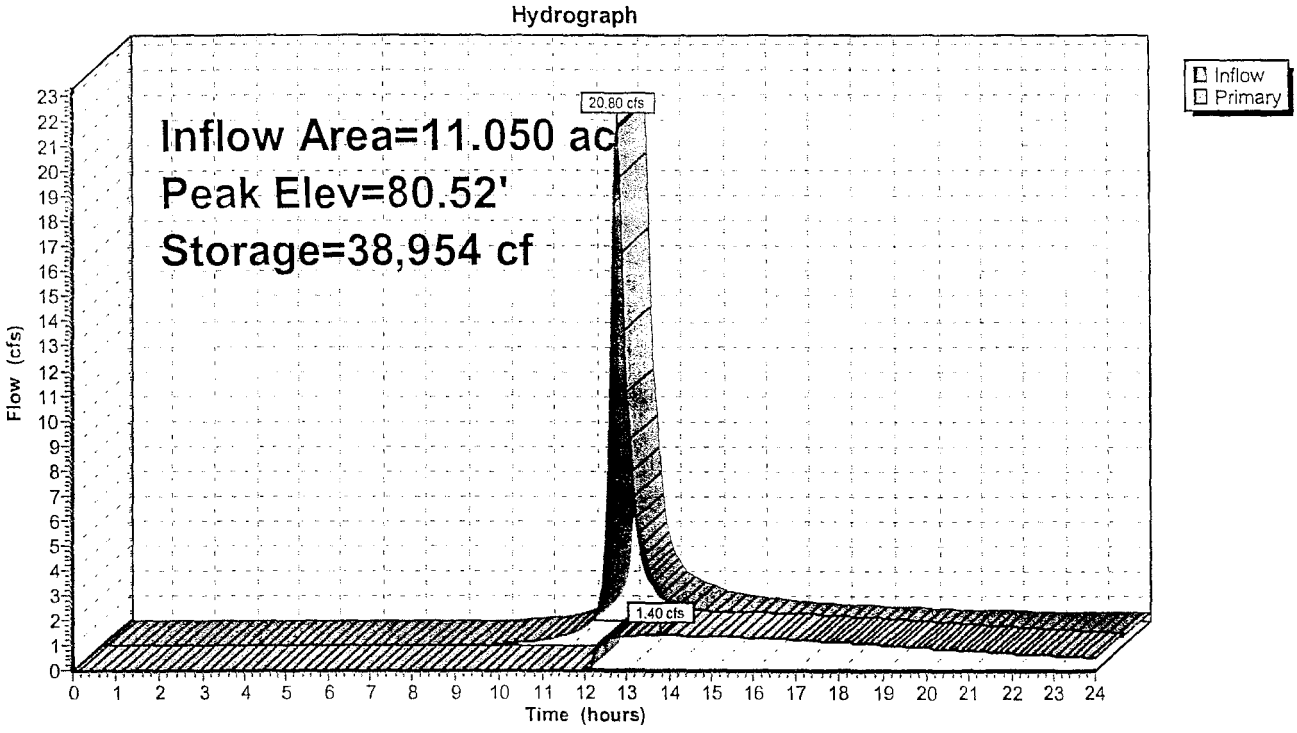
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	78.09'	**6.0" Vert. 6" Dewatering Device** C= 0.600
3	Device 1	80.64'	**60.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.40 cfs @ 13.79 hrs HW=80.52' (Free Discharge)
└**1=Culvert** (Passes 1.40 cfs of 79.92 cfs potential flow)
├**2=6" Dewatering Device** (Orifice Controls 1.40 cfs @ 7.1 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond SB - 1: Sediment Basin #1



Hydrograph for Pond SB - 1: Sediment Basin #1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	72.00	0.00
0.25	0.00	0	72.00	0.00
0.50	0.00	0	72.00	0.00
0.75	0.00	0	72.00	0.00
1.00	0.00	0	72.00	0.00
1.25	0.00	0	72.00	0.00
1.50	0.00	0	72.00	0.00
1.75	0.00	0	72.00	0.00
2.00	0.00	0	72.00	0.00
2.25	0.00	0	72.00	0.00
2.50	0.00	0	72.00	0.00
2.75	0.00	0	72.00	0.00
3.00	0.00	0	72.00	0.00
3.25	0.00	0	72.00	0.00
3.50	0.00	0	72.00	0.00
3.75	0.00	0	72.00	0.00
4.00	0.00	0	72.00	0.00
4.25	0.00	0	72.00	0.00
4.50	0.00	0	72.00	0.00
4.75	0.00	0	72.00	0.00
5.00	0.00	0	72.00	0.00
5.25	0.00	0	72.00	0.00
5.50	0.00	0	72.00	0.00
5.75	0.00	0	72.00	0.00
6.00	0.00	0	72.00	0.00
6.25	0.00	0	72.00	0.00
6.50	0.00	0	72.00	0.00
6.75	0.00	0	72.00	0.00
7.00	0.00	0	72.00	0.00
7.25	0.00	0	72.00	0.00
7.50	0.00	0	72.00	0.00
7.75	0.00	0	72.00	0.00
8.00	0.00	0	72.00	0.00
8.25	0.00	0	72.00	0.00
8.50	0.00	0	72.00	0.00
8.75	0.00	0	72.00	0.00
9.00	0.01	6	72.00	0.00
9.25	0.04	30	72.02	0.00
9.50	0.07	79	72.05	0.00
9.75	0.10	152	72.10	0.00
10.00	0.14	256	72.16	0.00
10.25	0.19	400	72.25	0.00
10.50	0.26	598	72.38	0.00
10.75	0.35	869	72.55	0.00
11.00	0.48	1,238	72.79	0.00
11.25	0.66	1,746	73.11	0.00
11.50	0.99	2,480	73.58	0.00
11.75	2.37	3,743	74.20	0.00
12.00	**13.74**	9,681	76.11	0.00
12.25	**15.72**	26,134	78.98	0.76
12.50	5.96	33,970	80.04	1.23
12.75	3.21	36,737	80.31	1.33
13.00	2.27	37,925	80.42	1.36
13.25	1.86	38,532	80.48	1.38
13.50	1.62	38,841	80.51	1.39
13.75	1.42	**38,952**	**80.52**	**1.40**
14.00	1.27	**38,904**	**80.52**	**1.40**
14.25	1.13	38,729	80.50	1.39
14.50	1.06	38,465	80.48	1.38
14.75	1.01	38,155	80.45	1.37
15.00	0.96	37,810	80.41	1.36
15.25	0.91	37,431	80.38	1.35
15.50	0.86	37,019	80.33	1.34
15.75	0.81	36,575	80.29	1.32
16.00	0.76	36,100	80.24	1.30
16.25	0.71	35,594	80.20	1.29
16.50	0.68	35,071	80.14	1.27
16.75	0.67	34,544	80.09	1.25
17.00	0.65	34,017	80.04	1.23
17.25	0.63	33,491	79.98	1.21
17.50	0.61	32,971	79.91	1.19
17.75	0.59	32,458	79.84	1.16
18.00	0.58	31,954	79.77	1.13
18.25	0.56	31,457	79.71	1.11
18.50	0.54	30,969	79.64	1.08
18.75	0.52	30,488	79.57	1.05
19.00	0.50	30,016	79.51	1.02
19.25	0.48	29,553	79.45	0.99
19.50	0.47	29,098	79.38	0.97
19.75	0.45	28,652	79.32	0.94
20.00	0.43	28,214	79.26	0.91
20.25	0.41	27,787	79.21	0.88
20.50	0.40	27,374	79.15	0.85
20.75	0.40	26,982	79.10	0.82
21.00	0.39	26,612	79.04	0.79
21.25	0.39	26,264	79.00	0.77
21.50	0.39	25,938	78.95	0.74
21.75	0.38	25,631	78.91	0.71
22.00	0.38	25,344	78.87	0.69
22.25	0.38	25,077	78.83	0.66
22.50	0.37	24,827	78.80	0.64
22.75	0.37	24,595	78.77	0.62
23.00	0.37	24,380	78.74	0.60
23.25	0.36	24,180	78.71	0.58
23.50	0.36	23,995	78.69	0.56
23.75	0.36	23,826	78.66	0.54
24.00	0.35	23,670	78.64	0.52

Stage-Area-Storage for Pond SB - 1: Sediment Basin #1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
72.00	978	0
72.15	1,067	236
72.30	1,157	472
72.45	1,246	708
72.60	1,336	944
72.75	1,425	1,181
72.90	1,514	1,417
73.05	1,604	1,653
73.20	1,693	1,889
73.35	1,783	2,125
73.50	1,872	2,361
73.65	1,961	2,597
73.80	2,051	2,833
73.95	2,140	3,069
74.10	2,253	3,448
74.25	2,378	3,899
74.40	2,503	4,349
74.55	2,628	4,800
74.70	2,753	5,250
74.85	2,878	5,701
75.00	3,003	6,151
75.15	3,128	6,601
75.30	3,253	7,052
75.45	3,378	7,502
75.60	3,503	7,953
75.75	3,628	8,403
75.90	3,753	8,854
76.05	3,890	9,399
76.20	4,050	10,135
76.35	4,211	10,871
76.50	4,371	11,607
76.65	4,532	12,343
76.80	4,692	13,079
76.95	4,853	13,815
77.10	5,014	14,551
77.25	5,174	15,287
77.40	5,335	16,023
77.55	5,495	16,759
77.70	5,656	17,495
77.85	5,816	18,231
78.00	5,977	18,967
78.15	6,178	20,065
78.30	6,380	21,163
78.45	6,581	22,261
78.60	6,782	23,358
78.75	6,984	24,456
78.90	7,185	25,554
79.05	7,386	26,652
79.20	7,587	27,750
79.35	7,789	28,848
79.50	7,990	29,946
79.65	8,191	31,043
79.80	8,393	32,141
79.95	8,594	33,239
80.10	8,815	34,625
80.25	9,045	36,154
80.40	9,275	37,684
80.55	9,506	39,213
80.70	9,736	40,743
80.85	9,966	42,272
81.00	10,197	43,802
81.15	10,427	45,331
81.30	10,657	46,860
81.45	10,887	48,390
81.60	11,118	49,919
81.75	11,348	51,449
81.90	11,578	52,978
82.05	11,909	54,673
82.20	12,441	56,699
82.35	12,973	58,725
82.50	13,505	60,750
82.65	14,036	62,776
82.80	14,568	64,802
82.95	**15,100**	**66,827**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1/3 ac lots SB: Post development to SB 1 Runoff Area=11.050 ac Runoff Depth=4.23"
Tc=20.0 min CN=81 Runoff=51.61 cfs 3.896 af

Pond SB - 1: Sediment Basin #1 Peak Elev=81.57' Storage=49,656 cf Inflow=51.61 cfs 3.896 af
Outflow=48.07 cfs 3.183 af

Total Runoff Area = 11.050 ac Runoff Volume = 3.896 af Average Runoff Depth = 4.23"

Subcatchment 1/3 ac lots SB: Post development to SB 1

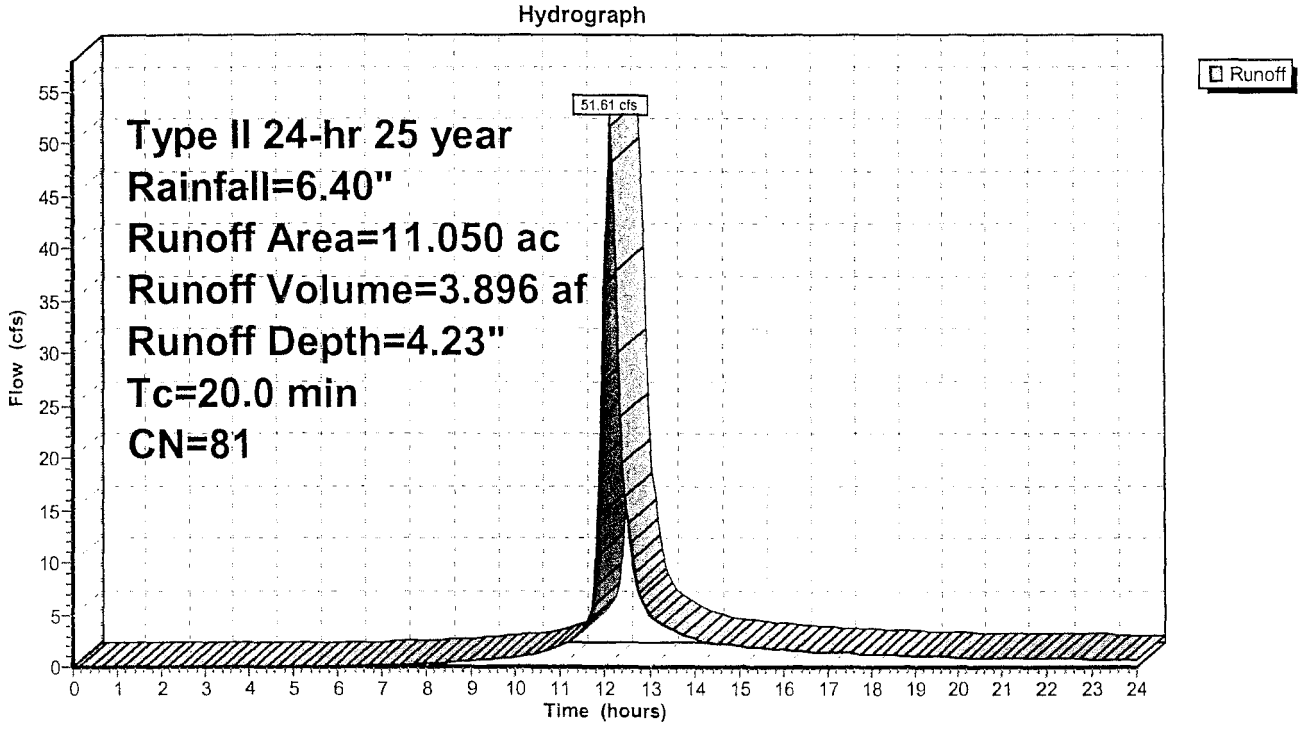
Runoff = 51.61 cfs @ 12.12 hrs, Volume= 3.896 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=6.40"

Area (ac)	CN	Description
11.050	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1/3 ac lots SB: Post development to SB 1



Hydrograph for Subcatchment 1/3 ac lots SB: Post development to SB 1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00
0.25	0.02	0.00	0.00
0.50	0.03	0.00	0.00
0.75	0.05	0.00	0.00
1.00	0.07	0.00	0.00
1.25	0.08	0.00	0.00
1.50	0.10	0.00	0.00
1.75	0.12	0.00	0.00
2.00	0.14	0.00	0.00
2.25	0.16	0.00	0.00
2.50	0.18	0.00	0.00
2.75	0.20	0.00	0.00
3.00	0.22	0.00	0.00
3.25	0.24	0.00	0.00
3.50	0.26	0.00	0.00
3.75	0.28	0.00	0.00
4.00	0.31	0.00	0.00
4.25	0.33	0.00	0.00
4.50	0.35	0.00	0.00
4.75	0.38	0.00	0.00
5.00	0.40	0.00	0.00
5.25	0.43	0.00	0.00
5.50	0.46	0.00	0.00
5.75	0.48	0.00	0.00
6.00	0.51	0.00	0.01
6.25	0.54	0.00	0.04
6.50	0.57	0.00	0.07
6.75	0.60	0.01	0.10
7.00	0.63	0.01	0.14
7.25	0.67	0.02	0.17
7.50	0.70	0.02	0.21
7.75	0.73	0.03	0.25
8.00	0.77	0.03	0.29
8.25	0.81	0.04	0.33
8.50	0.85	0.05	0.39
8.75	0.89	0.06	0.48
9.00	0.94	0.08	0.57
9.25	0.99	0.10	0.67
9.50	1.04	0.11	0.74
9.75	1.10	0.13	0.81
10.00	1.16	0.16	0.94
10.25	1.23	0.19	1.11
10.50	1.31	0.22	1.35
10.75	1.40	0.26	1.64
11.00	1.50	0.32	2.05
11.25	1.64	0.39	2.61
11.50	1.81	0.49	3.57
11.75	2.48	0.93	7.63
12.00	4.24	2.33	**36.47**
12.25	4.52	2.56	**37.76**
12.50	4.70	2.73	13.74
12.75	4.83	2.84	7.19
13.00	4.94	2.93	5.01
13.25	5.03	3.01	4.08
13.50	5.11	3.09	3.53
13.75	5.18	3.15	3.09
14.00	5.25	3.21	2.74
14.25	5.31	3.26	2.45
14.50	5.36	3.31	2.28
14.75	5.41	3.35	2.16
15.00	5.46	3.40	2.06
15.25	5.51	3.44	1.95
15.50	5.55	3.48	1.84
15.75	5.59	3.52	1.73
16.00	5.63	3.55	1.62
16.25	5.67	3.58	1.51
16.50	5.70	3.61	1.45
16.75	5.74	3.65	1.41
17.00	5.77	3.68	1.37
17.25	5.80	3.71	1.33
17.50	5.83	3.73	1.29
17.75	5.87	3.76	1.25
18.00	5.89	3.79	1.22
18.25	5.92	3.81	1.18
18.50	5.95	3.84	1.14
18.75	5.98	3.86	1.10
19.00	6.00	3.89	1.06
19.25	6.03	3.91	1.02
19.50	6.05	3.93	0.98
19.75	6.07	3.95	0.94
20.00	6.09	3.97	0.90
20.25	6.11	3.99	0.86
20.50	6.13	4.01	0.84
20.75	6.15	4.02	0.83
21.00	6.17	4.04	0.83
21.25	6.19	4.06	0.82
21.50	6.21	4.08	0.81
21.75	6.23	4.10	0.80
22.00	6.25	4.11	0.79
22.25	6.27	4.13	0.79
22.50	6.29	4.15	0.78
22.75	6.31	4.17	0.77
23.00	6.33	4.18	0.76
23.25	6.35	4.20	0.75
23.50	6.36	4.22	0.75
23.75	6.38	4.23	0.74
24.00	**6.40**	**4.25**	0.73

Pond SB - 1: Sediment Basin #1

Inflow Area =	11.050 ac,	Inflow Depth =	4.23"	for	25 year event
Inflow =	51.61 cfs @	12.12 hrs,	Volume=	3.896 af	
Outflow =	48.07 cfs @	12.18 hrs,	Volume=	3.183 af,	Atten= 7%, Lag= 3.7 min
Primary =	48.07 cfs @	12.18 hrs,	Volume=	3.183 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 81.57' @ 12.18 hrs Surf.Area= 11,078 sf Storage= 49,656 cf
Plug-Flow detention time= 147.3 min calculated for 3.176 af (82% of inflow)
Center-of-Mass det. time= 72.7 min (888.8 - 816.1)

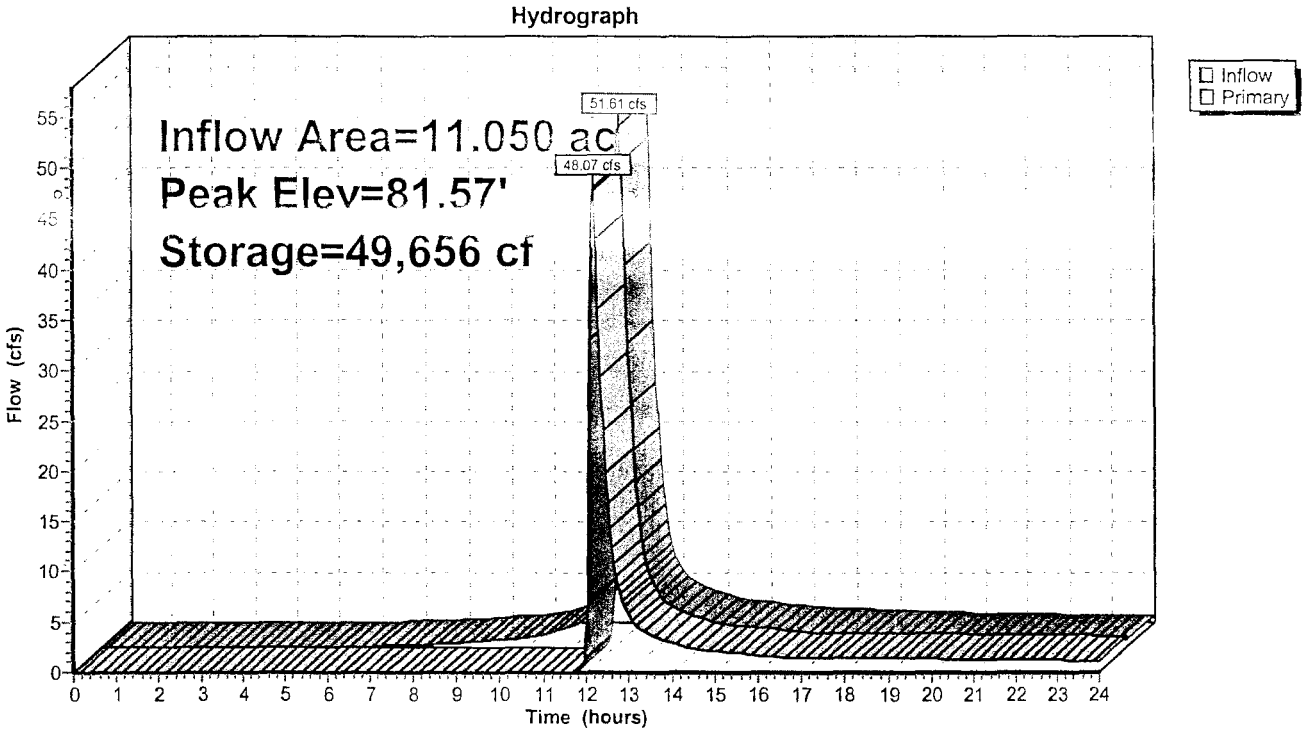
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	78.09'	**6.0" Vert. 6" Dewatering Device** C= 0.600
3	Device 1	80.64'	**60.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=47.42 cfs @ 12.18 hrs HW=81.57' (Free Discharge)
└**1=Culvert** (Passes 47.42 cfs of 83.48 cfs potential flow)
  ├**2=6" Dewatering Device** (Orifice Controls 1.70 cfs @ 8.6 fps)
  └**3=Orifice/Grate** (Weir Controls 45.73 cfs @ 3.1 fps)

Pond SB - 1: Sediment Basin #1

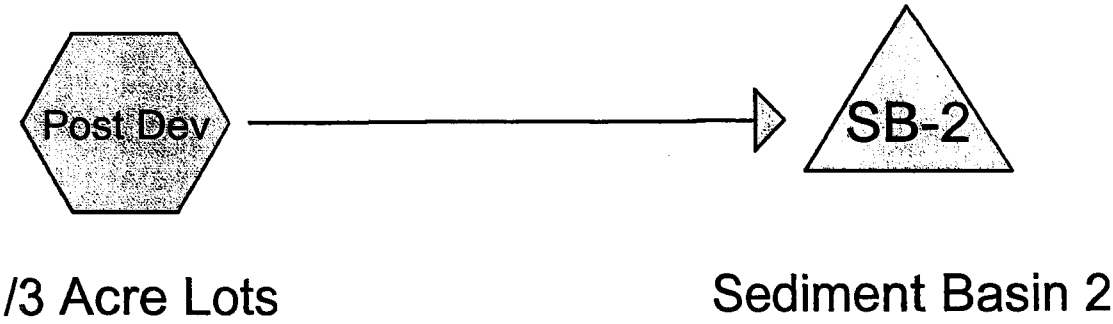


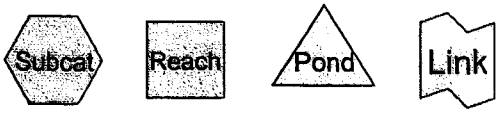
Hydrograph for Pond SB - 1: Sediment Basin #1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	72.00	0.00
0.25	0.00	0	72.00	0.00
0.50	0.00	0	72.00	0.00
0.75	0.00	0	72.00	0.00
1.00	0.00	0	72.00	0.00
1.25	0.00	0	72.00	0.00
1.50	0.00	0	72.00	0.00
1.75	0.00	0	72.00	0.00
2.00	0.00	0	72.00	0.00
2.25	0.00	0	72.00	0.00
2.50	0.00	0	72.00	0.00
2.75	0.00	0	72.00	0.00
3.00	0.00	0	72.00	0.00
3.25	0.00	0	72.00	0.00
3.50	0.00	0	72.00	0.00
3.75	0.00	0	72.00	0.00
4.00	0.00	0	72.00	0.00
4.25	0.00	0	72.00	0.00
4.50	0.00	0	72.00	0.00
4.75	0.00	0	72.00	0.00
5.00	0.00	0	72.00	0.00
5.25	0.00	0	72.00	0.00
5.50	0.00	0	72.00	0.00
5.75	0.00	0	72.00	0.00
6.00	0.01	4	72.00	0.00
6.25	0.04	27	72.02	0.00
6.50	0.07	76	72.05	0.00
6.75	0.10	153	72.10	0.00
7.00	0.14	261	72.17	0.00
7.25	0.17	400	72.25	0.00
7.50	0.21	572	72.36	0.00
7.75	0.25	777	72.49	0.00
8.00	0.29	1,016	72.65	0.00
8.25	0.33	1,292	72.82	0.00
8.50	0.39	1,616	73.03	0.00
8.75	0.48	2,007	73.28	0.00
9.00	0.57	2,478	73.57	0.00
9.25	0.67	3,037	73.93	0.00
9.50	0.74	3,674	74.17	0.00
9.75	0.81	4,367	74.41	0.00
10.00	0.94	5,149	74.67	0.00
10.25	1.11	6,069	74.97	0.00
10.50	1.35	7,175	75.34	0.00
10.75	1.64	8,516	75.79	0.00
11.00	2.05	10,171	76.21	0.00
11.25	2.61	12,249	76.63	0.00
11.50	3.57	14,998	77.19	0.00
11.75	7.63	19,299	78.05	0.00
12.00	**36.47**	**35,714**	**80.21**	**1.29**
12.25	**37.76**	**48,938**	**81.50**	**42.98**
12.50	13.74	44,642	81.08	16.77
12.75	7.19	42,817	80.90	8.49
13.00	5.01	41,993	80.82	5.58
13.25	4.08	41,623	80.79	4.43
13.50	3.53	41,356	80.76	3.78
13.75	3.09	41,158	80.74	3.29
14.00	2.74	40,999	80.73	2.90
14.25	2.45	40,868	80.71	2.58
14.50	2.28	40,777	80.70	2.36
14.75	2.16	40,720	80.70	2.22
15.00	2.06	40,674	80.69	2.11
15.25	1.95	40,628	80.69	2.01
15.50	1.84	40,557	80.68	1.93
15.75	1.73	40,471	80.67	1.83
16.00	1.62	40,379	80.66	1.72
16.25	1.51	40,286	80.66	1.61
16.50	1.45	40,209	80.65	1.52
16.75	1.41	40,156	80.64	1.46
17.00	1.37	40,111	80.64	1.43
17.25	1.33	40,040	80.63	1.43
17.50	1.29	39,936	80.62	1.43
17.75	1.25	39,800	80.61	1.42
18.00	1.22	39,633	80.59	1.42
18.25	1.18	39,435	80.57	1.41
18.50	1.14	39,208	80.55	1.41
18.75	1.10	38,951	80.52	1.40
19.00	1.06	38,667	80.50	1.39
19.25	1.02	38,355	80.47	1.38
19.50	0.98	38,016	80.43	1.37
19.75	0.94	37,651	80.40	1.36
20.00	0.90	37,262	80.36	1.34
20.25	0.86	36,848	80.32	1.33
20.50	0.84	36,423	80.28	1.32
20.75	0.83	35,999	80.23	1.30
21.00	0.83	35,581	80.19	1.29
21.25	0.82	35,168	80.15	1.27
21.50	0.81	34,761	80.11	1.26
21.75	0.80	34,360	80.07	1.24
22.00	0.79	33,964	80.04	1.23
22.25	0.79	33,573	80.00	1.22
22.50	0.78	33,192	79.94	1.20
22.75	0.77	32,820	79.89	1.18
23.00	0.76	32,458	79.84	1.16
23.25	0.75	32,106	79.80	1.14
23.50	0.75	31,764	79.75	1.12
23.75	0.74	31,432	79.70	1.10
24.00	0.73	31,108	79.66	1.09

Stage-Area-Storage for Pond SB - 1: Sediment Basin #1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
72.00	978	0
72.15	1,067	236
72.30	1,157	472
72.45	1,246	708
72.60	1,336	944
72.75	1,425	1,181
72.90	1,514	1,417
73.05	1,604	1,653
73.20	1,693	1,889
73.35	1,783	2,125
73.50	1,872	2,361
73.65	1,961	2,597
73.80	2,051	2,833
73.95	2,140	3,069
74.10	2,253	3,448
74.25	2,378	3,899
74.40	2,503	4,349
74.55	2,628	4,800
74.70	2,753	5,250
74.85	2,878	5,701
75.00	3,003	6,151
75.15	3,128	6,601
75.30	3,253	7,052
75.45	3,378	7,502
75.60	3,503	7,953
75.75	3,628	8,403
75.90	3,753	8,854
76.05	3,890	9,399
76.20	4,050	10,135
76.35	4,211	10,871
76.50	4,371	11,607
76.65	4,532	12,343
76.80	4,692	13,079
76.95	4,853	13,815
77.10	5,014	14,551
77.25	5,174	15,287
77.40	5,335	16,023
77.55	5,495	16,759
77.70	5,656	17,495
77.85	5,816	18,231
78.00	5,977	18,967
78.15	6,178	20,065
78.30	6,380	21,163
78.45	6,581	22,261
78.60	6,782	23,358
78.75	6,984	24,456
78.90	7,185	25,554
79.05	7,386	26,652
79.20	7,587	27,750
79.35	7,789	28,848
79.50	7,990	29,946
79.65	8,191	31,043
79.80	8,393	32,141
79.95	8,594	33,239
80.10	8,815	34,625
80.25	9,045	36,154
80.40	9,275	37,684
80.55	9,506	39,213
80.70	9,736	40,743
80.85	9,966	42,272
81.00	10,197	43,802
81.15	10,427	45,331
81.30	10,657	46,860
81.45	10,887	48,390
81.60	11,118	49,919
81.75	11,348	51,449
81.90	11,578	52,978
82.05	11,909	54,673
82.20	12,441	56,699
82.35	12,973	58,725
82.50	13,505	60,750
82.65	14,036	62,776
82.80	14,568	64,802
82.95	**15,100**	**66,827**





Drainage Diagram for SED BASIN 2
Prepared by LANDMARK DESIGN GROUP 10/26/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONE HOUSE GLEN PHASE I

Basin # #2 Location JAMES CITY COUNTY

Total area draining to basin: 6.1 acres.

Basin Volume Design

Wet Storage:

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 6.1 acres = 414.8 cu. yds.

2. Available basin volume = 417.2 cu. yds. at elevation 78.05. (From storage - elevation curve)

3. Excavate _____ cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 6.1 acres = 201.3 cu. yds.

5. Elevation corresponding to cleanout level = 75.80.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 1.6 ft. (Min. = 1.0 ft.)

Dry Storage:

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 6.1 acres = 414.8 cu. yds.

8. Total available basin volume at crest of riser* = 848.7 cu. yds. at elevation 80.55. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 6 in.

10. Diameter of flexible tubing = 8 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 80.55

Top of Dam = 83.55

Design High Water = 81.07 (25YR)

Upstream Toe of Dam = 68.00

Basin Shape

12. Length of Flow / Effective Width — L / We = 76 / 35

If > 2, baffles are not required 2.1

If < 2, baffles are required _____

Runoff

13. Q_2 = 8.10 cfs (From Chapter 5)

14. Q_{25} = 24.51 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = 8.10 cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 24.51 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using Q_2)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 0.52 ft. (Using Q_{25})

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter (D_r) = 48 in. Actual head (h) = 0.52 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 90 ft.

Head (H) on barrel through embankment = 17.9 ft.

(From Plate 3.14-7).

19. Barrel diameter = 24 in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 72 inches.

Height = 21 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = N/A cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 13.3 ft.

Slope of upstream face of embankment (Z) = 3. :1.

Slope of principal spillway barrel (S_b) = 1.00 %

Length of barrel in saturated zone (L_s) = 95. ft.

24. Number of collars required = 3. dimensions = 5.0'

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = 83.5

Design High Water = 81.07 (25 YR)

Emergency Spillway Crest = N/A.

Principal Spillway Crest = 80.55

Dewatering Orifice Invert = 78.05

Cleanout Elevation = 75.80

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = _____

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

LENGTH OF PIPE IN SATURATED ZONE

BMP #2

CREST OF RISER = 80.55
BOTTOM OF POND = 68.00

$$LS = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 12.55$

$Z = 3:1$ SLOPE

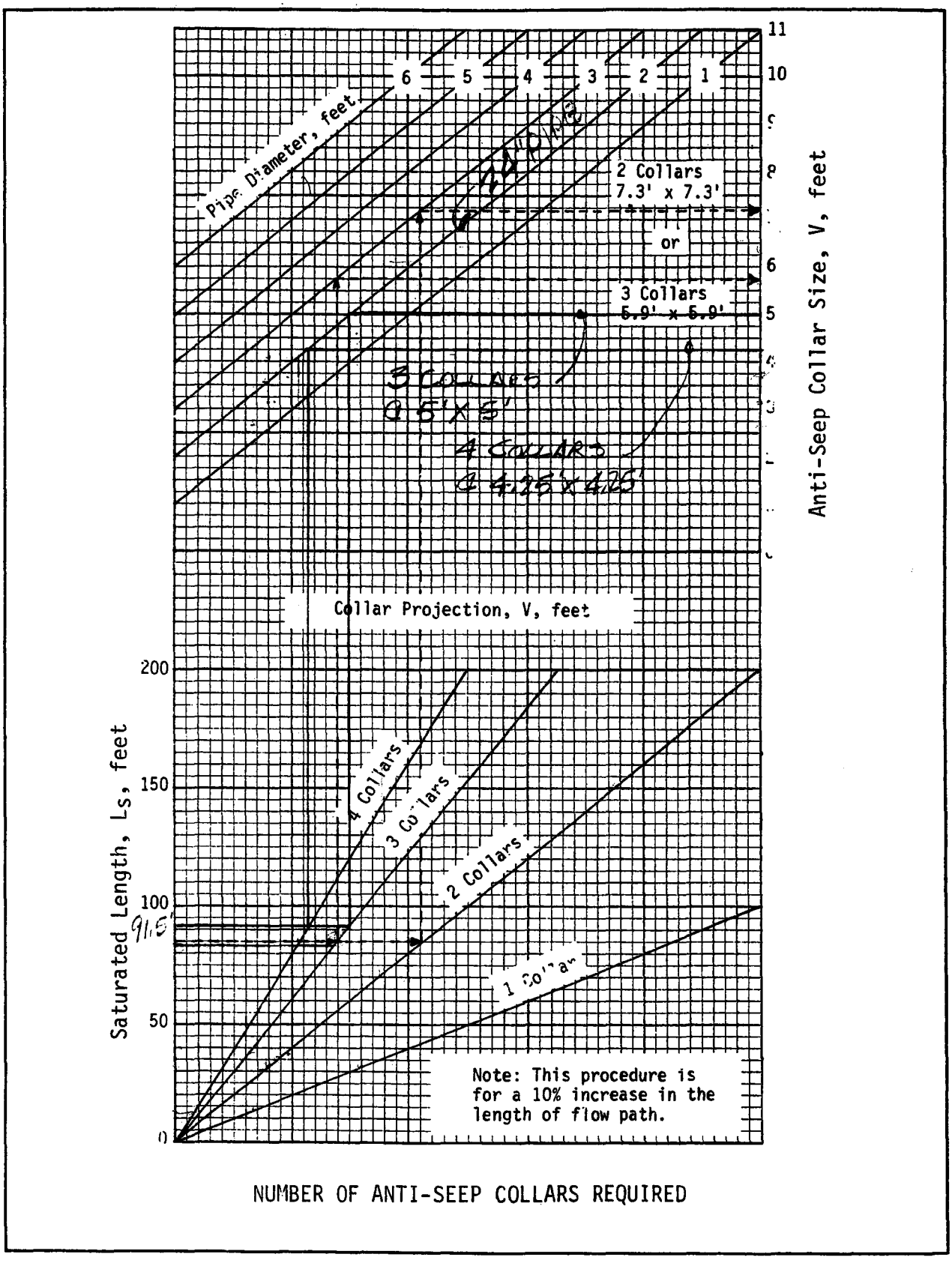
$S = 1.0\%$

$$LS = 12.55(3+4)\left(1+\frac{0.01}{0.25-0.01}\right)$$

$LS = 12.55 \times 7 \times 1.0417$

$LS = 91.51$

USE 4 COLLARS 4.25'X4.25'



Source: USDA-SCS

BMP #2

Plate 3.14-12

Time span=5.00-25.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Post Dev: 1/3 Acre Lots Runoff Area=6.100 ac Runoff Depth=1.18"
Tc=18.0 min CN=73 Runoff=8.10 cfs 0.600 af

Pond SB-2: Sediment Basin 2 Peak Elev=78.74' Storage=13,865 cf Inflow=8.10 cfs 0.600 af
Outflow=0.63 cfs 0.327 af

Total Runoff Area = 6.100 ac Runoff Volume = 0.600 af Average Runoff Depth = 1.18"

Subcatchment Post Dev: 1/3 Acre Lots

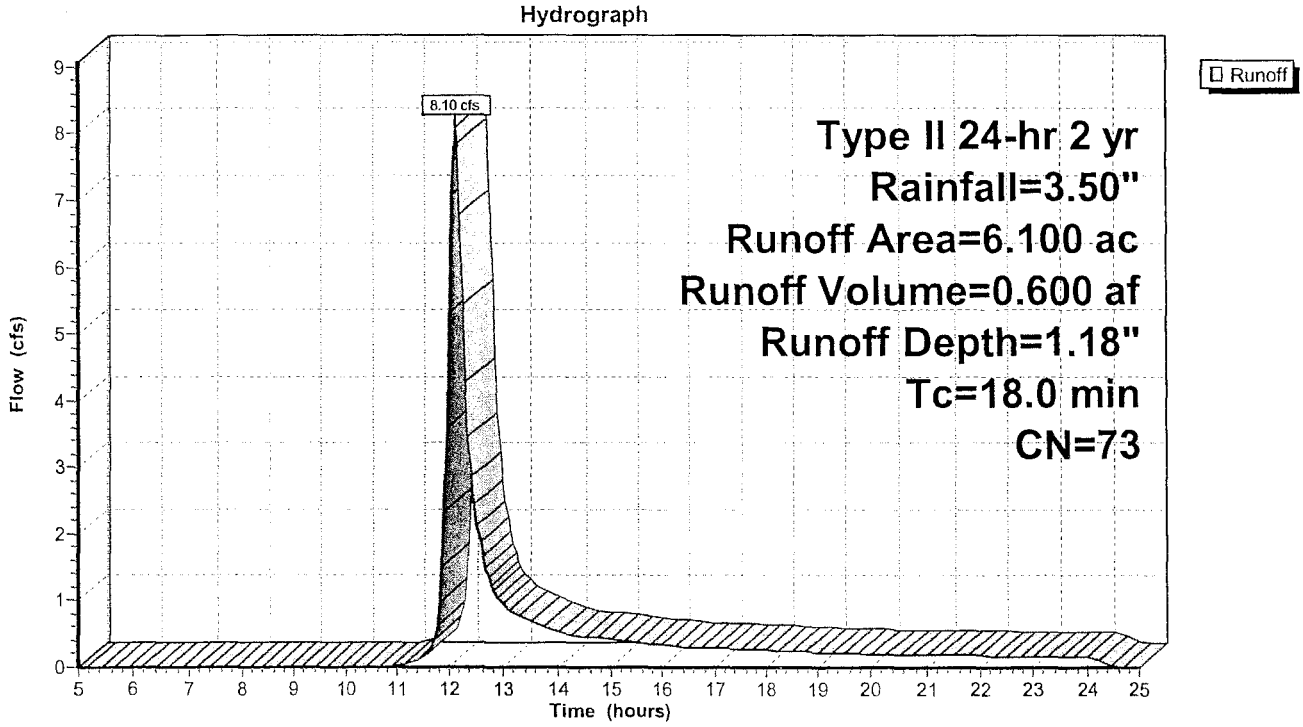
Runoff = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

Area (ac)	CN	Description
1.900	55	Woods, Good, HSG B
4.200	81	1/3 acre lots, 30% imp, HSG C
6.100	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.22	0.00	0.00
5.25	0.23	0.00	0.00
5.50	0.25	0.00	0.00
5.75	0.26	0.00	0.00
6.00	0.28	0.00	0.00
6.25	0.30	0.00	0.00
6.50	0.31	0.00	0.00
6.75	0.33	0.00	0.00
7.00	0.35	0.00	0.00
7.25	0.36	0.00	0.00
7.50	0.38	0.00	0.00
7.75	0.40	0.00	0.00
8.00	0.42	0.00	0.00
8.25	0.44	0.00	0.00
8.50	0.46	0.00	0.00
8.75	0.49	0.00	0.00
9.00	0.51	0.00	0.00
9.25	0.54	0.00	0.00
9.50	0.57	0.00	0.00
9.75	0.60	0.00	0.00
10.00	0.63	0.00	0.00
10.25	0.67	0.00	0.00
10.50	0.71	0.00	0.00
10.75	0.76	0.00	0.00
11.00	0.82	0.00	0.02
11.25	0.90	0.01	0.07
11.50	0.99	0.02	0.16
11.75	1.35	0.09	0.61
12.00	2.32	0.47	**5.33**
12.25	2.47	0.55	**5.45**
12.50	2.57	0.61	2.13
12.75	2.64	0.65	1.23
13.00	2.70	0.68	0.93
13.25	2.75	0.71	0.78
13.50	2.80	0.74	0.69
13.75	2.84	0.76	0.61
14.00	2.87	0.78	0.54
14.25	2.90	0.80	0.49
14.50	2.93	0.82	0.46
14.75	2.96	0.83	0.44
15.00	2.99	0.85	0.42
15.25	3.01	0.87	0.40
15.50	3.04	0.88	0.38
15.75	3.06	0.89	0.36
16.00	3.08	0.91	0.33
16.25	3.10	0.92	0.31
16.50	3.12	0.93	0.30
16.75	3.14	0.94	0.30
17.00	3.16	0.95	0.29
17.25	3.17	0.97	0.28
17.50	3.19	0.98	0.27
17.75	3.21	0.99	0.27
18.00	3.22	1.00	0.26
18.25	3.24	1.01	0.25
18.50	3.25	1.02	0.24
18.75	3.27	1.03	0.23
19.00	3.28	1.04	0.23
19.25	3.30	1.04	0.22
19.50	3.31	1.05	0.21
19.75	3.32	1.06	0.20
20.00	3.33	1.07	0.19
20.25	3.34	1.08	0.19
20.50	3.35	1.08	0.18
20.75	3.37	1.09	0.18
21.00	3.38	1.10	0.18
21.25	3.39	1.10	0.18
21.50	3.40	1.11	0.18
21.75	3.41	1.12	0.17
22.00	3.42	1.13	0.17
22.25	3.43	1.13	0.17
22.50	3.44	1.14	0.17
22.75	3.45	1.15	0.17
23.00	3.46	1.15	0.17
23.25	3.47	1.16	0.17
23.50	3.48	1.17	0.16
23.75	3.49	1.17	0.16
24.00	**3.50**	**1.18**	0.16
24.25	3.50	1.18	0.08
24.50	3.50	1.18	0.01
24.75	3.50	1.18	0.00
25.00	3.50	1.18	0.00

Pond SB-2: Sediment Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 1.18" for 2 yr event
Inflow = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af
Outflow = 0.63 cfs @ 13.68 hrs, Volume= 0.327 af, Atten= 92%, Lag= 93.9 min
Primary = 0.63 cfs @ 13.68 hrs, Volume= 0.327 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 78.74' @ 13.68 hrs Surf.Area= 3,988 sf Storage= 13,865 cf
Plug-Flow detention time= 292.4 min calculated for 0.327 af (55% of inflow)
Center-of-Mass det. time= 158.8 min (1,026.3 - 867.5)

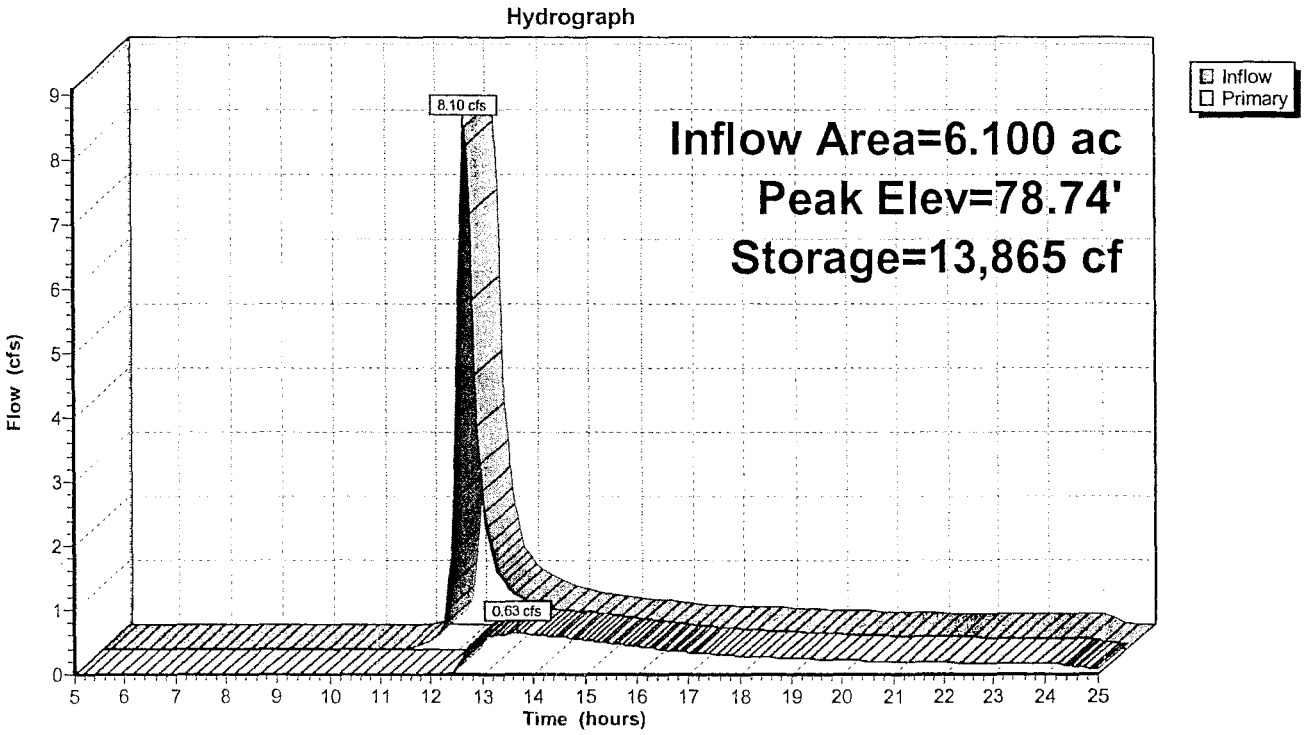
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,029 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	0	0	0
70.00	95	95	95
71.00	305	200	295
72.00	667	486	781
73.00	944	806	1,587
74.00	1,267	1,106	2,692
75.00	1,590	1,429	4,121
76.00	1,954	1,772	5,893
77.00	2,570	2,262	8,155
78.00	3,275	2,923	11,077
79.00	4,236	3,756	14,833
80.00	5,320	4,778	19,611
81.00	6,700	6,010	25,621
82.00	8,117	7,409	33,029

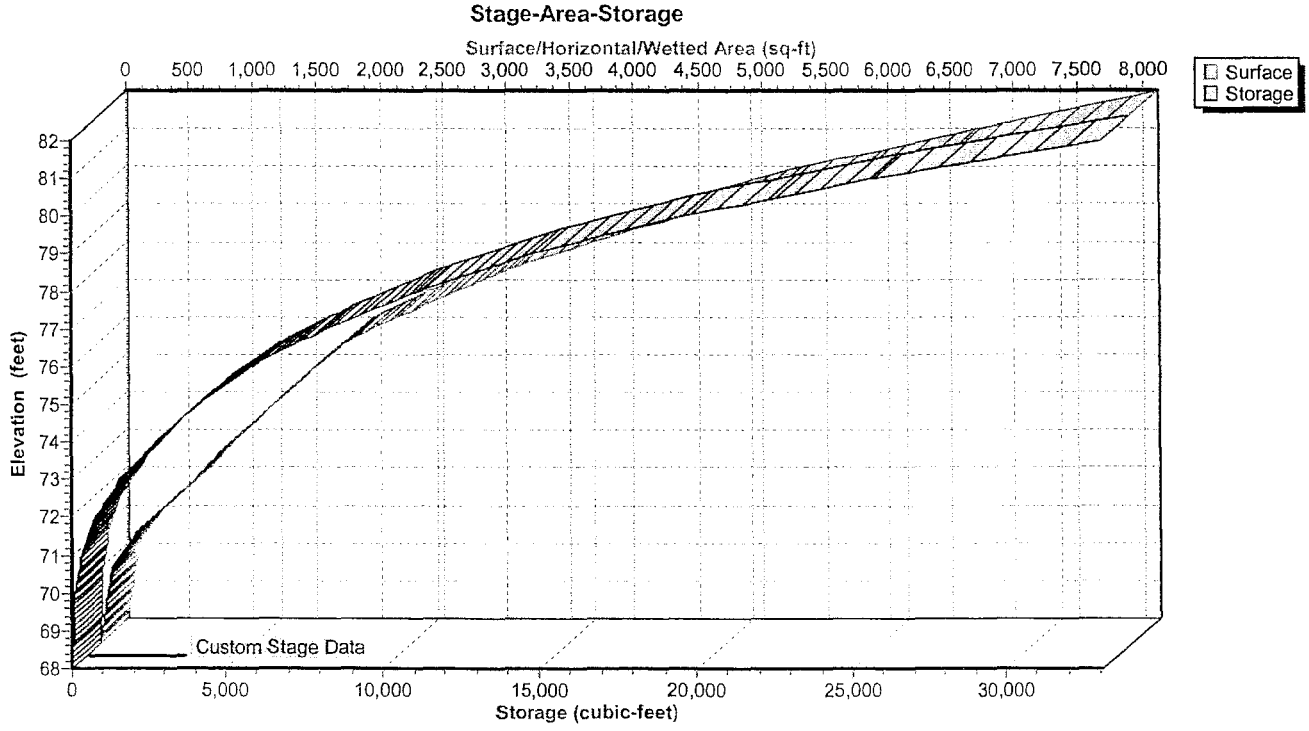
#	Routing	Invert	Outlet Devices
1	Primary	66.50'	**24.0" x 90.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 65.60' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	78.05'	**6.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	80.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.63 cfs @ 13.68 hrs HW=78.74' (Free Discharge)
└─**1=Culvert** (Passes 0.63 cfs of 50.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.63 cfs @ 3.2 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond SB-2: Sediment Basin 2



Pond SB-2: Sediment Basin 2



Hydrograph for Pond SB-2: Sediment Basin 2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	68.00	0.00
5.50	0.00	0	68.00	0.00
6.00	0.00	0	68.00	0.00
6.50	0.00	0	68.00	0.00
7.00	0.00	0	68.00	0.00
7.50	0.00	0	68.00	0.00
8.00	0.00	0	68.00	0.00
8.50	0.00	0	68.00	0.00
9.00	0.00	0	68.00	0.00
9.50	0.00	0	68.00	0.00
10.00	0.00	0	68.00	0.00
10.50	0.00	0	68.00	0.00
11.00	0.02	6	68.12	0.00
11.50	0.16	138	70.22	0.00
12.00	**5.33**	2,442	73.77	0.00
12.50	**2.13**	11,794	78.19	0.07
13.00	0.93	13,499	78.64	0.55
13.50	0.69	**13,845**	**78.74**	**0.62**
14.00	0.54	**13,818**	**78.73**	**0.62**
14.50	0.46	13,626	78.68	0.58
15.00	0.42	13,412	78.62	0.53
15.50	0.38	13,210	78.57	0.49
16.00	0.33	13,017	78.52	0.44
16.50	0.30	12,841	78.47	0.39
17.00	0.29	12,720	78.44	0.34
17.50	0.27	12,635	78.41	0.31
18.00	0.26	12,569	78.40	0.29
18.50	0.24	12,512	78.38	0.27
19.00	0.23	12,461	78.37	0.25
19.50	0.21	12,411	78.36	0.24
20.00	0.19	12,360	78.34	0.22
20.50	0.18	12,310	78.33	0.21
21.00	0.18	12,274	78.32	0.20
21.50	0.18	12,249	78.31	0.19
22.00	0.17	12,231	78.31	0.18
22.50	0.17	12,216	78.30	0.18
23.00	0.17	12,203	78.30	0.17
23.50	0.16	12,192	78.30	0.17
24.00	0.16	12,181	78.29	0.17
24.50	0.01	12,058	78.26	0.13
25.00	0.00	11,880	78.21	0.08

Stage-Area-Storage for Pond SB-2: Sediment Basin 2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
68.00	0	0
68.15	7	7
68.30	14	14
68.45	21	21
68.60	28	28
68.75	36	36
68.90	43	43
69.05	50	50
69.20	57	57
69.35	64	64
69.50	71	71
69.65	78	78
69.80	85	85
69.95	93	93
70.10	116	115
70.25	148	145
70.40	179	175
70.55	210	205
70.70	242	235
70.85	273	265
71.00	305	295
71.15	359	368
71.30	414	441
71.45	468	514
71.60	522	587
71.75	577	660
71.90	631	732
72.05	681	821
72.20	722	942
72.35	764	1,063
72.50	806	1,184
72.65	847	1,305
72.80	889	1,425
72.95	930	1,546
73.10	976	1,697
73.25	1,025	1,863
73.40	1,073	2,029
73.55	1,122	2,195
73.70	1,170	2,360
73.85	1,219	2,526
74.00	1,267	2,692
74.15	1,315	2,906
74.30	1,364	3,121
74.45	1,412	3,335
74.60	1,461	3,549
74.75	1,509	3,763
74.90	1,558	3,978
75.05	1,608	4,209
75.20	1,663	4,475
75.35	1,717	4,741
75.50	1,772	5,007
75.65	1,827	5,272
75.80	1,881	5,538
75.95	1,936	5,804
76.10	2,016	6,119
76.25	2,108	6,458
76.40	2,200	6,797
76.55	2,293	7,137
76.70	2,385	7,476
76.85	2,478	7,815
77.00	2,570	8,155
77.15	2,676	8,593
77.30	2,781	9,031
77.45	2,887	9,470
77.60	2,993	9,908
77.75	3,099	10,346
77.90	3,205	10,785
78.05	3,323	11,265
78.20	3,467	11,828
78.35	3,611	12,391
78.50	3,756	12,955
78.65	3,900	13,518
78.80	4,044	14,081
78.95	4,188	14,645
79.10	4,344	15,310
79.25	4,507	16,027
79.40	4,670	16,744
79.55	4,832	17,460
79.70	4,995	18,177
79.85	5,157	18,894
80.00	5,320	19,611
80.15	5,527	20,512
80.30	5,734	21,413
80.45	5,941	22,315
80.60	6,148	23,216
80.75	6,355	24,118
80.90	6,562	25,020
81.05	6,771	25,991
81.20	6,983	27,102
81.35	7,196	28,213
81.50	7,409	29,325
81.65	7,621	30,436
81.80	7,834	31,547
81.95	**8,046**	**32,659**

Time span=5.00-25.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Post Dev: 1/3 Acre Lots Runoff Area=6.100 ac Runoff Depth=3.42"
Tc=18.0 min CN=73 Runoff=24.51 cfs 1.740 af

Pond SB-2: Sediment Basin 2 Peak Elev=81.07' Storage=26,122 cf Inflow=24.51 cfs 1.740 af
Outflow=18.99 cfs 1.461 af

Total Runoff Area = 6.100 ac Runoff Volume = 1.740 af Average Runoff Depth = 3.42"

Subcatchment Post Dev: 1/3 Acre Lots

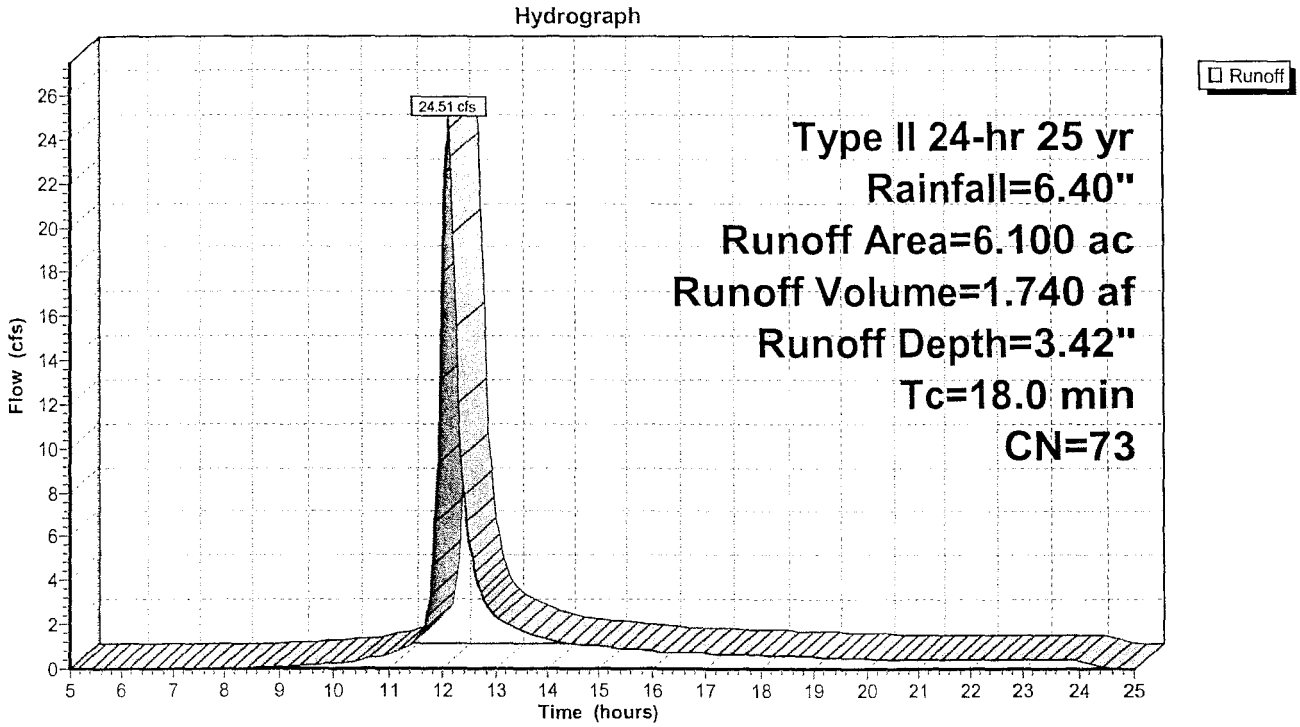
Runoff = 24.51 cfs @ 12.11 hrs, Volume= 1.740 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.40"

Area (ac)	CN	Description
1.900	55	Woods, Good, HSG B
4.200	81	1/3 acre lots, 30% imp, HSG C
6.100	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.40	0.00	0.00
5.25	0.43	0.00	0.00
5.50	0.46	0.00	0.00
5.75	0.48	0.00	0.00
6.00	0.51	0.00	0.00
6.25	0.54	0.00	0.00
6.50	0.57	0.00	0.00
6.75	0.60	0.00	0.00
7.00	0.63	0.00	0.00
7.25	0.67	0.00	0.00
7.50	0.70	0.00	0.00
7.75	0.73	0.00	0.00
8.00	0.77	0.00	0.00
8.25	0.81	0.00	0.01
8.50	0.85	0.00	0.03
8.75	0.89	0.01	0.06
9.00	0.94	0.01	0.09
9.25	0.99	0.02	0.12
9.50	1.04	0.02	0.15
9.75	1.10	0.03	0.18
10.00	1.16	0.04	0.23
10.25	1.23	0.06	0.30
10.50	1.31	0.08	0.39
10.75	1.40	0.10	0.50
11.00	1.50	0.13	0.67
11.25	1.64	0.18	0.89
11.50	1.81	0.24	1.30
11.75	2.48	0.56	3.27
12.00	4.24	1.70	**17.98**
12.25	4.52	1.91	**15.56**
12.50	4.70	2.05	5.70
12.75	4.83	2.15	3.16
13.00	4.94	2.23	2.34
13.25	5.03	2.31	1.95
13.50	5.11	2.37	1.70
13.75	5.18	2.43	1.49
14.00	5.25	2.48	1.33
14.25	5.31	2.52	1.19
14.50	5.36	2.57	1.12
14.75	5.41	2.61	1.06
15.00	5.46	2.65	1.01
15.25	5.51	2.69	0.96
15.50	5.55	2.72	0.91
15.75	5.59	2.75	0.85
16.00	5.63	2.79	0.80
16.25	5.67	2.82	0.75
16.50	5.70	2.84	0.72
16.75	5.74	2.87	0.70
17.00	5.77	2.90	0.68
17.25	5.80	2.93	0.66
17.50	5.83	2.95	0.65
17.75	5.87	2.98	0.63
18.00	5.89	3.00	0.61
18.25	5.92	3.02	0.59
18.50	5.95	3.05	0.57
18.75	5.98	3.07	0.55
19.00	6.00	3.09	0.53
19.25	6.03	3.11	0.51
19.50	6.05	3.13	0.49
19.75	6.07	3.15	0.47
20.00	6.09	3.17	0.45
20.25	6.11	3.18	0.43
20.50	6.13	3.20	0.42
20.75	6.15	3.22	0.42
21.00	6.17	3.23	0.42
21.25	6.19	3.25	0.41
21.50	6.21	3.27	0.41
21.75	6.23	3.28	0.40
22.00	6.25	3.30	0.40
22.25	6.27	3.32	0.40
22.50	6.29	3.33	0.39
22.75	6.31	3.35	0.39
23.00	6.33	3.36	0.39
23.25	6.35	3.38	0.38
23.50	6.36	3.39	0.38
23.75	6.38	3.41	0.37
24.00	**6.40**	**3.42**	0.37
24.25	6.40	3.42	0.19
24.50	6.40	3.42	0.02
24.75	6.40	3.42	0.00
25.00	6.40	3.42	0.00

Pond SB-2: Sediment Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 3.42" for 25 yr event
Inflow = 24.51 cfs @ 12.11 hrs, Volume= 1.740 af
Outflow = 18.99 cfs @ 12.22 hrs, Volume= 1.461 af, Atten= 23%, Lag= 7.1 min
Primary = 18.99 cfs @ 12.22 hrs, Volume= 1.461 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 81.07' @ 12.22 hrs Surf.Area= 6,796 sf Storage= 26,122 cf
Plug-Flow detention time= 161.7 min calculated for 1.457 af (84% of inflow)
Center-of-Mass det. time= 90.1 min (926.3 - 836.2)

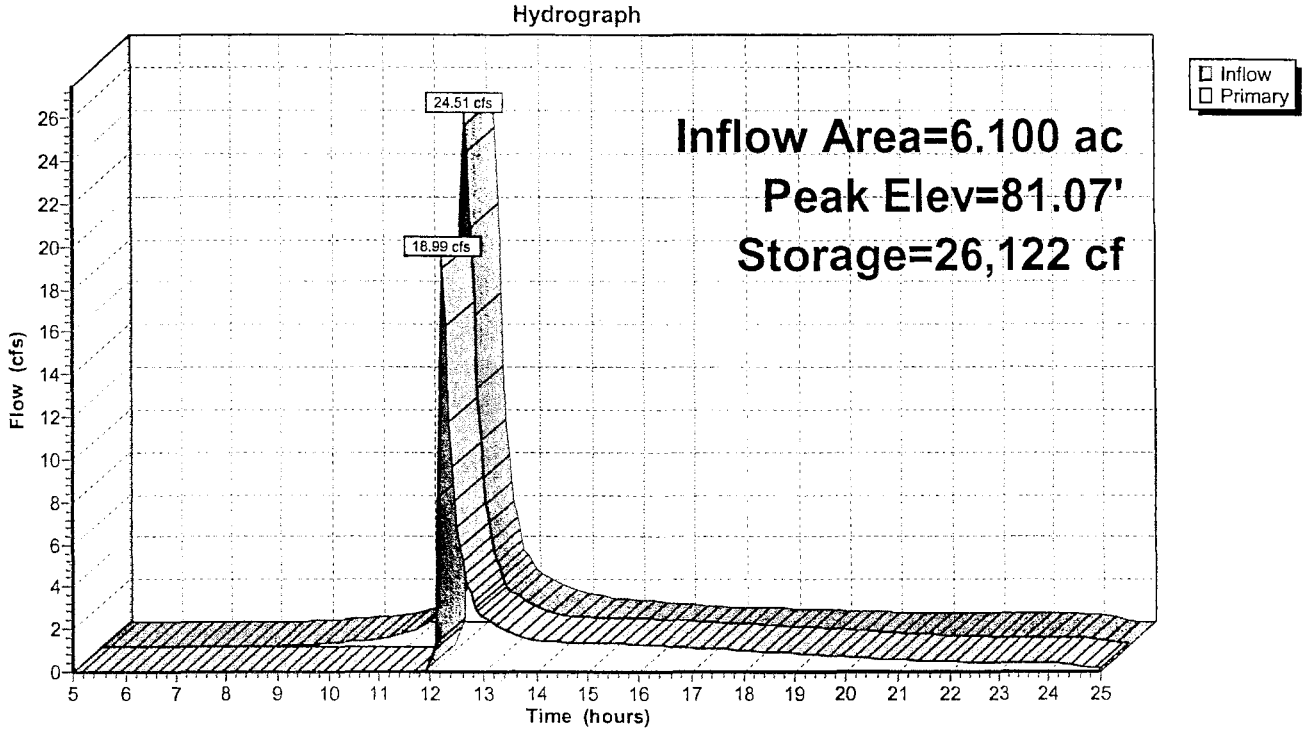
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,029 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	0	0	0
70.00	95	95	95
71.00	305	200	295
72.00	667	486	781
73.00	944	806	1,587
74.00	1,267	1,106	2,692
75.00	1,590	1,429	4,121
76.00	1,954	1,772	5,893
77.00	2,570	2,262	8,155
78.00	3,275	2,923	11,077
79.00	4,236	3,756	14,833
80.00	5,320	4,778	19,611
81.00	6,700	6,010	25,621
82.00	8,117	7,409	33,029

#	Routing	Invert	Outlet Devices
1	Primary	66.50'	**24.0" x 90.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 65.60' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	78.05'	**6.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	80.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=17.72 cfs @ 12.22 hrs HW=81.04' (Free Discharge)
└─**1=Culvert** (Passes 17.72 cfs of 55.65 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.56 cfs @ 8.0 fps)
  └─**3=Orifice/Grate** (Weir Controls 16.16 cfs @ 2.4 fps)

Pond SB-2: Sediment Basin 2

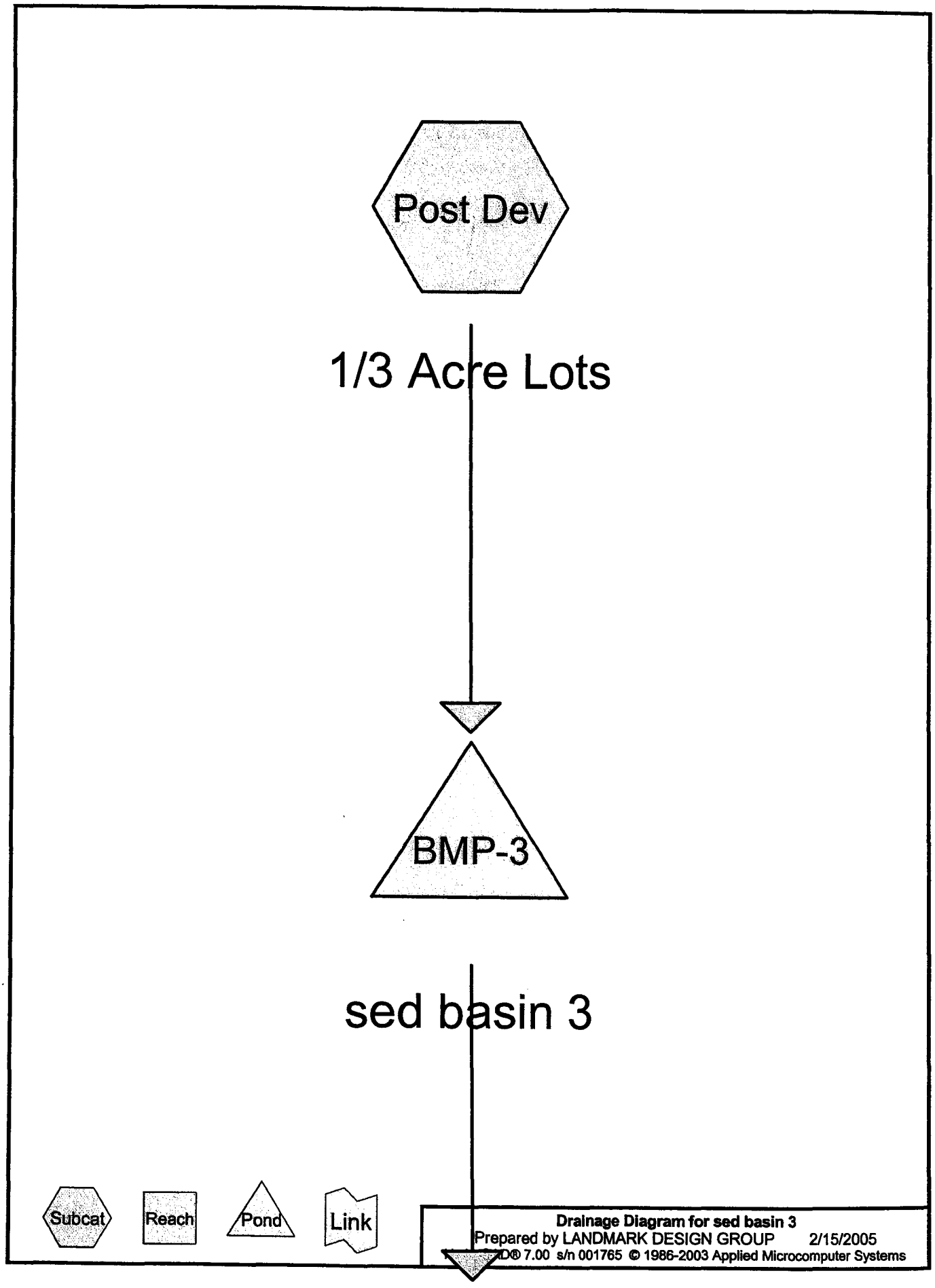


Hydrograph for Pond SB-2: Sediment Basin 2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	68.00	0.00
5.50	0.00	0	68.00	0.00
6.00	0.00	0	68.00	0.00
6.50	0.00	0	68.00	0.00
7.00	0.00	0	68.00	0.00
7.50	0.00	0	68.00	0.00
8.00	0.00	0	68.00	0.00
8.50	0.03	25	68.52	0.00
9.00	0.09	128	70.16	0.00
9.50	0.15	345	71.10	0.00
10.00	0.23	682	71.80	0.00
10.50	0.39	1,230	72.56	0.00
11.00	0.67	2,150	73.51	0.00
11.50	1.30	3,817	74.79	0.00
12.00	**17.98**	**13,433**	**78.63**	**0.54**
12.50	**5.70**	**24,137**	**80.75**	**6.76**
13.00	2.34	23,149	80.59	2.58
13.50	1.70	22,807	80.53	1.83
14.00	1.33	22,621	80.50	1.41
14.50	1.12	22,277	80.44	1.38
15.00	1.01	21,728	80.35	1.35
15.50	0.91	21,049	80.24	1.32
16.00	0.80	20,253	80.11	1.27
16.50	0.72	19,369	79.95	1.21
17.00	0.68	18,510	79.77	1.15
17.50	0.65	17,704	79.60	1.08
18.00	0.61	16,951	79.44	1.01
18.50	0.57	16,249	79.30	0.94
19.00	0.53	15,598	79.16	0.88
19.50	0.49	14,995	79.03	0.81
20.00	0.45	14,449	78.90	0.73
20.50	0.42	13,987	78.77	0.65
21.00	0.42	13,636	78.68	0.58
21.50	0.41	13,379	78.61	0.53
22.00	0.40	13,199	78.57	0.48
22.50	0.39	13,072	78.53	0.45
23.00	0.39	12,977	78.51	0.43
23.50	0.38	12,908	78.49	0.41
24.00	0.37	12,860	78.47	0.39
24.50	0.02	12,572	78.40	0.29
25.00	0.00	12,181	78.29	0.17

Stage-Area-Storage for Pond SB-2: Sediment Basin 2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
68.00	0	0
68.15	7	7
68.30	14	14
68.45	21	21
68.60	28	28
68.75	36	36
68.90	43	43
69.05	50	50
69.20	57	57
69.35	64	64
69.50	71	71
69.65	78	78
69.80	85	85
69.95	93	93
70.10	116	115
70.25	148	145
70.40	179	175
70.55	210	205
70.70	242	235
70.85	273	265
71.00	305	295
71.15	359	368
71.30	414	441
71.45	468	514
71.60	522	587
71.75	577	660
71.90	631	732
72.05	681	821
72.20	722	942
72.35	764	1,063
72.50	806	1,184
72.65	847	1,305
72.80	889	1,425
72.95	930	1,546
73.10	976	1,697
73.25	1,025	1,863
73.40	1,073	2,029
73.55	1,122	2,195
73.70	1,170	2,360
73.85	1,219	2,526
74.00	1,267	2,692
74.15	1,315	2,906
74.30	1,364	3,121
74.45	1,412	3,335
74.60	1,461	3,549
74.75	1,509	3,763
74.90	1,558	3,978
75.05	1,608	4,209
75.20	1,663	4,475
75.35	1,717	4,741
75.50	1,772	5,007
75.65	1,827	5,272
75.80	1,881	5,538 c/o ELEV.
75.95	1,936	5,804
76.10	2,016	6,119
76.25	2,108	6,458
76.40	2,200	6,797
76.55	2,293	7,137
76.70	2,385	7,476
76.85	2,478	7,815
77.00	2,570	8,155
77.15	2,676	8,593
77.30	2,781	9,031
77.45	2,887	9,470
77.60	2,993	9,908
77.75	3,099	10,346
77.90	3,205	10,785
78.05	3,323	11,265 WET STORAGE.
78.20	3,467	11,828
78.35	3,611	12,391
78.50	3,756	12,955
78.65	3,900	13,518
78.80	4,044	14,081
78.95	4,188	14,645
79.10	4,344	15,310
79.25	4,507	16,027
79.40	4,670	16,744
79.55	4,832	17,460
79.70	4,995	18,177
79.85	5,157	18,894
80.00	5,320	19,611
80.15	5,527	20,512
80.30	5,734	21,413
80.45	5,941	22,315 ← 80.55 = 22915.
80.60	6,148	23,216
80.75	6,355	24,118 (848.7)
80.90	6,562	25,020
81.05	6,771	25,991
81.20	6,983	27,102
81.35	7,196	28,213
81.50	7,409	29,325
81.65	7,621	30,436
81.80	7,834	31,547
81.95	**8,046**	**32,659**


Post Dev
1/3 Acre Lots
BMP-3
sed basin 3
Subcat
Reach
Pond
Link
Drainage Diagram for sed basin 3
Prepared by LANDMARK DESIGN GROUP 2/15/2005
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TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project Stonehouse Glen Section I

Basin # 3. Location James City County

Total area draining to basin: 5.3 acres.

Basin Volume Design

Wet Storage:

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 5.3 acres = 355.1 cu. yds.

2. Available basin volume = 370.4 cu. yds. at elevation 62.0. (From storage - elevation curve)

3. Excavate N/A cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 5.3 acres = 174.9 cu. yds.

5. Elevation corresponding to cleanout level = 60.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 2' ft. (Min. = 1.0 ft.)

Dry Storage:

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 5.3 acres = 355.1 cu. yds.

8. Total available basin volume at crest of riser* = 1130 cu. yds. at elevation 66.50. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 6 in.

10. Diameter of flexible tubing = 8 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 66.50.

Top of Dam = 69.50.

Design High Water = 66.98

Upstream Toe of Dam = 56.00.

Basin Shape

12. Length of Flow / Effective Width — L / We = _____

If > 2, baffles are not required _____

If < 2, baffles are required YES

Runoff

13. Q_2 = 8.74 cfs (From Chapter 5)

14. Q_{25} = 22.21 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 22.21 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using Q_2)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = _____ ft. (Using Q_{25})

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter (D_r) = 48 in. Actual head (h) = 0.33 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = _____ ft.

Head (H) on barrel through embankment = _____ft.

(From Plate 3.14-7).

19. Barrel diameter = _____ in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = _____ inches.

Height = _____ inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = _____cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = ____ ft.

Slope of upstream face of embankment (Z) = _____:1.

Slope of principal spillway barrel (S_b) = _____%

Length of barrel in saturated zone (L_s) = _____ ft.

24. Number of collars required = _____ dimensions = _____

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = _____

Design High Water = _____

Emergency Spillway Crest = _____

Principal Spillway Crest = _____

Dewatering Orifice Invert = _____

Cleanout Elevation = _____

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = _____

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

LENGTH OF PIPE IN SATURATED ZONE

BMP #3

CREST OF RISER = 59.60
BOTTOM OF POND = 50.00

$$LS = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 9.60$

$Z = 3:1$ SLOPE

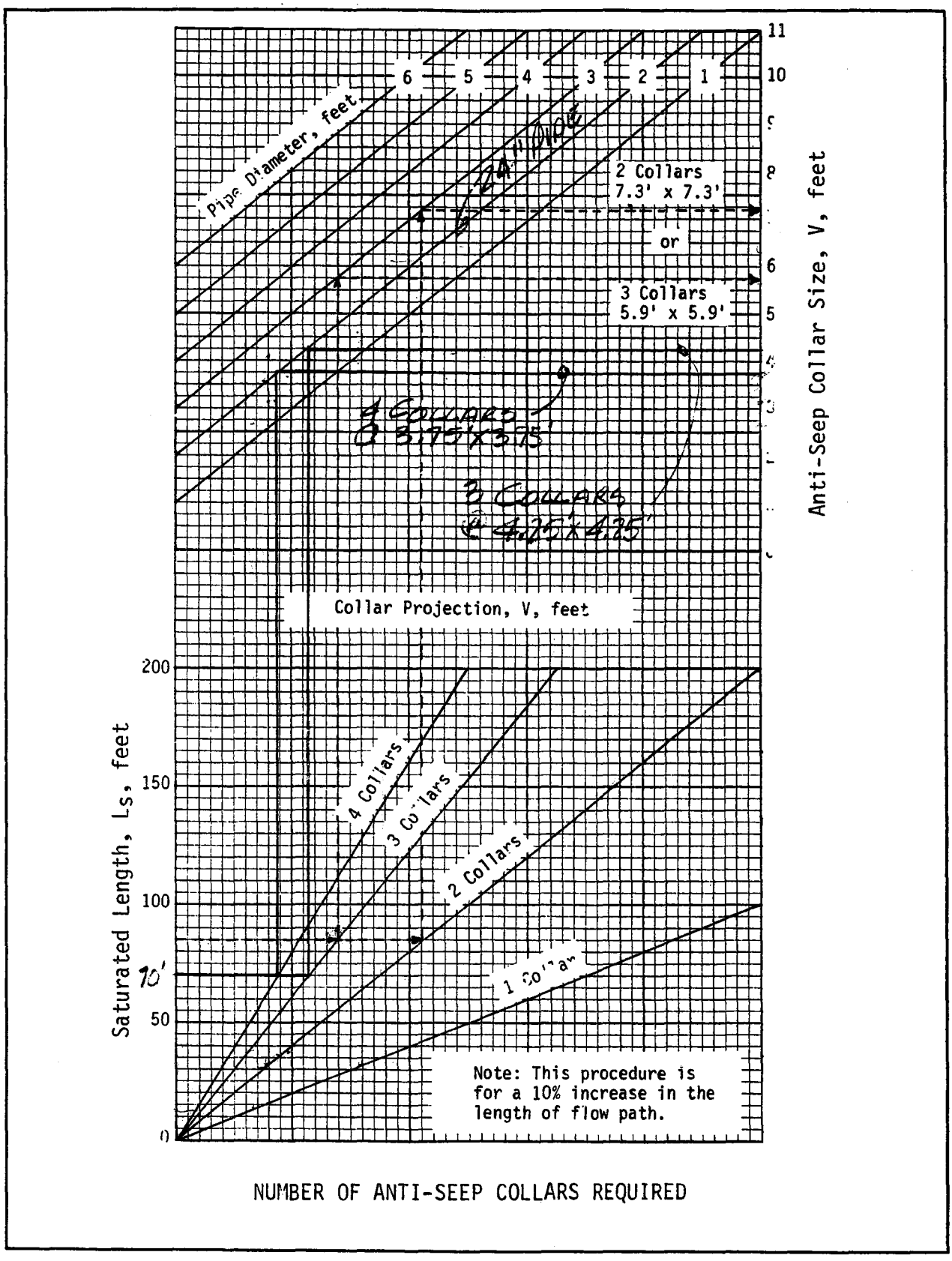
$S = 1.0\%$

$$LS = 9.60\,(3+4)\left(1+\frac{0.01}{0.25-0.01}\right)$$

$LS = 9.60 \times 7 \times 1.0417$

$LS = 70.00$

USE 4 COLLARS 3.75' X 3.75'



Source: USDA-SCS

Plate 3.14-12

BMP # 3

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Post Dev: 1/3 Acre Lots Runoff Area=5.300 ac Runoff Depth=1.56"
Tc=25.0 min CN=81 Runoff=8.74 cfs 0.689 af

Pond BMP-3: sed basin 3 Peak Elev=63.87' Storage=16,801 cf Inflow=8.74 cfs 0.689 af
Outflow=1.20 cfs 0.434 af

Total Runoff Area = 5.300 ac Runoff Volume = 0.689 af Average Runoff Depth = 1.56"

Subcatchment Post Dev: 1/3 Acre Lots

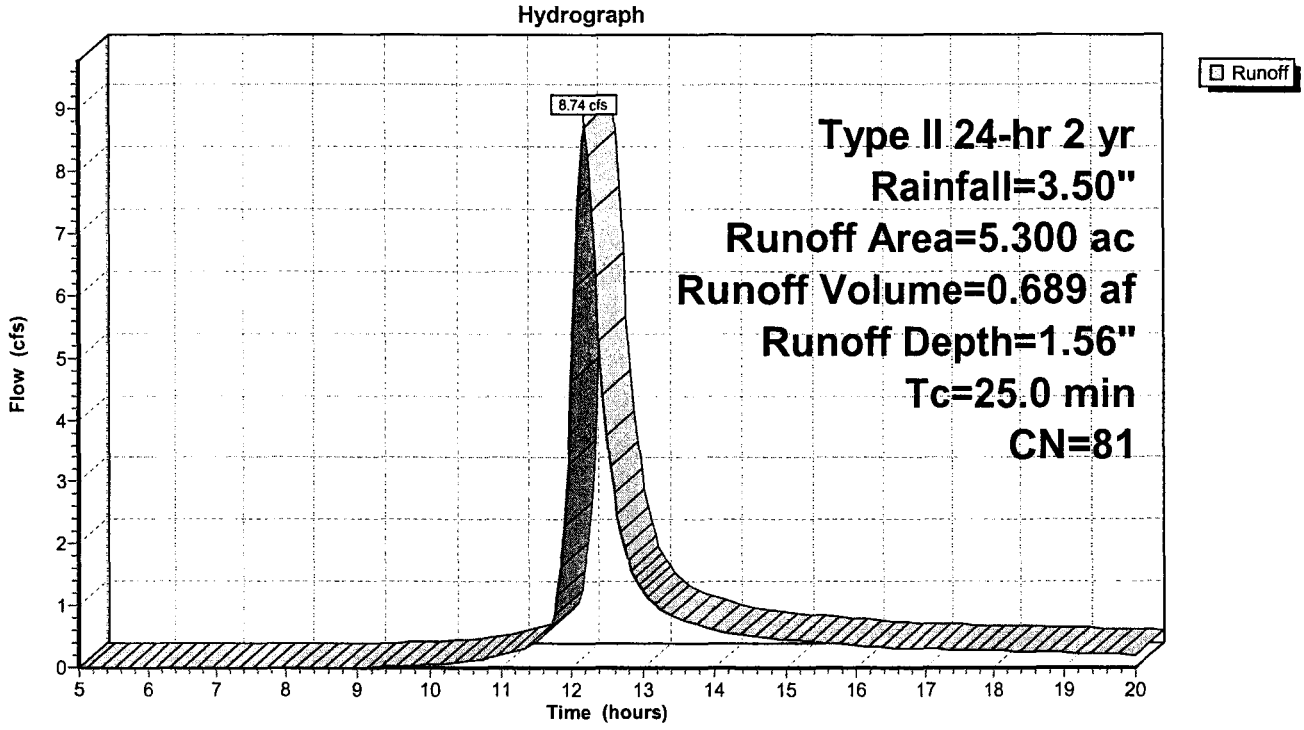
Runoff = 8.74 cfs @ 12.19 hrs, Volume= 0.689 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

Area (ac)	CN	Description
5.300	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.22	0.00	0.00	7.60	0.39	0.00	0.00
5.05	0.22	0.00	0.00	7.65	0.39	0.00	0.00
5.10	0.23	0.00	0.00	7.70	0.40	0.00	0.00
5.15	0.23	0.00	0.00	7.75	0.40	0.00	0.00
5.20	0.23	0.00	0.00	7.80	0.40	0.00	0.00
5.25	0.23	0.00	0.00	7.85	0.41	0.00	0.00
5.30	0.24	0.00	0.00	7.90	0.41	0.00	0.00
5.35	0.24	0.00	0.00	7.95	0.42	0.00	0.00
5.40	0.24	0.00	0.00	8.00	0.42	0.00	0.00
5.45	0.25	0.00	0.00	8.05	0.42	0.00	0.00
5.50	0.25	0.00	0.00	8.10	0.43	0.00	0.00
5.55	0.25	0.00	0.00	8.15	0.43	0.00	0.00
5.60	0.26	0.00	0.00	8.20	0.44	0.00	0.00
5.65	0.26	0.00	0.00	8.25	0.44	0.00	0.00
5.70	0.26	0.00	0.00	8.30	0.44	0.00	0.00
5.75	0.26	0.00	0.00	8.35	0.45	0.00	0.00
5.80	0.27	0.00	0.00	8.40	0.45	0.00	0.00
5.85	0.27	0.00	0.00	8.45	0.46	0.00	0.00
5.90	0.27	0.00	0.00	8.50	0.46	0.00	0.00
5.95	0.28	0.00	0.00	8.55	0.47	0.00	0.00
6.00	0.28	0.00	0.00	8.60	0.47	0.00	0.00
6.05	0.28	0.00	0.00	8.65	0.48	0.00	0.00
6.10	0.29	0.00	0.00	8.70	0.48	0.00	0.00
6.15	0.29	0.00	0.00	8.75	0.49	0.00	0.00
6.20	0.29	0.00	0.00	8.80	0.49	0.00	0.00
6.25	0.30	0.00	0.00	8.85	0.50	0.00	0.00
6.30	0.30	0.00	0.00	8.90	0.50	0.00	0.00
6.35	0.30	0.00	0.00	8.95	0.51	0.00	0.00
6.40	0.31	0.00	0.00	9.00	0.51	0.00	0.00
6.45	0.31	0.00	0.00	9.05	0.52	0.00	0.01
6.50	0.31	0.00	0.00	9.10	0.53	0.00	0.01
6.55	0.32	0.00	0.00	9.15	0.53	0.00	0.01
6.60	0.32	0.00	0.00	9.20	0.54	0.00	0.01
6.65	0.32	0.00	0.00	9.25	0.54	0.00	0.02
6.70	0.33	0.00	0.00	9.30	0.55	0.00	0.02
6.75	0.33	0.00	0.00	9.35	0.55	0.00	0.02
6.80	0.33	0.00	0.00	9.40	0.56	0.00	0.02
6.85	0.34	0.00	0.00	9.45	0.56	0.00	0.03
6.90	0.34	0.00	0.00	9.50	0.57	0.00	0.03
6.95	0.34	0.00	0.00	9.55	0.58	0.00	0.03
7.00	0.35	0.00	0.00	9.60	0.58	0.01	0.03
7.05	0.35	0.00	0.00	9.65	0.59	0.01	0.04
7.10	0.35	0.00	0.00	9.70	0.59	0.01	0.04
7.15	0.36	0.00	0.00	9.75	0.60	0.01	0.04
7.20	0.36	0.00	0.00	9.80	0.61	0.01	0.04
7.25	0.36	0.00	0.00	9.85	0.61	0.01	0.05
7.30	0.37	0.00	0.00	9.90	0.62	0.01	0.05
7.35	0.37	0.00	0.00	9.95	0.63	0.01	0.06
7.40	0.38	0.00	0.00	10.00	0.63	0.01	0.06
7.45	0.38	0.00	0.00	10.05	0.64	0.01	0.06
7.50	0.38	0.00	0.00	10.10	0.65	0.01	0.07
7.55	0.39	0.00	0.00	10.15	0.66	0.01	0.07

Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
10.20	0.66	0.01	0.08	12.80	2.66	1.05	1.75
10.25	0.67	0.02	0.08	12.85	2.67	1.06	1.59
10.30	0.68	0.02	0.09	12.90	2.68	1.07	1.46
10.35	0.69	0.02	0.09	12.95	2.69	1.08	1.35
10.40	0.70	0.02	0.10	13.00	2.70	1.09	1.26
10.45	0.71	0.02	0.11	13.05	2.71	1.10	1.19
10.50	0.71	0.02	0.11	13.10	2.72	1.10	1.12
10.55	0.72	0.02	0.12	13.15	2.73	1.11	1.07
10.60	0.73	0.03	0.13	13.20	2.74	1.12	1.01
10.65	0.74	0.03	0.14	13.25	2.75	1.13	0.97
10.70	0.75	0.03	0.14	13.30	2.76	1.13	0.93
10.75	0.76	0.03	0.15	13.35	2.77	1.14	0.89
10.80	0.77	0.04	0.16	13.40	2.78	1.15	0.86
10.85	0.79	0.04	0.17	13.45	2.79	1.15	0.84
10.90	0.80	0.04	0.19	13.50	2.80	1.16	0.81
10.95	0.81	0.04	0.20	13.55	2.80	1.17	0.79
11.00	0.82	0.05	0.21	13.60	2.81	1.17	0.77
11.05	0.84	0.05	0.22	13.65	2.82	1.18	0.75
11.10	0.85	0.05	0.24	13.70	2.83	1.18	0.73
11.15	0.86	0.06	0.25	13.75	2.84	1.19	0.71
11.20	0.88	0.06	0.27	13.80	2.84	1.19	0.69
11.25	0.90	0.07	0.29	13.85	2.85	1.20	0.68
11.30	0.91	0.07	0.31	13.90	2.86	1.20	0.66
11.35	0.93	0.08	0.34	13.95	2.86	1.21	0.65
11.40	0.95	0.08	0.36	14.00	2.87	1.21	0.63
11.45	0.97	0.09	0.39	14.05	2.88	1.22	0.62
11.50	0.99	0.09	0.43	14.10	2.88	1.22	0.60
11.55	1.02	0.11	0.46	14.15	2.89	1.23	0.59
11.60	1.07	0.12	0.50	14.20	2.90	1.23	0.58
11.65	1.15	0.15	0.57	14.25	2.90	1.24	0.56
11.70	1.24	0.19	0.67	14.30	2.91	1.24	0.55
11.75	1.35	0.24	0.86	14.35	2.91	1.25	0.54
11.80	1.51	0.32	1.17	14.40	2.92	1.25	0.53
11.85	1.72	0.43	1.63	14.45	2.93	1.26	0.53
11.90	1.99	0.60	2.31	14.50	2.93	1.26	0.52
11.95	2.22	0.75	3.29	14.55	2.94	1.27	0.51
12.00	2.32	0.82	4.61	14.60	2.94	1.27	0.51
12.05	2.35	0.84	6.15	14.65	2.95	1.27	0.50
12.10	2.39	0.86	7.59	14.70	2.95	1.28	0.50
12.15	2.42	0.88	8.52	14.75	2.96	1.28	0.49
12.20	2.45	0.90	**8.72**	14.80	2.97	1.29	0.49
12.25	2.47	0.92	8.26	14.85	2.97	1.29	0.48
12.30	2.50	0.94	7.37	14.90	2.98	1.30	0.48
12.35	2.52	0.96	6.31	14.95	2.98	1.30	0.47
12.40	2.54	0.97	5.27	15.00	2.99	1.30	0.47
12.45	2.56	0.98	4.42	15.05	2.99	1.31	0.46
12.50	2.57	0.99	3.77	15.10	3.00	1.31	0.46
12.55	2.59	1.01	3.26	15.15	3.00	1.32	0.45
12.60	2.60	1.02	2.84	15.20	3.01	1.32	0.45
12.65	2.62	1.03	2.49	15.25	3.01	1.32	0.44
12.70	2.63	1.04	2.20	15.30	3.02	1.33	0.44
12.75	2.64	1.05	1.95	15.35	3.02	1.33	0.43

Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
15.40	3.03	1.33	0.43
15.45	3.03	1.34	0.42
15.50	3.04	1.34	0.42
15.55	3.04	1.35	0.41
15.60	3.05	1.35	0.41
15.65	3.05	1.35	0.41
15.70	3.05	1.36	0.40
15.75	3.06	1.36	0.40
15.80	3.06	1.36	0.39
15.85	3.07	1.37	0.39
15.90	3.07	1.37	0.38
15.95	3.08	1.37	0.38
16.00	3.08	1.38	0.37
16.05	3.08	1.38	0.37
16.10	3.09	1.38	0.36
16.15	3.09	1.38	0.36
16.20	3.10	1.39	0.35
16.25	3.10	1.39	0.35
16.30	3.10	1.39	0.34
16.35	3.11	1.40	0.34
16.40	3.11	1.40	0.34
16.45	3.12	1.40	0.33
16.50	3.12	1.41	0.33
16.55	3.12	1.41	0.33
16.60	3.13	1.41	0.33
16.65	3.13	1.41	0.33
16.70	3.13	1.42	0.32
16.75	3.14	1.42	0.32
16.80	3.14	1.42	0.32
16.85	3.15	1.43	0.32
16.90	3.15	1.43	0.32
16.95	3.15	1.43	0.32
17.00	3.16	1.43	0.31
17.05	3.16	1.44	0.31
17.10	3.16	1.44	0.31
17.15	3.17	1.44	0.31
17.20	3.17	1.45	0.31
17.25	3.17	1.45	0.30
17.30	3.18	1.45	0.30
17.35	3.18	1.45	0.30
17.40	3.18	1.46	0.30
17.45	3.19	1.46	0.30
17.50	3.19	1.46	0.30
17.55	3.19	1.46	0.29
17.60	3.20	1.47	0.29
17.65	3.20	1.47	0.29
17.70	3.20	1.47	0.29
17.75	3.21	1.47	0.29
17.80	3.21	1.48	0.29
17.85	3.21	1.48	0.28
17.90	3.22	1.48	0.28
17.95	3.22	1.49	0.28
18.00	3.22	1.49	0.28
18.05	3.23	1.49	0.28
18.10	3.23	1.49	0.28
18.15	3.23	1.49	0.27
18.20	3.24	1.50	0.27
18.25	3.24	1.50	0.27
18.30	3.24	1.50	0.27
18.35	3.25	1.50	0.27
18.40	3.25	1.51	0.26
18.45	3.25	1.51	0.26
18.50	3.25	1.51	0.26
18.55	3.26	1.51	0.26
18.60	3.26	1.52	0.26
18.65	3.26	1.52	0.26
18.70	3.27	1.52	0.25
18.75	3.27	1.52	0.25
18.80	3.27	1.53	0.25
18.85	3.27	1.53	0.25
18.90	3.28	1.53	0.25
18.95	3.28	1.53	0.25
19.00	3.28	1.53	0.24
19.05	3.28	1.54	0.24
19.10	3.29	1.54	0.24
19.15	3.29	1.54	0.24
19.20	3.29	1.54	0.24
19.25	3.30	1.54	0.23
19.30	3.30	1.55	0.23
19.35	3.30	1.55	0.23
19.40	3.30	1.55	0.23
19.45	3.31	1.55	0.23
19.50	3.31	1.55	0.23
19.55	3.31	1.56	0.22
19.60	3.31	1.56	0.22
19.65	3.32	1.56	0.22
19.70	3.32	1.56	0.22
19.75	3.32	1.56	0.22
19.80	3.32	1.57	0.22
19.85	3.33	1.57	0.21
19.90	3.33	1.57	0.21
19.95	3.33	1.57	0.21
20.00	**3.33**	**1.57**	0.21

Pond BMP-3: sed basin 3

Inflow Area = 5.300 ac, Inflow Depth = 1.56" for 2 yr event
Inflow = 8.74 cfs @ 12.19 hrs, Volume= 0.689 af
Outflow = 1.20 cfs @ 13.04 hrs, Volume= 0.434 af, Atten= 86%, Lag= 51.2 min
Primary = 1.20 cfs @ 13.04 hrs, Volume= 0.434 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 63.87' @ 13.04 hrs Surf.Area= 4,192 sf Storage= 16,801 cf
Plug-Flow detention time= 175.1 min calculated for 0.432 af (63% of inflow)
Center-of-Mass det. time= 103.1 min (907.0 - 803.9)

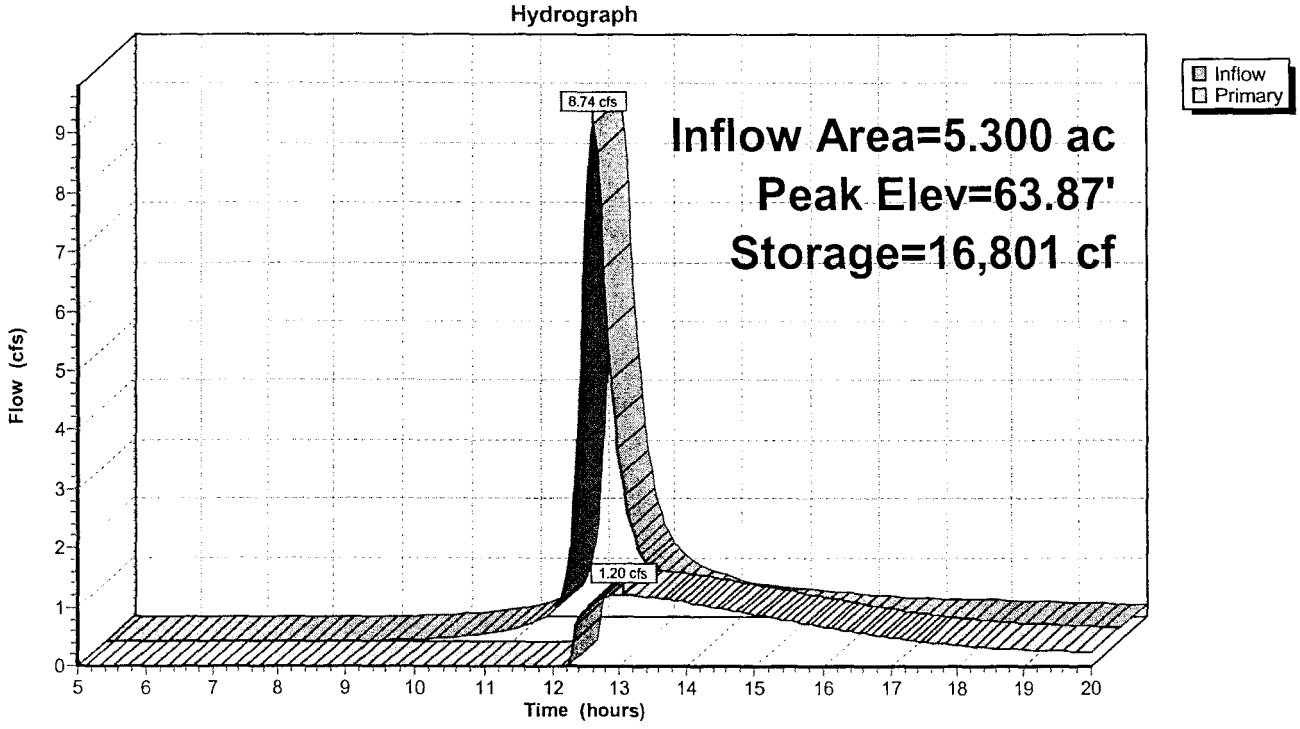
#	Invert	Avail.Storage	Storage Description
1	56.00'	77,692 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	600	0	0	600
59.50	1,800	4,012	4,012	1,888
60.00	2,020	954	4,967	2,125
62.00	3,050	5,035	10,002	3,230
64.00	4,275	7,291	17,292	4,547
66.00	5,720	9,960	27,252	6,098
68.00	7,375	13,060	40,312	7,874
70.00	9,300	16,638	56,950	9,933
72.00	11,480	20,742	77,692	12,260

#	Routing	Invert	Outlet Devices
1	Primary	53.00'	**24.0" x 80.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 45.30' S= 0.0963 '/' n= 0.012 Cc= 0.900
2	Device 1	62.00'	**6.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	66.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.20 cfs @ 13.04 hrs HW=63.86' (Free Discharge)
└─**1=Culvert** (Passes 1.20 cfs of 47.51 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.20 cfs @ 6.1 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond BMP-3: sed basin 3



Hydrograph for Pond BMP-3: sed basin 3

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	56.00	0.00
5.05	0.00	0	56.00	0.00
5.10	0.00	0	56.00	0.00
5.15	0.00	0	56.00	0.00
5.20	0.00	0	56.00	0.00
5.25	0.00	0	56.00	0.00
5.30	0.00	0	56.00	0.00
5.35	0.00	0	56.00	0.00
5.40	0.00	0	56.00	0.00
5.45	0.00	0	56.00	0.00
5.50	0.00	0	56.00	0.00
5.55	0.00	0	56.00	0.00
5.60	0.00	0	56.00	0.00
5.65	0.00	0	56.00	0.00
5.70	0.00	0	56.00	0.00
5.75	0.00	0	56.00	0.00
5.80	0.00	0	56.00	0.00
5.85	0.00	0	56.00	0.00
5.90	0.00	0	56.00	0.00
5.95	0.00	0	56.00	0.00
6.00	0.00	0	56.00	0.00
6.05	0.00	0	56.00	0.00
6.10	0.00	0	56.00	0.00
6.15	0.00	0	56.00	0.00
6.20	0.00	0	56.00	0.00
6.25	0.00	0	56.00	0.00
6.30	0.00	0	56.00	0.00
6.35	0.00	0	56.00	0.00
6.40	0.00	0	56.00	0.00
6.45	0.00	0	56.00	0.00
6.50	0.00	0	56.00	0.00
6.55	0.00	0	56.00	0.00
6.60	0.00	0	56.00	0.00
6.65	0.00	0	56.00	0.00
6.70	0.00	0	56.00	0.00
6.75	0.00	0	56.00	0.00
6.80	0.00	0	56.00	0.00
6.85	0.00	0	56.00	0.00
6.90	0.00	0	56.00	0.00
6.95	0.00	0	56.00	0.00
7.00	0.00	0	56.00	0.00
7.05	0.00	0	56.00	0.00
7.10	0.00	0	56.00	0.00
7.15	0.00	0	56.00	0.00
7.20	0.00	0	56.00	0.00
7.25	0.00	0	56.00	0.00
7.30	0.00	0	56.00	0.00
7.35	0.00	0	56.00	0.00
7.40	0.00	0	56.00	0.00
7.45	0.00	0	56.00	0.00
7.50	0.00	0	56.00	0.00
7.55	0.00	0	56.00	0.00

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
7.60	0.00	0	56.00	0.00
7.65	0.00	0	56.00	0.00
7.70	0.00	0	56.00	0.00
7.75	0.00	0	56.00	0.00
7.80	0.00	0	56.00	0.00
7.85	0.00	0	56.00	0.00
7.90	0.00	0	56.00	0.00
7.95	0.00	0	56.00	0.00
8.00	0.00	0	56.00	0.00
8.05	0.00	0	56.00	0.00
8.10	0.00	0	56.00	0.00
8.15	0.00	0	56.00	0.00
8.20	0.00	0	56.00	0.00
8.25	0.00	0	56.00	0.00
8.30	0.00	0	56.00	0.00
8.35	0.00	0	56.00	0.00
8.40	0.00	0	56.00	0.00
8.45	0.00	0	56.00	0.00
8.50	0.00	0	56.00	0.00
8.55	0.00	0	56.00	0.00
8.60	0.00	0	56.00	0.00
8.65	0.00	0	56.00	0.00
8.70	0.00	0	56.00	0.00
8.75	0.00	0	56.00	0.00
8.80	0.00	0	56.00	0.00
8.85	0.00	0	56.00	0.00
8.90	0.00	1	56.00	0.00
8.95	0.00	1	56.00	0.00
9.00	0.00	2	56.00	0.00
9.05	0.01	3	56.00	0.00
9.10	0.01	4	56.00	0.00
9.15	0.01	6	56.01	0.00
9.20	0.01	8	56.01	0.00
9.25	0.02	11	56.01	0.00
9.30	0.02	14	56.01	0.00
9.35	0.02	17	56.01	0.00
9.40	0.02	21	56.02	0.00
9.45	0.03	25	56.02	0.00
9.50	0.03	30	56.03	0.00
9.55	0.03	36	56.03	0.00
9.60	0.03	42	56.04	0.00
9.65	0.04	48	56.04	0.00
9.70	0.04	55	56.05	0.00
9.75	0.04	62	56.05	0.00
9.80	0.04	70	56.06	0.00
9.85	0.05	78	56.07	0.00
9.90	0.05	87	56.08	0.00
9.95	0.06	97	56.08	0.00
10.00	0.06	107	56.09	0.00
10.05	0.06	118	56.10	0.00
10.10	0.07	130	56.11	0.00
10.15	0.07	142	56.12	0.00

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
10.20	0.08	156	56.14	0.00
10.25	0.08	170	56.15	0.00
10.30	0.09	185	56.16	0.00
10.35	0.09	202	56.18	0.00
10.40	0.10	219	56.19	0.00
10.45	0.11	237	56.21	0.00
10.50	0.11	257	56.22	0.00
10.55	0.12	278	56.24	0.00
10.60	0.13	300	56.26	0.00
10.65	0.14	324	56.28	0.00
10.70	0.14	349	56.30	0.00
10.75	0.15	376	56.33	0.00
10.80	0.16	405	56.35	0.00
10.85	0.17	435	56.38	0.00
10.90	0.19	467	56.41	0.00
10.95	0.20	502	56.44	0.00
11.00	0.21	538	56.47	0.00
11.05	0.22	577	56.50	0.00
11.10	0.24	619	56.54	0.00
11.15	0.25	663	56.58	0.00
11.20	0.27	710	56.62	0.00
11.25	0.29	761	56.66	0.00
11.30	0.31	815	56.71	0.00
11.35	0.34	873	56.76	0.00
11.40	0.36	936	56.82	0.00
11.45	0.39	1,004	56.88	0.00
11.50	0.43	1,078	56.94	0.00
11.55	0.46	1,157	57.01	0.00
11.60	0.50	1,244	57.09	0.00
11.65	0.57	1,340	57.17	0.00
11.70	0.67	1,452	57.27	0.00
11.75	0.86	1,590	57.39	0.00
11.80	1.17	1,772	57.55	0.00
11.85	1.63	2,023	57.76	0.00
11.90	2.31	2,377	58.07	0.00
11.95	3.29	2,881	58.51	0.00
12.00	4.61	3,592	59.13	0.00
12.05	6.15	4,560	59.79	0.00
12.10	7.59	5,796	60.33	0.00
12.15	8.52	7,246	60.91	0.00
12.20	**8.72**	8,799	61.52	0.00
12.25	8.26	10,325	62.09	0.03
12.30	7.37	11,691	62.46	0.43
12.35	6.31	12,823	62.77	0.68
12.40	5.27	13,729	63.02	0.83
12.45	4.42	14,443	63.22	0.93
12.50	3.77	15,006	63.37	1.00
12.55	3.26	15,453	63.50	1.05
12.60	2.84	15,808	63.59	1.10
12.65	2.49	16,087	63.67	1.13
12.70	2.20	16,304	63.73	1.15
12.75	1.95	16,469	63.77	1.17

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
12.80	1.75	16,591	63.81	1.18
12.85	1.59	16,679	63.83	1.19
12.90	1.46	16,739	63.85	1.20
12.95	1.35	16,777	63.86	1.20
13.00	1.26	16,796	63.86	1.20
13.05	1.19	**16,801**	**63.87**	**1.20**
13.10	1.12	16,793	63.86	1.20
13.15	1.07	16,774	63.86	1.20
13.20	1.01	16,746	63.85	1.20
13.25	0.97	16,709	63.84	1.19
13.30	0.93	16,665	63.83	1.19
13.35	0.89	16,616	63.81	1.18
13.40	0.86	16,561	63.80	1.18
13.45	0.84	16,503	63.78	1.17
13.50	0.81	16,442	63.77	1.16
13.55	0.79	16,377	63.75	1.16
13.60	0.77	16,310	63.73	1.15
13.65	0.75	16,241	63.71	1.14
13.70	0.73	16,169	63.69	1.14
13.75	0.71	16,096	63.67	1.13
13.80	0.69	16,020	63.65	1.12
13.85	0.68	15,943	63.63	1.11
13.90	0.66	15,865	63.61	1.10
13.95	0.65	15,785	63.59	1.09
14.00	0.63	15,704	63.56	1.08
14.05	0.62	15,622	63.54	1.07
14.10	0.60	15,539	63.52	1.07
14.15	0.59	15,456	63.50	1.06
14.20	0.58	15,372	63.47	1.05
14.25	0.56	15,287	63.45	1.04
14.30	0.55	15,202	63.43	1.02
14.35	0.54	15,117	63.40	1.01
14.40	0.53	15,032	63.38	1.00
14.45	0.53	14,947	63.36	0.99
14.50	0.52	14,863	63.33	0.98
14.55	0.51	14,780	63.31	0.97
14.60	0.51	14,698	63.29	0.96
14.65	0.50	14,616	63.27	0.95
14.70	0.50	14,536	63.24	0.94
14.75	0.49	14,456	63.22	0.93
14.80	0.49	14,377	63.20	0.92
14.85	0.48	14,299	63.18	0.91
14.90	0.48	14,223	63.16	0.90
14.95	0.47	14,147	63.14	0.89
15.00	0.47	14,072	63.12	0.88
15.05	0.46	13,998	63.10	0.87
15.10	0.46	13,926	63.08	0.86
15.15	0.45	13,854	63.06	0.85
15.20	0.45	13,783	63.04	0.84
15.25	0.44	13,713	63.02	0.83
15.30	0.44	13,645	63.00	0.82
15.35	0.43	13,577	62.98	0.81

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
15.40	0.43	13,510	62.96	0.80
15.45	0.42	13,445	62.94	0.79
15.50	0.42	13,380	62.93	0.78
15.55	0.41	13,316	62.91	0.77
15.60	0.41	13,253	62.89	0.76
15.65	0.41	13,191	62.88	0.75
15.70	0.40	13,130	62.86	0.74
15.75	0.40	13,070	62.84	0.73
15.80	0.39	13,011	62.83	0.72
15.85	0.39	12,954	62.81	0.71
15.90	0.38	12,896	62.79	0.70
15.95	0.38	12,840	62.78	0.69
16.00	0.37	12,785	62.76	0.68
16.05	0.37	12,731	62.75	0.67
16.10	0.36	12,677	62.73	0.66
16.15	0.36	12,625	62.72	0.65
16.20	0.35	12,573	62.71	0.64
16.25	0.35	12,522	62.69	0.63
16.30	0.34	12,473	62.68	0.62
16.35	0.34	12,424	62.66	0.61
16.40	0.34	12,377	62.65	0.60
16.45	0.33	12,331	62.64	0.59
16.50	0.33	12,286	62.63	0.58
16.55	0.33	12,243	62.61	0.57
16.60	0.33	12,201	62.60	0.56
16.65	0.33	12,160	62.59	0.55
16.70	0.32	12,120	62.58	0.54
16.75	0.32	12,081	62.57	0.53
16.80	0.32	12,043	62.56	0.53
16.85	0.32	12,007	62.55	0.52
16.90	0.32	11,972	62.54	0.51
16.95	0.32	11,939	62.53	0.50
17.00	0.31	11,907	62.52	0.49
17.05	0.31	11,876	62.51	0.48
17.10	0.31	11,846	62.51	0.47
17.15	0.31	11,818	62.50	0.46
17.20	0.31	11,790	62.49	0.46
17.25	0.30	11,764	62.48	0.45
17.30	0.30	11,739	62.48	0.44
17.35	0.30	11,714	62.47	0.43
17.40	0.30	11,691	62.46	0.43
17.45	0.30	11,668	62.46	0.42
17.50	0.30	11,647	62.45	0.42
17.55	0.29	11,626	62.45	0.41
17.60	0.29	11,605	62.44	0.40
17.65	0.29	11,586	62.43	0.40
17.70	0.29	11,567	62.43	0.39
17.75	0.29	11,549	62.42	0.39
17.80	0.29	11,531	62.42	0.38
17.85	0.28	11,514	62.41	0.38
17.90	0.28	11,497	62.41	0.37
17.95	0.28	11,481	62.41	0.37

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
18.00	0.28	11,465	62.40	0.36
18.05	0.28	11,450	62.40	0.36
18.10	0.28	11,436	62.39	0.35
18.15	0.27	11,422	62.39	0.35
18.20	0.27	11,409	62.39	0.34
18.25	0.27	11,396	62.38	0.34
18.30	0.27	11,384	62.38	0.34
18.35	0.27	11,372	62.38	0.33
18.40	0.26	11,360	62.37	0.33
18.45	0.26	11,349	62.37	0.32
18.50	0.26	11,339	62.37	0.32
18.55	0.26	11,328	62.36	0.32
18.60	0.26	11,318	62.36	0.31
18.65	0.26	11,309	62.36	0.31
18.70	0.25	11,299	62.36	0.31
18.75	0.25	11,290	62.35	0.30
18.80	0.25	11,282	62.35	0.30
18.85	0.25	11,273	62.35	0.30
18.90	0.25	11,265	62.35	0.29
18.95	0.25	11,256	62.34	0.29
19.00	0.24	11,248	62.34	0.29
19.05	0.24	11,241	62.34	0.28
19.10	0.24	11,233	62.34	0.28
19.15	0.24	11,226	62.34	0.28
19.20	0.24	11,218	62.33	0.28
19.25	0.23	11,211	62.33	0.27
19.30	0.23	11,204	62.33	0.27
19.35	0.23	11,197	62.33	0.27
19.40	0.23	11,190	62.33	0.27
19.45	0.23	11,184	62.32	0.26
19.50	0.23	11,177	62.32	0.26
19.55	0.22	11,171	62.32	0.26
19.60	0.22	11,164	62.32	0.26
19.65	0.22	11,158	62.32	0.26
19.70	0.22	11,152	62.32	0.25
19.75	0.22	11,145	62.31	0.25
19.80	0.22	11,139	62.31	0.25
19.85	0.21	11,133	62.31	0.25
19.90	0.21	11,127	62.31	0.24
19.95	0.21	11,121	62.31	0.24
20.00	0.21	11,116	62.31	0.24

Stage-Discharge for Pond BMP-3: sed basin 3

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
56.00	0.00	58.08	0.00	60.16	0.00	62.24	0.16
56.04	0.00	58.12	0.00	60.20	0.00	62.28	0.20
56.08	0.00	58.16	0.00	60.24	0.00	62.32	0.26
56.12	0.00	58.20	0.00	60.28	0.00	62.36	0.31
56.16	0.00	58.24	0.00	60.32	0.00	62.40	0.36
56.20	0.00	58.28	0.00	60.36	0.00	62.44	0.41
56.24	0.00	58.32	0.00	60.40	0.00	62.48	0.46
56.28	0.00	58.36	0.00	60.44	0.00	62.52	0.49
56.32	0.00	58.40	0.00	60.48	0.00	62.56	0.53
56.36	0.00	58.44	0.00	60.52	0.00	62.60	0.56
56.40	0.00	58.48	0.00	60.56	0.00	62.64	0.59
56.44	0.00	58.52	0.00	60.60	0.00	62.68	0.62
56.48	0.00	58.56	0.00	60.64	0.00	62.72	0.65
56.52	0.00	58.60	0.00	60.68	0.00	62.76	0.68
56.56	0.00	58.64	0.00	60.72	0.00	62.80	0.70
56.60	0.00	58.68	0.00	60.76	0.00	62.84	0.73
56.64	0.00	58.72	0.00	60.80	0.00	62.88	0.75
56.68	0.00	58.76	0.00	60.84	0.00	62.92	0.77
56.72	0.00	58.80	0.00	60.88	0.00	62.96	0.80
56.76	0.00	58.84	0.00	60.92	0.00	63.00	0.82
56.80	0.00	58.88	0.00	60.96	0.00	63.04	0.84
56.84	0.00	58.92	0.00	61.00	0.00	63.08	0.86
56.88	0.00	58.96	0.00	61.04	0.00	63.12	0.88
56.92	0.00	59.00	0.00	61.08	0.00	63.16	0.90
56.96	0.00	59.04	0.00	61.12	0.00	63.20	0.92
57.00	0.00	59.08	0.00	61.16	0.00	63.24	0.94
57.04	0.00	59.12	0.00	61.20	0.00	63.28	0.96
57.08	0.00	59.16	0.00	61.24	0.00	63.32	0.98
57.12	0.00	59.20	0.00	61.28	0.00	63.36	1.00
57.16	0.00	59.24	0.00	61.32	0.00	63.40	1.01
57.20	0.00	59.28	0.00	61.36	0.00	63.44	1.03
57.24	0.00	59.32	0.00	61.40	0.00	63.48	1.05
57.28	0.00	59.36	0.00	61.44	0.00	63.52	1.07
57.32	0.00	59.40	0.00	61.48	0.00	63.56	1.08
57.36	0.00	59.44	0.00	61.52	0.00	63.60	1.10
57.40	0.00	59.48	0.00	61.56	0.00	63.64	1.11
57.44	0.00	59.52	0.00	61.60	0.00	63.68	1.13
57.48	0.00	59.56	0.00	61.64	0.00	63.72	1.15
57.52	0.00	59.60	0.00	61.68	0.00	63.76	1.16
57.56	0.00	59.64	0.00	61.72	0.00	63.80	1.18
57.60	0.00	59.68	0.00	61.76	0.00	63.84	1.19
57.64	0.00	59.72	0.00	61.80	0.00	63.88	1.21
57.68	0.00	59.76	0.00	61.84	0.00	63.92	1.22
57.72	0.00	59.80	0.00	61.88	0.00	63.96	1.24
57.76	0.00	59.84	0.00	61.92	0.00	64.00	1.25
57.80	0.00	59.88	0.00	61.96	0.00	64.04	1.26
57.84	0.00	59.92	0.00	62.00	0.00	64.08	1.28
57.88	0.00	59.96	0.00	62.04	0.01	64.12	1.29
57.92	0.00	60.00	0.00	62.08	0.02	64.16	1.31
57.96	0.00	60.04	0.00	62.12	0.04	64.20	1.32
58.00	0.00	60.08	0.00	62.16	0.07	64.24	1.33
58.04	0.00	60.12	0.00	62.20	0.11	64.28	1.35

Stage-Discharge for Pond BMP-3: sed basin 3 (continued)

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
64.32	1.36	66.40	1.93	68.48	57.56	70.56	61.56
64.36	1.37	66.44	1.94	68.52	57.64	70.60	61.63
64.40	1.39	66.48	1.94	68.56	57.72	70.64	61.71
64.44	1.40	66.52	2.07	68.60	57.80	70.68	61.78
64.48	1.41	66.56	2.57	68.64	57.88	70.72	61.85
64.52	1.42	66.60	3.27	68.68	57.96	70.76	61.93
64.56	1.44	66.64	4.13	68.72	58.04	70.80	62.00
64.60	1.45	66.68	5.13	68.76	58.11	70.84	62.07
64.64	1.46	66.72	6.24	68.80	58.19	70.88	62.15
64.68	1.47	66.76	7.46	68.84	58.27	70.92	62.22
64.72	1.49	66.80	8.77	68.88	58.35	70.96	62.30
64.76	1.50	66.84	10.17	68.92	58.43	71.00	62.37
64.80	1.51	66.88	11.66	68.96	58.51	71.04	62.44
64.84	1.52	66.92	13.23	69.00	58.59	71.08	62.52
64.88	1.53	66.96	14.87	69.04	58.66	71.12	62.59
64.92	1.54	67.00	16.59	69.08	58.74	71.16	62.66
64.96	1.56	67.04	18.38	69.12	58.82	71.20	62.73
65.00	1.57	67.08	20.23	69.16	58.90	71.24	62.81
65.04	1.58	67.12	22.15	69.20	58.97	71.28	62.88
65.08	1.59	67.16	24.13	69.24	59.05	71.32	62.95
65.12	1.60	67.20	26.17	69.28	59.13	71.36	63.03
65.16	1.61	67.24	28.27	69.32	59.21	71.40	63.10
65.20	1.62	67.28	30.43	69.36	59.28	71.44	63.17
65.24	1.63	67.32	32.64	69.40	59.36	71.48	63.24
65.28	1.65	67.36	34.91	69.44	59.44	71.52	63.32
65.32	1.66	67.40	37.23	69.48	59.52	71.56	63.39
65.36	1.67	67.44	39.60	69.52	59.59	71.60	63.46
65.40	1.68	67.48	42.03	69.56	59.67	71.64	63.53
65.44	1.69	67.52	44.50	69.60	59.75	71.68	63.60
65.48	1.70	67.56	47.02	69.64	59.82	71.72	63.68
65.52	1.71	67.60	49.59	69.68	59.90	71.76	63.75
65.56	1.72	67.64	52.21	69.72	59.98	71.80	63.82
65.60	1.73	67.68	54.88	69.76	60.05	71.84	63.89
65.64	1.74	67.72	56.03	69.80	60.13	71.88	63.96
65.68	1.75	67.76	56.11	69.84	60.20	71.92	64.03
65.72	1.76	67.80	56.19	69.88	60.28	71.96	64.11
65.76	1.77	67.84	56.27	69.92	60.36	72.00	**64.18**
65.80	1.78	67.88	56.36	69.96	60.43		
65.84	1.79	67.92	56.44	70.00	60.51		
65.88	1.80	67.96	56.52	70.04	60.58		
65.92	1.81	68.00	56.60	70.08	60.66		
65.96	1.82	68.04	56.68	70.12	60.73		
66.00	1.83	68.08	56.76	70.16	60.81		
66.04	1.84	68.12	56.84	70.20	60.88		
66.08	1.85	68.16	56.92	70.24	60.96		
66.12	1.86	68.20	57.00	70.28	61.03		
66.16	1.87	68.24	57.08	70.32	61.11		
66.20	1.88	68.28	57.16	70.36	61.18		
66.24	1.89	68.32	57.24	70.40	61.26		
66.28	1.90	68.36	57.32	70.44	61.33		
66.32	1.91	68.40	57.40	70.48	61.41		
66.36	1.92	68.44	57.48	70.52	61.48		

Stage-Area-Storage for Pond BMP-3: sed basin 3

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
56.00	600	0	58.08	1,313	2,385
56.04	614	46	58.12	1,327	2,430
56.08	627	92	58.16	1,341	2,476
56.12	641	138	58.20	1,354	2,522
56.16	655	183	58.24	1,368	2,568
56.20	669	229	58.28	1,382	2,614
56.24	682	275	58.32	1,395	2,660
56.28	696	321	58.36	1,409	2,706
56.32	710	367	58.40	1,423	2,751
56.36	723	413	58.44	1,437	2,797
56.40	737	459	58.48	1,450	2,843
56.44	751	504	58.52	1,464	2,889
56.48	765	550	58.56	1,478	2,935
56.52	778	596	58.60	1,491	2,981
56.56	792	642	58.64	1,505	3,027
56.60	806	688	58.68	1,519	3,072
56.64	819	734	58.72	1,533	3,118
56.68	833	780	58.76	1,546	3,164
56.72	847	825	58.80	1,560	3,210
56.76	861	871	58.84	1,574	3,256
56.80	874	917	58.88	1,587	3,302
56.84	888	963	58.92	1,601	3,348
56.88	902	1,009	58.96	1,615	3,393
56.92	915	1,055	59.00	1,629	3,439
56.96	929	1,101	59.04	1,642	3,485
57.00	943	1,146	59.08	1,656	3,531
57.04	957	1,192	59.12	1,670	3,577
57.08	970	1,238	59.16	1,683	3,623
57.12	984	1,284	59.20	1,697	3,669
57.16	998	1,330	59.24	1,711	3,714
57.20	1,011	1,376	59.28	1,725	3,760
57.24	1,025	1,422	59.32	1,738	3,806
57.28	1,039	1,467	59.36	1,752	3,852
57.32	1,053	1,513	59.40	1,766	3,898
57.36	1,066	1,559	59.44	1,779	3,944
57.40	1,080	1,605	59.48	1,793	3,990
57.44	1,094	1,651	59.52	1,809	4,051
57.48	1,107	1,697	59.56	1,826	4,127
57.52	1,121	1,743	59.60	1,844	4,203
57.56	1,135	1,788	59.64	1,862	4,280
57.60	1,149	1,834	59.68	1,879	4,356
57.64	1,162	1,880	59.72	1,897	4,432
57.68	1,176	1,926	59.76	1,914	4,509
57.72	1,190	1,972	59.80	1,932	4,585
57.76	1,203	2,018	59.84	1,950	4,661
57.80	1,217	2,064	59.88	1,967	4,738
57.84	1,231	2,109	59.92	1,985	4,814
57.88	1,245	2,155	59.96	2,002	4,891
57.92	1,258	2,201	60.00	2,020	4,967
57.96	1,272	2,247	60.04	2,041	5,068
58.00	1,286	2,293	60.08	2,061	5,168
58.04	1,299	2,339	60.12	2,082	5,269

Stage-Area-Storage for Pond BMP-3: sed basin 3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
60.16	2,102	5,370	62.24	3,197	10,877
60.20	2,123	5,470	62.28	3,222	11,022
60.24	2,144	5,571	62.32	3,246	11,168
60.28	2,164	5,672	62.36	3,270	11,314
60.32	2,185	5,772	62.40	3,295	11,460
60.36	2,205	5,873	62.44	3,319	11,606
60.40	2,226	5,974	62.48	3,344	11,751
60.44	2,247	6,075	62.52	3,369	11,897
60.48	2,267	6,175	62.56	3,393	12,043
60.52	2,288	6,276	62.60	3,418	12,189
60.56	2,308	6,377	62.64	3,442	12,335
60.60	2,329	6,477	62.68	3,467	12,480
60.64	2,350	6,578	62.72	3,491	12,626
60.68	2,370	6,679	62.76	3,515	12,772
60.72	2,391	6,779	62.80	3,540	12,918
60.76	2,411	6,880	62.84	3,565	13,064
60.80	2,432	6,981	62.88	3,589	13,210
60.84	2,453	7,082	62.92	3,614	13,355
60.88	2,473	7,182	62.96	3,638	13,501
60.92	2,494	7,283	63.00	3,663	13,647
60.96	2,514	7,384	63.04	3,687	13,793
61.00	2,535	7,484	63.08	3,711	13,939
61.04	2,556	7,585	63.12	3,736	14,084
61.08	2,576	7,686	63.16	3,760	14,230
61.12	2,597	7,786	63.20	3,785	14,376
61.16	2,617	7,887	63.24	3,810	14,522
61.20	2,638	7,988	63.28	3,834	14,668
61.24	2,659	8,088	63.32	3,859	14,813
61.28	2,679	8,189	63.36	3,883	14,959
61.32	2,700	8,290	63.40	3,907	15,105
61.36	2,720	8,391	63.44	3,932	15,251
61.40	2,741	8,491	63.48	3,957	15,397
61.44	2,762	8,592	63.52	3,981	15,543
61.48	2,782	8,693	63.56	4,006	15,688
61.52	2,803	8,793	63.60	4,030	15,834
61.56	2,823	8,894	63.64	4,055	15,980
61.60	2,844	8,995	63.68	4,079	16,126
61.64	2,865	9,095	63.72	4,103	16,272
61.68	2,885	9,196	63.76	4,128	16,417
61.72	2,906	9,297	63.80	4,152	16,563
61.76	2,926	9,397	63.84	4,177	16,709
61.80	2,947	9,498	63.88	4,202	16,855
61.84	2,968	9,599	63.92	4,226	17,001
61.88	2,988	9,700	63.96	4,251	17,146
61.92	3,009	9,800	64.00	4,275	17,292
61.96	3,029	9,901	64.04	4,304	17,491
62.00	3,050	10,002	64.08	4,333	17,691
62.04	3,074	10,147	64.12	4,362	17,890
62.08	3,099	10,293	64.16	4,391	18,089
62.12	3,123	10,439	64.20	4,420	18,288
62.16	3,148	10,585	64.24	4,448	18,487
62.20	3,173	10,731	64.28	4,477	18,687

Stage-Area-Storage for Pond BMP-3: sed basin 3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
64.32	4,506	18,886	66.40	6,051	29,864
64.36	4,535	19,085	66.44	6,084	30,125
64.40	4,564	19,284	66.48	6,117	30,387
64.44	4,593	19,483	66.52	6,150	30,648
64.48	4,622	19,683	66.56	6,183	30,909
64.52	4,651	19,882	66.60	6,216	31,170
64.56	4,680	20,081	66.64	6,250	31,431
64.60	4,708	20,280	66.68	6,283	31,693
64.64	4,737	20,479	66.72	6,316	31,954
64.68	4,766	20,679	66.76	6,349	32,215
64.72	4,795	20,878	66.80	6,382	32,476
64.76	4,824	21,077	66.84	6,415	32,737
64.80	4,853	21,276	66.88	6,448	32,999
64.84	4,882	21,475	66.92	6,481	33,260
64.88	4,911	21,675	66.96	6,514	33,521
64.92	4,940	21,874	67.00	6,548	33,782
64.96	4,969	22,073	67.04	6,581	34,043
65.00	4,998	22,272	67.08	6,614	34,305
65.04	5,026	22,471	67.12	6,647	34,566
65.08	5,055	22,671	67.16	6,680	34,827
65.12	5,084	22,870	67.20	6,713	35,088
65.16	5,113	23,069	67.24	6,746	35,349
65.20	5,142	23,268	67.28	6,779	35,611
65.24	5,171	23,467	67.32	6,812	35,872
65.28	5,200	23,667	67.36	6,845	36,133
65.32	5,229	23,866	67.40	6,879	36,394
65.36	5,258	24,065	67.44	6,912	36,655
65.40	5,287	24,264	67.48	6,945	36,917
65.44	5,315	24,463	67.52	6,978	37,178
65.48	5,344	24,663	67.56	7,011	37,439
65.52	5,373	24,862	67.60	7,044	37,700
65.56	5,402	25,061	67.64	7,077	37,961
65.60	5,431	25,260	67.68	7,110	38,223
65.64	5,460	25,459	67.72	7,143	38,484
65.68	5,489	25,659	67.76	7,176	38,745
65.72	5,518	25,858	67.80	7,209	39,006
65.76	5,547	26,057	67.84	7,243	39,267
65.80	5,575	26,256	67.88	7,276	39,529
65.84	5,604	26,455	67.92	7,309	39,790
65.88	5,633	26,655	67.96	7,342	40,051
65.92	5,662	26,854	68.00	7,375	40,312
65.96	5,691	27,053	68.04	7,414	40,645
66.00	5,720	27,252	68.08	7,452	40,978
66.04	5,753	27,513	68.12	7,491	41,311
66.08	5,786	27,775	68.16	7,529	41,643
66.12	5,819	28,036	68.20	7,568	41,976
66.16	5,852	28,297	68.24	7,606	42,309
66.20	5,886	28,558	68.28	7,645	42,642
66.24	5,919	28,819	68.32	7,683	42,974
66.28	5,952	29,081	68.36	7,721	43,307
66.32	5,985	29,342	68.40	7,760	43,640
66.36	6,018	29,603	68.44	7,798	43,973

Stage-Area-Storage for Pond BMP-3: sed basin 3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
68.48	7,837	44,305
68.52	7,875	44,638
68.56	7,914	44,971
68.60	7,952	45,304
68.64	7,991	45,636
68.68	8,030	45,969
68.72	8,068	46,302
68.76	8,107	46,635
68.80	8,145	46,967
68.84	8,184	47,300
68.88	8,222	47,633
68.92	8,261	47,966
68.96	8,299	48,298
69.00	8,338	48,631
69.04	8,376	48,964
69.08	8,414	49,297
69.12	8,453	49,629
69.16	8,491	49,962
69.20	8,530	50,295
69.24	8,568	50,628
69.28	8,607	50,960
69.32	8,645	51,293
69.36	8,684	51,626
69.40	8,723	51,959
69.44	8,761	52,292
69.48	8,800	52,624
69.52	8,838	52,957
69.56	8,877	53,290
69.60	8,915	53,623
69.64	8,954	53,955
69.68	8,992	54,288
69.72	9,030	54,621
69.76	9,069	54,954
69.80	9,107	55,286
69.84	9,146	55,619
69.88	9,184	55,952
69.92	9,223	56,285
69.96	9,262	56,617
70.00	9,300	56,950
70.04	9,344	57,365
70.08	9,387	57,780
70.12	9,431	58,195
70.16	9,474	58,609
70.20	9,518	59,024
70.24	9,562	59,439
70.28	9,605	59,854
70.32	9,649	60,269
70.36	9,692	60,684
70.40	9,736	61,098
70.44	9,780	61,513
70.48	9,823	61,928
70.52	9,867	62,343
70.56	9,910	62,758
70.60	9,954	63,173
70.64	9,998	63,587
70.68	10,041	64,002
70.72	10,085	64,417
70.76	10,128	64,832
70.80	10,172	65,247
70.84	10,216	65,662
70.88	10,259	66,076
70.92	10,303	66,491
70.96	10,346	66,906
71.00	10,390	67,321
71.04	10,434	67,736
71.08	10,477	68,151
71.12	10,521	68,566
71.16	10,564	68,980
71.20	10,608	69,395
71.24	10,652	69,810
71.28	10,695	70,225
71.32	10,739	70,640
71.36	10,782	71,055
71.40	10,826	71,469
71.44	10,870	71,884
71.48	10,913	72,299
71.52	10,957	72,714
71.56	11,000	73,129
71.60	11,044	73,544
71.64	11,088	73,958
71.68	11,131	74,373
71.72	11,175	74,788
71.76	11,218	75,203
71.80	11,262	75,618
71.84	11,306	76,033
71.88	11,349	76,447
71.92	11,393	76,862
71.96	11,436	77,277
72.00	**11,480**	**77,692**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Post Dev: 1/3 Acre Lots Runoff Area=5.300 ac Runoff Depth=4.03"
Tc=25.0 min CN=81 Runoff=22.21 cfs 1.778 af

Pond BMP-3: sed basin 3 Peak Elev=66.98' Storage=33,625 cf Inflow=22.21 cfs 1.778 af
Outflow=15.69 cfs 1.455 af

Total Runoff Area = 5.300 ac Runoff Volume = 1.778 af Average Runoff Depth = 4.03"

Subcatchment Post Dev: 1/3 Acre Lots

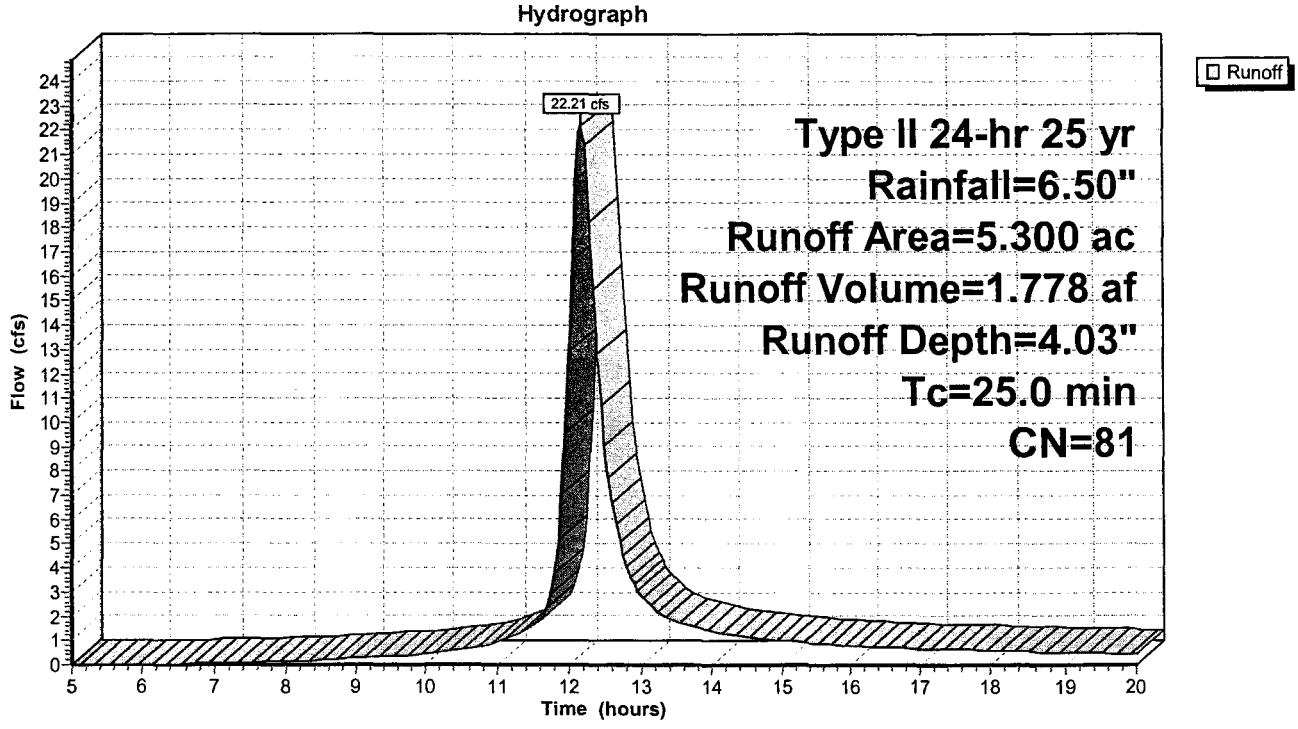
Runoff = 22.21 cfs @ 12.18 hrs, Volume= 1.778 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.50"

Area (ac)	CN	Description
5.300	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.41	0.00	0.00	7.60	0.72	0.02	0.11
5.05	0.41	0.00	0.00	7.65	0.73	0.03	0.11
5.10	0.42	0.00	0.00	7.70	0.74	0.03	0.12
5.15	0.43	0.00	0.00	7.75	0.74	0.03	0.12
5.20	0.43	0.00	0.00	7.80	0.75	0.03	0.12
5.25	0.44	0.00	0.00	7.85	0.76	0.03	0.13
5.30	0.44	0.00	0.00	7.90	0.77	0.03	0.13
5.35	0.45	0.00	0.00	7.95	0.77	0.03	0.13
5.40	0.45	0.00	0.00	8.00	0.78	0.04	0.14
5.45	0.46	0.00	0.00	8.05	0.79	0.04	0.14
5.50	0.46	0.00	0.00	8.10	0.79	0.04	0.15
5.55	0.47	0.00	0.00	8.15	0.80	0.04	0.15
5.60	0.47	0.00	0.00	8.20	0.81	0.04	0.15
5.65	0.48	0.00	0.00	8.25	0.82	0.05	0.16
5.70	0.49	0.00	0.00	8.30	0.83	0.05	0.16
5.75	0.49	0.00	0.00	8.35	0.83	0.05	0.17
5.80	0.50	0.00	0.00	8.40	0.84	0.05	0.17
5.85	0.50	0.00	0.00	8.45	0.85	0.05	0.18
5.90	0.51	0.00	0.00	8.50	0.86	0.06	0.19
5.95	0.51	0.00	0.00	8.55	0.87	0.06	0.20
6.00	0.52	0.00	0.01	8.60	0.88	0.06	0.20
6.05	0.53	0.00	0.01	8.65	0.89	0.06	0.21
6.10	0.53	0.00	0.01	8.70	0.90	0.07	0.22
6.15	0.54	0.00	0.01	8.75	0.91	0.07	0.23
6.20	0.54	0.00	0.02	8.80	0.92	0.07	0.23
6.25	0.55	0.00	0.02	8.85	0.93	0.07	0.24
6.30	0.56	0.00	0.02	8.90	0.94	0.08	0.25
6.35	0.56	0.00	0.02	8.95	0.95	0.08	0.26
6.40	0.57	0.00	0.03	9.00	0.96	0.08	0.27
6.45	0.57	0.00	0.03	9.05	0.97	0.09	0.28
6.50	0.58	0.01	0.03	9.10	0.98	0.09	0.29
6.55	0.59	0.01	0.04	9.15	0.99	0.09	0.30
6.60	0.59	0.01	0.04	9.20	1.00	0.10	0.31
6.65	0.60	0.01	0.04	9.25	1.01	0.10	0.32
6.70	0.61	0.01	0.05	9.30	1.02	0.10	0.33
6.75	0.61	0.01	0.05	9.35	1.03	0.11	0.34
6.80	0.62	0.01	0.05	9.40	1.04	0.11	0.34
6.85	0.62	0.01	0.06	9.45	1.05	0.11	0.35
6.90	0.63	0.01	0.06	9.50	1.06	0.12	0.36
6.95	0.64	0.01	0.06	9.55	1.07	0.12	0.36
7.00	0.64	0.01	0.07	9.60	1.08	0.13	0.37
7.05	0.65	0.01	0.07	9.65	1.09	0.13	0.38
7.10	0.66	0.01	0.07	9.70	1.10	0.13	0.38
7.15	0.66	0.01	0.08	9.75	1.11	0.14	0.39
7.20	0.67	0.02	0.08	9.80	1.13	0.14	0.40
7.25	0.68	0.02	0.08	9.85	1.14	0.15	0.41
7.30	0.68	0.02	0.09	9.90	1.15	0.15	0.42
7.35	0.69	0.02	0.09	9.95	1.16	0.16	0.43
7.40	0.70	0.02	0.09	10.00	1.18	0.16	0.45
7.45	0.70	0.02	0.10	10.05	1.19	0.17	0.46
7.50	0.71	0.02	0.10	10.10	1.20	0.17	0.48
7.55	0.72	0.02	0.10	10.15	1.22	0.18	0.49

Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
10.20	1.23	0.19	0.51	12.80	4.93	2.93	4.05
10.25	1.25	0.19	0.53	12.85	4.95	2.95	3.66
10.30	1.26	0.20	0.54	12.90	4.98	2.96	3.34
10.35	1.28	0.21	0.57	12.95	5.00	2.98	3.08
10.40	1.29	0.21	0.59	13.00	5.02	3.00	2.87
10.45	1.31	0.22	0.61	13.05	5.04	3.02	2.69
10.50	1.33	0.23	0.63	13.10	5.06	3.04	2.53
10.55	1.34	0.24	0.66	13.15	5.08	3.05	2.40
10.60	1.36	0.25	0.68	13.20	5.09	3.07	2.28
10.65	1.38	0.25	0.71	13.25	5.11	3.08	2.17
10.70	1.40	0.26	0.74	13.30	5.13	3.10	2.07
10.75	1.42	0.27	0.77	13.35	5.15	3.11	1.99
10.80	1.44	0.28	0.80	13.40	5.16	3.13	1.92
10.85	1.46	0.29	0.83	13.45	5.18	3.14	1.86
10.90	1.48	0.31	0.87	13.50	5.19	3.16	1.81
10.95	1.50	0.32	0.91	13.55	5.21	3.17	1.76
11.00	1.53	0.33	0.95	13.60	5.22	3.18	1.71
11.05	1.55	0.34	0.99	13.65	5.24	3.20	1.66
11.10	1.58	0.36	1.04	13.70	5.25	3.21	1.62
11.15	1.60	0.37	1.09	13.75	5.27	3.22	1.58
11.20	1.63	0.39	1.14	13.80	5.28	3.23	1.54
11.25	1.66	0.40	1.20	13.85	5.29	3.25	1.50
11.30	1.70	0.42	1.26	13.90	5.31	3.26	1.46
11.35	1.73	0.44	1.34	13.95	5.32	3.27	1.43
11.40	1.76	0.46	1.42	14.00	5.33	3.28	1.39
11.45	1.80	0.48	1.51	14.05	5.34	3.29	1.36
11.50	1.84	0.51	1.61	14.10	5.35	3.30	1.33
11.55	1.90	0.54	1.72	14.15	5.37	3.31	1.30
11.60	1.99	0.60	1.84	14.20	5.38	3.32	1.27
11.65	2.13	0.69	2.03	14.25	5.39	3.33	1.24
11.70	2.30	0.80	2.35	14.30	5.40	3.34	1.21
11.75	2.52	0.95	2.92	14.35	5.41	3.35	1.19
11.80	2.80	1.16	3.82	14.40	5.42	3.36	1.17
11.85	3.19	1.46	5.15	14.45	5.43	3.37	1.16
11.90	3.69	1.86	7.02	14.50	5.44	3.38	1.14
11.95	4.12	2.22	9.59	14.55	5.46	3.39	1.13
12.00	4.31	2.38	12.91	14.60	5.47	3.40	1.11
12.05	4.37	2.44	16.62	14.65	5.48	3.41	1.10
12.10	4.43	2.49	19.94	14.70	5.49	3.42	1.09
12.15	4.49	2.54	21.93	14.75	5.50	3.43	1.08
12.20	4.54	2.58	**22.09**	14.80	5.51	3.44	1.06
12.25	4.59	2.63	20.67	14.85	5.52	3.45	1.05
12.30	4.63	2.66	18.26	14.90	5.53	3.46	1.04
12.35	4.68	2.70	15.48	14.95	5.54	3.47	1.03
12.40	4.71	2.73	12.84	15.00	5.55	3.47	1.02
12.45	4.75	2.76	10.69	15.05	5.56	3.48	1.01
12.50	4.78	2.79	9.05	15.10	5.57	3.49	1.00
12.55	4.81	2.81	7.76	15.15	5.58	3.50	0.99
12.60	4.83	2.84	6.71	15.20	5.59	3.51	0.98
12.65	4.86	2.86	5.84	15.25	5.60	3.52	0.97
12.70	4.88	2.88	5.13	15.30	5.60	3.52	0.96
12.75	4.91	2.90	4.54	15.35	5.61	3.53	0.95

Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
15.40	5.62	3.54	0.94
15.45	5.63	3.55	0.92
15.50	5.64	3.56	0.91
15.55	5.65	3.56	0.90
15.60	5.66	3.57	0.89
15.65	5.66	3.58	0.88
15.70	5.67	3.59	0.87
15.75	5.68	3.59	0.86
15.80	5.69	3.60	0.85
15.85	5.70	3.61	0.84
15.90	5.70	3.62	0.83
15.95	5.71	3.62	0.82
16.00	5.72	3.63	0.81
16.05	5.73	3.64	0.80
16.10	5.73	3.64	0.78
16.15	5.74	3.65	0.77
16.20	5.75	3.66	0.76
16.25	5.76	3.66	0.75
16.30	5.76	3.67	0.75
16.35	5.77	3.68	0.74
16.40	5.78	3.68	0.73
16.45	5.79	3.69	0.72
16.50	5.79	3.70	0.72
16.55	5.80	3.70	0.71
16.60	5.81	3.71	0.71
16.65	5.81	3.71	0.70
16.70	5.82	3.72	0.70
16.75	5.83	3.73	0.70
16.80	5.83	3.73	0.69
16.85	5.84	3.74	0.69
16.90	5.85	3.75	0.68
16.95	5.85	3.75	0.68
17.00	5.86	3.76	0.68
17.05	5.87	3.76	0.67
17.10	5.87	3.77	0.67
17.15	5.88	3.78	0.66
17.20	5.89	3.78	0.66
17.25	5.89	3.79	0.66
17.30	5.90	3.79	0.65
17.35	5.91	3.80	0.65
17.40	5.91	3.80	0.65
17.45	5.92	3.81	0.64
17.50	5.93	3.82	0.64
17.55	5.93	3.82	0.63
17.60	5.94	3.83	0.63
17.65	5.94	3.83	0.63
17.70	5.95	3.84	0.62
17.75	5.96	3.84	0.62
17.80	5.96	3.85	0.61
17.85	5.97	3.86	0.61
17.90	5.97	3.86	0.61
17.95	5.98	3.87	0.60
18.00	5.99	3.87	0.60
18.05	5.99	3.88	0.60
18.10	6.00	3.88	0.59
18.15	6.00	3.89	0.59
18.20	6.01	3.89	0.58
18.25	6.02	3.90	0.58
18.30	6.02	3.90	0.58
18.35	6.03	3.91	0.57
18.40	6.03	3.91	0.57
18.45	6.04	3.92	0.56
18.50	6.04	3.92	0.56
18.55	6.05	3.93	0.56
18.60	6.05	3.93	0.55
18.65	6.06	3.94	0.55
18.70	6.06	3.94	0.55
18.75	6.07	3.95	0.54
18.80	6.07	3.95	0.54
18.85	6.08	3.96	0.53
18.90	6.09	3.96	0.53
18.95	6.09	3.97	0.53
19.00	6.10	3.97	0.52
19.05	6.10	3.98	0.52
19.10	6.11	3.98	0.51
19.15	6.11	3.98	0.51
19.20	6.12	3.99	0.51
19.25	6.12	3.99	0.50
19.30	6.12	4.00	0.50
19.35	6.13	4.00	0.49
19.40	6.13	4.01	0.49
19.45	6.14	4.01	0.49
19.50	6.14	4.01	0.48
19.55	6.15	4.02	0.48
19.60	6.15	4.02	0.48
19.65	6.16	4.03	0.47
19.70	6.16	4.03	0.47
19.75	6.17	4.04	0.46
19.80	6.17	4.04	0.46
19.85	6.18	4.04	0.46
19.90	6.18	4.05	0.45
19.95	6.18	4.05	0.45
20.00	**6.19**	**4.06**	0.44

Pond BMP-3: sed basin 3

Inflow Area =	5.300 ac,	Inflow Depth =	4.03"	for	25 yr event	
Inflow =	22.21 cfs @	12.18 hrs,	Volume=		1.778 af	
Outflow =	15.69 cfs @	12.36 hrs,	Volume=		1.455 af,	Atten= 29%, Lag= 11.1 min
Primary =	15.69 cfs @	12.36 hrs,	Volume=		1.455 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 66.98' @ 12.36 hrs Surf.Area= 6,528 sf Storage= 33,625 cf
Plug-Flow detention time= 149.7 min calculated for 1.455 af (82% of inflow)
Center-of-Mass det. time= 100.1 min (883.4 - 783.3)

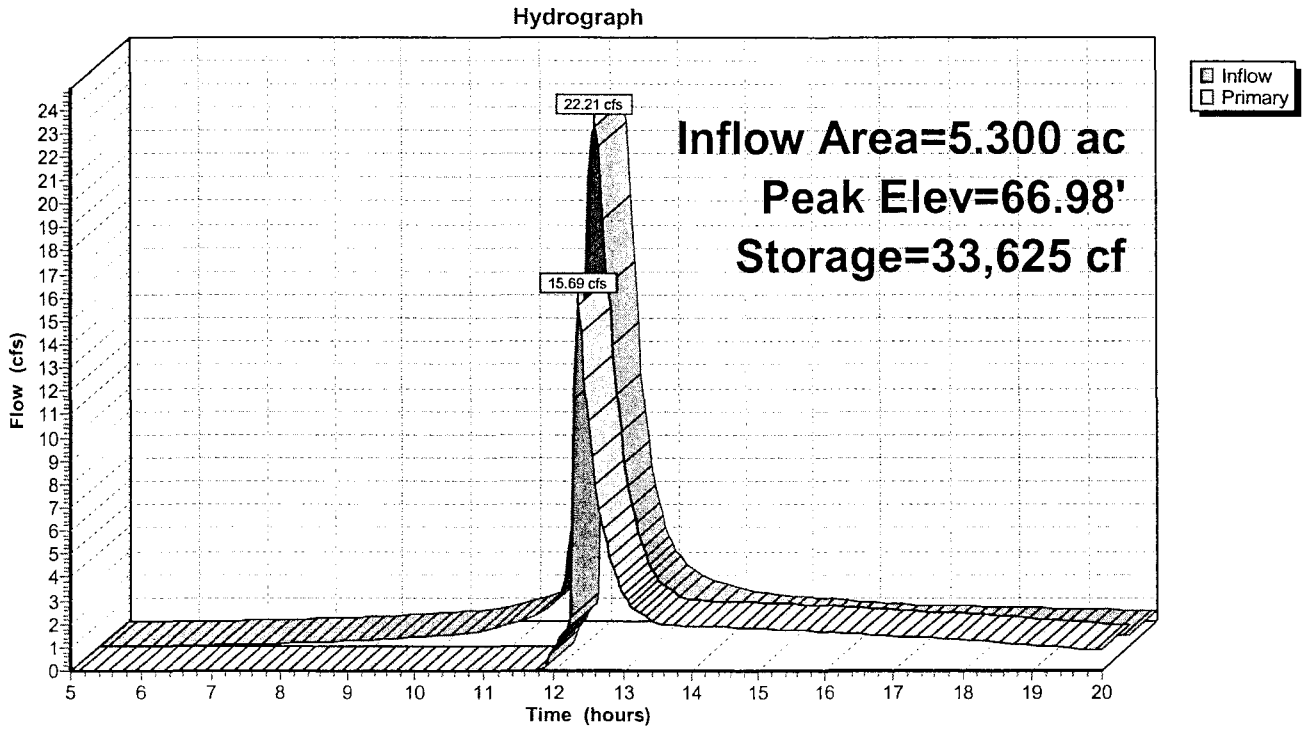
#	Invert	Avail.Storage	Storage Description
1	56.00'	77,692 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	600	0	0	600
59.50	1,800	4,012	4,012	1,888
60.00	2,020	954	4,967	2,125
62.00	3,050	5,035	10,002	3,230
64.00	4,275	7,291	17,292	4,547
66.00	5,720	9,960	27,252	6,098
68.00	7,375	13,060	40,312	7,874
70.00	9,300	16,638	56,950	9,933
72.00	11,480	20,742	77,692	12,260

#	Routing	Invert	Outlet Devices
1	Primary	53.00'	**24.0" x 80.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 45.30' S= 0.0963 '/' n= 0.012 Cc= 0.900
2	Device 1	62.00'	**6.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	66.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=15.04 cfs @ 12.36 hrs HW=66.96' (Free Discharge)
└─**1=Culvert** (Passes 15.04 cfs of 54.46 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.05 cfs @ 10.5 fps)
  └─**3=Orifice/Grate** (Weir Controls 12.99 cfs @ 2.2 fps)

Pond BMP-3: sed basin 3



Hydrograph for Pond BMP-3: sed basin 3

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	56.00	0.00
5.05	0.00	0	56.00	0.00
5.10	0.00	0	56.00	0.00
5.15	0.00	0	56.00	0.00
5.20	0.00	0	56.00	0.00
5.25	0.00	0	56.00	0.00
5.30	0.00	0	56.00	0.00
5.35	0.00	0	56.00	0.00
5.40	0.00	0	56.00	0.00
5.45	0.00	0	56.00	0.00
5.50	0.00	0	56.00	0.00
5.55	0.00	0	56.00	0.00
5.60	0.00	0	56.00	0.00
5.65	0.00	0	56.00	0.00
5.70	0.00	0	56.00	0.00
5.75	0.00	0	56.00	0.00
5.80	0.00	0	56.00	0.00
5.85	0.00	0	56.00	0.00
5.90	0.00	1	56.00	0.00
5.95	0.00	1	56.00	0.00
6.00	0.01	2	56.00	0.00
6.05	0.01	4	56.00	0.00
6.10	0.01	5	56.00	0.00
6.15	0.01	8	56.01	0.00
6.20	0.02	10	56.01	0.00
6.25	0.02	13	56.01	0.00
6.30	0.02	17	56.01	0.00
6.35	0.02	21	56.02	0.00
6.40	0.03	26	56.02	0.00
6.45	0.03	31	56.03	0.00
6.50	0.03	37	56.03	0.00
6.55	0.04	43	56.04	0.00
6.60	0.04	50	56.04	0.00
6.65	0.04	57	56.05	0.00
6.70	0.05	65	56.06	0.00
6.75	0.05	74	56.06	0.00
6.80	0.05	83	56.07	0.00
6.85	0.06	93	56.08	0.00
6.90	0.06	103	56.09	0.00
6.95	0.06	114	56.10	0.00
7.00	0.07	126	56.11	0.00
7.05	0.07	138	56.12	0.00
7.10	0.07	151	56.13	0.00
7.15	0.08	165	56.14	0.00
7.20	0.08	179	56.16	0.00
7.25	0.08	193	56.17	0.00
7.30	0.09	209	56.18	0.00
7.35	0.09	225	56.20	0.00
7.40	0.09	241	56.21	0.00
7.45	0.10	258	56.23	0.00
7.50	0.10	276	56.24	0.00
7.55	0.10	295	56.26	0.00

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
7.60	0.11	314	56.27	0.00
7.65	0.11	334	56.29	0.00
7.70	0.12	354	56.31	0.00
7.75	0.12	375	56.33	0.00
7.80	0.12	397	56.35	0.00
7.85	0.13	420	56.37	0.00
7.90	0.13	443	56.39	0.00
7.95	0.13	467	56.41	0.00
8.00	0.14	491	56.43	0.00
8.05	0.14	517	56.45	0.00
8.10	0.15	543	56.47	0.00
8.15	0.15	569	56.50	0.00
8.20	0.15	597	56.52	0.00
8.25	0.16	625	56.55	0.00
8.30	0.16	654	56.57	0.00
8.35	0.17	684	56.60	0.00
8.40	0.17	715	56.62	0.00
8.45	0.18	747	56.65	0.00
8.50	0.19	780	56.68	0.00
8.55	0.20	815	56.71	0.00
8.60	0.20	850	56.74	0.00
8.65	0.21	887	56.77	0.00
8.70	0.22	926	56.81	0.00
8.75	0.23	966	56.84	0.00
8.80	0.23	1,008	56.88	0.00
8.85	0.24	1,051	56.92	0.00
8.90	0.25	1,095	56.96	0.00
8.95	0.26	1,142	57.00	0.00
9.00	0.27	1,190	57.04	0.00
9.05	0.28	1,239	57.08	0.00
9.10	0.29	1,291	57.13	0.00
9.15	0.30	1,344	57.17	0.00
9.20	0.31	1,399	57.22	0.00
9.25	0.32	1,455	57.27	0.00
9.30	0.33	1,514	57.32	0.00
9.35	0.34	1,573	57.37	0.00
9.40	0.34	1,635	57.43	0.00
9.45	0.35	1,697	57.48	0.00
9.50	0.36	1,761	57.54	0.00
9.55	0.36	1,826	57.59	0.00
9.60	0.37	1,892	57.65	0.00
9.65	0.38	1,959	57.71	0.00
9.70	0.38	2,028	57.77	0.00
9.75	0.39	2,097	57.83	0.00
9.80	0.40	2,168	57.89	0.00
9.85	0.41	2,241	57.95	0.00
9.90	0.42	2,315	58.02	0.00
9.95	0.43	2,392	58.09	0.00
10.00	0.45	2,471	58.16	0.00
10.05	0.46	2,553	58.23	0.00
10.10	0.48	2,637	58.30	0.00
10.15	0.49	2,724	58.38	0.00

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
10.20	0.51	2,814	58.45	0.00
10.25	0.53	2,907	58.54	0.00
10.30	0.54	3,003	58.62	0.00
10.35	0.57	3,103	58.71	0.00
10.40	0.59	3,207	58.80	0.00
10.45	0.61	3,314	58.89	0.00
10.50	0.63	3,426	58.99	0.00
10.55	0.66	3,542	59.09	0.00
10.60	0.68	3,663	59.19	0.00
10.65	0.71	3,788	59.30	0.00
10.70	0.74	3,918	59.42	0.00
10.75	0.77	4,054	59.52	0.00
10.80	0.80	4,195	59.60	0.00
10.85	0.83	4,342	59.67	0.00
10.90	0.87	4,495	59.75	0.00
10.95	0.91	4,655	59.84	0.00
11.00	0.95	4,823	59.92	0.00
11.05	0.99	4,998	60.01	0.00
11.10	1.04	5,181	60.09	0.00
11.15	1.09	5,373	60.16	0.00
11.20	1.14	5,573	60.24	0.00
11.25	1.20	5,783	60.32	0.00
11.30	1.26	6,005	60.41	0.00
11.35	1.34	6,239	60.51	0.00
11.40	1.42	6,487	60.60	0.00
11.45	1.51	6,751	60.71	0.00
11.50	1.61	7,032	60.82	0.00
11.55	1.72	7,332	60.94	0.00
11.60	1.84	7,652	61.07	0.00
11.65	2.03	8,000	61.20	0.00
11.70	2.35	8,393	61.36	0.00
11.75	2.92	8,868	61.55	0.00
11.80	3.82	9,474	61.79	0.00
11.85	5.15	10,280	62.08	0.02
11.90	7.02	11,344	62.37	0.32
11.95	9.59	12,749	62.75	0.67
12.00	12.91	14,628	63.27	0.95
12.05	16.62	17,089	63.94	1.23
12.10	19.94	20,138	64.57	1.44
12.15	21.93	23,629	65.27	1.64
12.20	**22.09**	27,277	66.00	1.83
12.25	20.67	30,752	66.54	2.32
12.30	18.26	32,997	66.88	11.65
12.35	15.48	**33,592**	**66.97**	**15.47**
12.40	12.84	33,442	66.95	14.51
12.45	10.69	33,129	66.90	12.50
12.50	9.05	32,816	66.85	10.71
12.55	7.76	32,533	66.81	9.24
12.60	6.71	32,287	66.77	7.97
12.65	5.84	32,080	66.74	6.89
12.70	5.13	31,902	66.71	6.06
12.75	4.54	31,734	66.69	5.47

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
12.80	4.05	31,574	66.66	4.90
12.85	3.66	31,430	66.64	4.40
12.90	3.34	31,307	66.62	3.97
12.95	3.08	31,204	66.61	3.60
13.00	2.87	31,118	66.59	3.30
13.05	2.69	31,046	66.58	3.05
13.10	2.53	30,986	66.57	2.84
13.15	2.40	30,935	66.56	2.66
13.20	2.28	30,889	66.56	2.53
13.25	2.17	30,839	66.55	2.46
13.30	2.07	30,786	66.54	2.37
13.35	1.99	30,732	66.53	2.29
13.40	1.92	30,680	66.52	2.20
13.45	1.86	30,631	66.52	2.13
13.50	1.81	30,585	66.51	2.06
13.55	1.76	30,542	66.50	1.99
13.60	1.71	30,500	66.50	1.95
13.65	1.66	30,454	66.49	1.95
13.70	1.62	30,399	66.48	1.94
13.75	1.58	30,337	66.47	1.94
13.80	1.54	30,268	66.46	1.94
13.85	1.50	30,192	66.45	1.94
13.90	1.46	30,110	66.44	1.93
13.95	1.43	30,022	66.42	1.93
14.00	1.39	29,929	66.41	1.93
14.05	1.36	29,830	66.39	1.92
14.10	1.33	29,726	66.38	1.92
14.15	1.30	29,616	66.36	1.92
14.20	1.27	29,503	66.34	1.91
14.25	1.24	29,384	66.33	1.91
14.30	1.21	29,262	66.31	1.90
14.35	1.19	29,136	66.29	1.90
14.40	1.17	29,008	66.27	1.90
14.45	1.16	28,876	66.25	1.89
14.50	1.14	28,743	66.23	1.89
14.55	1.13	28,608	66.21	1.88
14.60	1.11	28,471	66.19	1.88
14.65	1.10	28,333	66.17	1.87
14.70	1.09	28,194	66.14	1.87
14.75	1.08	28,053	66.12	1.86
14.80	1.06	27,912	66.10	1.86
14.85	1.05	27,769	66.08	1.85
14.90	1.04	27,625	66.06	1.84
14.95	1.03	27,480	66.03	1.84
15.00	1.02	27,334	66.01	1.83
15.05	1.01	27,187	65.99	1.83
15.10	1.00	27,040	65.96	1.82
15.15	0.99	26,892	65.93	1.81
15.20	0.98	26,743	65.90	1.81
15.25	0.97	26,594	65.87	1.80
15.30	0.96	26,444	65.84	1.79
15.35	0.95	26,293	65.81	1.78

Hydrograph for Pond BMP-3: sed basin 3 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
15.40	0.94	26,142	65.78	1.78
15.45	0.92	25,991	65.75	1.77
15.50	0.91	25,839	65.72	1.76
15.55	0.90	25,686	65.69	1.75
15.60	0.89	25,533	65.65	1.74
15.65	0.88	25,379	65.62	1.74
15.70	0.87	25,225	65.59	1.73
15.75	0.86	25,071	65.56	1.72
15.80	0.85	24,915	65.53	1.71
15.85	0.84	24,760	65.50	1.70
15.90	0.83	24,604	65.47	1.70
15.95	0.82	24,447	65.44	1.69
16.00	0.81	24,290	65.41	1.68
16.05	0.80	24,133	65.37	1.67
16.10	0.78	23,975	65.34	1.66
16.15	0.77	23,817	65.31	1.65
16.20	0.76	23,659	65.28	1.65
16.25	0.75	23,500	65.25	1.64
16.30	0.75	23,341	65.21	1.63
16.35	0.74	23,183	65.18	1.62
16.40	0.73	23,024	65.15	1.61
16.45	0.72	22,866	65.12	1.60
16.50	0.72	22,709	65.09	1.59
16.55	0.71	22,552	65.06	1.58
16.60	0.71	22,396	65.02	1.57
16.65	0.70	22,240	64.99	1.57
16.70	0.70	22,086	64.96	1.56
16.75	0.70	21,932	64.93	1.55
16.80	0.69	21,779	64.90	1.54
16.85	0.69	21,627	64.87	1.53
16.90	0.68	21,476	64.84	1.52
16.95	0.68	21,326	64.81	1.51
17.00	0.68	21,176	64.78	1.50
17.05	0.67	21,028	64.75	1.49
17.10	0.67	20,880	64.72	1.49
17.15	0.66	20,734	64.69	1.48
17.20	0.66	20,588	64.66	1.47
17.25	0.66	20,443	64.63	1.46
17.30	0.65	20,299	64.60	1.45
17.35	0.65	20,156	64.58	1.44
17.40	0.65	20,014	64.55	1.43
17.45	0.64	19,873	64.52	1.42
17.50	0.64	19,732	64.49	1.41
17.55	0.63	19,593	64.46	1.41
17.60	0.63	19,455	64.43	1.40
17.65	0.63	19,317	64.41	1.39
17.70	0.62	19,180	64.38	1.38
17.75	0.62	19,045	64.35	1.37
17.80	0.61	18,910	64.32	1.36
17.85	0.61	18,776	64.30	1.35
17.90	0.61	18,643	64.27	1.34
17.95	0.60	18,511	64.24	1.33

Hydrograph for Pond BMP-3: sed basin 3 (continued)

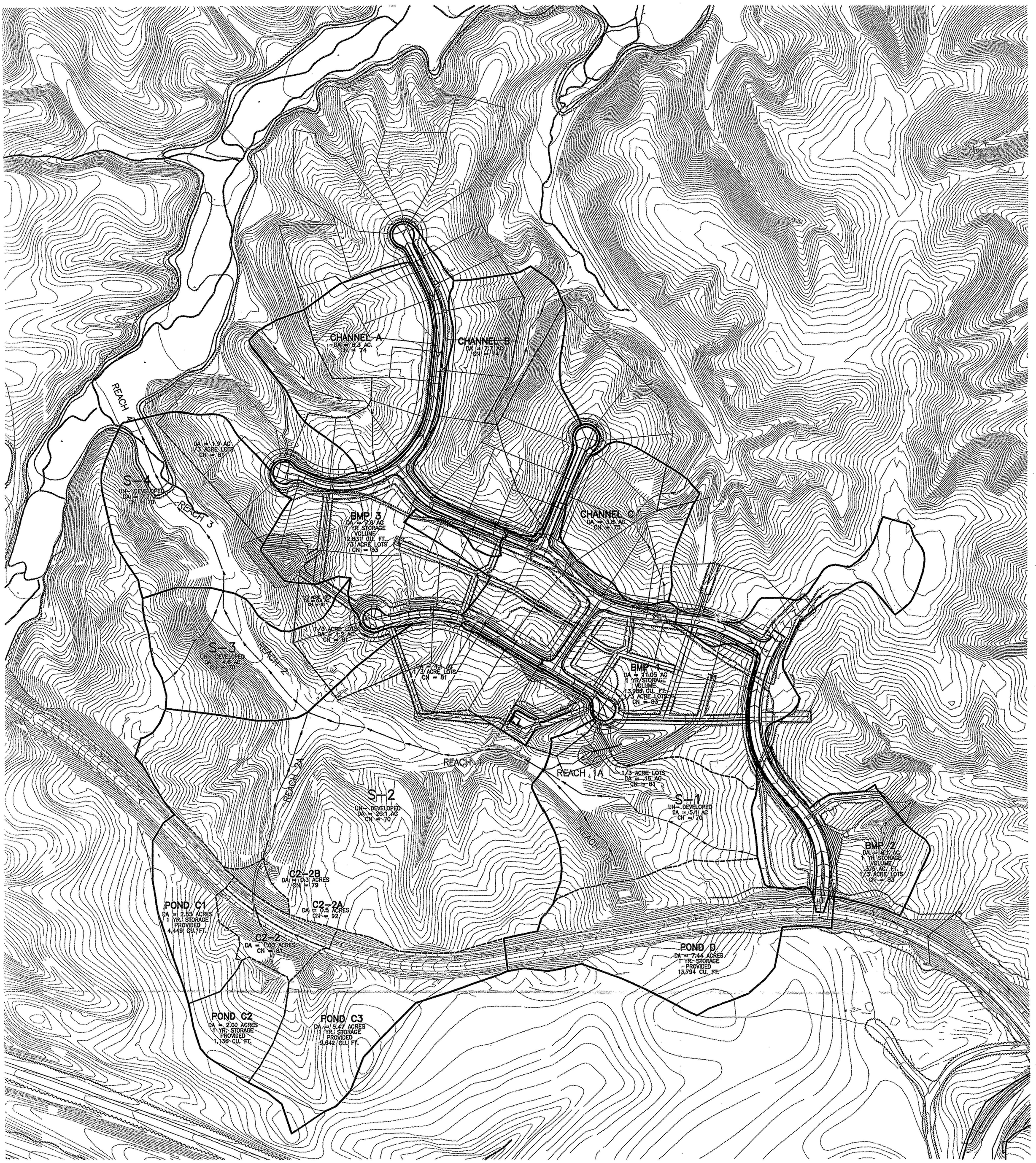
Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
18.00	0.60	18,379	64.22	1.33
18.05	0.60	18,249	64.19	1.32
18.10	0.59	18,119	64.17	1.31
18.15	0.59	17,991	64.14	1.30
18.20	0.58	17,863	64.11	1.29
18.25	0.58	17,736	64.09	1.28
18.30	0.58	17,611	64.06	1.27
18.35	0.57	17,486	64.04	1.26
18.40	0.57	17,362	64.01	1.26
18.45	0.56	17,238	63.99	1.25
18.50	0.56	17,117	63.95	1.23
18.55	0.56	16,996	63.92	1.22
18.60	0.55	16,878	63.89	1.21
18.65	0.55	16,760	63.85	1.20
18.70	0.55	16,644	63.82	1.19
18.75	0.54	16,530	63.79	1.17
18.80	0.54	16,417	63.76	1.16
18.85	0.53	16,305	63.73	1.15
18.90	0.53	16,195	63.70	1.14
18.95	0.53	16,086	63.67	1.13
19.00	0.52	15,979	63.64	1.11
19.05	0.52	15,873	63.61	1.10
19.10	0.51	15,769	63.58	1.09
19.15	0.51	15,666	63.55	1.08
19.20	0.51	15,564	63.53	1.07
19.25	0.50	15,464	63.50	1.06
19.30	0.50	15,365	63.47	1.04
19.35	0.49	15,267	63.44	1.03
19.40	0.49	15,171	63.42	1.02
19.45	0.49	15,076	63.39	1.01
19.50	0.48	14,983	63.37	1.00
19.55	0.48	14,890	63.34	0.99
19.60	0.48	14,800	63.32	0.98
19.65	0.47	14,710	63.29	0.96
19.70	0.47	14,622	63.27	0.95
19.75	0.46	14,535	63.24	0.94
19.80	0.46	14,450	63.22	0.93
19.85	0.46	14,366	63.20	0.92
19.90	0.45	14,283	63.17	0.91
19.95	0.45	14,201	63.15	0.90
20.00	0.44	14,121	63.13	0.89

Stage-Area-Storage for Pond BMP-3: Basin 3

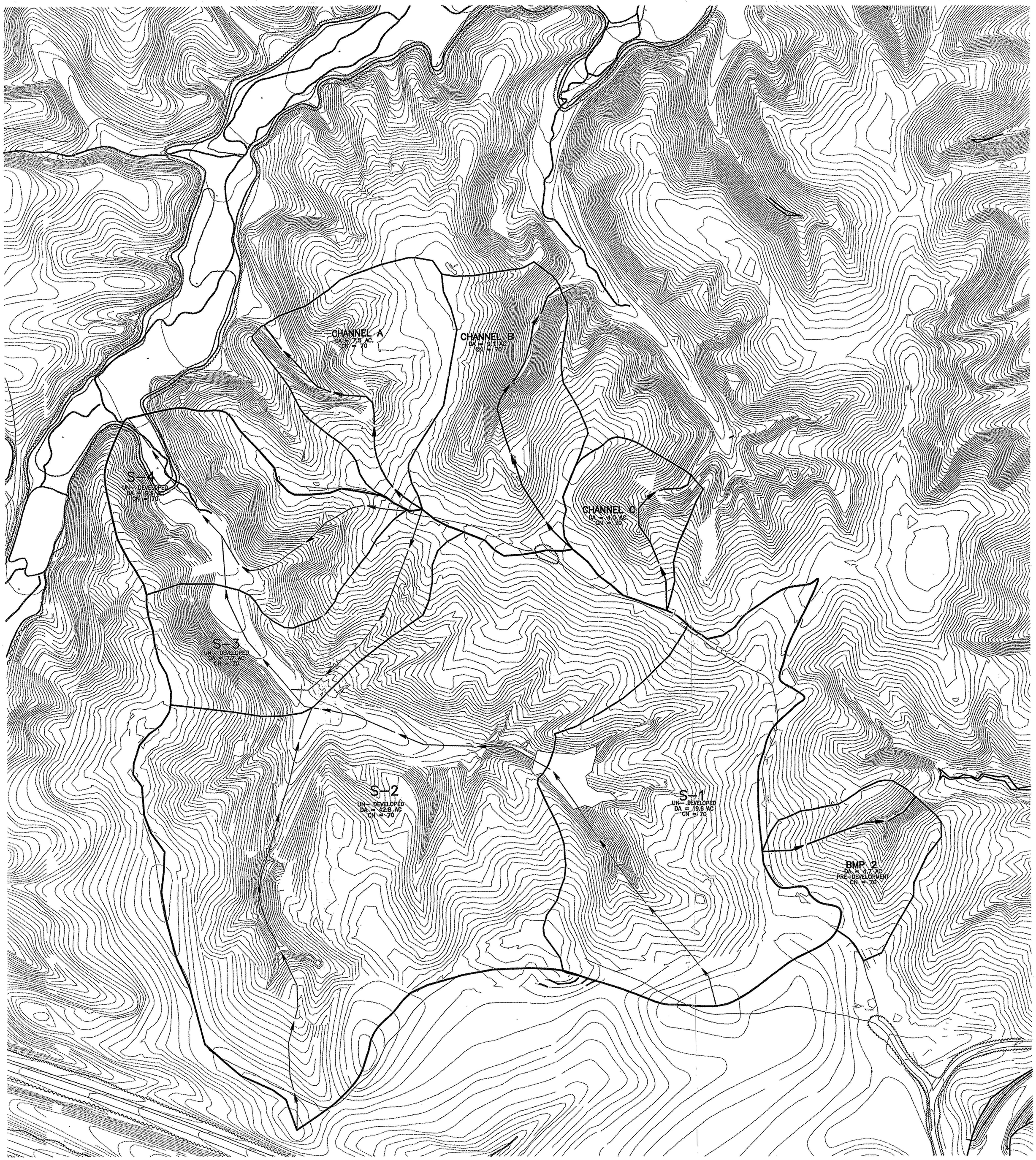
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
56.00	600	0
56.20	669	229
56.40	737	459
56.60	806	688
56.80	874	917
57.00	943	1,146
57.20	1,011	1,376
57.40	1,080	1,605
57.60	1,149	1,834
57.80	1,217	2,064
58.00	1,286	2,293
58.20	1,354	2,522
58.40	1,423	2,751
58.60	1,491	2,981
58.80	1,560	3,210
59.00	1,629	3,439
59.20	1,697	3,669
59.40	1,766	3,898
59.60	1,844	4,203
59.80	1,932	4,585
c/s 60.00	2,020	4,967
60.20	2,123	5,470
60.40	2,226	5,974
60.60	2,329	6,477
60.80	2,432	6,981
61.00	2,535	7,484
61.20	2,638	7,988
61.40	2,741	8,491
61.60	2,844	8,995
61.80	2,947	9,498
WET 62.00	3,050	10,002
62.20	3,173	10,731
62.40	3,295	11,460
62.60	3,418	12,189
62.80	3,540	12,918
63.00	3,663	13,647
63.20	3,785	14,376
63.40	3,907	15,105
63.60	4,030	15,834
63.80	4,152	16,563
64.00	4,275	17,292
64.20	4,420	18,288
64.40	4,564	19,284
DRY 64.60	4,708	20,280
64.80	4,853	21,276
65.00	4,998	22,272
65.20	5,142	23,268
65.40	5,287	24,264
65.60	5,431	25,260
65.80	5,575	26,256
66.00	5,720	27,252
66.20	5,886	28,558
66.40	6,051	29,864
66.60	6,216	31,170
66.80	6,382	32,476
67.00	6,548	33,782
67.20	6,713	35,088
67.40	6,879	36,394
67.60	7,044	37,700
67.80	7,209	39,006
68.00	7,375	40,312
68.20	7,568	41,976
68.40	7,760	43,640
68.60	7,952	45,304
68.80	8,145	46,967
69.00	8,338	48,631
69.20	8,530	50,295
69.40	8,723	51,959
69.60	8,915	53,623
69.80	9,107	55,286
70.00	9,300	56,950
70.20	9,518	59,024
70.40	9,736	61,098
70.60	9,954	63,173
70.80	10,172	65,247
71.00	10,390	67,321
71.20	10,608	69,395
71.40	10,826	71,469
71.60	11,044	73,544
71.80	11,262	75,618
72.00	**11,480**	**77,692**

Stage-Area-Storage for Pond 1P: (new Pond)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	
60.00	790	0	62.60	1,540	3,110	
60.05	803	52	62.65	1,560	3,195	WET.
60.10	816	105	62.70	1,580	3,280	
60.15	828	157	62.75	1,600	3,365	
60.20	841	209	62.80	1,620	3,450	
60.25	854	261	62.85	1,640	3,535	
60.30	866	313	62.90	1,660	3,620	
60.35	879	366	62.95	1,680	3,705	
60.40	892	418	63.00	1,700	3,790	
60.45	905	470	63.05	1,720	3,875	
60.50	918	523	63.10	1,740	3,960	
60.55	930	575	63.15	1,760	4,045	
60.60	943	627	63.20	1,780	4,130	
60.65	956	679	63.25	1,800	4,215	
60.70	969	732	63.30	1,820	4,300	
60.75	981	784	63.35	1,840	4,385	
60.80	994	836	63.40	1,860	4,470	
60.85	1,007	888	63.45	1,880	4,555	
60.90	1,019	940	63.50	1,900	4,640	
60.95	1,032	993	63.55	1,920	4,725	
61.00	1,045	1,045	63.60	1,940	4,810	
61.05	1,058	1,097	63.65	1,960	4,895	
61.10	1,071	1,150	63.70	1,980	4,980	
61.15	1,083	1,202	63.75	2,000	5,065	
61.20	1,096	1,254	63.80	2,020	5,150	
61.25	1,109	1,306	63.85	2,040	5,235	
61.30	1,121	1,358	63.90	2,060	5,320	
61.35	1,134	1,411	63.95	2,080	5,405	
61.40	1,147	1,463	64.00	2,100	5,490	
61.45	1,160	1,515	64.05	2,115	5,602	
61.50	1,173	1,568	64.10	2,130	5,715	
61.6 61.55	1,185	1,620	64.15	2,145	5,828	
61.60	1,198	1,672	64.20	2,160	5,940	
61.65	1,211	1,724	64.25	2,175	6,053	
61.70	1,224	1,777	64.30	2,190	6,165	
61.75	1,236	1,829	64.35	2,205	6,277	
61.80	1,249	1,881	64.40	2,220	6,390	
61.85	1,262	1,933	64.45	2,235	6,503	
61.90	1,274	1,985	64.50	2,250	6,615	
61.95	1,287	2,038	64.55	2,265	6,727	
62.00	1,300	2,090	64.60	2,280	6,840	
62.05	1,320	2,175	64.65	2,295	6,953	
62.10	1,340	2,260	64.70	2,310	7,065	
62.15	1,360	2,345	64.75	2,325	7,178	
62.20	1,380	2,430	64.80	2,340	7,290	
62.25	1,400	2,515	64.85	2,355	7,402	
62.30	1,420	2,600	64.90	2,370	7,515	
62.35	1,440	2,685	64.95	2,385	7,628	
62.40	1,460	2,770	65.00	**2,400**	**7,740**	DRY.
62.45	1,480	2,855				
62.50	1,500	2,940				
62.55	1,520	3,025				



DRAINAGE AREAS FOR
POST-DEVELOPMENT FLOW CALCULATIONS



EXISTING CONDITIONS
DRAINAGE AREAS FOR
PRE-DEVELOPMENT FLOW CALCULATIONS

STONEHOUSE GLEN
PHASE I
STONEHOUSE AT WILLIAMSBURG L.L.C.
DRAINAGE AREA EXHIBIT

SCALE: 1" = 200' DATE: 10/29/04

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STORMWATER MANAGEMENT NARRATIVE
STONEHOUSE GLEN SECTION I

Stonehouse Glen Section I is proposed as an 85.47-acre single-family subdivision that will be developed into 76 home sites and two recreational park sites.

Of the 85.47 acres, 6.5 acres will be contained within the road right of ways, 1.9 acres will be developed into 2 recreational parks. The 76 lots will contain 44.7 acres, open spaces provided will consist of approximately 30 acres and a residual area of 2.5 acres will contain the pump station and 3 BMP sites. Lot areas will typically be 0.3 acre in size with some lots exceeding one acre on the cul-de-sacs and on lots with unique landforms and parcel lines.

Stonehouse Glen lies within the Richardson Mill Pond watershed, which provides water quanity as well as water quality protection under the Chesapeake Bay Preservation Ordinance. As this development drains to several different ravine systems, we are proposing to manage the storm water run-off as follows:

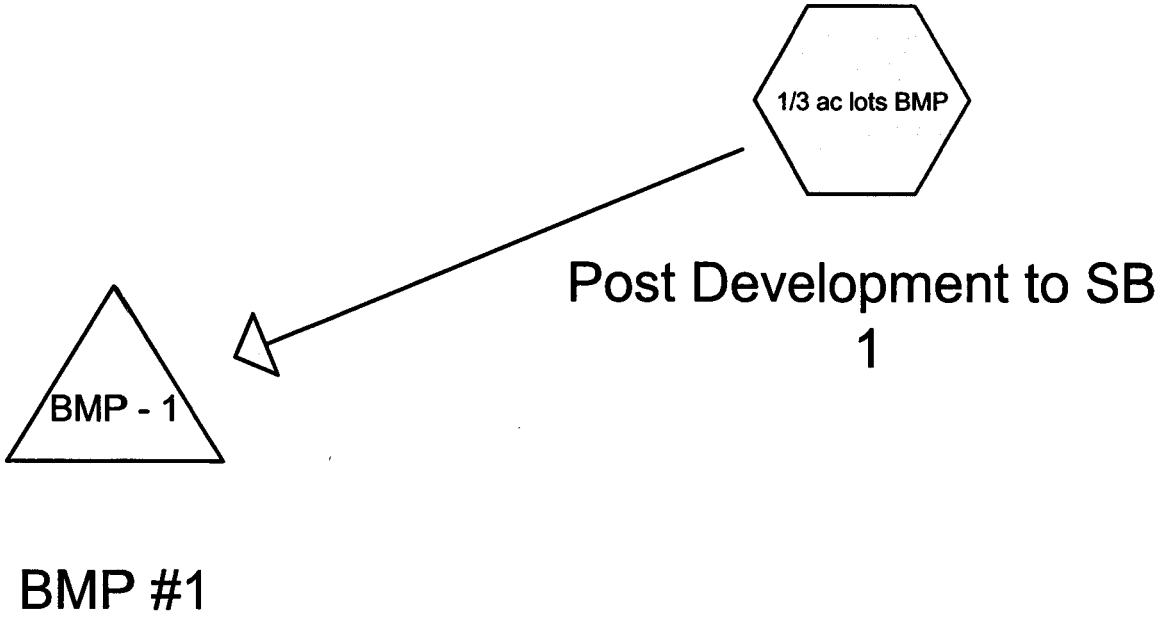
1. provide storm water management to maintain approximately the same 2-year post-development peak flows as the 2-year pre-development peak flows. This will be accomplished using three extended detention BMPs to provide attenuation of the 1-year storm, and stream channel protection.
2. intercept runoff from all proposed road construction impervious.

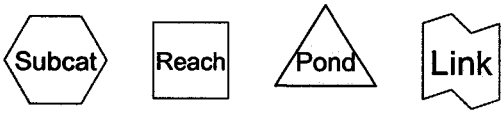
BMP 1 and BMP 3 will intercept runoff from approximately 5 acres of roadway drainage and 13.6 acres of lot drainage. This runoff will be released into the major ravine between Fiedstone Parkway and Stonehouse Glen, which flows into Bird Swamp and eventually Richardson Mill Pond. Calculations and drainage maps showing the Fieldstone Parkway development in relation to the Stonehouse Glen project have been provided to show pre- and post development runoff associated with the major ravine leading to Bird Swamp.

BMP 2 will intercept runoff from approximately 1.5 acres of roadway drainage, and 4.6 acres of lot drainage. This runoff will be released into a smaller ravine, which eventually intersects with Bird Swamp downstream of the other outfalls.

The remaining drainage from Stonehouse Glen Phase I will continue to flow in its pre-developed state. Ravines that have the potential to receive concentrated runoff from future lot development have been analyzed for channel adequacy. Calculations have been provided to show MS-19 compliance for all existing receiving channels deemed necessary by James City County.

As a final stage of the construction of the site's storm water management system, as described above, all existing drainage swales/outfalls will be visually inspected for erosion problems and/or blockage and repairs will be completed as required.





Drainage Diagram for bmp 1 temp sed basin Revised
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Subcatchment 1/3 ac lots BMP: Post Development to SB 1

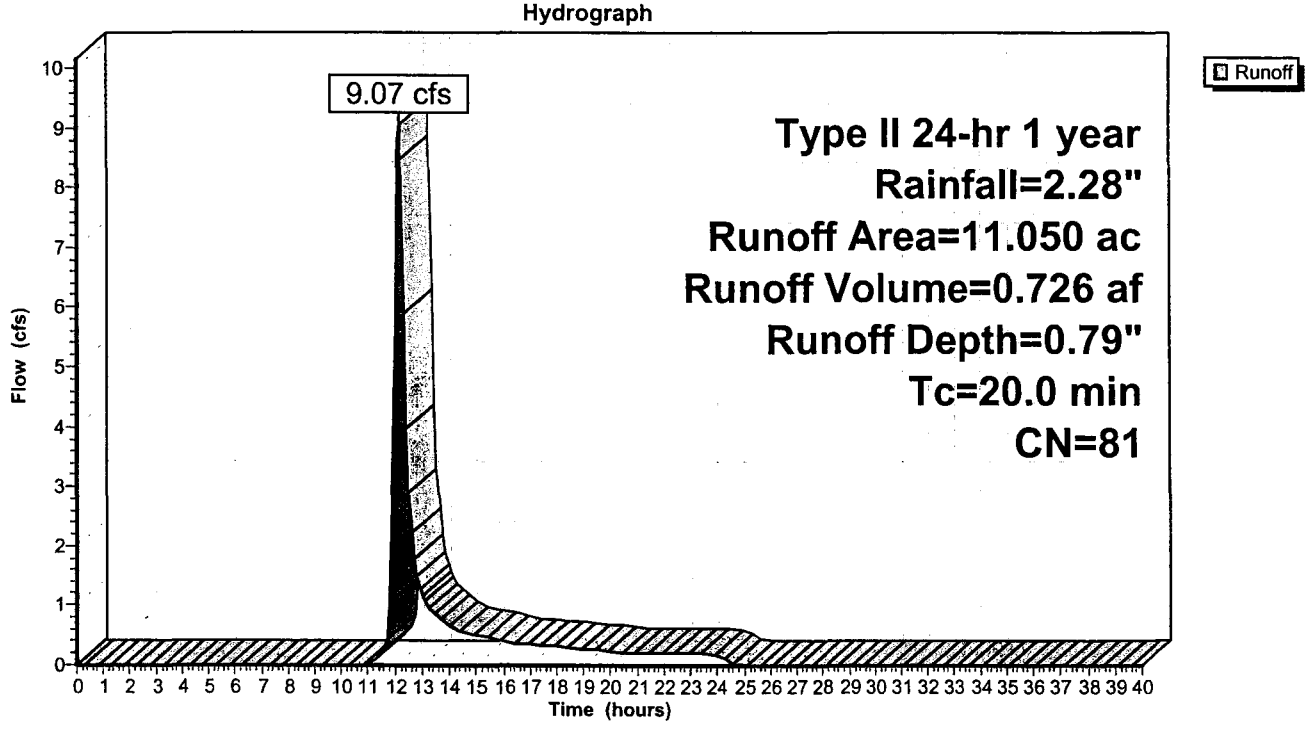
Runoff = 9.07 cfs @ 12.14 hrs, Volume= 0.726 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 1 year Rainfall=2.28"

Area (ac)	CN	Description
11.050	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1/3 ac lots BMP: Post Development to SB 1



Pond BMP - 1: BMP #1

Inflow Area =	11.050 ac,	Inflow Depth =	0.79"	for	1 year event
Inflow =	9.07 cfs @	12.14 hrs,	Volume=	0.726 af	
Outflow =	0.52 cfs @	14.87 hrs,	Volume=	0.726 af,	Atten= 94%, Lag= 164.0 min
Primary =	0.52 cfs @	14.87 hrs,	Volume=	0.726 af	

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 77.54' @ 14.87 hrs Surf.Area= 5,488 sf Storage= 16,724 cf
Plug-Flow detention time= 387.9 min calculated for 0.724 af (100% of inflow)
Center-of-Mass det. time= 388.7 min (1,256.4 - 867.7)

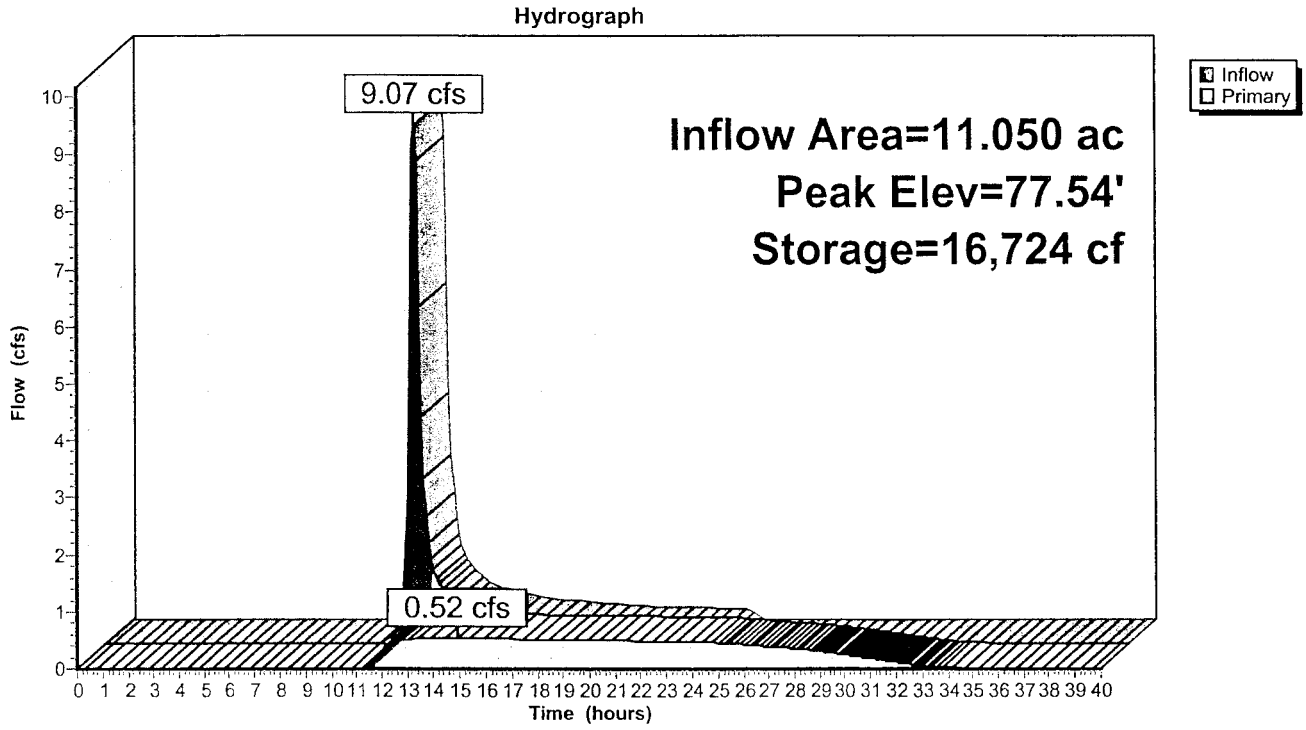
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	72.00'	**3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900
3	Device 1	80.64'	**60.0" Horiz. Orifice** Limited to weir flow C= 0.600

Primary OutFlow Max=0.52 cfs @ 14.87 hrs HW=77.54' (Free Discharge)
└─**1=Culvert** (Passes 0.52 cfs of 68.72 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.52 cfs @ 10.6 fps)
  └─**3=Orifice** (Controls 0.00 cfs)

Pond BMP - 1: BMP #1



Subcatchment 1/3 ac lots BMP: Post Development to SB 1

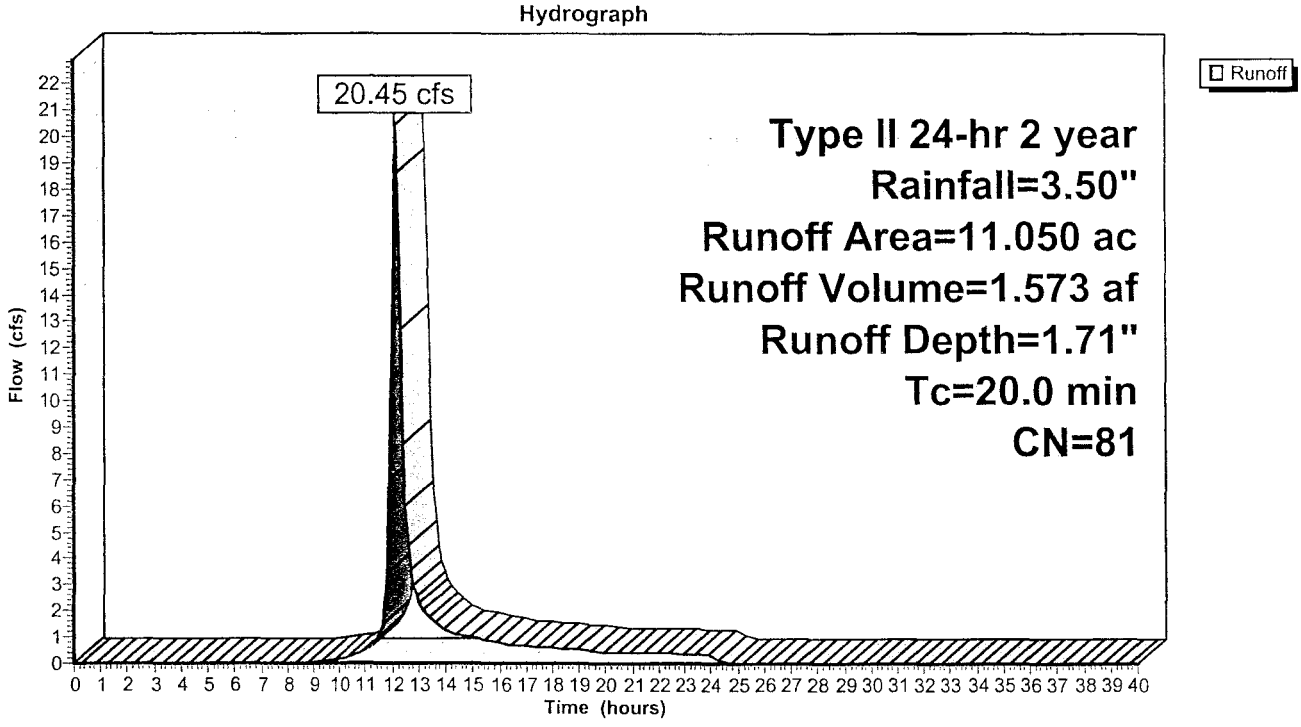
Runoff = 20.45 cfs @ 12.13 hrs, Volume= 1.573 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 2 year Rainfall=3.50"

Area (ac)	CN	Description
11.050	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1/3 ac lots BMP: Post Development to SB 1



Pond BMP - 1: BMP #1

Inflow Area =	11.050 ac,	Inflow Depth =	1.71"	for	2 year event
Inflow =	20.45 cfs @	12.13 hrs,	Volume=	1.573 af	
Outflow =	1.36 cfs @	13.87 hrs,	Volume=	1.439 af,	Atten= 93%, Lag= 104.3 min
Primary =	1.36 cfs @	13.87 hrs,	Volume=	1.439 af	

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 80.70' @ 13.87 hrs Surf.Area= 9,731 sf Storage= 40,707 cf
Plug-Flow detention time= 652.1 min calculated for 1.435 af (91% of inflow)
Center-of-Mass det. time= 608.5 min (1,453.4 - 844.9)

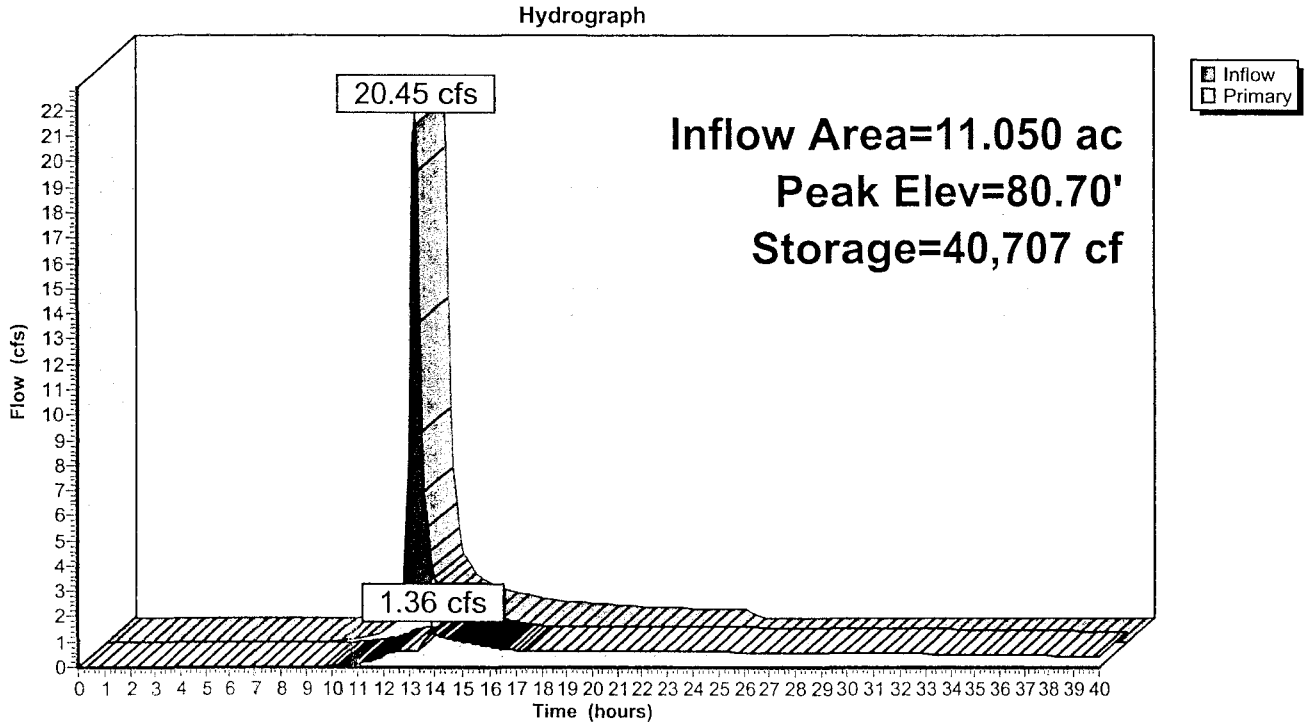
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	72.00'	**3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900
3	Device 1	80.64'	**60.0" Horiz. Orifice** Limited to weir flow C= 0.600

Primary OutFlow Max=1.31 cfs @ 13.87 hrs HW=80.70' (Free Discharge)
└**1=Culvert** (Passes 1.31 cfs of 80.52 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.62 cfs @ 12.6 fps)
  └**3=Orifice** (Weir Controls 0.69 cfs @ 0.8 fps)

Pond BMP - 1: BMP #1



Subcatchment 1/3 ac lots BMP: Post Development to SB 1

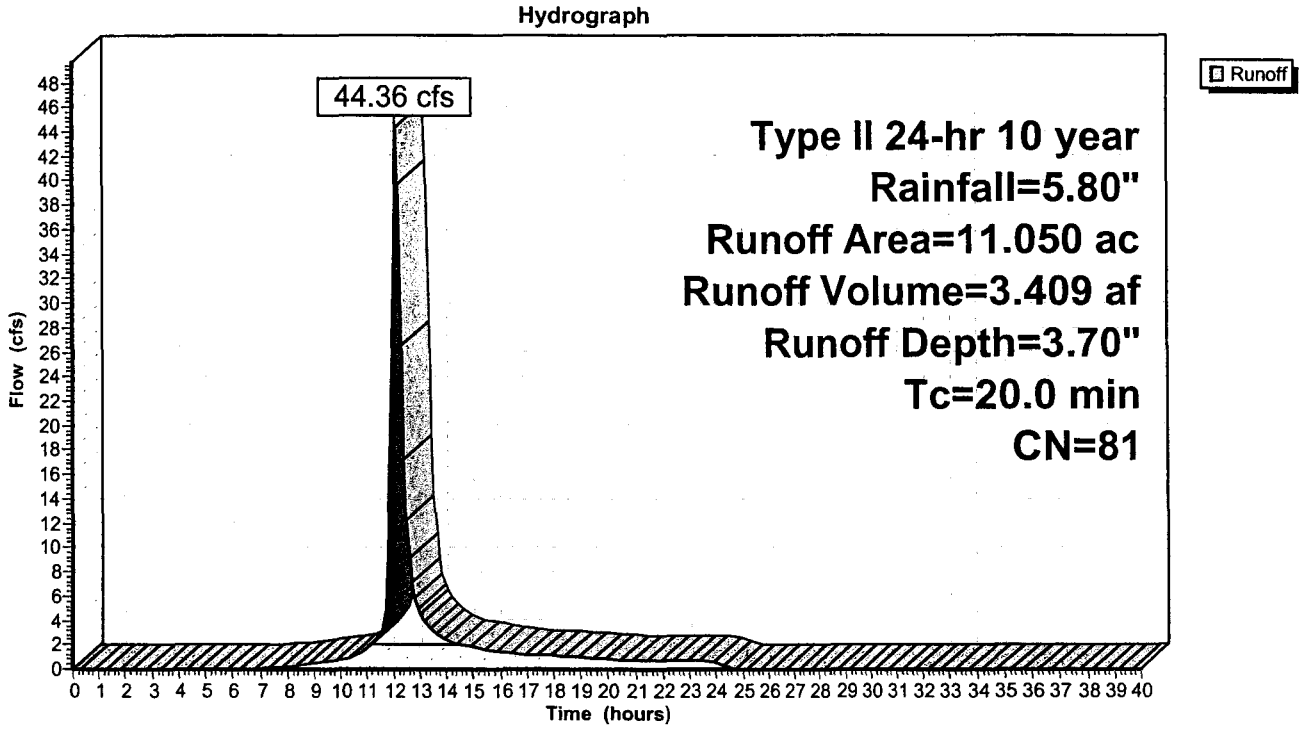
Runoff = 44.36 cfs @ 12.12 hrs, Volume= 3.409 af, Depth= 3.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 10 year Rainfall=5.80"

Area (ac)	CN	Description
11.050	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1/3 ac lots BMP: Post Development to SB 1



Pond BMP - 1: BMP #1

Inflow Area =	11.050 ac,	Inflow Depth =	3.70"	for	10 year event
Inflow =	44.36 cfs @	12.12 hrs,	Volume=	3.409 af	
Outflow =	39.52 cfs @	12.24 hrs,	Volume=	3.202 af,	Atten= 11%, Lag= 7.0 min
Primary =	39.52 cfs @	12.24 hrs,	Volume=	3.202 af	

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 81.51' @ 12.24 hrs Surf.Area= 10,975 sf Storage= 48,972 cf
Plug-Flow detention time= 316.2 min calculated for 3.202 af (94% of inflow)
Center-of-Mass det. time= 282.3 min (1,105.1 - 822.8)

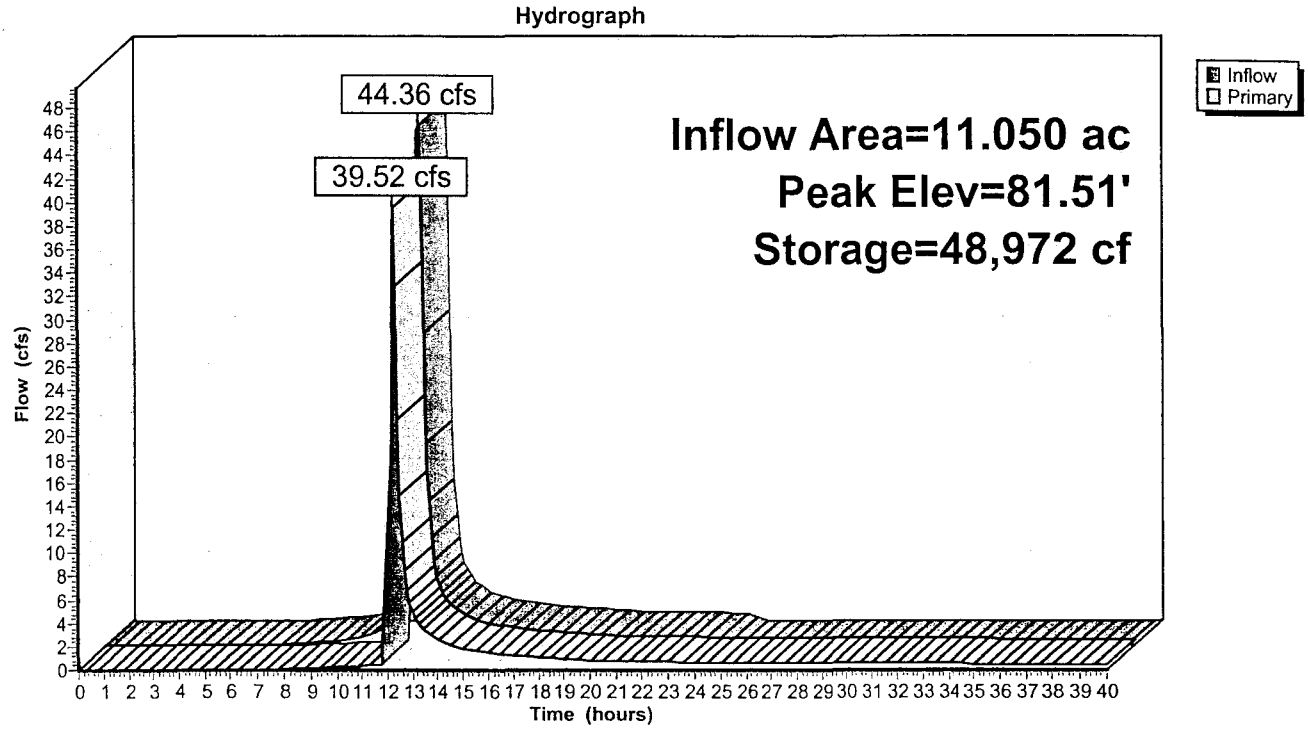
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	72.00'	**3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900
3	Device 1	80.64'	**60.0" Horiz. Orifice** Limited to weir flow C= 0.600

Primary OutFlow Max=34.73 cfs @ 12.24 hrs HW=81.40' (Free Discharge)
└**1=Culvert** (Passes 34.73 cfs of 82.93 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.64 cfs @ 13.1 fps)
  └**3=Orifice** (Weir Controls 34.09 cfs @ 2.9 fps)

Pond BMP - 1: BMP #1



Subcatchment 1/3 ac lots BMP: Post Development to SB 1

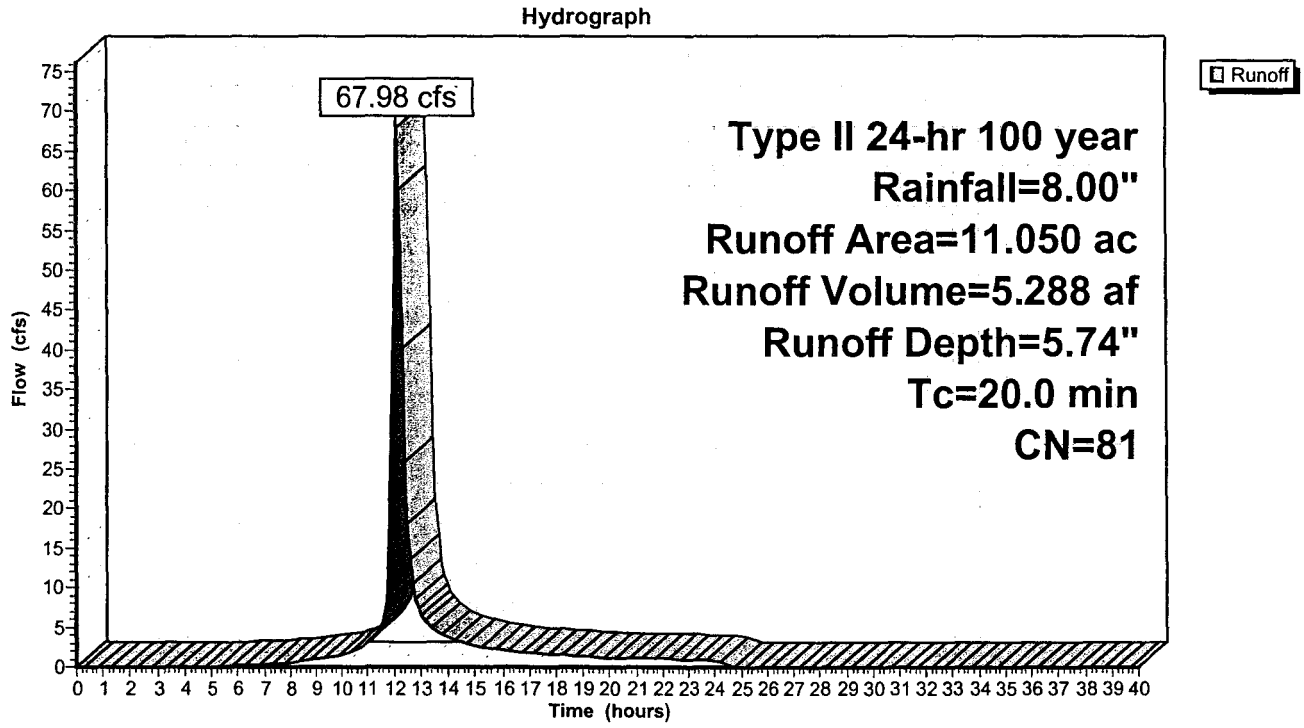
Runoff = 67.98 cfs @ 12.12 hrs, Volume= 5.288 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 100 year Rainfall=8.00"

Area (ac)	CN	Description
11.050	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1/3 ac lots BMP: Post Development to SB 1



Pond BMP - 1: BMP #1

Inflow Area =	11.050 ac,	Inflow Depth =	5.74"	for	100 year event
Inflow =	67.98 cfs @	12.12 hrs,	Volume=		5.288 af
Outflow =	65.51 cfs @	12.16 hrs,	Volume=		5.076 af, Atten= 4%, Lag= 2.3 min
Primary =	65.51 cfs @	12.16 hrs,	Volume=		5.076 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 81.81' @ 12.16 hrs Surf.Area= 11,439 sf Storage= 52,054 cf
Plug-Flow detention time= 208.9 min calculated for 5.076 af (96% of inflow)
Center-of-Mass det. time= 185.2 min (995.6 - 810.4)

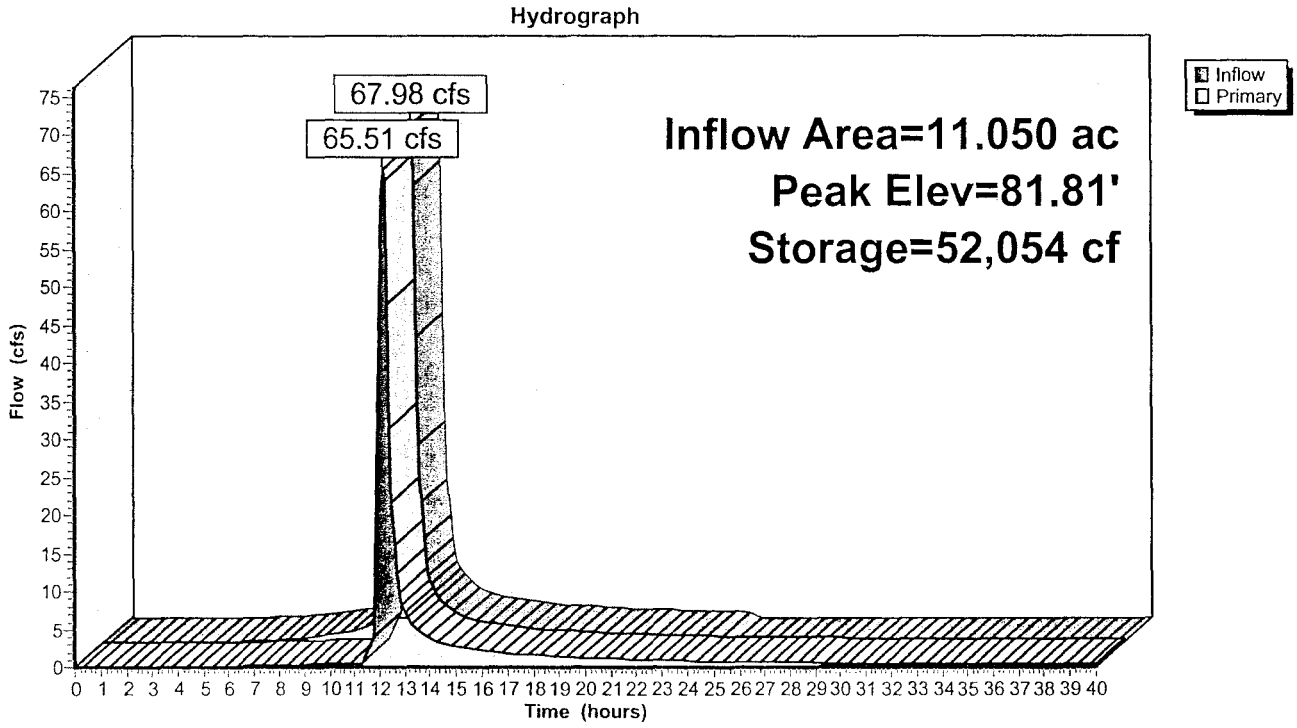
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

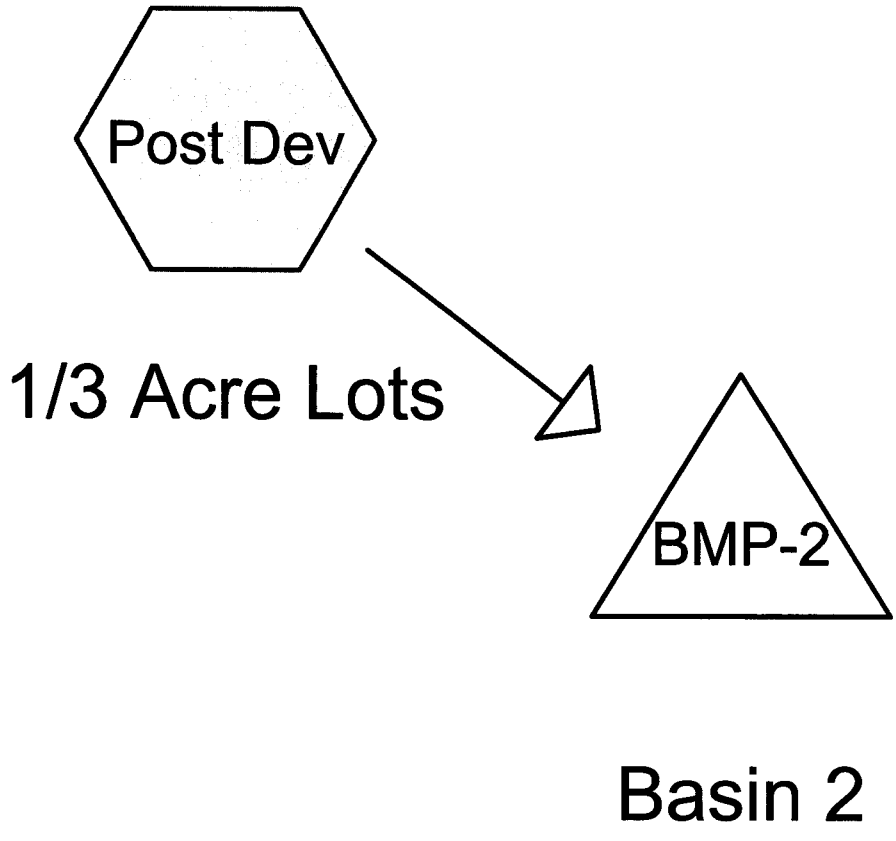
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

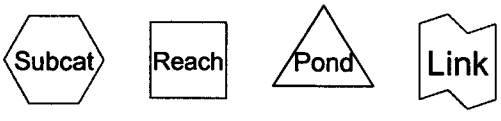
#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	72.00'	**3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900
3	Device 1	80.64'	**60.0" Horiz. Orifice** Limited to weir flow C= 0.600

Primary OutFlow Max=63.34 cfs @ 12.16 hrs HW=81.78' (Free Discharge)
└**1=Culvert** (Passes 63.34 cfs of 84.20 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.65 cfs @ 13.3 fps)
  └**3=Orifice** (Weir Controls 62.69 cfs @ 3.5 fps)

Pond BMP - 1: BMP #1







Drainage Diagram for bmp2
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Subcatchment Post Dev: 1/3 Acre Lots

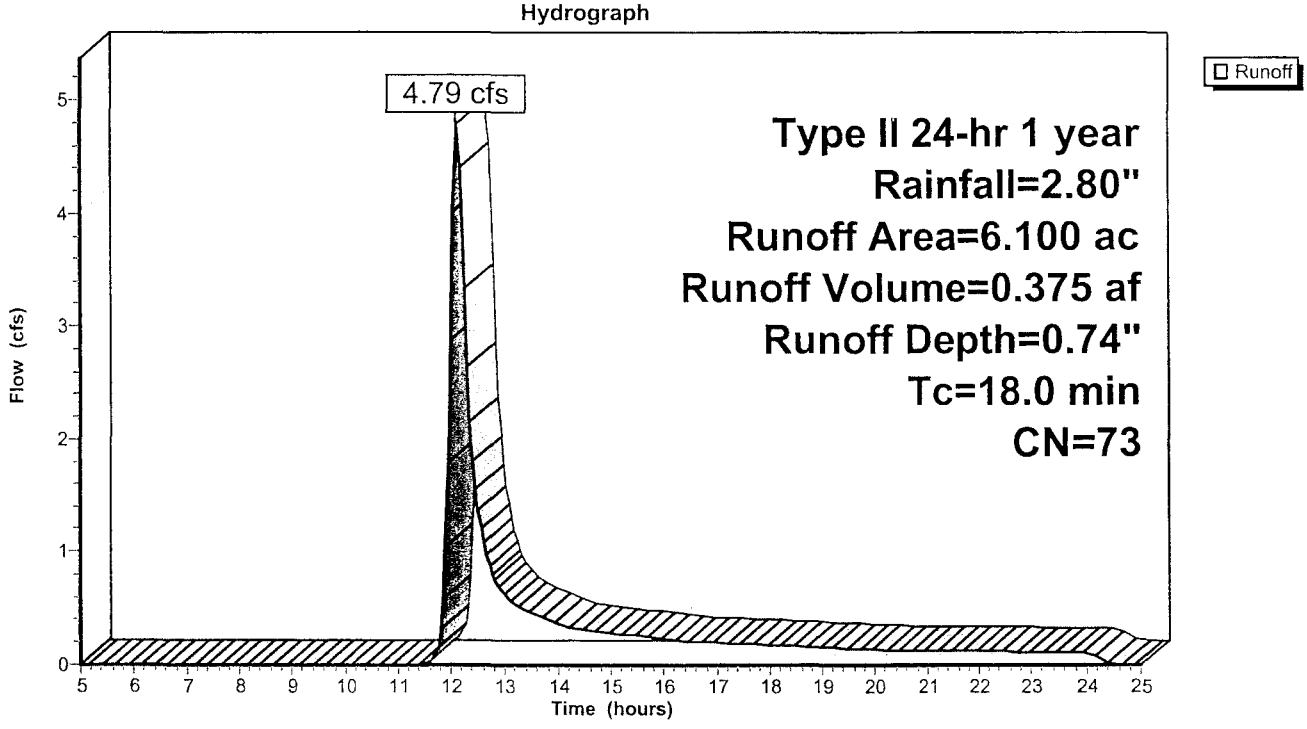
Runoff = 4.79 cfs @ 12.12 hrs, Volume= 0.375 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.80"

Area (ac)	CN	Description
1.900	55	Woods, Good, HSG B
4.200	81	1/3 acre lots, 30% imp, HSG C
6.100	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond BMP-2: Basin 2

Inflow Area =	6.100 ac,	Inflow Depth =	0.74"	for	1 year event
Inflow =	4.79 cfs @	12.12 hrs,	Volume=	0.375 af	
Outflow =	0.59 cfs @	13.06 hrs,	Volume=	0.375 af,	Atten= 88%, Lag= 56.1 min
Primary =	0.59 cfs @	13.06 hrs,	Volume=	0.375 af	

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 75.98' @ 13.06 hrs Surf.Area= 1,947 sf Storage= 5,861 cf
Plug-Flow detention time= 91.4 min calculated for 0.375 af (100% of inflow)
Center-of-Mass det. time= 91.4 min (974.1 - 882.7)

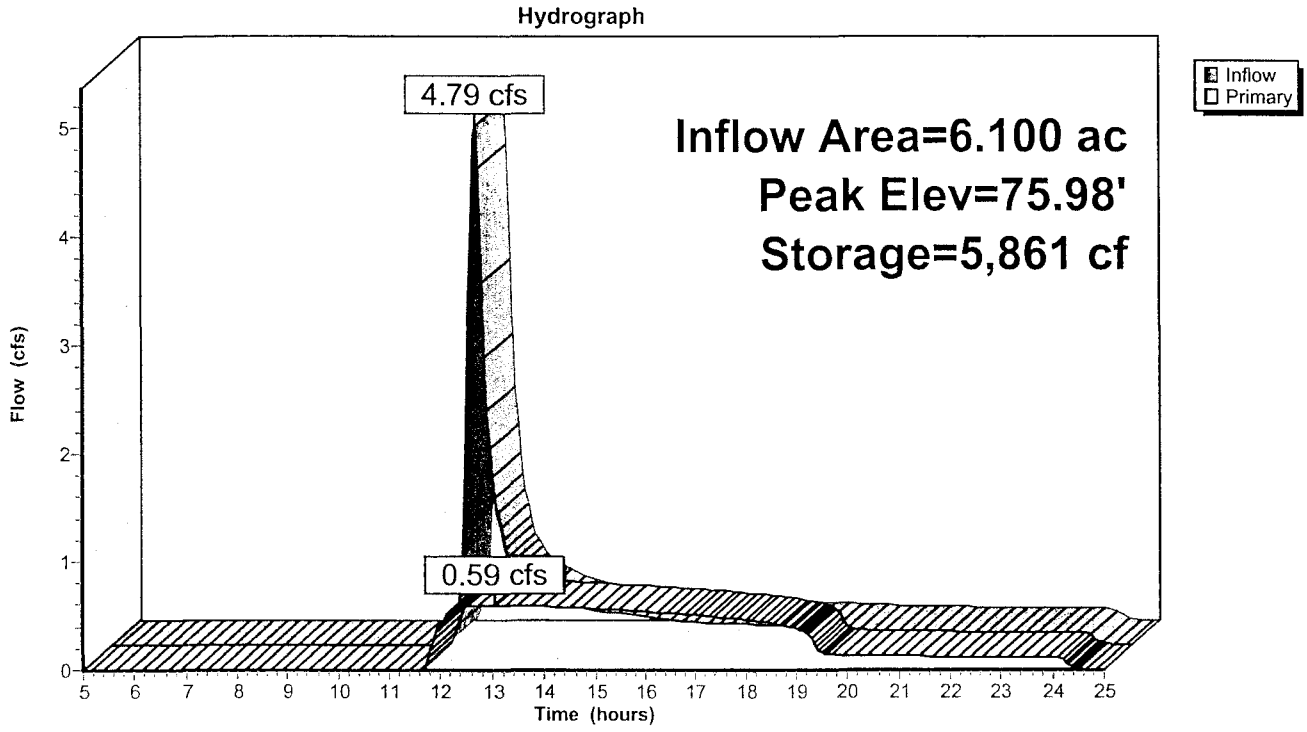
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,029 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	0	0	0
70.00	95	95	95
71.00	305	200	295
72.00	667	486	781
73.00	944	806	1,587
74.00	1,267	1,106	2,692
75.00	1,590	1,429	4,121
76.00	1,954	1,772	5,893
77.00	2,570	2,262	8,155
78.00	3,275	2,923	11,077
79.00	4,236	3,756	14,833
80.00	5,320	4,778	19,611
81.00	6,700	6,010	25,621
82.00	8,117	7,409	33,029

#	Routing	Invert	Outlet Devices
1	Primary	66.80'	**24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	68.00'	**3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900
3	Device 1	80.55'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.59 cfs @ 13.06 hrs HW=75.98' (Free Discharge)
└─**1=Culvert** (Passes 0.59 cfs of 43.27 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.59 cfs @ 12.0 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond BMP-2: Basin 2



Subcatchment Post Dev: 1/3 Acre Lots

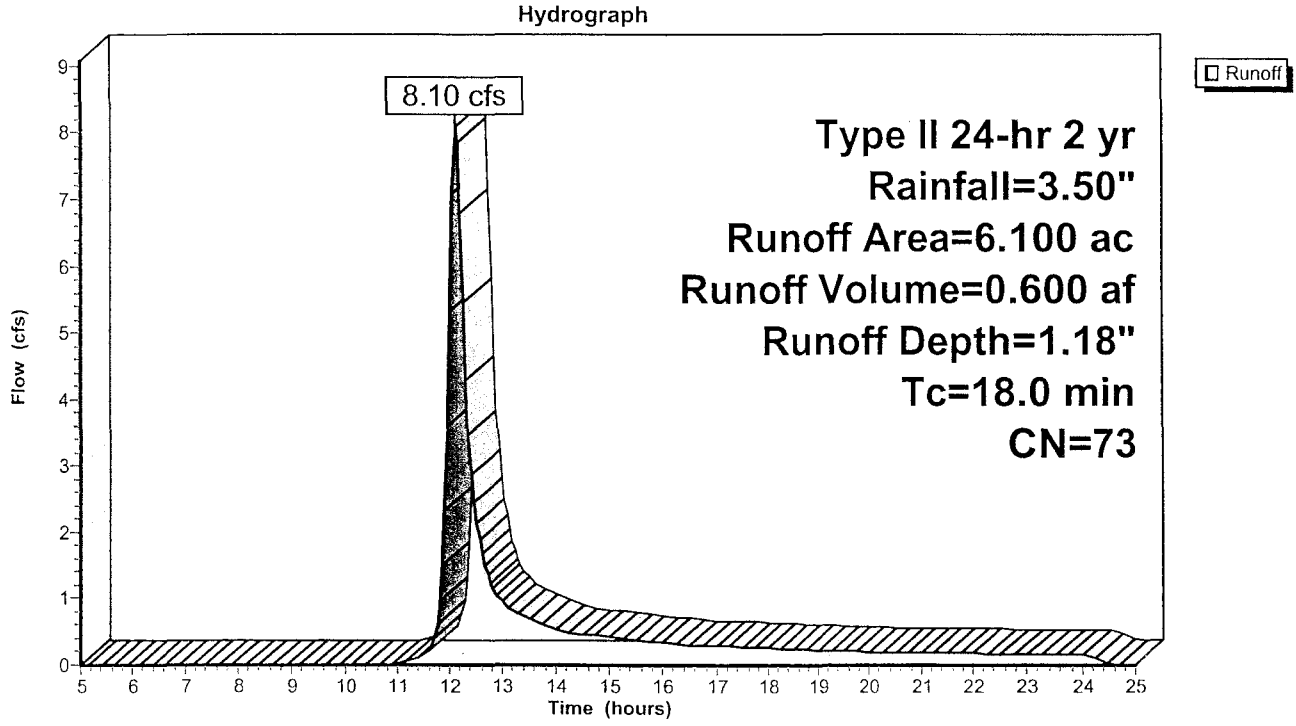
Runoff = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

Area (ac)	CN	Description
1.900	55	Woods, Good, HSG B
4.200	81	1/3 acre lots, 30% imp, HSG C
6.100	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond BMP-2: Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 1.18" for 2 yr event
Inflow = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af
Outflow = 0.66 cfs @ 13.58 hrs, Volume= 0.600 af, Atten= 92%, Lag= 87.7 min
Primary = 0.66 cfs @ 13.58 hrs, Volume= 0.600 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 78.12' @ 13.58 hrs Surf.Area= 3,389 sf Storage= 11,523 cf
Plug-Flow detention time= 183.6 min calculated for 0.600 af (100% of inflow)
Center-of-Mass det. time= 183.6 min (1,051.1 - 867.5)

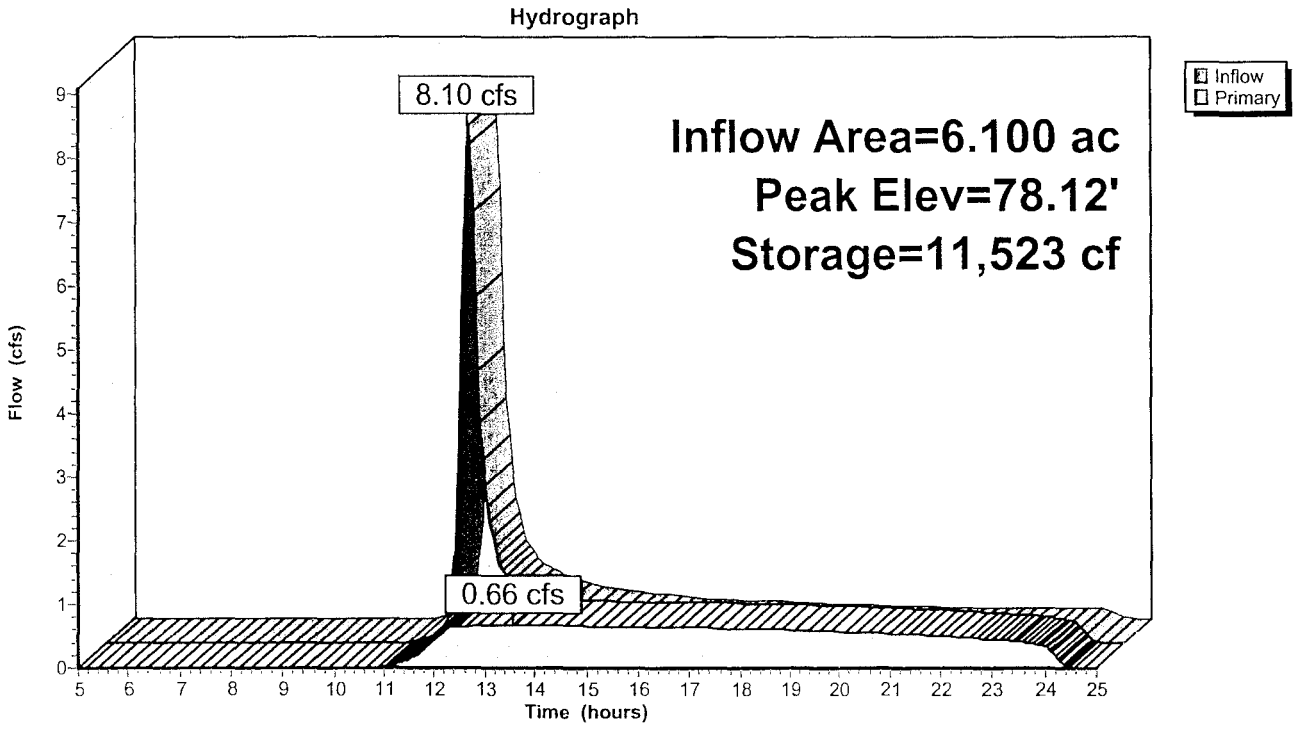
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,029 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	0	0	0
70.00	95	95	95
71.00	305	200	295
72.00	667	486	781
73.00	944	806	1,587
74.00	1,267	1,106	2,692
75.00	1,590	1,429	4,121
76.00	1,954	1,772	5,893
77.00	2,570	2,262	8,155
78.00	3,275	2,923	11,077
79.00	4,236	3,756	14,833
80.00	5,320	4,778	19,611
81.00	6,700	6,010	25,621
82.00	8,117	7,409	33,029

#	Routing	Invert	Outlet Devices
1	Primary	66.80'	**24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	68.00'	**3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900
3	Device 1	80.55'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.66 cfs @ 13.58 hrs HW=78.12' (Free Discharge)
└─**1=Culvert** (Passes 0.66 cfs of 48.59 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.66 cfs @ 13.4 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond BMP-2: Basin 2



Subcatchment Post Dev: 1/3 Acre Lots

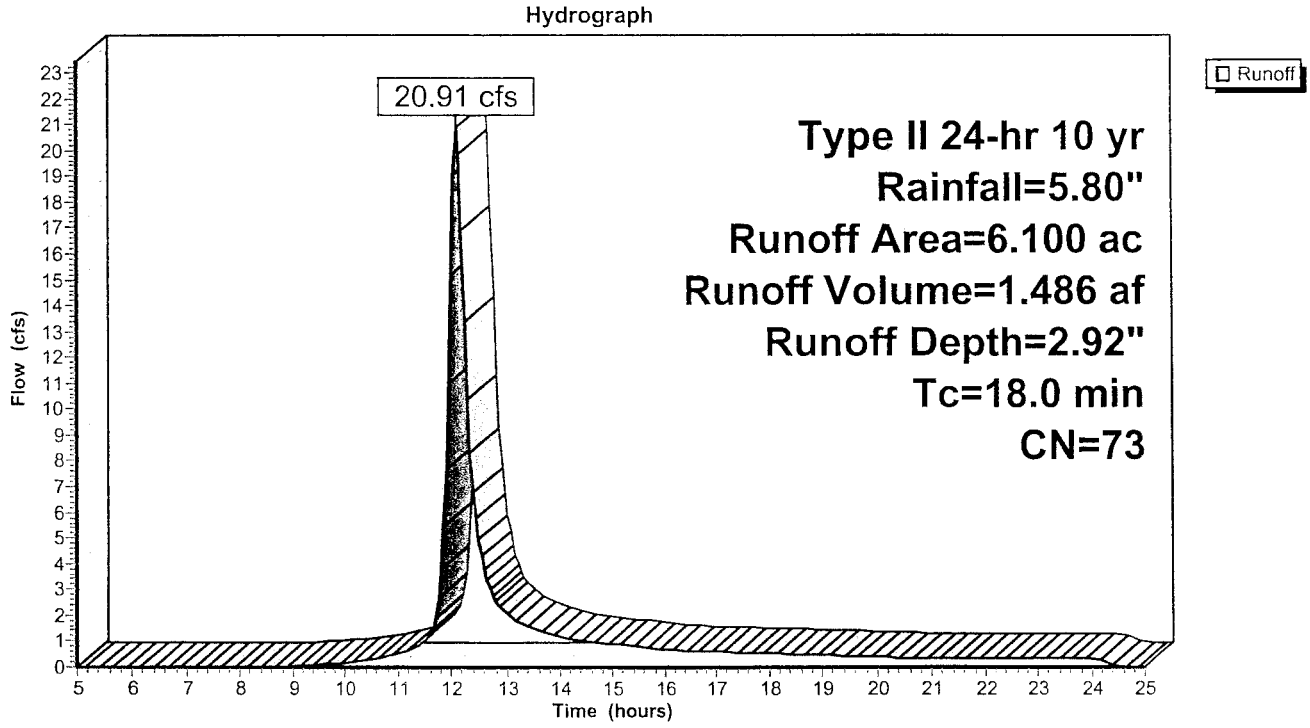
Runoff = 20.91 cfs @ 12.11 hrs, Volume= 1.486 af, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr Rainfall=5.80"

Area (ac)	CN	Description
1.900	55	Woods, Good, HSG B
4.200	81	1/3 acre lots, 30% imp, HSG C
6.100	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond BMP-2: Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 2.92" for 10 yr event
Inflow = 20.91 cfs @ 12.11 hrs, Volume= 1.486 af
Outflow = 8.76 cfs @ 12.35 hrs, Volume= 1.189 af, Atten= 58%, Lag= 14.8 min
Primary = 8.76 cfs @ 12.35 hrs, Volume= 1.189 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 80.89' @ 12.35 hrs Surf.Area= 6,543 sf Storage= 24,936 cf
Plug-Flow detention time= 226.9 min calculated for 1.189 af (80% of inflow)
Center-of-Mass det. time= 142.6 min (983.3 - 840.7)

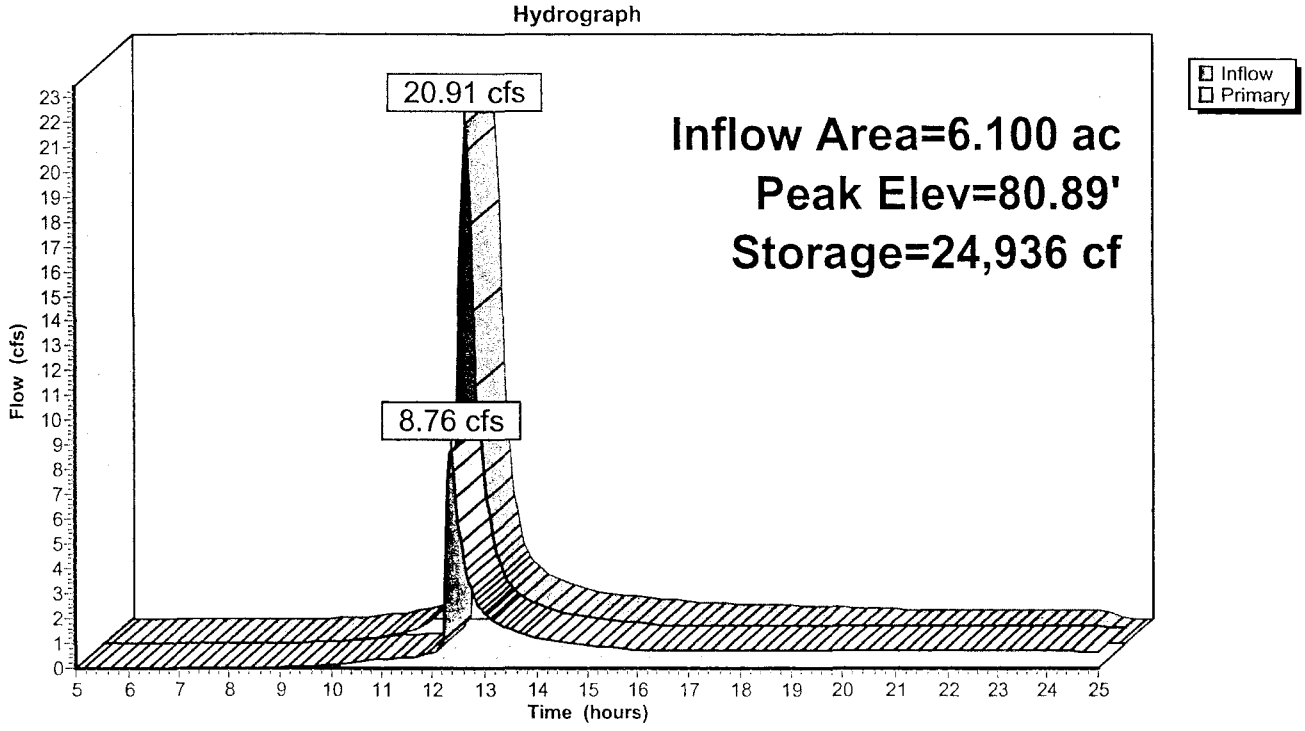
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,029 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	0	0	0
70.00	95	95	95
71.00	305	200	295
72.00	667	486	781
73.00	944	806	1,587
74.00	1,267	1,106	2,692
75.00	1,590	1,429	4,121
76.00	1,954	1,772	5,893
77.00	2,570	2,262	8,155
78.00	3,275	2,923	11,077
79.00	4,236	3,756	14,833
80.00	5,320	4,778	19,611
81.00	6,700	6,010	25,621
82.00	8,117	7,409	33,029

#	Routing	Invert	Outlet Devices
1	Primary	66.80'	**24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	68.00'	**3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900
3	Device 1	80.55'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=8.67 cfs @ 12.35 hrs HW=80.88' (Free Discharge)
└**1=Culvert** (Passes 8.67 cfs of 54.72 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.74 cfs @ 15.0 fps)
  └**3=Orifice/Grate** (Weir Controls 7.93 cfs @ 1.9 fps)

Pond BMP-2: Basin 2



Subcatchment Post Dev: 1/3 Acre Lots

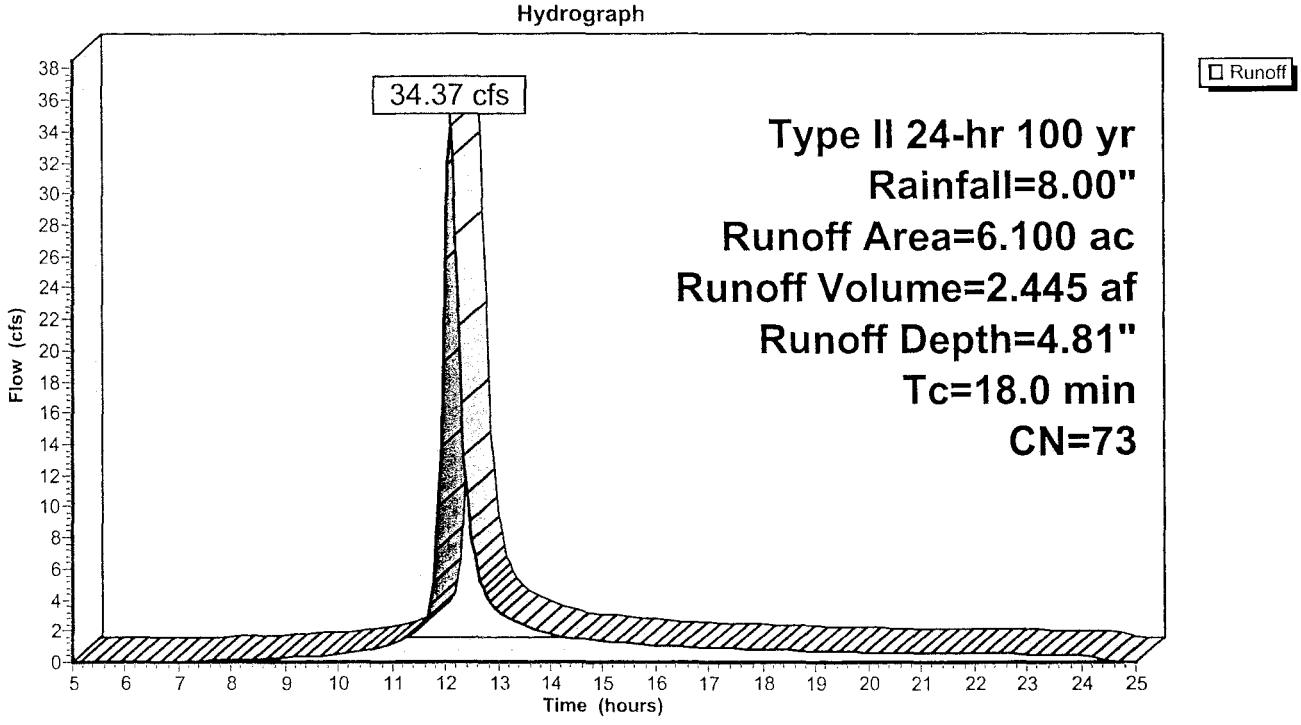
Runoff = 34.37 cfs @ 12.10 hrs, Volume= 2.445 af, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 yr Rainfall=8.00"

Area (ac)	CN	Description
1.900	55	Woods, Good, HSG B
4.200	81	1/3 acre lots, 30% imp, HSG C
6.100	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond BMP-2: Basin 2

Inflow Area =	6.100 ac,	Inflow Depth =	4.81"	for	100 yr event
Inflow =	34.37 cfs @	12.10 hrs,	Volume=	2.445 af	
Outflow =	30.00 cfs @	12.18 hrs,	Volume=	2.040 af,	Atten= 13%, Lag= 4.7 min
Primary =	30.00 cfs @	12.18 hrs,	Volume=	2.040 af	

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 81.35' @ 12.18 hrs Surf.Area= 7,191 sf Storage= 28,186 cf
Plug-Flow detention time= 138.8 min calculated for 2.035 af (83% of inflow)
Center-of-Mass det. time= 66.2 min (892.7 - 826.5)

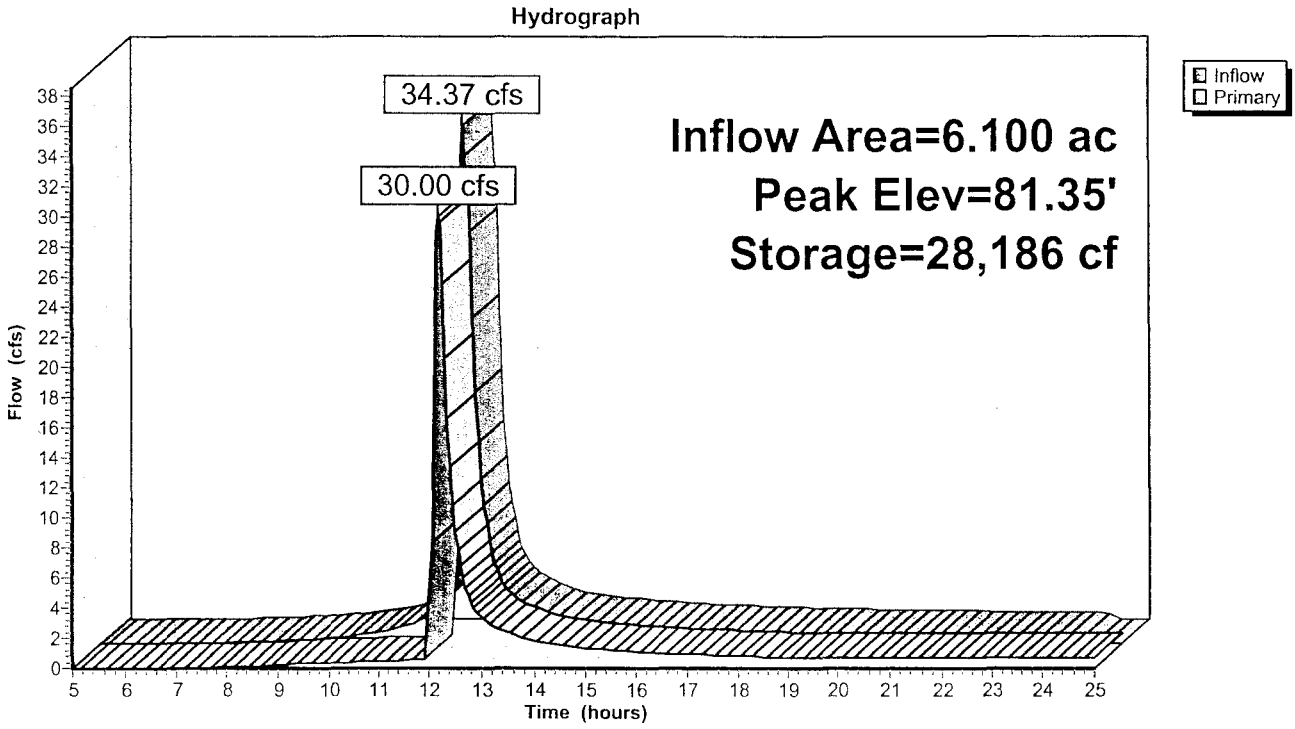
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,029 cf	**Custom Stage Data (Prismatic)** Listed below

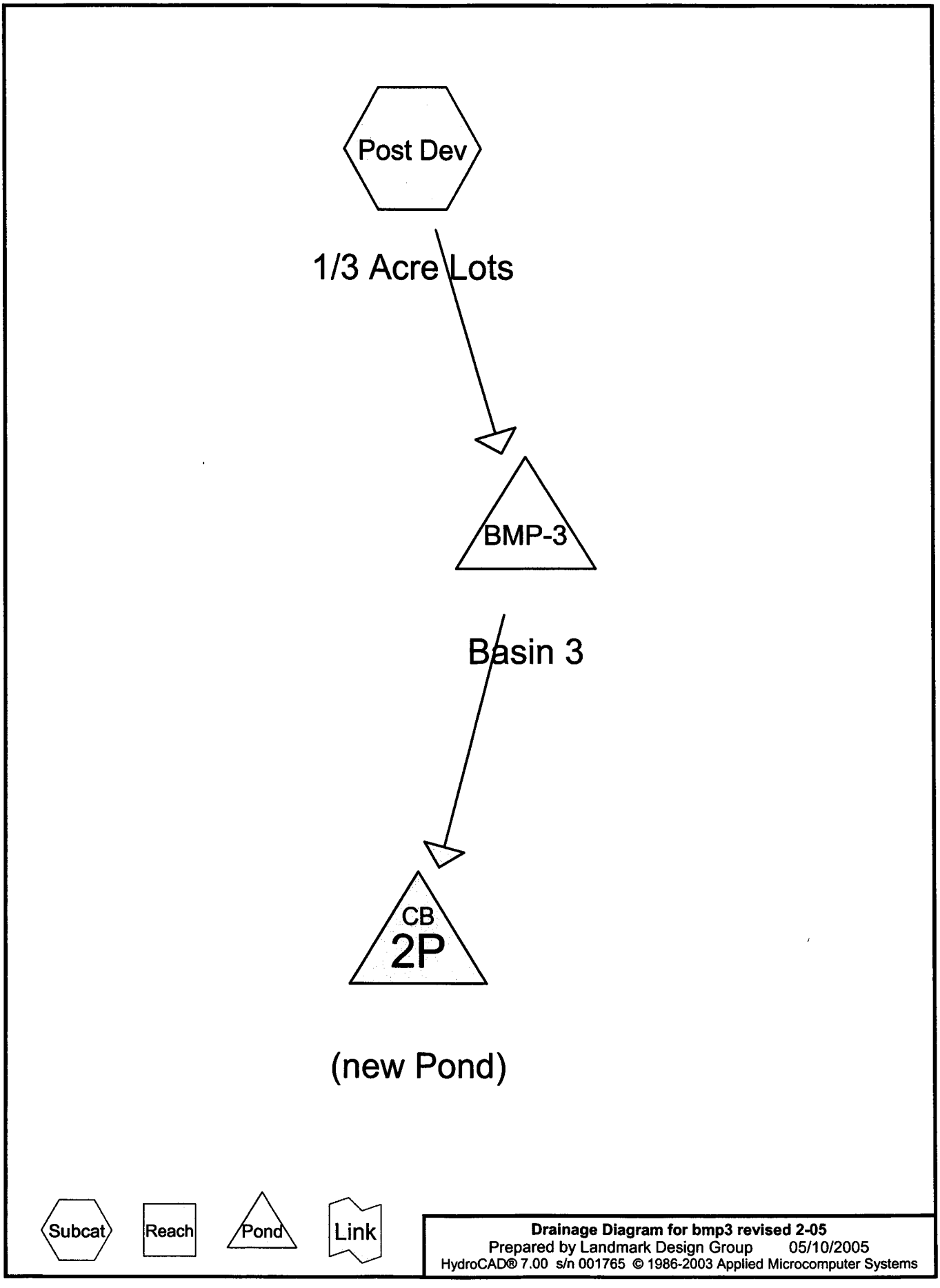
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	0	0	0
70.00	95	95	95
71.00	305	200	295
72.00	667	486	781
73.00	944	806	1,587
74.00	1,267	1,106	2,692
75.00	1,590	1,429	4,121
76.00	1,954	1,772	5,893
77.00	2,570	2,262	8,155
78.00	3,275	2,923	11,077
79.00	4,236	3,756	14,833
80.00	5,320	4,778	19,611
81.00	6,700	6,010	25,621
82.00	8,117	7,409	33,029

#	Routing	Invert	Outlet Devices
1	Primary	66.80'	**24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	68.00'	**3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900
3	Device 1	80.55'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=29.38 cfs @ 12.18 hrs HW=81.34' (Free Discharge)
└─**1=Culvert** (Passes 29.38 cfs of 55.65 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.75 cfs @ 15.3 fps)
  └─**3=Orifice/Grate** (Weir Controls 28.63 cfs @ 2.9 fps)

Pond BMP-2: Basin 2




Post Dev
1/3 Acre Lots
BMP-3
Basin 3
CB
2P
(new Pond)
Subcat
Reach
Pond
Link
Drainage Diagram for bmp3 revised 2-05
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Subcatchment Post Dev: 1/3 Acre Lots

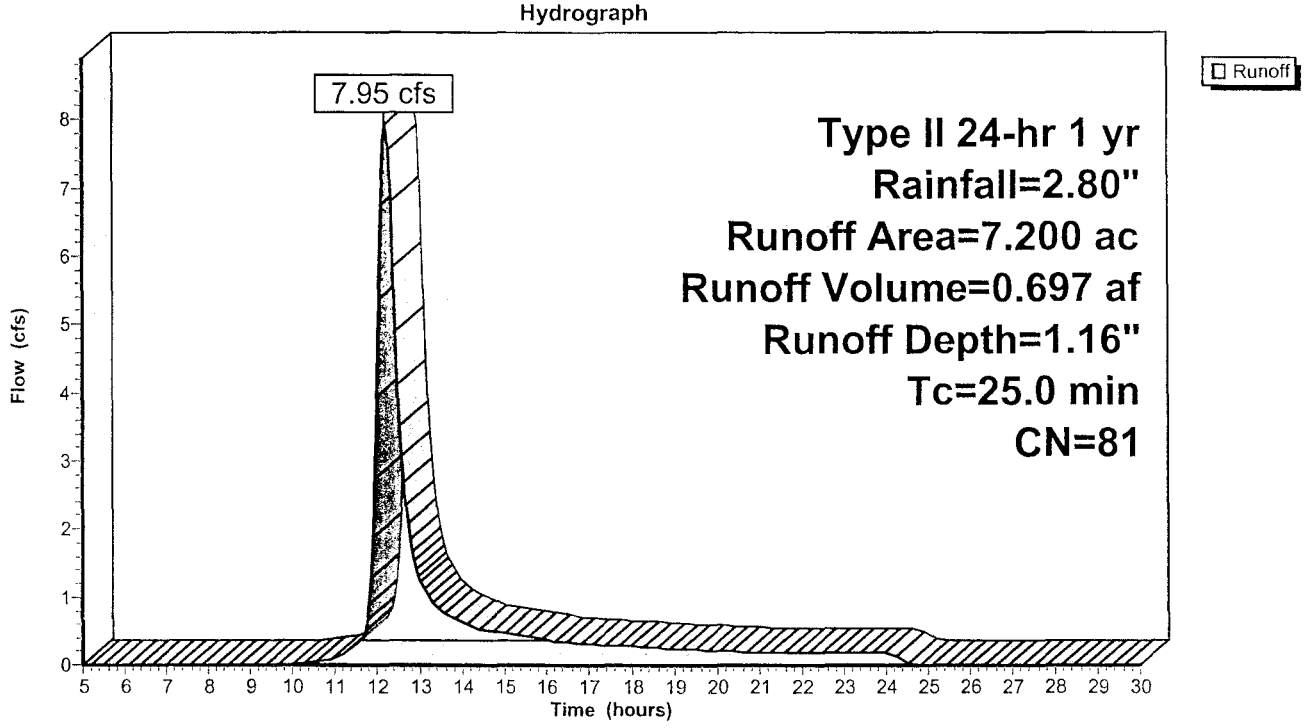
Runoff = 7.95 cfs @ 12.20 hrs, Volume= 0.697 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 yr Rainfall=2.80"

Area (ac)	CN	Description
7.200	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond 2P: (new Pond)

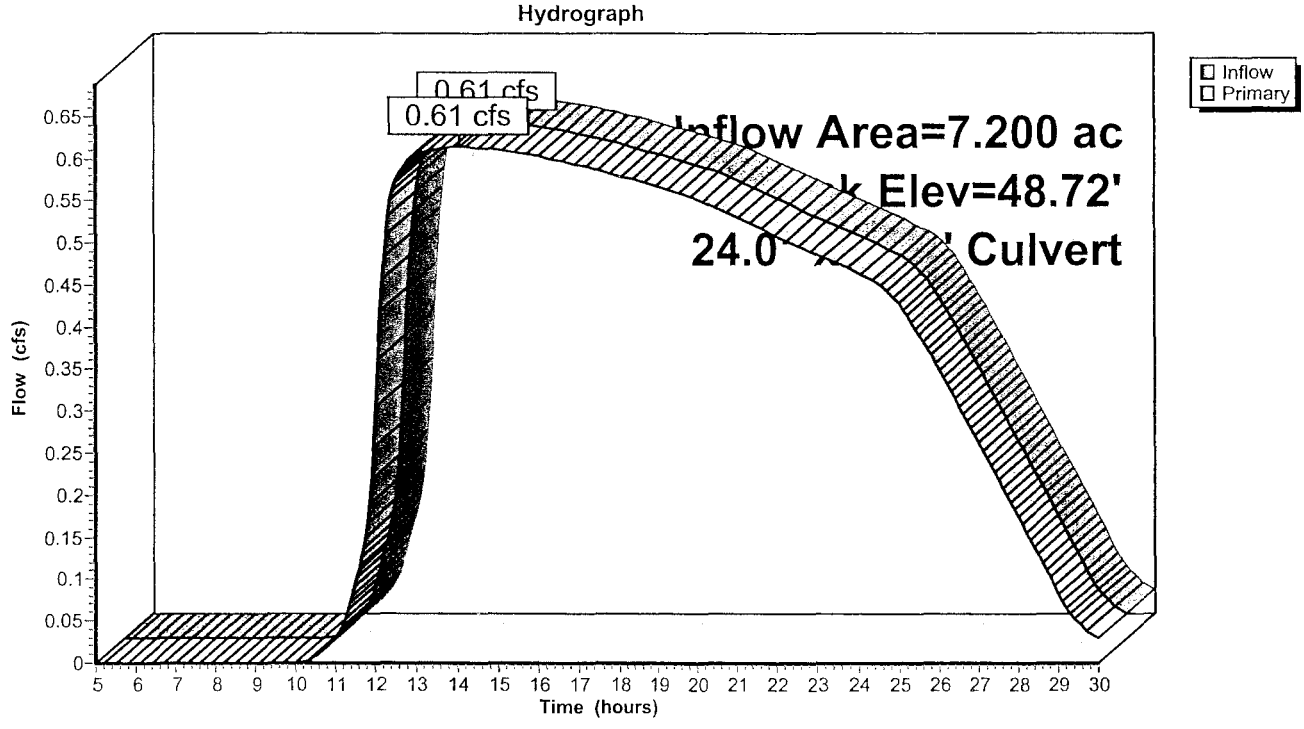
Inflow Area =	7.200 ac,	Inflow Depth =	1.16"	for	1 yr event
Inflow =	0.61 cfs @	14.02 hrs,	Volume=	0.694 af	
Outflow =	0.61 cfs @	14.02 hrs,	Volume=	0.694 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.61 cfs @	14.02 hrs,	Volume=	0.694 af	

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 48.72' @ 14.02 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	48.40'	**24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900

Primary OutFlow Max=0.61 cfs @ 14.02 hrs HW=48.72' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.61 cfs @ 1.9 fps)

Pond 2P: (new Pond)



Pond BMP-3: Basin 3

Inflow Area =	7.200 ac,	Inflow Depth = 1.16"	for 1 yr event		
Inflow =	7.95 cfs @	12.20 hrs, Volume=	0.697 af		
Outflow =	0.61 cfs @	14.02 hrs, Volume=	0.694 af,	Atten= 92%,	Lag= 109.5 min
Primary =	0.61 cfs @	14.02 hrs, Volume=	0.694 af		

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 63.51' @ 14.02 hrs Surf.Area= 3,975 sf Storage= 15,509 cf
Plug-Flow detention time= 295.4 min calculated for 0.694 af (100% of inflow)
Center-of-Mass det. time= 293.0 min (1,153.7 - 860.7)

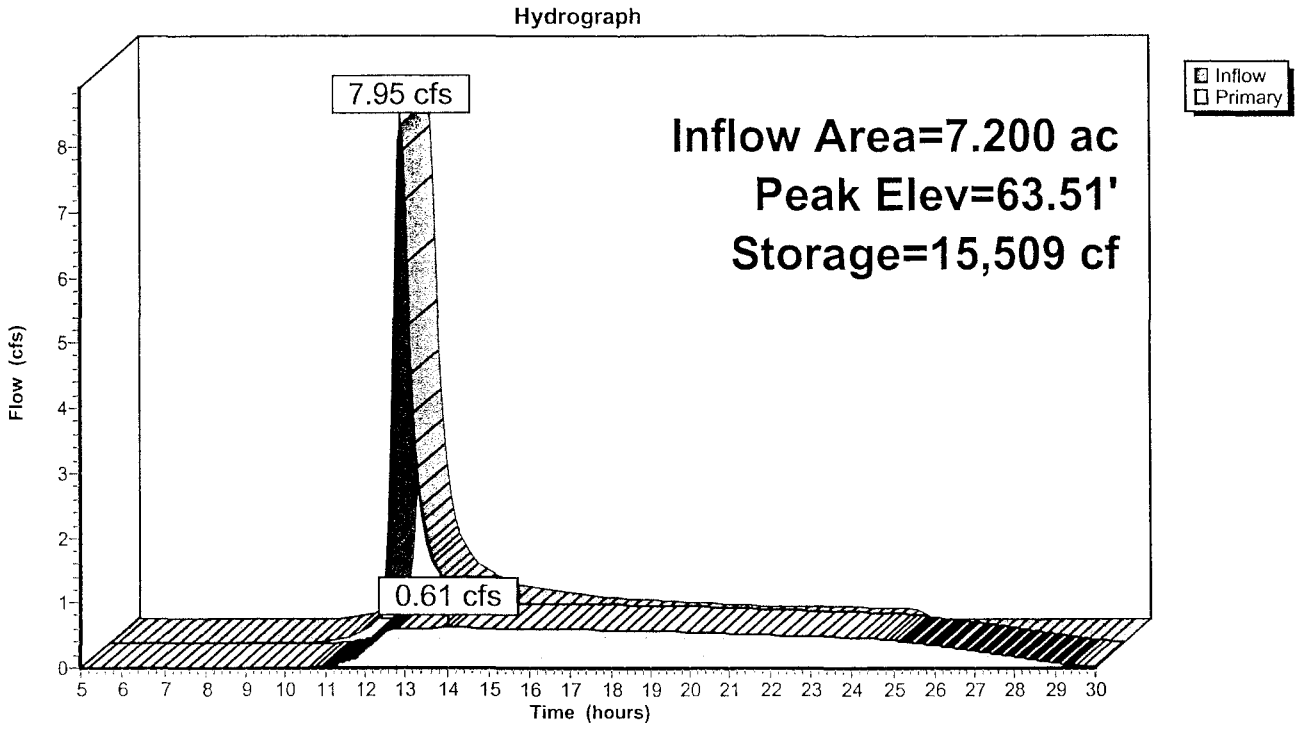
#	Invert	Avail.Storage	Storage Description
1	56.00'	77,692 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	600	0	0	600
59.50	1,800	4,012	4,012	1,888
60.00	2,020	954	4,967	2,125
62.00	3,050	5,035	10,002	3,230
64.00	4,275	7,291	17,292	4,547
66.00	5,720	9,960	27,252	6,098
68.00	7,375	13,060	40,312	7,874
70.00	9,300	16,638	56,950	9,933
72.00	11,480	20,742	77,692	12,260

#	Routing	Invert	Outlet Devices
1	Primary	55.00'	**24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900
2	Device 1	56.00'	**3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900
3	Device 1	66.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.61 cfs @ 14.02 hrs HW=63.51' (Free Discharge)
└**1=Culvert** (Passes 0.61 cfs of 41.46 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.61 cfs @ 12.5 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond BMP-3: Basin 3



Subcatchment Post Dev: 1/3 Acre Lots

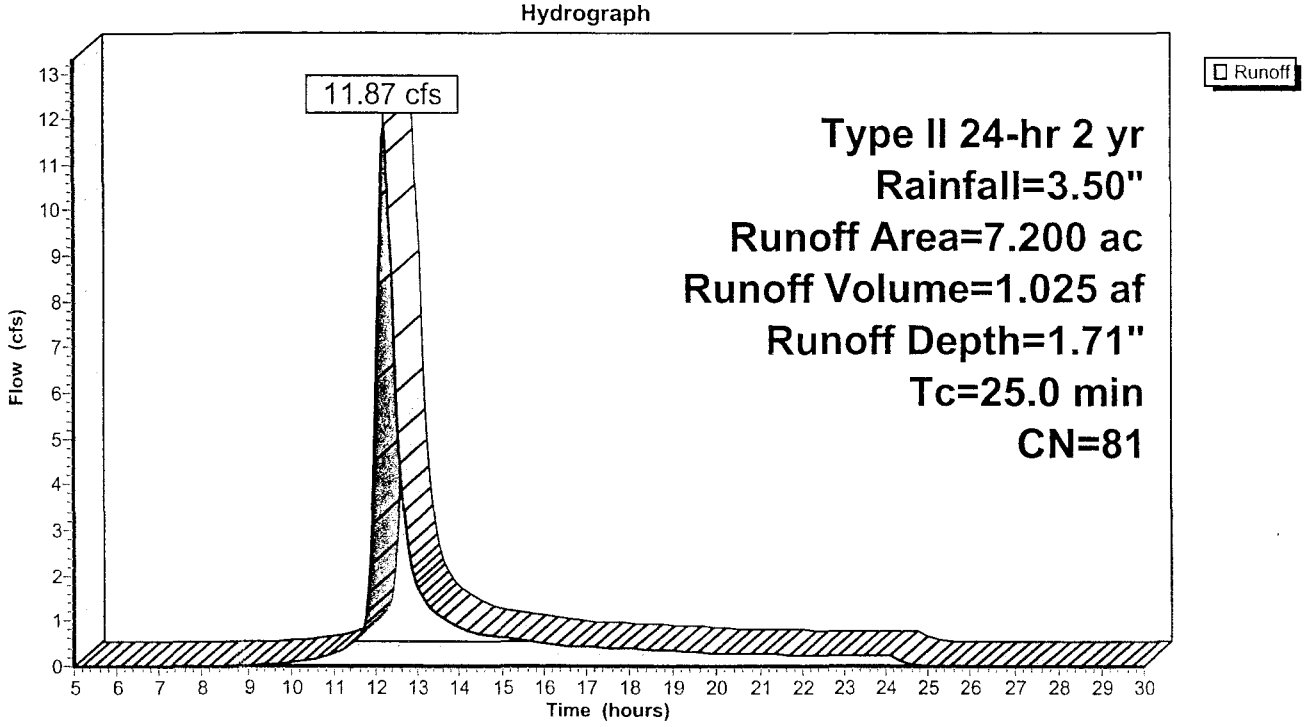
Runoff = 11.87 cfs @ 12.19 hrs, Volume= 1.025 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

Area (ac)	CN	Description
7.200	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond 2P: (new Pond)

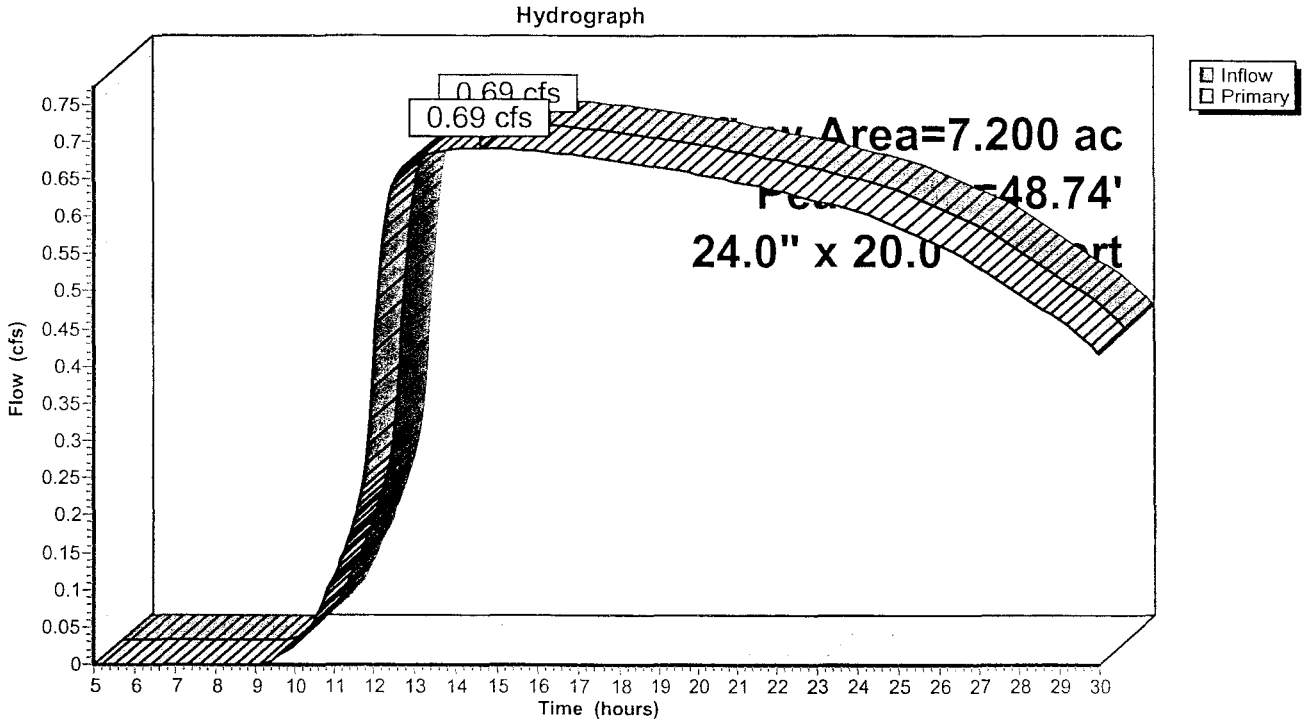
Inflow Area =	7.200 ac,	Inflow Depth =	1.56"	for	2 yr event
Inflow =	0.69 cfs @	14.59 hrs,	Volume=	0.939 af	
Outflow =	0.69 cfs @	14.59 hrs,	Volume=	0.939 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.69 cfs @	14.59 hrs,	Volume=	0.939 af	

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 48.74' @ 14.59 hrs
Plug-Flow detention time= 0.0 min calculated for 0.937 af (100% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

#	Routing	Invert	Outlet Devices
1	Primary	48.40'	**24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900

Primary OutFlow Max=0.69 cfs @ 14.59 hrs HW=48.74' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.69 cfs @ 2.0 fps)

Pond 2P: (new Pond)



Pond BMP-3: Basin 3

Inflow Area =	7.200 ac,	Inflow Depth = 1.71"	for 2 yr event		
Inflow =	11.87 cfs @	12.19 hrs, Volume=	1.025 af		
Outflow =	0.69 cfs @	14.59 hrs, Volume=	0.939 af,	Atten= 94%,	Lag= 144.3 min
Primary =	0.69 cfs @	14.59 hrs, Volume=	0.939 af		

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 65.56' @ 14.59 hrs Surf.Area= 5,402 sf Storage= 25,061 cf
Plug-Flow detention time= 409.2 min calculated for 0.937 af (91% of inflow)
Center-of-Mass det. time= 365.2 min (1,214.7 - 849.5)

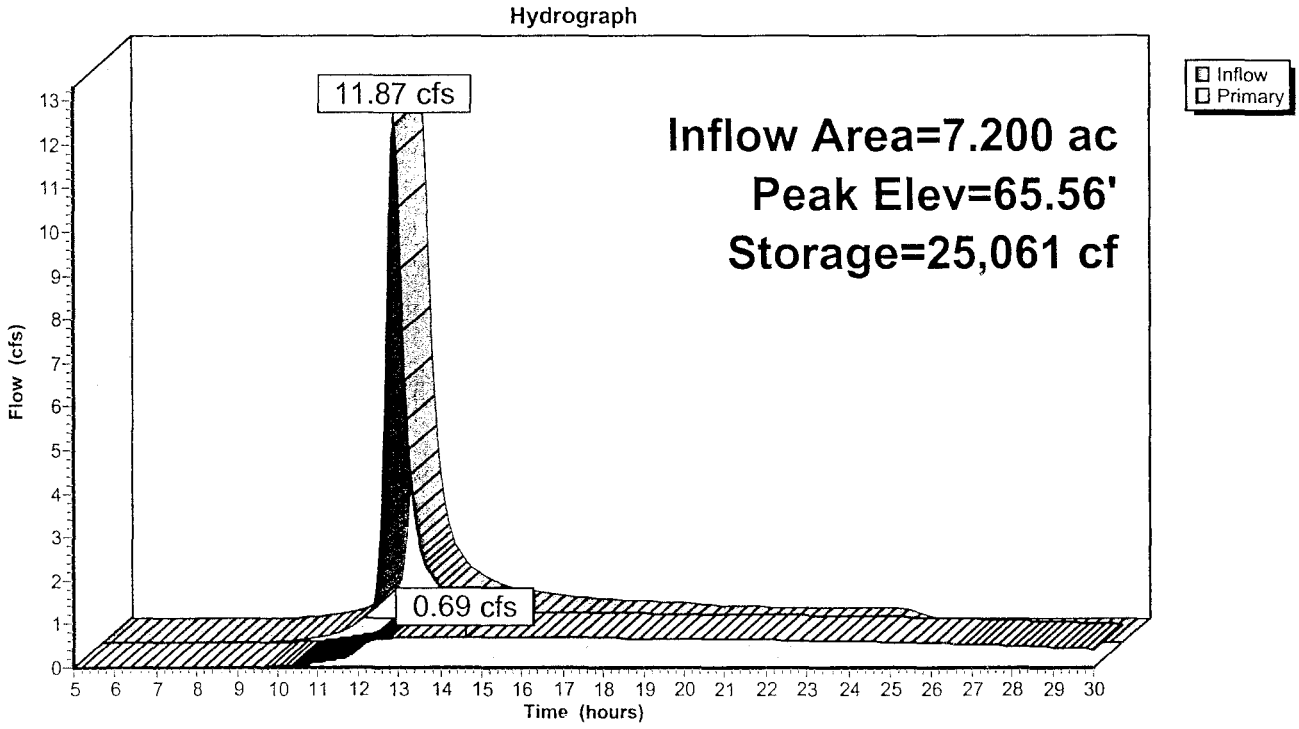
#	Invert	Avail.Storage	Storage Description
1	56.00'	77,692 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	600	0	0	600
59.50	1,800	4,012	4,012	1,888
60.00	2,020	954	4,967	2,125
62.00	3,050	5,035	10,002	3,230
64.00	4,275	7,291	17,292	4,547
66.00	5,720	9,960	27,252	6,098
68.00	7,375	13,060	40,312	7,874
70.00	9,300	16,638	56,950	9,933
72.00	11,480	20,742	77,692	12,260

#	Routing	Invert	Outlet Devices
1	Primary	55.00'	**24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900
2	Device 1	56.00'	**3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900
3	Device 1	66.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.69 cfs @ 14.59 hrs HW=65.56' (Free Discharge)
└**1=Culvert** (Passes 0.69 cfs of 46.77 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.69 cfs @ 14.1 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond BMP-3: Basin 3



Subcatchment Post Dev: 1/3 Acre Lots

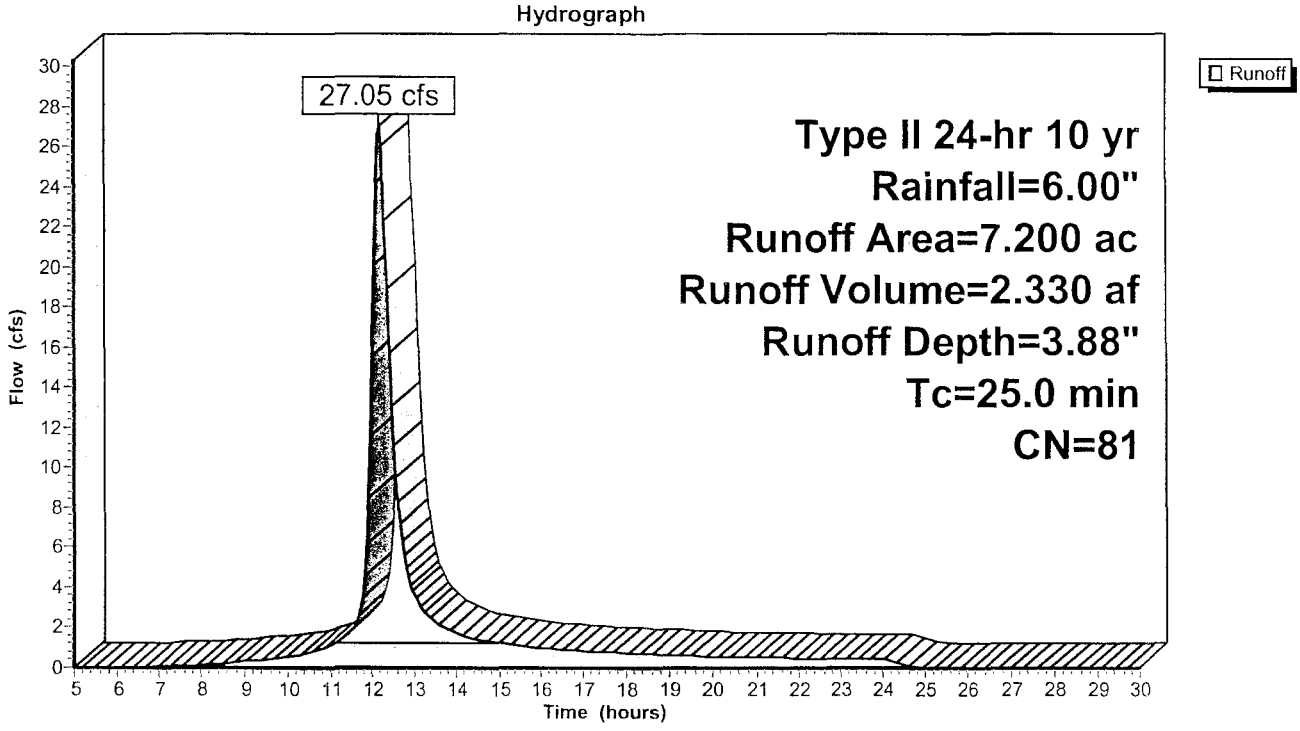
Runoff = 27.05 cfs @ 12.18 hrs, Volume= 2.330 af, Depth= 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr Rainfall=6.00"

Area (ac)	CN	Description
7.200	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond 2P: (new Pond)

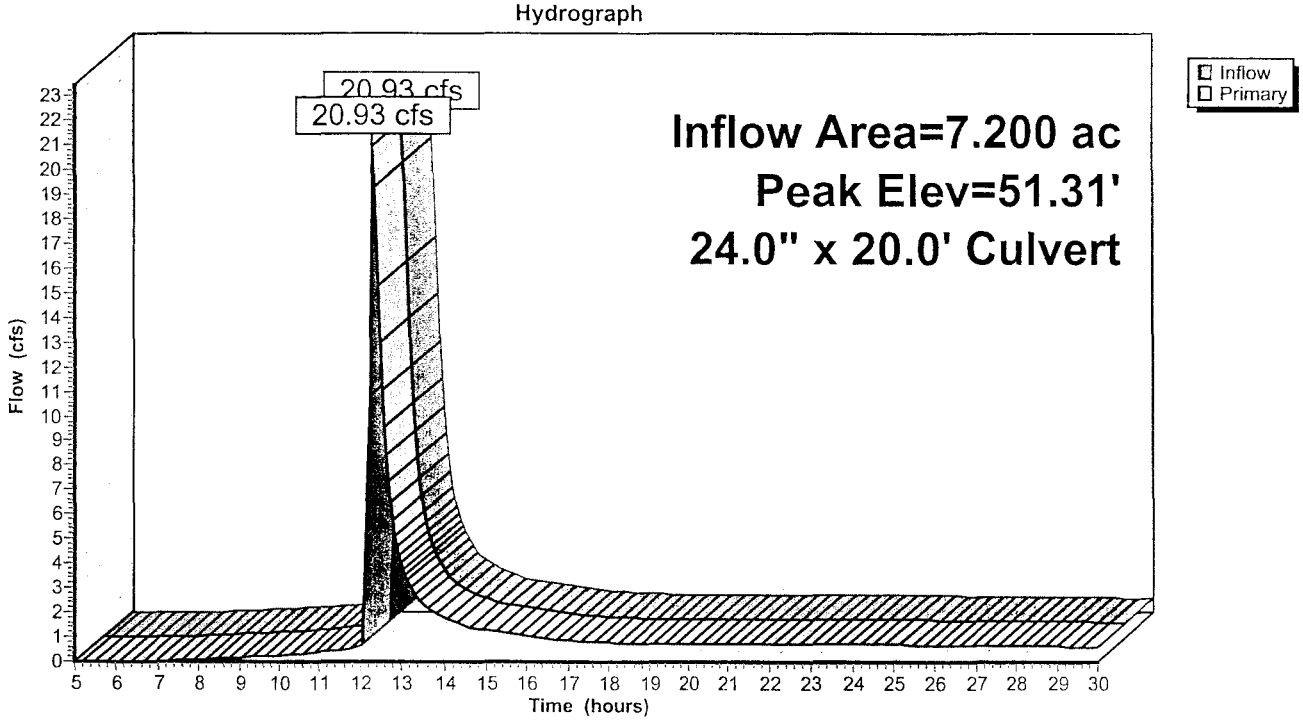
Inflow Area =	7.200 ac,	Inflow Depth =	3.38"	for	10 yr event
Inflow =	20.93 cfs @	12.33 hrs,	Volume=	2.027 af	
Outflow =	20.93 cfs @	12.33 hrs,	Volume=	2.027 af,	Atten= 0%, Lag= 0.0 min
Primary =	20.93 cfs @	12.33 hrs,	Volume=	2.027 af	

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 51.31' @ 12.33 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	48.40'	**24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900

Primary OutFlow Max=20.60 cfs @ 12.33 hrs HW=51.25' (Free Discharge)
└**1=Culvert** (Inlet Controls 20.60 cfs @ 6.6 fps)

Pond 2P: (new Pond)



Pond BMP-3: Basin 3

Inflow Area =	7.200 ac,	Inflow Depth =	3.88"	for	10 yr event	
Inflow =	27.05 cfs @	12.18 hrs,	Volume=		2.330 af	
Outflow =	20.93 cfs @	12.33 hrs,	Volume=		2.027 af,	Atten= 23%, Lag= 8.6 min
Primary =	20.93 cfs @	12.33 hrs,	Volume=		2.027 af	

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 67.12' @ 12.33 hrs Surf.Area= 6,647 sf Storage= 34,566 cf
Plug-Flow detention time= 248.4 min calculated for 2.027 af (87% of inflow)
Center-of-Mass det. time= 186.3 min (1,012.4 - 826.1)

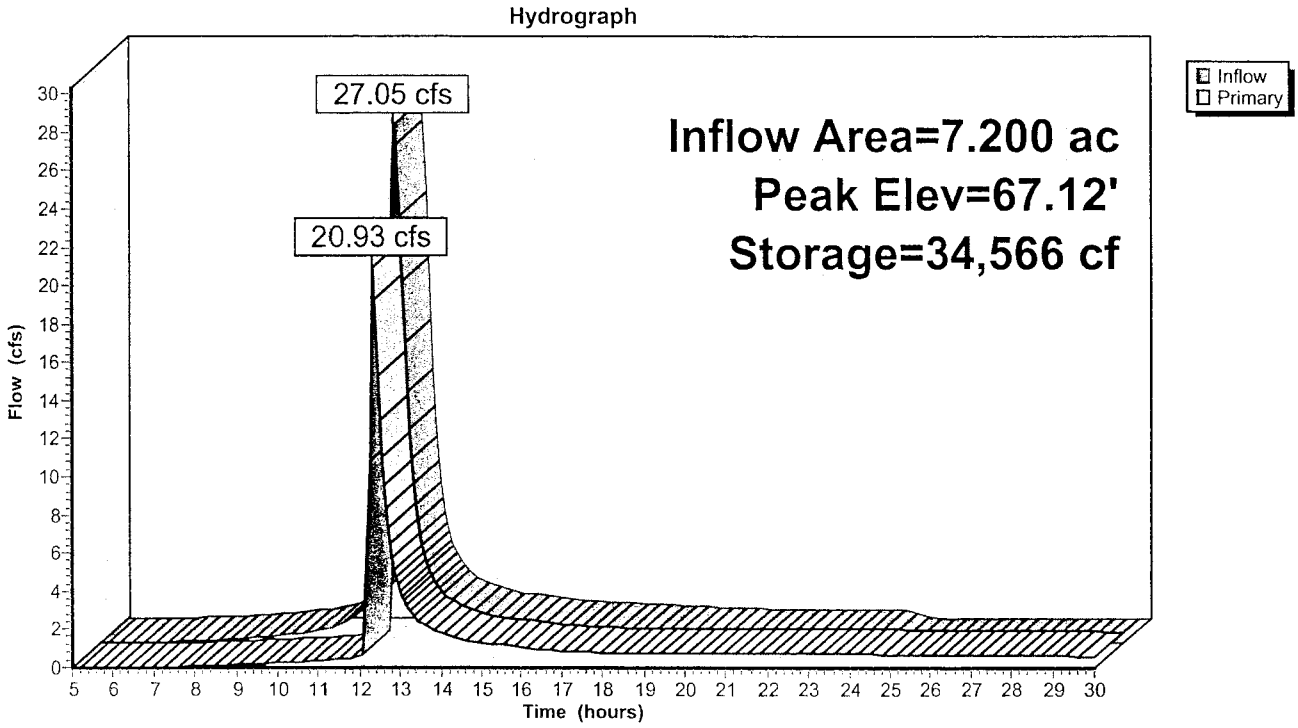
#	Invert	Avail.Storage	Storage Description
1	56.00'	77,692 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	600	0	0	600
59.50	1,800	4,012	4,012	1,888
60.00	2,020	954	4,967	2,125
62.00	3,050	5,035	10,002	3,230
64.00	4,275	7,291	17,292	4,547
66.00	5,720	9,960	27,252	6,098
68.00	7,375	13,060	40,312	7,874
70.00	9,300	16,638	56,950	9,933
72.00	11,480	20,742	77,692	12,260

#	Routing	Invert	Outlet Devices
1	Primary	55.00'	**24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900
2	Device 1	56.00'	**3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900
3	Device 1	66.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=20.48 cfs @ 12.33 hrs HW=67.11' (Free Discharge)
└─**1=Culvert** (Passes 20.48 cfs of 50.43 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.74 cfs @ 15.1 fps)
  └─**3=Orifice/Grate** (Weir Controls 19.73 cfs @ 2.6 fps)

Pond BMP-3: Basin 3



Subcatchment Post Dev: 1/3 Acre Lots

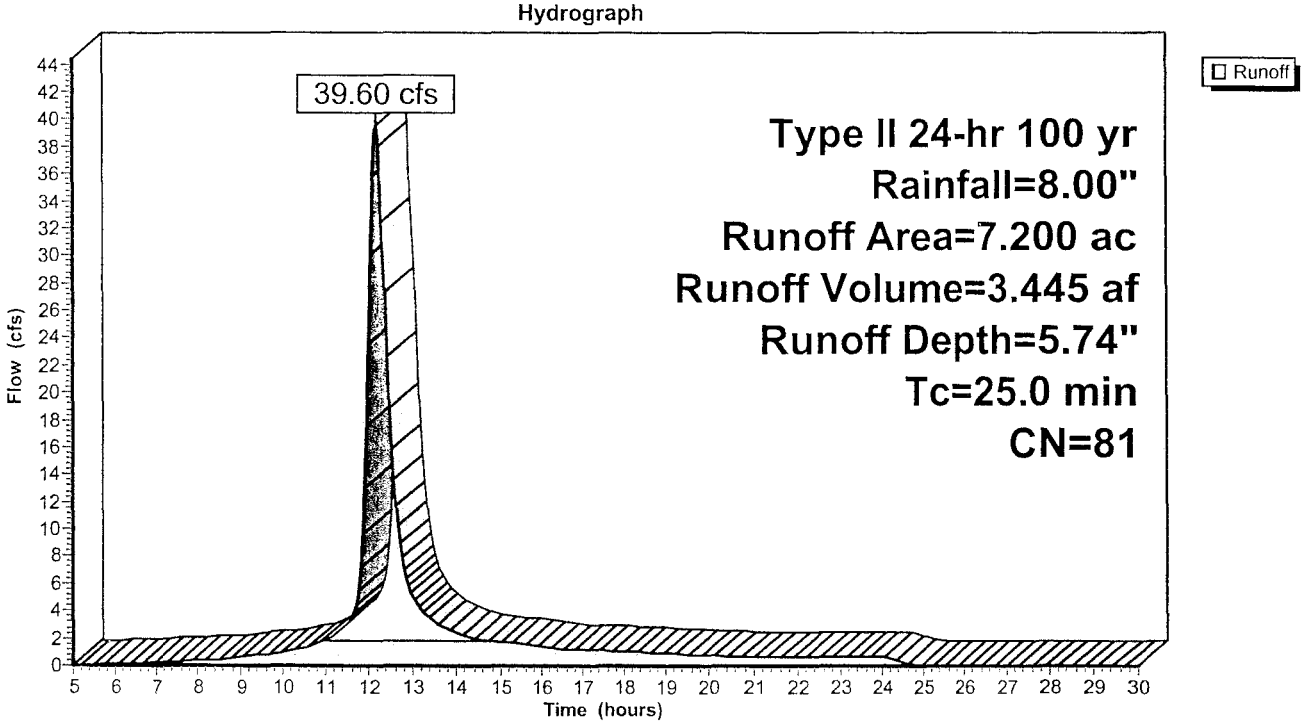
Runoff = 39.60 cfs @ 12.18 hrs, Volume= 3.445 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 yr Rainfall=8.00"

Area (ac)	CN	Description
7.200	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Pond 2P: (new Pond)

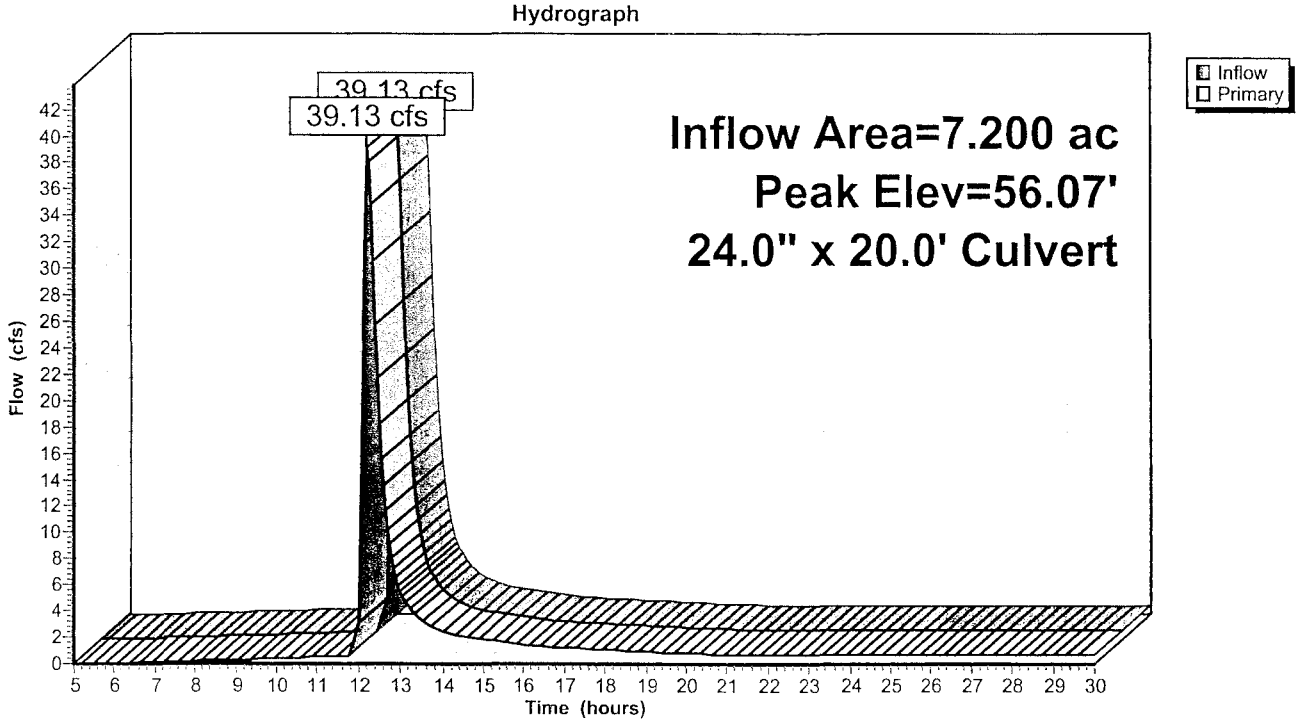
Inflow Area =	7.200 ac,	Inflow Depth =	5.13"	for	100 yr event
Inflow =	39.13 cfs @	12.22 hrs,	Volume=	3.079 af	
Outflow =	39.13 cfs @	12.22 hrs,	Volume=	3.079 af,	Atten= 0%, Lag= 0.0 min
Primary =	39.13 cfs @	12.22 hrs,	Volume=	3.079 af	

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 56.07' @ 12.22 hrs
Plug-Flow detention time= 0.0 min calculated for 3.079 af (100% of inflow)
Center-of-Mass det. time= 0.0 min (934.8 - 934.8)

#	Routing	Invert	Outlet Devices
1	Primary	48.40'	**24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900

Primary OutFlow Max=38.28 cfs @ 12.22 hrs HW=55.80' (Free Discharge)
└**1=Culvert** (Inlet Controls 38.28 cfs @ 12.2 fps)

Pond 2P: (new Pond)



Pond BMP-3: Basin 3

Inflow Area =	7.200 ac,	Inflow Depth =	5.74"	for	100 yr event
Inflow =	39.60 cfs @	12.18 hrs,	Volume=	3.445 af	
Outflow =	39.13 cfs @	12.22 hrs,	Volume=	3.079 af,	Atten= 1%, Lag= 2.7 min
Primary =	39.13 cfs @	12.22 hrs,	Volume=	3.079 af	

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 67.45' @ 12.22 hrs Surf.Area= 6,923 sf Storage= 36,748 cf
Plug-Flow detention time= 172.3 min calculated for 3.073 af (89% of inflow)
Center-of-Mass det. time= 119.8 min (934.8 - 815.0)

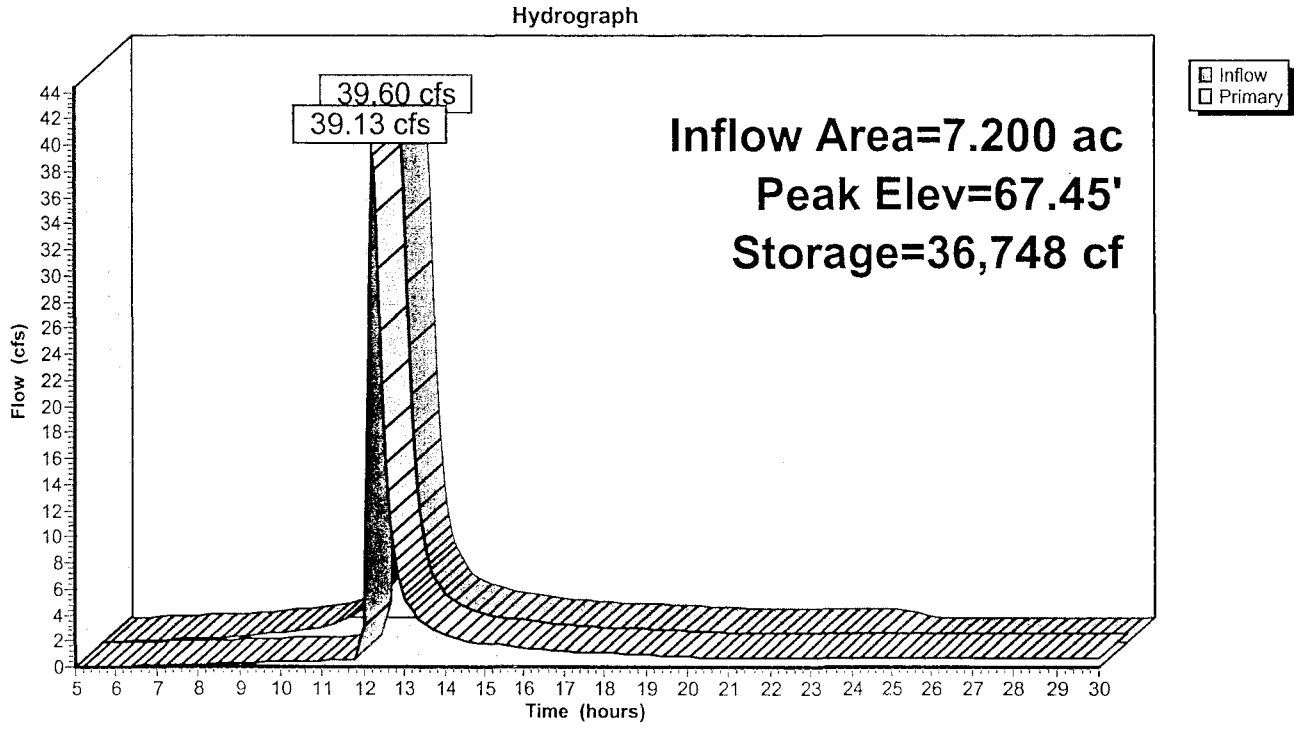
#	Invert	Avail.Storage	Storage Description
1	56.00'	77,692 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	600	0	0	600
59.50	1,800	4,012	4,012	1,888
60.00	2,020	954	4,967	2,125
62.00	3,050	5,035	10,002	3,230
64.00	4,275	7,291	17,292	4,547
66.00	5,720	9,960	27,252	6,098
68.00	7,375	13,060	40,312	7,874
70.00	9,300	16,638	56,950	9,933
72.00	11,480	20,742	77,692	12,260

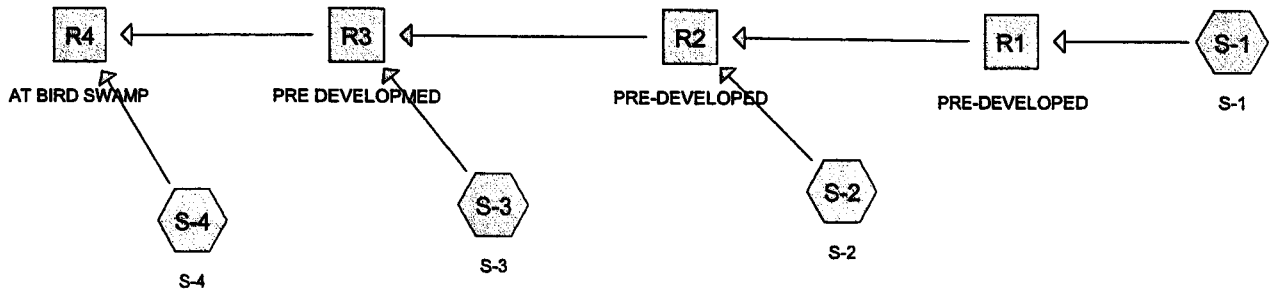
#	Routing	Invert	Outlet Devices
1	Primary	55.00'	**24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900
2	Device 1	56.00'	**3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900
3	Device 1	66.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

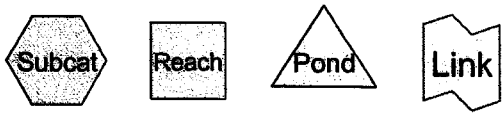
Primary OutFlow Max=38.17 cfs @ 12.22 hrs HW=67.44' (Free Discharge)
└**1=Culvert** (Passes 38.17 cfs of 51.16 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.75 cfs @ 15.3 fps)
  └**3=Orifice/Grate** (Weir Controls 37.42 cfs @ 3.2 fps)

Pond BMP-3: Basin 3



CHANNEL 1
PRE-DEVELOPMENT





Drainage Diagram for channel 1 pre development
Prepared by LANDMARK DESIGN GROUP 11/4/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S-1: S-1 Runoff Area=19.200 ac Runoff Depth=0.53"
Flow Length=950' Tc=32.6 min CN=70 Runoff=7.72 cfs 0.844 af

Subcatchment S-2: S-2 Runoff Area=42.800 ac Runoff Depth=0.52"
Flow Length=1,460' Tc=58.5 min CN=70 Runoff=11.26 cfs 1.851 af

Subcatchment S-3: S-3 Runoff Area=7.800 ac Runoff Depth=0.52"
Flow Length=2,200' Tc=47.3 min CN=70 Runoff=2.40 cfs 0.340 af

Subcatchment S-4: S-4 Runoff Area=9.900 ac Runoff Depth=0.53"
Flow Length=680' Tc=18.9 min CN=70 Runoff=5.79 cfs 0.439 af

Reach R1: PRE-DEVELOPED Peak Depth=0.23' Max Vel=1.2 fps Inflow=7.72 cfs 0.844 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=6.54 cfs 0.823 af

Reach R2: PRE-DEVELOPED Peak Depth=0.37' Max Vel=1.6 fps Inflow=17.78 cfs 2.674 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=17.40 cfs 2.642 af

Reach R3: PRE DEVELOPMED Peak Depth=0.45' Max Vel=1.1 fps Inflow=19.22 cfs 2.982 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=17.88 cfs 2.911 af

Reach R4: AT BIRD SWAMP Peak Depth=0.46' Max Vel=1.1 fps Inflow=18.67 cfs 3.350 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=18.67 cfs 3.349 af

Total Runoff Area = 79.700 ac Runoff Volume = 3.473 af Average Runoff Depth = 0.52"

Subcatchment S-1: S-1

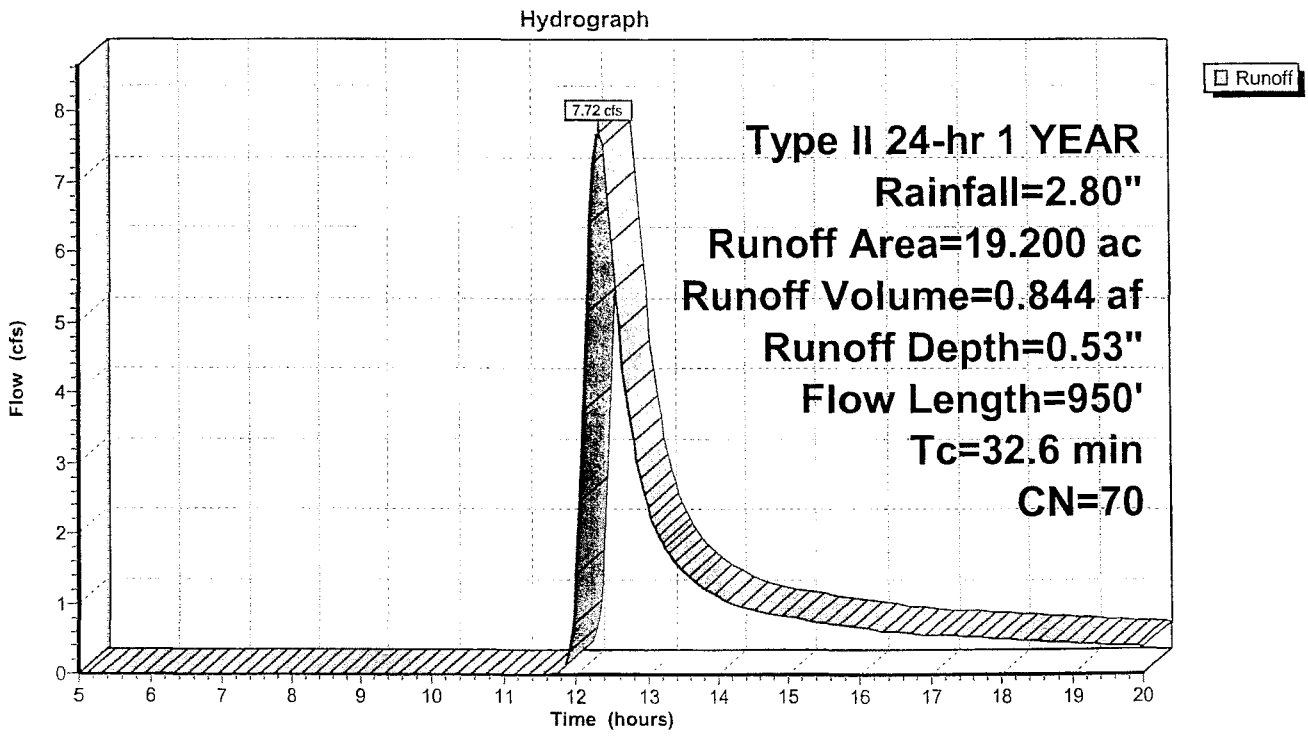
Runoff = 7.72 cfs @ 12.33 hrs, Volume= 0.844 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
19.200	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	100	0.0200	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
8.7	600	0.0530	1.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.9	250	0.0700	4.7	31.47	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
32.6	950	Total			

Subcatchment S-1: S-1



Subcatchment S-2: S-2

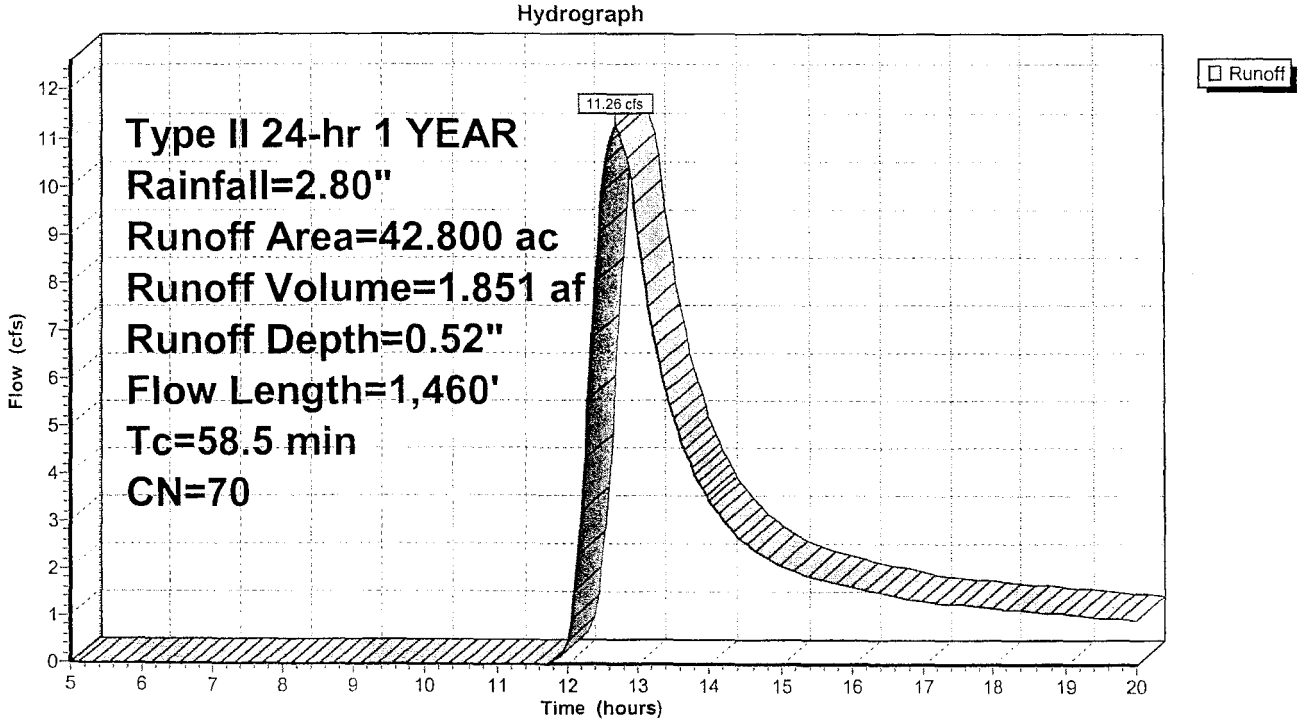
Runoff = 11.26 cfs @ 12.69 hrs, Volume= 1.851 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
42.800	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
46.4	300	0.0310	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
10.5	830	0.0700	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	330	0.0150	3.5	138.82	**Parabolic Channel,** W=60.00' D=1.00' Area=40.0 sf Perim=60.0' n= 0.040
58.5	1,460	Total			

Subcatchment S-2: S-2



Subcatchment S-3: S-3

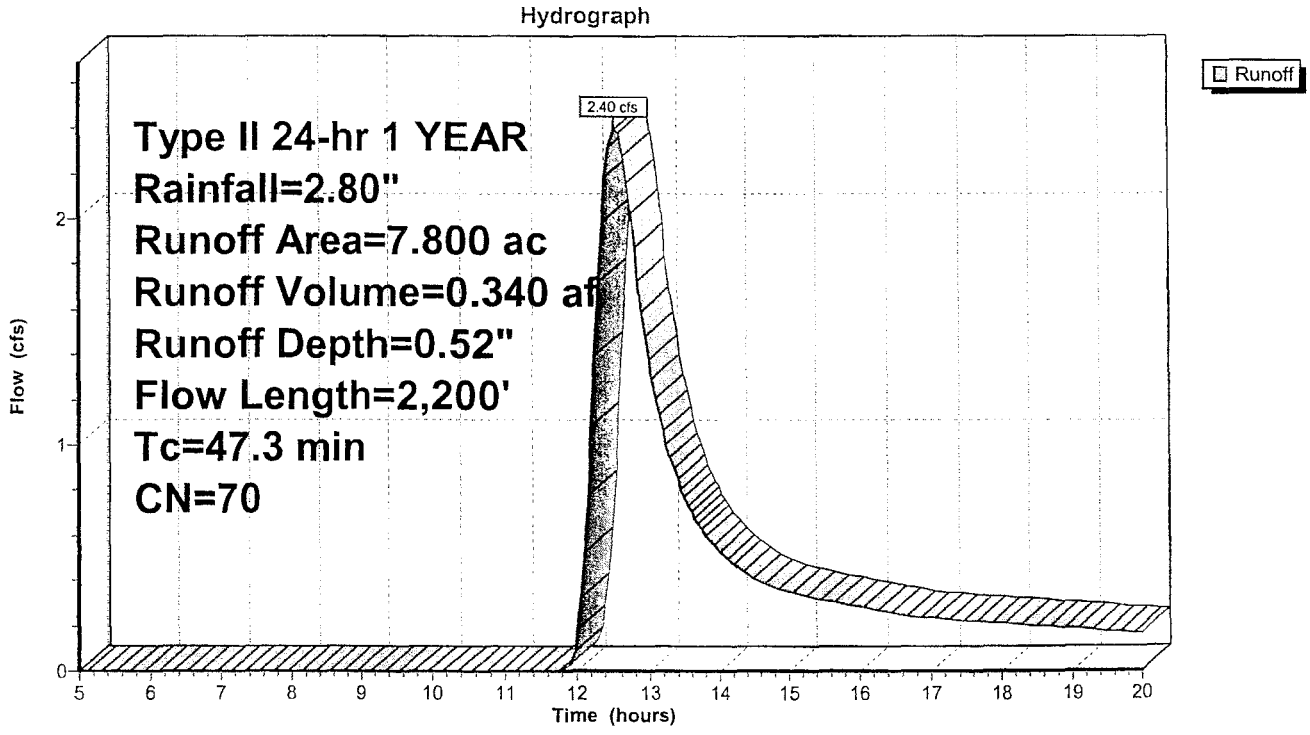
Runoff = 2.40 cfs @ 12.54 hrs, Volume= 0.340 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
7.800	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.1	300	0.0720	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
3.9	300	0.0670	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	1,600	0.0210	2.6	60.38	**Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040
47.3	2,200	Total			

Subcatchment S-3: S-3



Subcatchment S-4: S-4

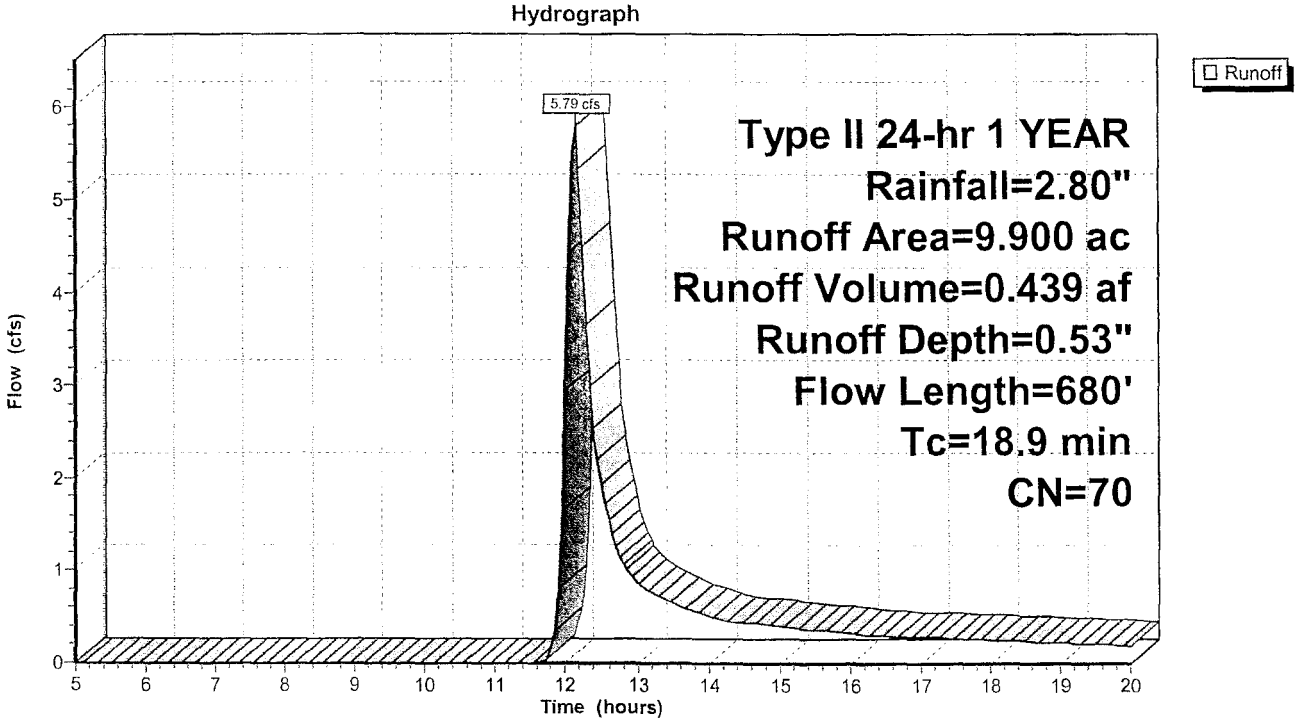
Runoff = 5.79 cfs @ 12.14 hrs, Volume= 0.439 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
9.900	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	130	0.1080	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.4	200	0.2250	2.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	350	0.0110	1.9	37.46	**Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040
18.9	680	Total			

Subcatchment S-4: S-4



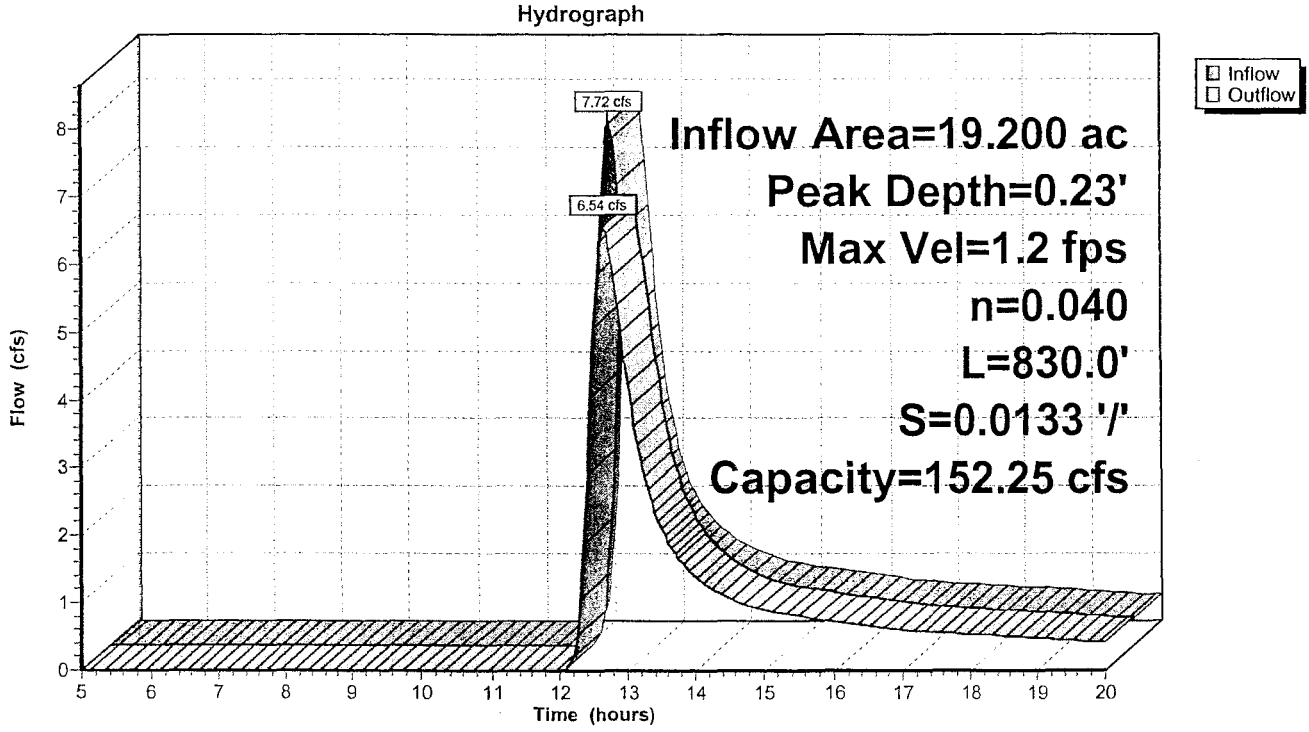
Reach R1: PRE-DEVELOPED

Inflow Area = 19.200 ac, Inflow Depth = 0.53" for 1 YEAR event
Inflow = 7.72 cfs @ 12.33 hrs, Volume= 0.844 af
Outflow = 6.54 cfs @ 12.66 hrs, Volume= 0.823 af, Atten= 15%, Lag= 20.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 11.2 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 20.7 min

Peak Depth= 0.23' @ 12.47 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

Reach R1: PRE-DEVELOPED



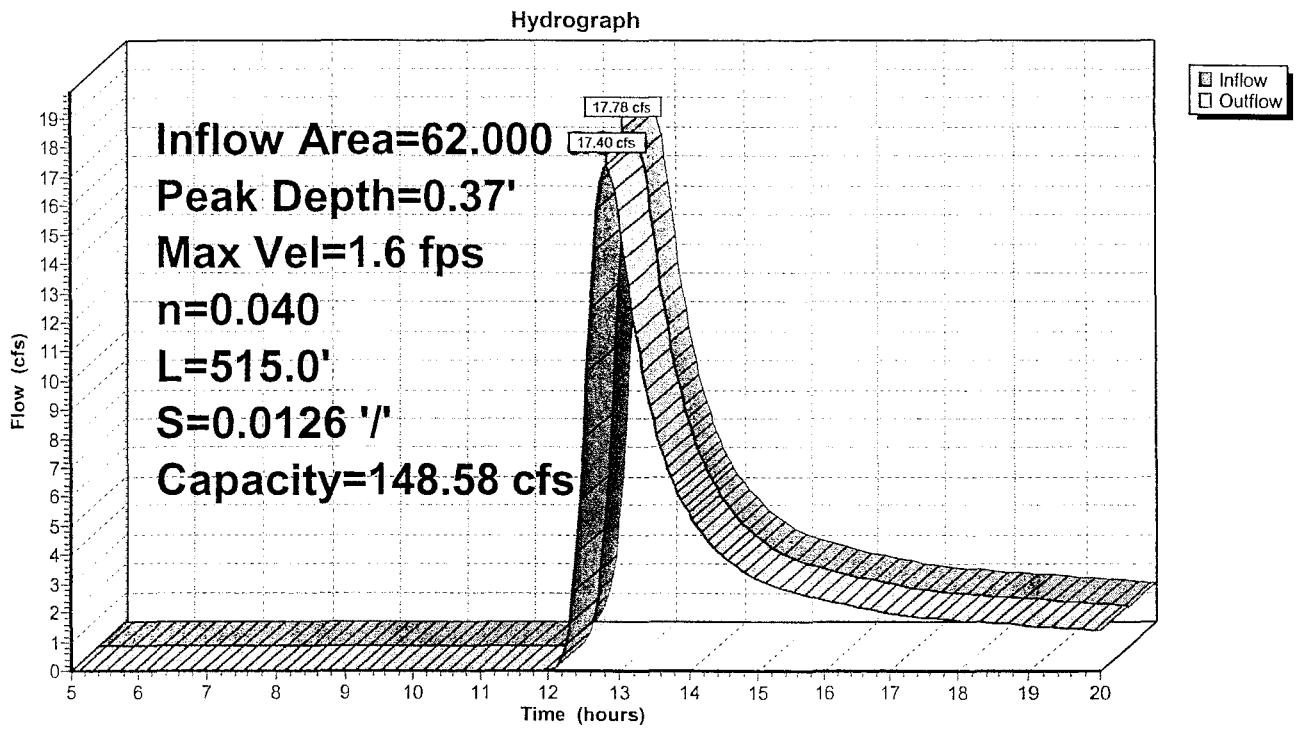
Reach R2: PRE-DEVELOPED

Inflow Area = 62.000 ac, Inflow Depth = 0.52" for 1 YEAR event
Inflow = 17.78 cfs @ 12.67 hrs, Volume= 2.674 af
Outflow = 17.40 cfs @ 12.83 hrs, Volume= 2.642 af, Atten= 2%, Lag= 9.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.6 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 9.1 min

Peak Depth= 0.37' @ 12.74 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

Reach R2: PRE-DEVELOPED



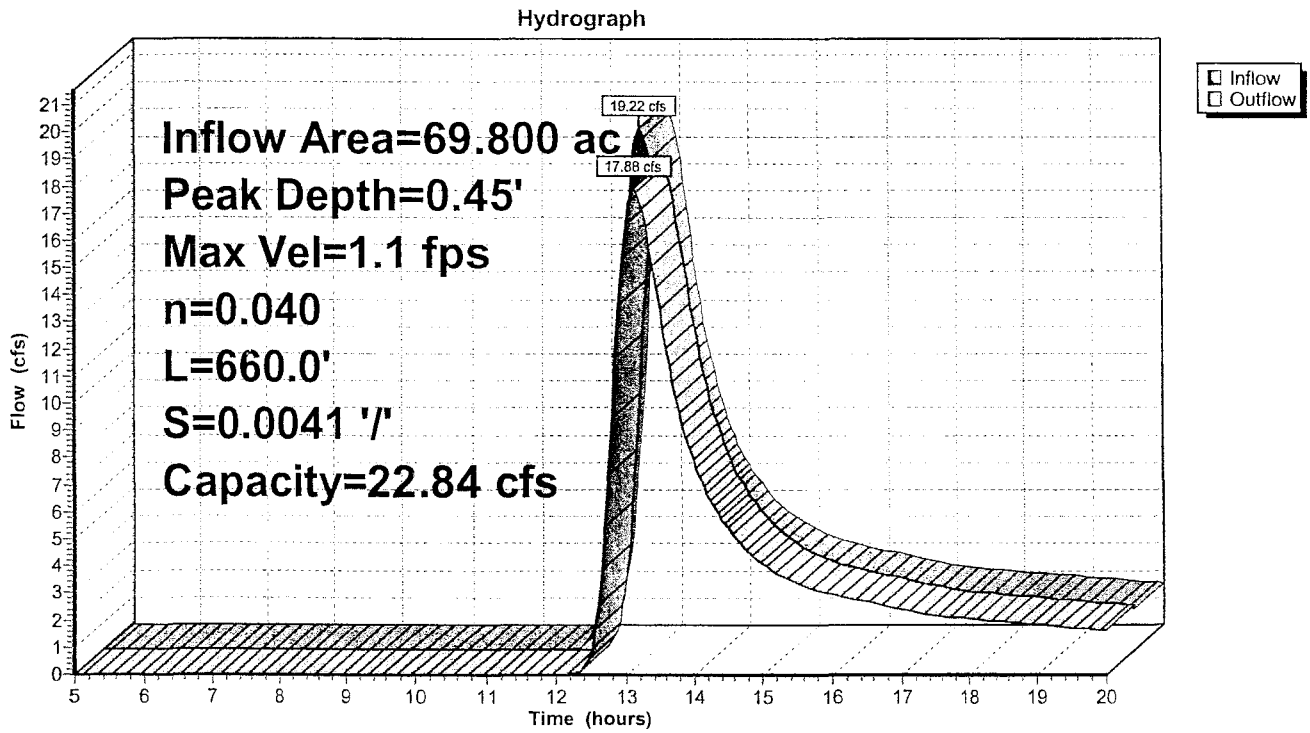
Reach R3: PRE DEVELOPMED

Inflow Area = 69.800 ac, Inflow Depth = 0.51" for 1 YEAR event
Inflow = 19.22 cfs @ 12.81 hrs, Volume= 2.982 af
Outflow = 17.88 cfs @ 13.13 hrs, Volume= 2.911 af, Atten= 7%, Lag= 19.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.1 fps, Min. Travel Time= 10.4 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 17.8 min

Peak Depth= 0.45' @ 12.96 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

Reach R3: PRE DEVELOPMED



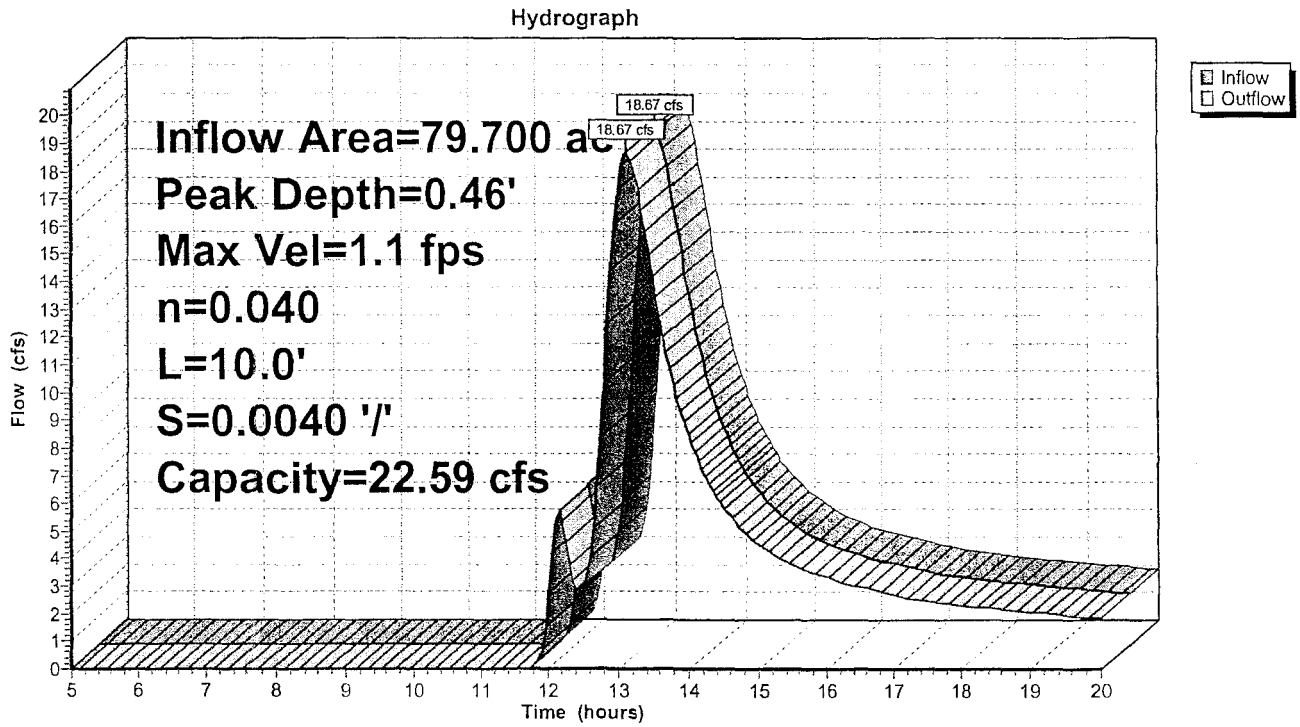
Reach R4: AT BIRD SWAMP

Inflow Area = 79.700 ac, Inflow Depth = 0.50" for 1 YEAR event
Inflow = 18.67 cfs @ 13.13 hrs, Volume= 3.350 af
Outflow = 18.67 cfs @ 13.13 hrs, Volume= 3.349 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.1 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.46' @ 13.13 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

Reach R4: AT BIRD SWAMP



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment S-1: S-1 Runoff Area=19.200 ac Runoff Depth=0.89"
Flow Length=950' Tc=32.6 min CN=70 Runoff=14.26 cfs 1.428 af

Subcatchment S-2: S-2 Runoff Area=42.800 ac Runoff Depth=0.88"
Flow Length=1,460' Tc=58.5 min CN=70 Runoff=20.80 cfs 3.138 af

Subcatchment S-3: S-3 Runoff Area=7.800 ac Runoff Depth=0.89"
Flow Length=2,200' Tc=47.3 min CN=70 Runoff=4.43 cfs 0.575 af

Subcatchment S-4: S-4 Runoff Area=9.900 ac Runoff Depth=0.90"
Flow Length=680' Tc=18.9 min CN=70 Runoff=10.53 cfs 0.741 af

Reach R1: PRE-DEVELOPED Peak Depth=0.32' Max Vel=1.5 fps Inflow=14.26 cfs 1.428 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=12.72 cfs 1.401 af

Reach R2: PRE-DEVELOPED Peak Depth=0.50' Max Vel=2.0 fps Inflow=33.21 cfs 4.538 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=32.71 cfs 4.498 af

Reach R3: PRE DEVELOPMED Peak Depth=0.62' Max Vel=1.3 fps Inflow=36.40 cfs 5.074 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=34.27 cfs 4.983 af

Reach R4: AT BIRD SWAMP Peak Depth=0.63' Max Vel=1.3 fps Inflow=35.64 cfs 5.724 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=35.63 cfs 5.723 af

Total Runoff Area = 79.700 ac Runoff Volume = 5.882 af Average Runoff Depth = 0.89"

Subcatchment S-1: S-1

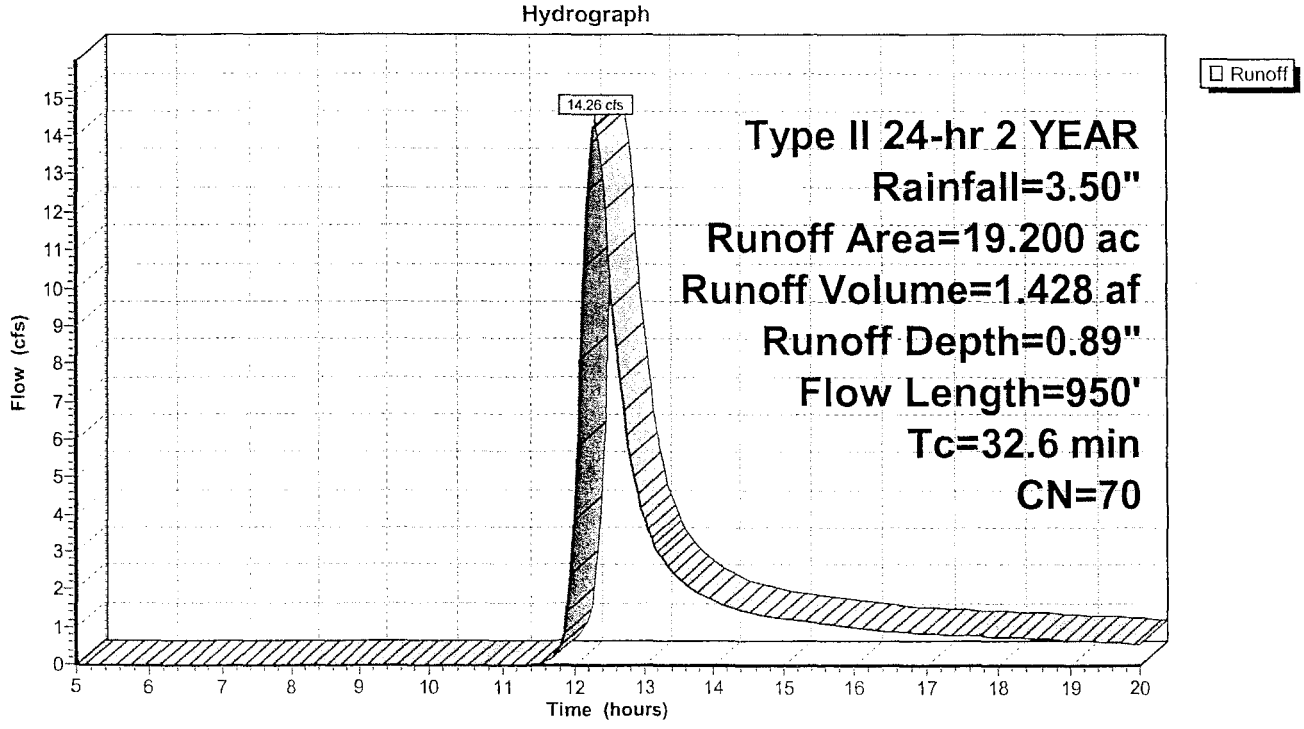
Runoff = 14.26 cfs @ 12.31 hrs, Volume= 1.428 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
19.200	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	100	0.0200	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
8.7	600	0.0530	1.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.9	250	0.0700	4.7	31.47	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
32.6	950	Total			

Subcatchment S-1: S-1



Subcatchment S-2: S-2

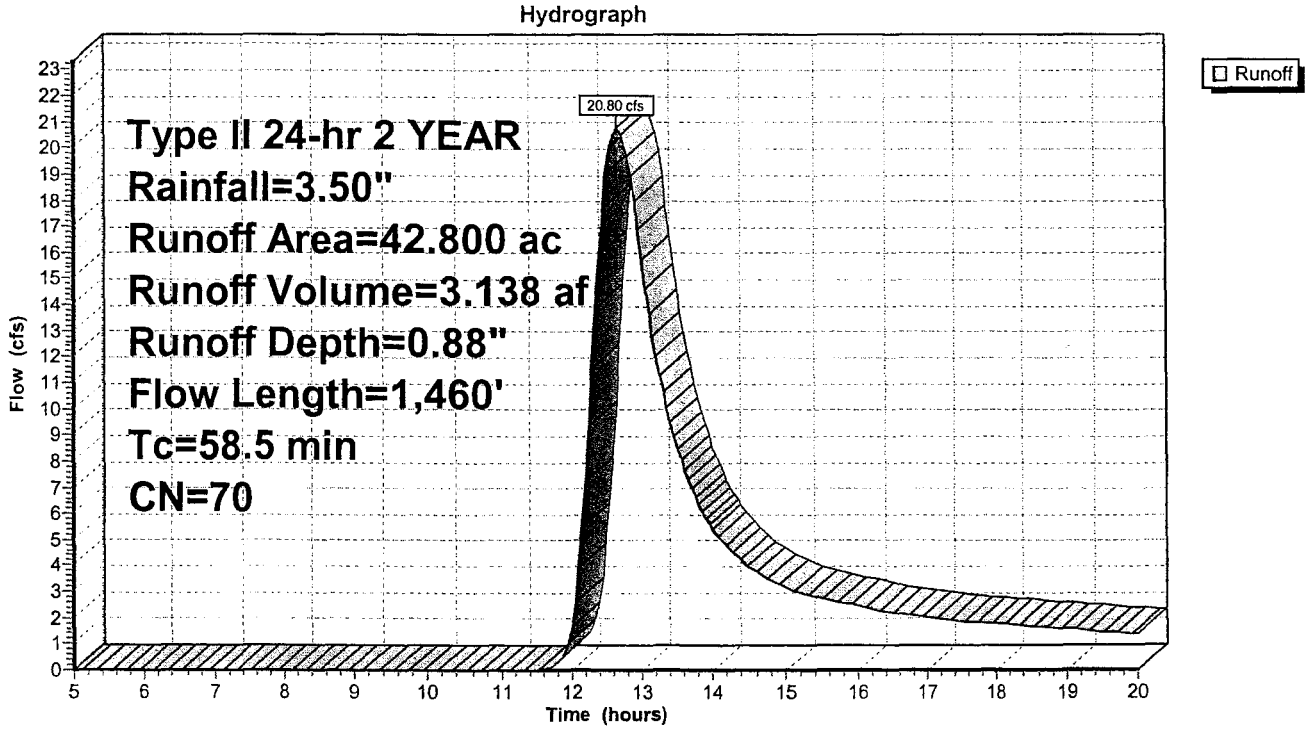
Runoff = 20.80 cfs @ 12.66 hrs, Volume= 3.138 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
42.800	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
46.4	300	0.0310	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
10.5	830	0.0700	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	330	0.0150	3.5	138.82	**Parabolic Channel,** W=60.00' D=1.00' Area=40.0 sf Perim=60.0' n= 0.040
58.5	1,460	Total			

Subcatchment S-2: S-2



Subcatchment S-3: S-3

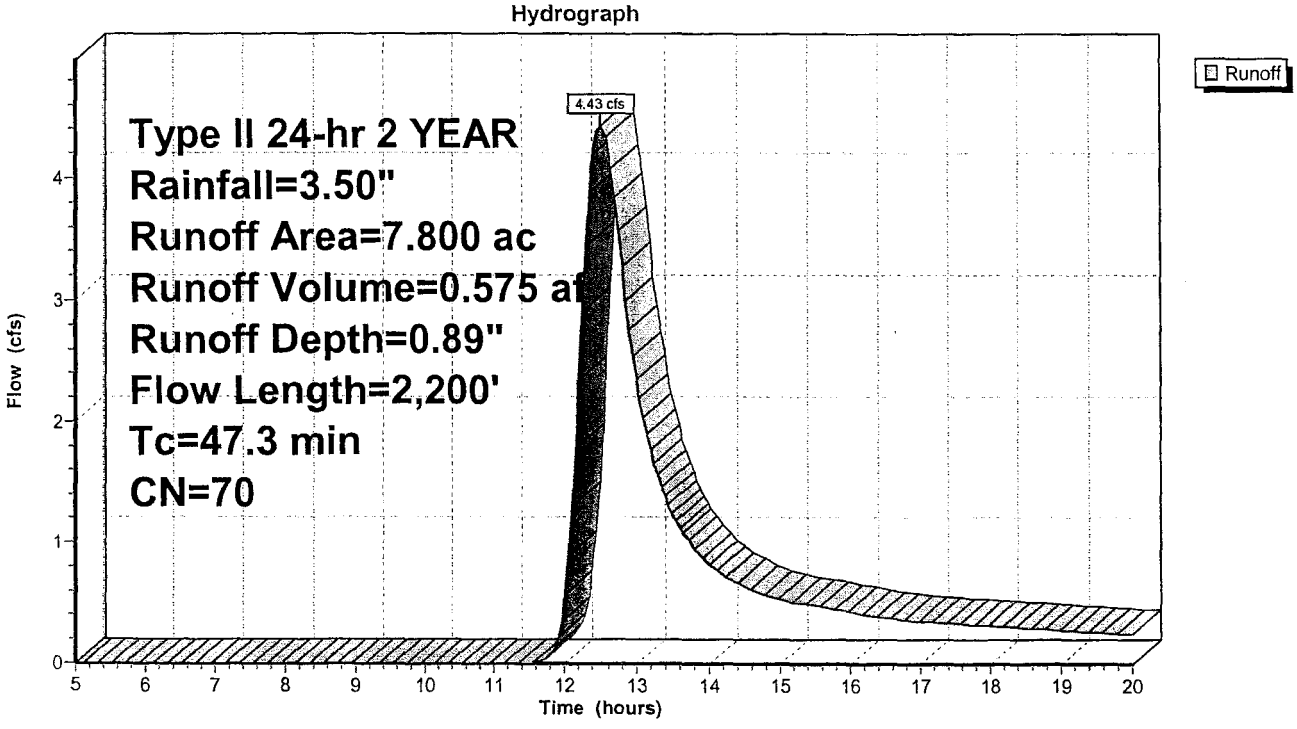
Runoff = 4.43 cfs @ 12.51 hrs, Volume= 0.575 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
7.800	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.1	300	0.0720	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
3.9	300	0.0670	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	1,600	0.0210	2.6	60.38	**Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040
47.3	2,200	Total			

Subcatchment S-3: S-3



Subcatchment S-4: S-4

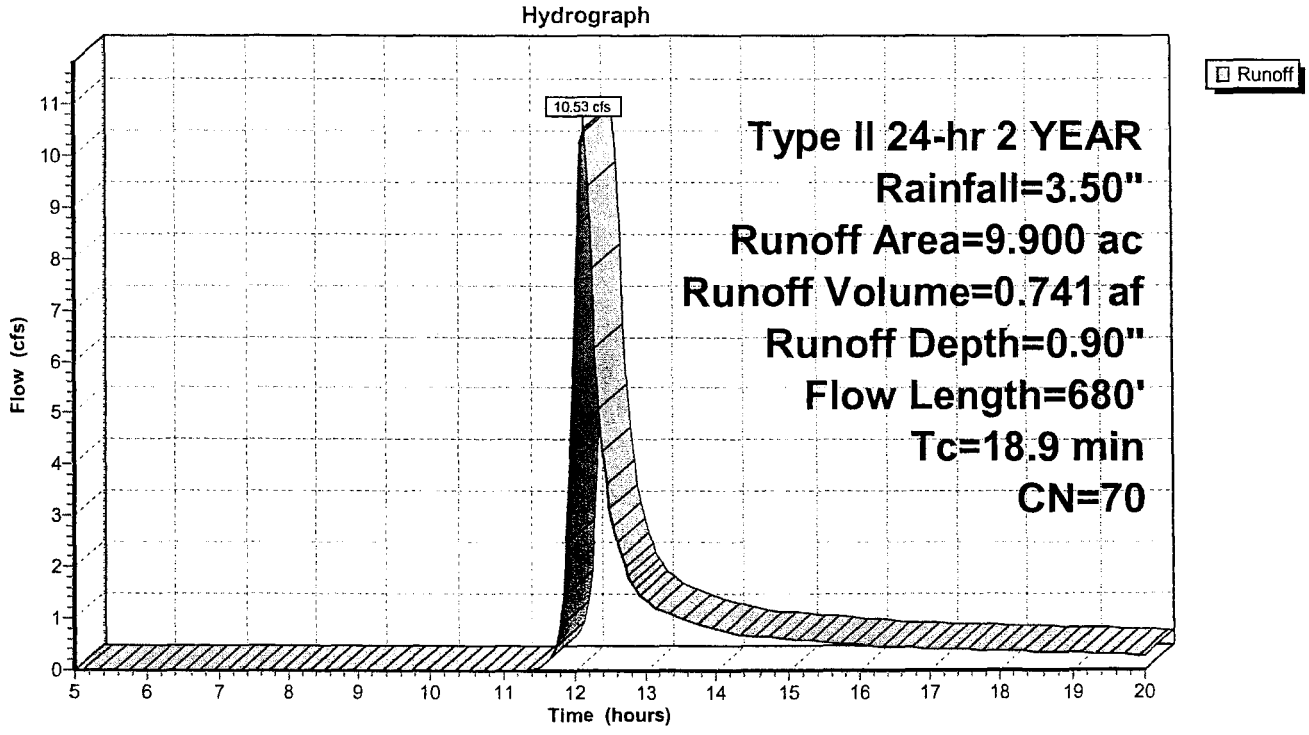
Runoff = 10.53 cfs @ 12.13 hrs, Volume= 0.741 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
9.900	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	130	0.1080	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.4	200	0.2250	2.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	350	0.0110	1.9	37.46	**Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040
18.9	680	Total			

Subcatchment S-4: S-4



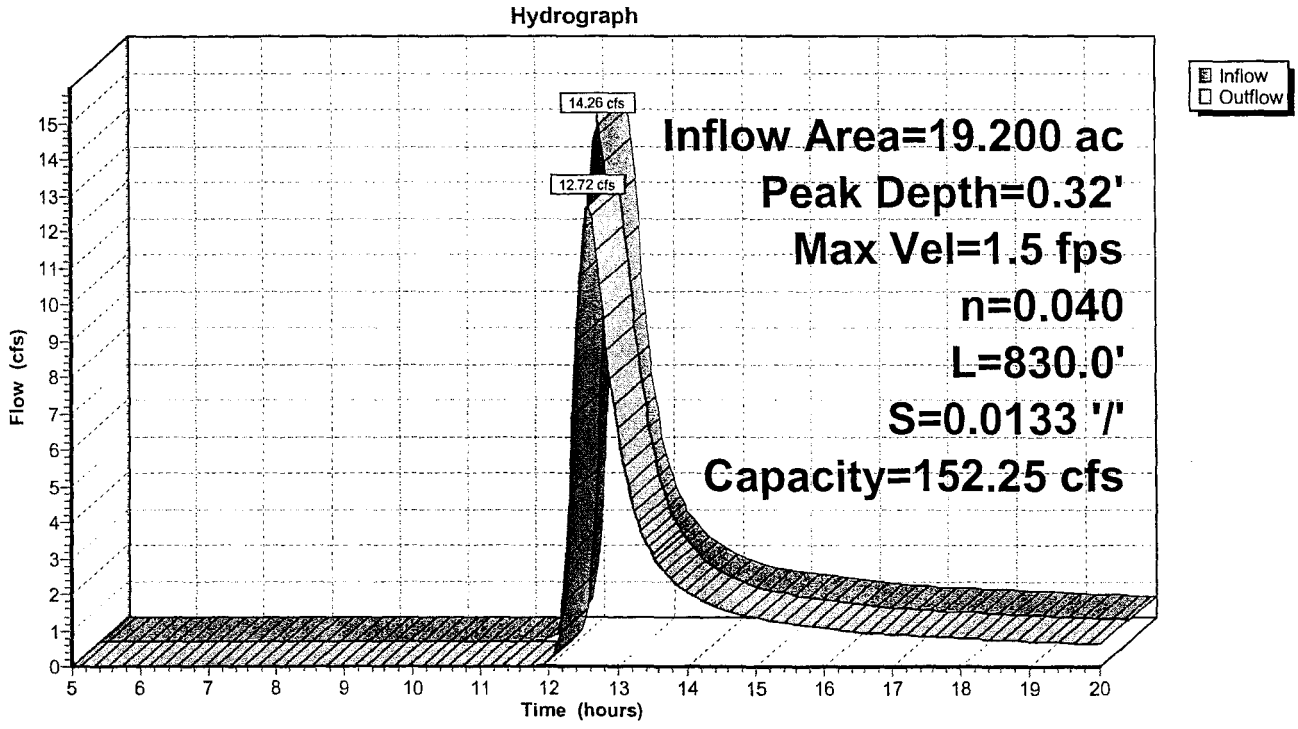
Reach R1: PRE-DEVELOPED

Inflow Area = 19.200 ac, Inflow Depth = 0.89" for 2 YEAR event
Inflow = 14.26 cfs @ 12.31 hrs, Volume= 1.428 af
Outflow = 12.72 cfs @ 12.58 hrs, Volume= 1.401 af, Atten= 11%, Lag= 16.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.5 fps, Min. Travel Time= 9.1 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 18.5 min

Peak Depth= 0.32' @ 12.42 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

Reach R1: PRE-DEVELOPED



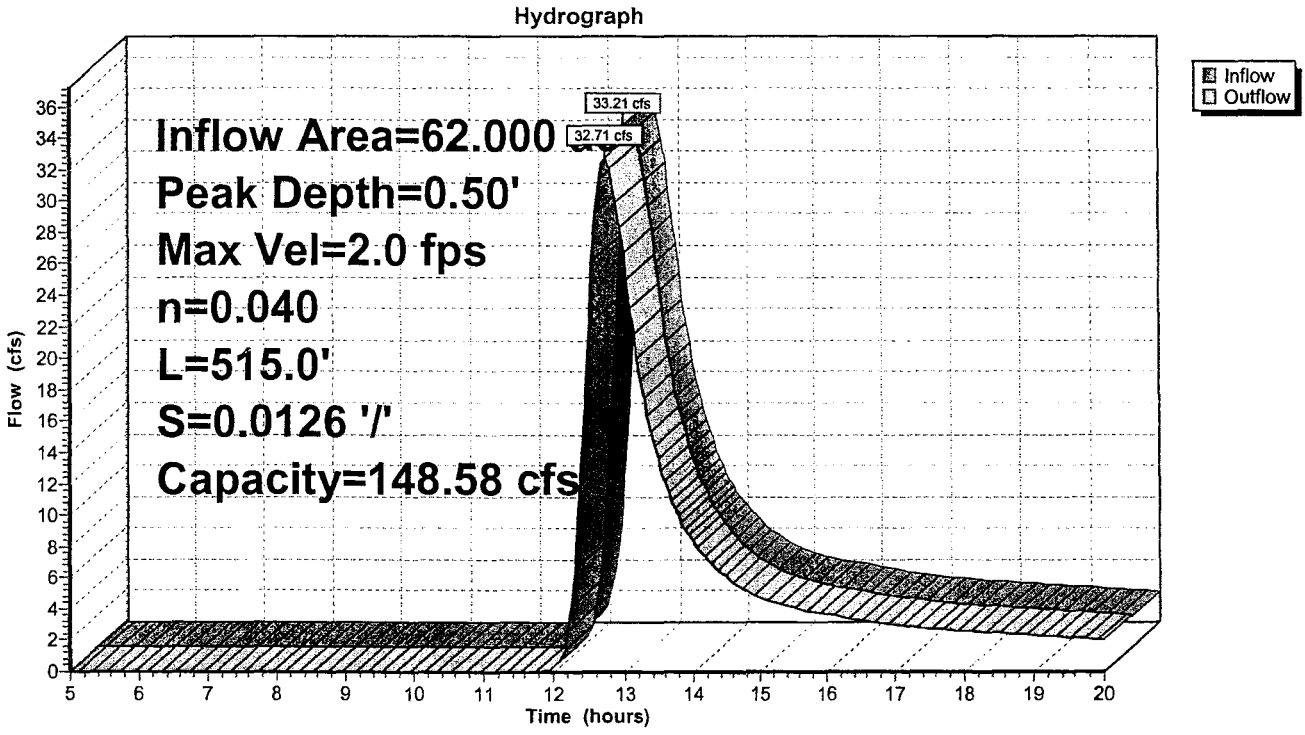
Reach R2: PRE-DEVELOPED

Inflow Area = 62.000 ac, Inflow Depth = 0.88" for 2 YEAR event
Inflow = 33.21 cfs @ 12.61 hrs, Volume= 4.538 af
Outflow = 32.71 cfs @ 12.74 hrs, Volume= 4.498 af, Atten= 2%, Lag= 7.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 8.1 min

Peak Depth= 0.50' @ 12.67 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

Reach R2: PRE-DEVELOPED



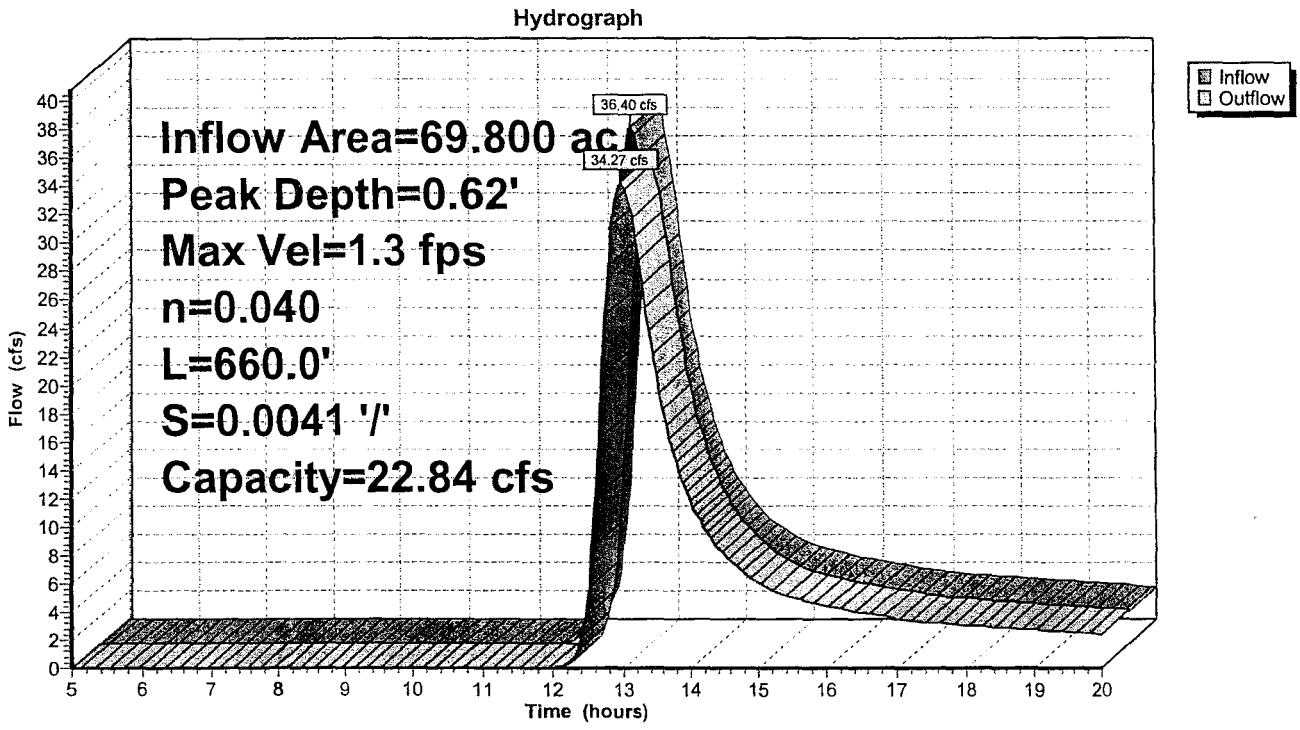
Reach R3: PRE DEVELOPMED

Inflow Area = 69.800 ac, Inflow Depth = 0.87" for 2 YEAR event
Inflow = 36.40 cfs @ 12.72 hrs, Volume= 5.074 af
Outflow = 34.27 cfs @ 12.99 hrs, Volume= 4.983 af, Atten= 6%, Lag= 16.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.3 fps, Min. Travel Time= 8.6 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 15.9 min

Peak Depth= 0.62' @ 12.85 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

Reach R3: PRE DEVELOPMED



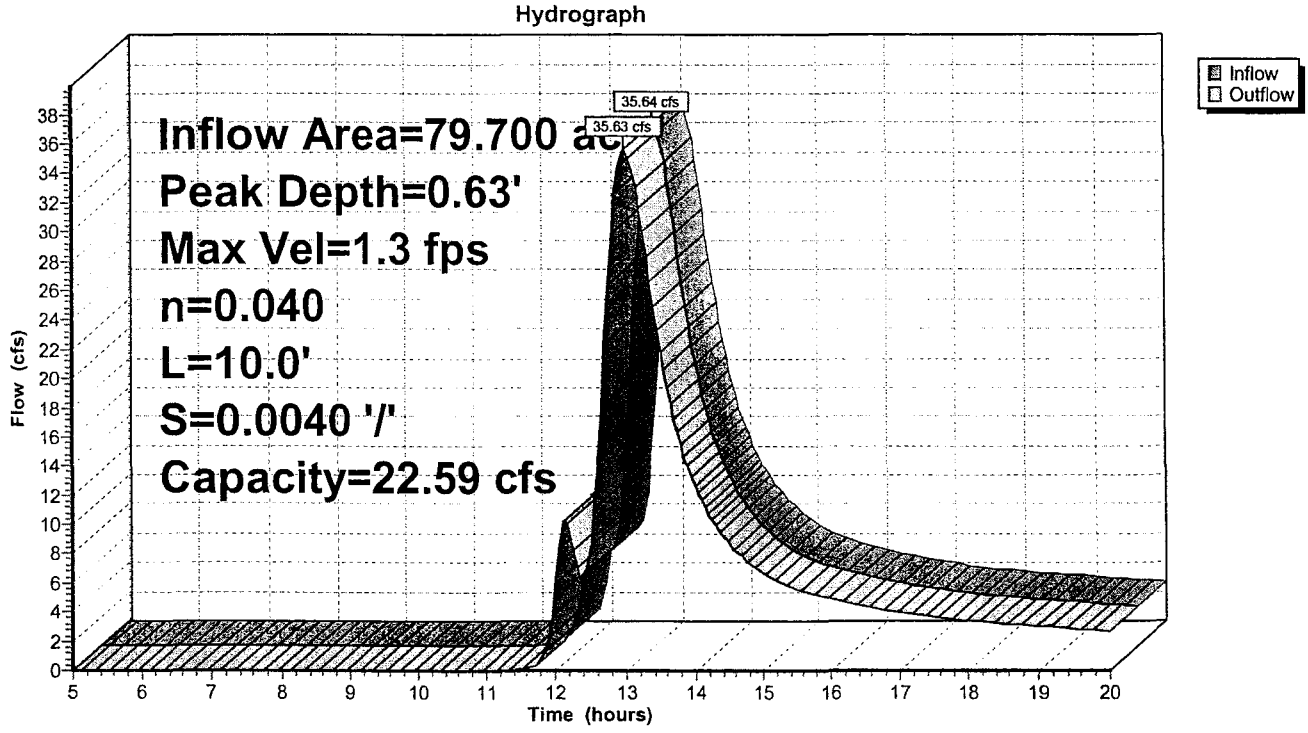
Reach R4: AT BIRD SWAMP

Inflow Area = 79.700 ac, Inflow Depth = 0.86" for 2 YEAR event
Inflow = 35.64 cfs @ 12.99 hrs, Volume= 5.724 af
Outflow = 35.63 cfs @ 12.99 hrs, Volume= 5.723 af, Atten= 0%, Lag= 0.3 min

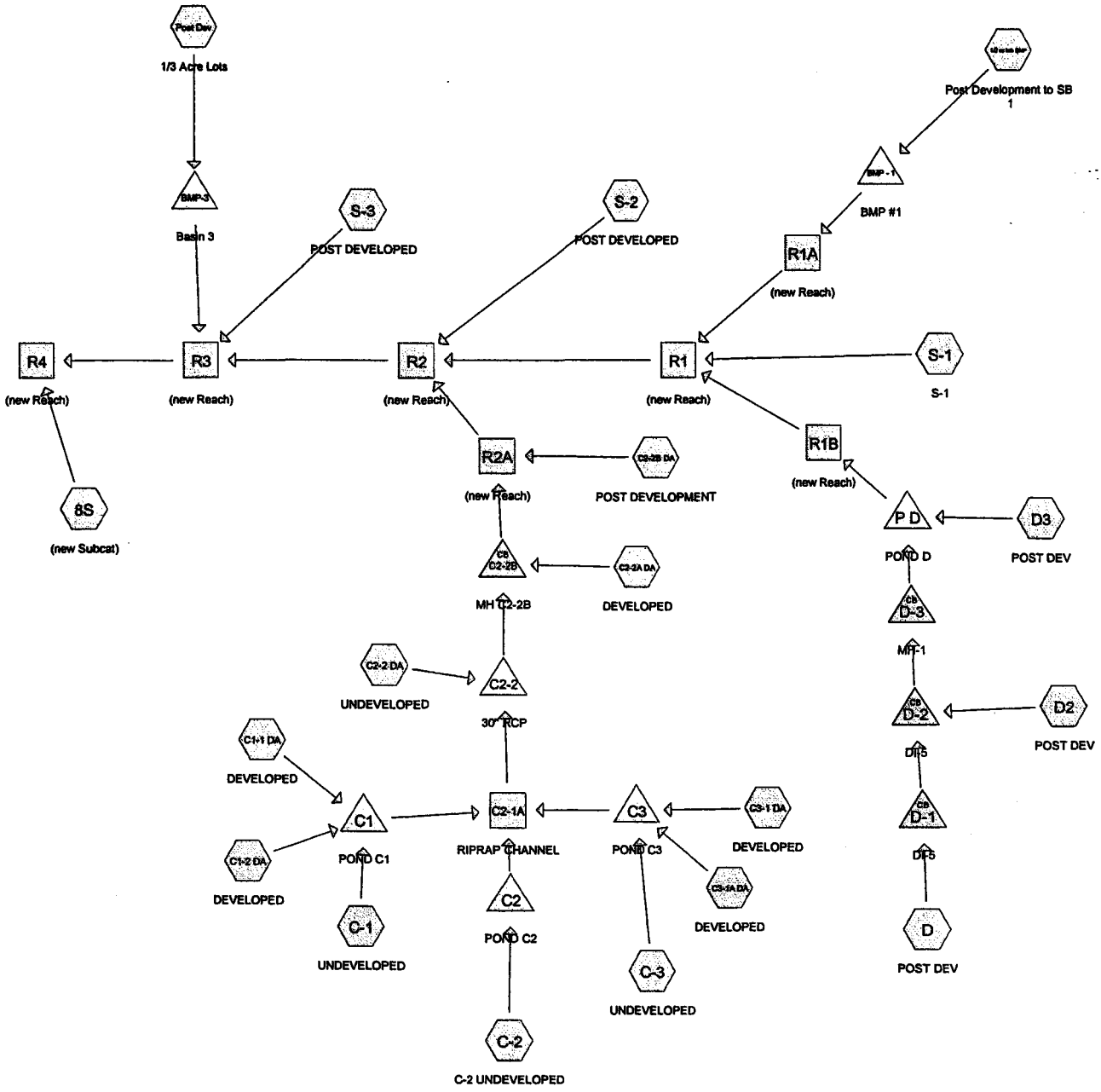
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.3 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.63' @ 12.99 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

Reach R4: AT BIRD SWAMP



CHANNEL 1
POST DEVELOPMENT



Drainage Diagram for channel 1 POST development
Prepared by LANDMARK DESIGN GROUP 11/4/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1/3 ac lots BMP: Post Development to SB 1 Runoff Area=11.050 ac Runoff Depth=1.05"
Tc=20.0 min CN=81 Runoff=13.96 cfs 0.971 af

Subcatchment 8S: (new Subcat) Runoff Area=7.700 ac Runoff Depth=0.65"
Flow Length=680' Tc=18.9 min CN=73 Runoff=5.85 cfs 0.419 af

Subcatchment C-1: UNDEVELOPED Runoff Area=1.560 ac Runoff Depth=0.53"
Tc=15.0 min CN=70 Runoff=1.05 cfs 0.069 af

Subcatchment C-2: C-2 UNDEVELOPED Runoff Area=2.000 ac Runoff Depth=0.53"
Tc=25.0 min CN=70 Runoff=0.97 cfs 0.088 af

Subcatchment C-3: UNDEVELOPED Runoff Area=4.200 ac Runoff Depth=0.53"
Flow Length=560' Tc=25.6 min CN=70 Runoff=2.00 cfs 0.185 af

Subcatchment C1-1 DA: DEVELOPED Runoff Area=0.330 ac Runoff Depth=1.85"
Tc=5.0 min CN=92 Runoff=1.12 cfs 0.051 af

Subcatchment C1-2 DA: DEVELOPED Runoff Area=0.640 ac Runoff Depth=1.84"
Tc=10.0 min CN=92 Runoff=1.86 cfs 0.098 af

Subcatchment C2-2 DA: UNDEVELOPED Runoff Area=1.000 ac Runoff Depth=1.06"
Tc=10.0 min CN=81 Runoff=1.75 cfs 0.088 af

Subcatchment C2-2A DA: DEVELOPED Runoff Area=0.480 ac Runoff Depth=1.84"
Tc=10.0 min CN=92 Runoff=1.39 cfs 0.074 af

Subcatchment C2-2B DA: POST DEVELOPMENT Runoff Area=0.350 ac Runoff Depth=0.95"
Flow Length=100' Tc=3.4 min CN=79 Runoff=0.70 cfs 0.028 af

Subcatchment C3-1 DA: DEVELOPED Runoff Area=0.760 ac Runoff Depth=1.85"
Tc=5.0 min CN=92 Runoff=2.59 cfs 0.117 af

Subcatchment C3-1A DA: DEVELOPED Runoff Area=0.510 ac Runoff Depth=1.85"
Tc=5.0 min CN=92 Runoff=1.74 cfs 0.078 af

Subcatchment D: POST DEV Runoff Area=3.670 ac Runoff Depth=0.79"
Flow Length=250' Tc=25.1 min CN=76 Runoff=2.93 cfs 0.241 af

Subcatchment D2: POST DEV Runoff Area=1.570 ac Runoff Depth=1.85"
Flow Length=620' Tc=5.0 min CN=92 Runoff=5.35 cfs 0.241 af

Subcatchment D3: POST DEV Runoff Area=2.200 ac Runoff Depth=0.53"
Tc=15.0 min CN=70 Runoff=1.48 cfs 0.098 af

Subcatchment Post Dev: 1/3 Acre Lots Runoff Area=7.600 ac Runoff Depth=1.05"
Tc=25.0 min CN=81 Runoff=8.39 cfs 0.666 af

Subcatchment S-1: S-1 Runoff Area=5.250 ac Runoff Depth=0.53"
Flow Length=785' Tc=19.2 min CN=70 Runoff=3.04 cfs 0.233 af

Subcatchment S-2: POST DEVELOPED Runoff Area=24.200 ac Runoff Depth=0.60"
Flow Length=2,200' Tc=47.3 min CN=72 Runoff=8.96 cfs 1.214 af

Subcatchment S-3: POST DEVELOPED Runoff Area=5.800 ac Runoff Depth=0.61"
Tc=20.0 min CN=72 Runoff=3.93 cfs 0.295 af

Reach C2-1A: RIPRAP CHANNEL Peak Depth=0.11' Max Vel=1.8 fps Inflow=1.03 cfs 0.517 af
n=0.040 L=40.0' S=0.0500 '/' Capacity=177.27 cfs Outflow=1.03 cfs 0.517 af

Reach R1: (new Reach) Peak Depth=0.17' Max Vel=1.0 fps Inflow=4.14 cfs 1.272 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=3.12 cfs 1.206 af

Reach R1A: (new Reach) Peak Depth=0.16' Max Vel=2.7 fps Inflow=1.06 cfs 0.684 af
n=0.040 L=180.0' S=0.0778 '/' Capacity=1,634.29 cfs Outflow=1.06 cfs 0.681 af

Reach R1B: (new Reach) Peak Depth=0.36' Max Vel=1.4 fps Inflow=0.55 cfs 0.372 af
n=0.040 L=831.0' S=0.0142 '/' Capacity=325.67 cfs Outflow=0.55 cfs 0.358 af

Reach R2: (new Reach) Peak Depth=0.33' Max Vel=1.5 fps Inflow=13.57 cfs 3.115 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=13.28 cfs 3.061 af

Reach R2A: (new Reach) Peak Depth=0.31' Max Vel=2.0 fps Inflow=4.04 cfs 0.705 af
n=0.040 L=510.0' S=0.0176 '/' Capacity=125.75 cfs Outflow=3.65 cfs 0.695 af

Reach R3: (new Reach) Peak Depth=0.41' Max Vel=1.0 fps Inflow=15.34 cfs 4.021 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=14.54 cfs 3.897 af

Reach R4: (new Reach) Peak Depth=0.42' Max Vel=1.0 fps Inflow=15.33 cfs 4.317 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=15.33 cfs 4.315 af

Pond BMP - 1: BMP #1 Peak Elev=78.55' Storage=23,005 cf Inflow=13.96 cfs 0.971 af
Outflow=1.06 cfs 0.684 af

Pond BMP-3: Basin 3 Peak Elev=58.25' Storage=12,831 cf Inflow=8.39 cfs 0.666 af
Outflow=1.19 cfs 0.665 af

Pond C1: POND C1 Peak Elev=74.05' Storage=4,449 cf Inflow=3.52 cfs 0.218 af
Outflow=0.40 cfs 0.205 af

Pond C2: POND C2 Peak Elev=72.62' Storage=1,136 cf Inflow=0.97 cfs 0.088 af
Outflow=0.28 cfs 0.086 af

Subcatchment 8S: (new Subcat)

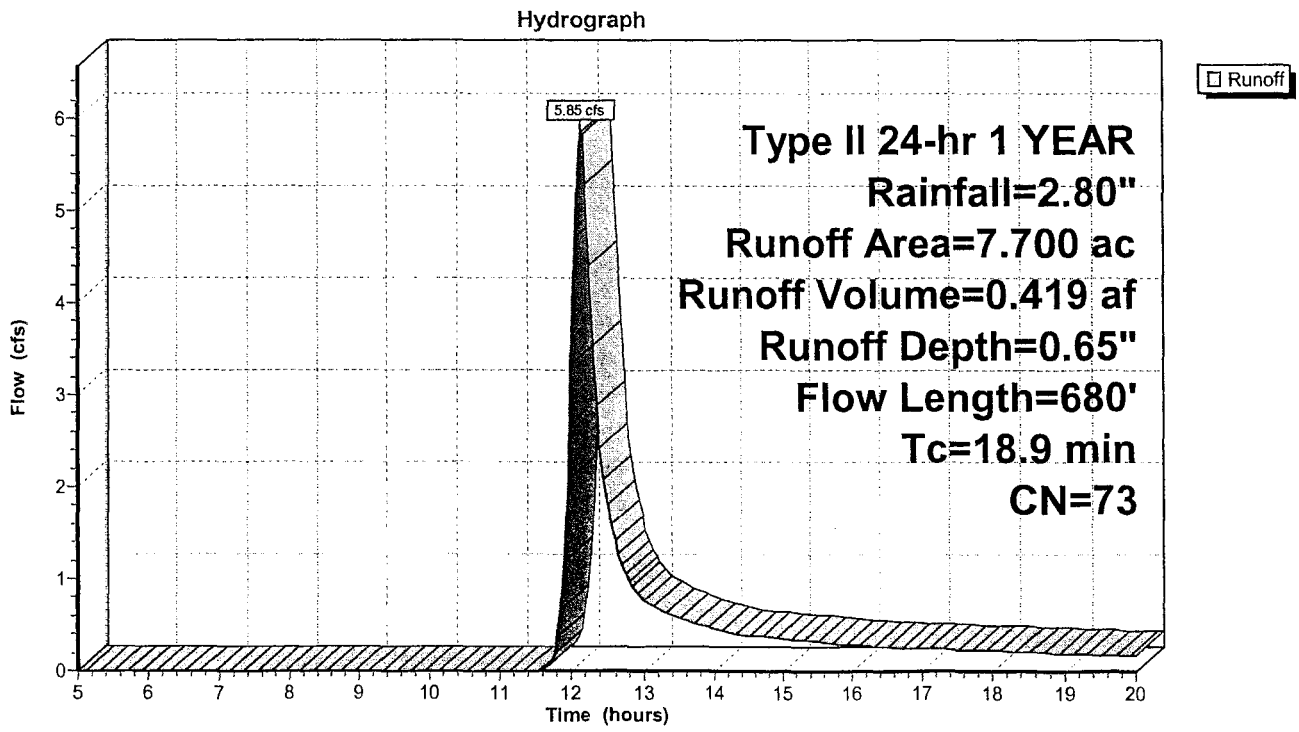
Runoff = 5.85 cfs @ 12.14 hrs, Volume= 0.419 af, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
5.400	70	Woods, Good, HSG C
2.300	81	1/3 acre lots, 30% imp, HSG C
7.700	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	130	0.1080	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.4	200	0.2250	2.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	350	0.0110	1.9	37.46	**Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040
18.9	680	Total			

Subcatchment 8S: (new Subcat)



Subcatchment C-1: UNDEVELOPED

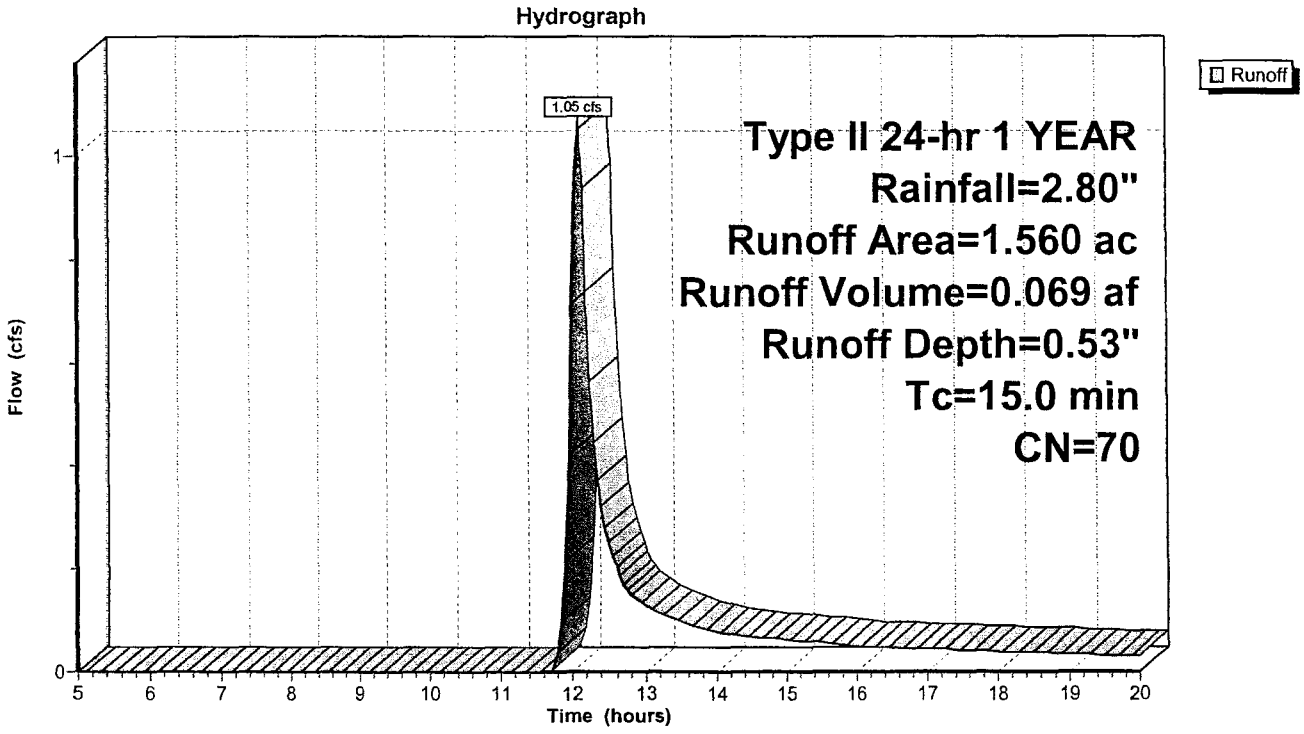
Runoff = 1.05 cfs @ 12.10 hrs, Volume= 0.069 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
1.560	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment C-1: UNDEVELOPED



Subcatchment C-2: C-2 UNDEVELOPED

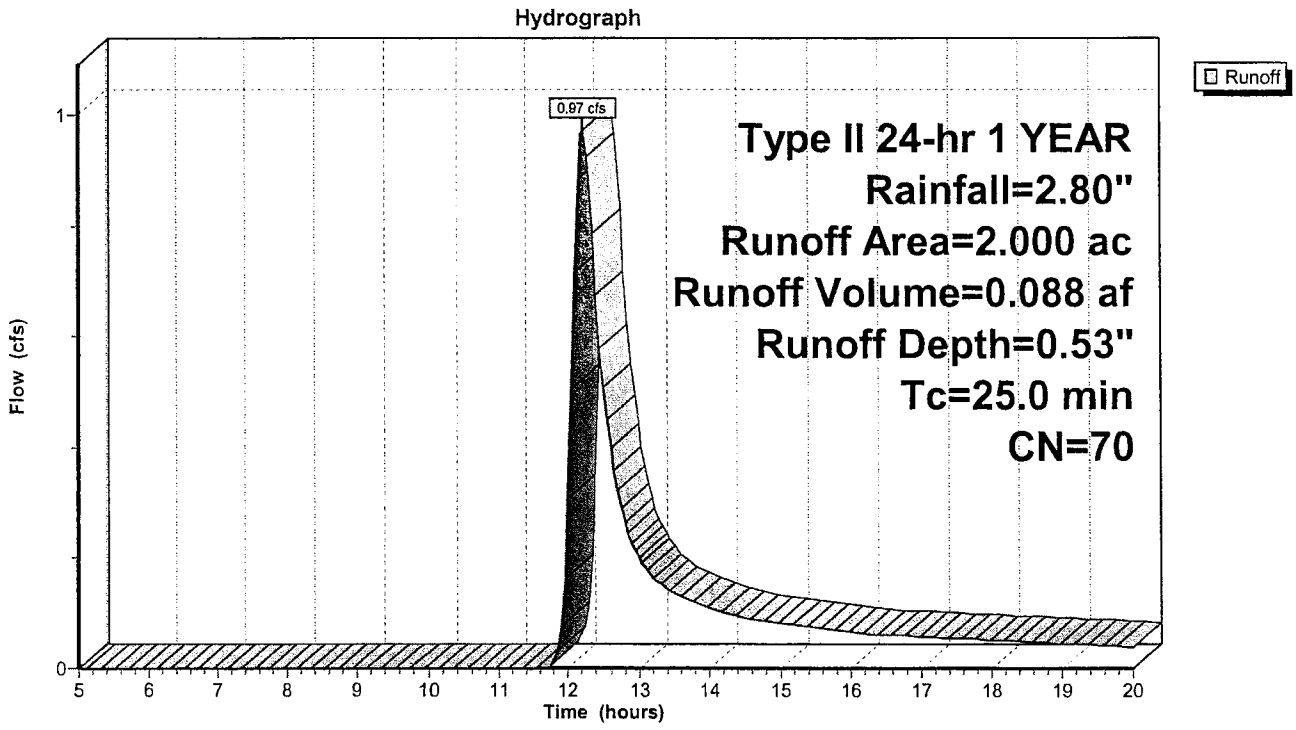
Runoff = 0.97 cfs @ 12.22 hrs, Volume= 0.088 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment C-2: C-2 UNDEVELOPED



Subcatchment C-3: UNDEVELOPED

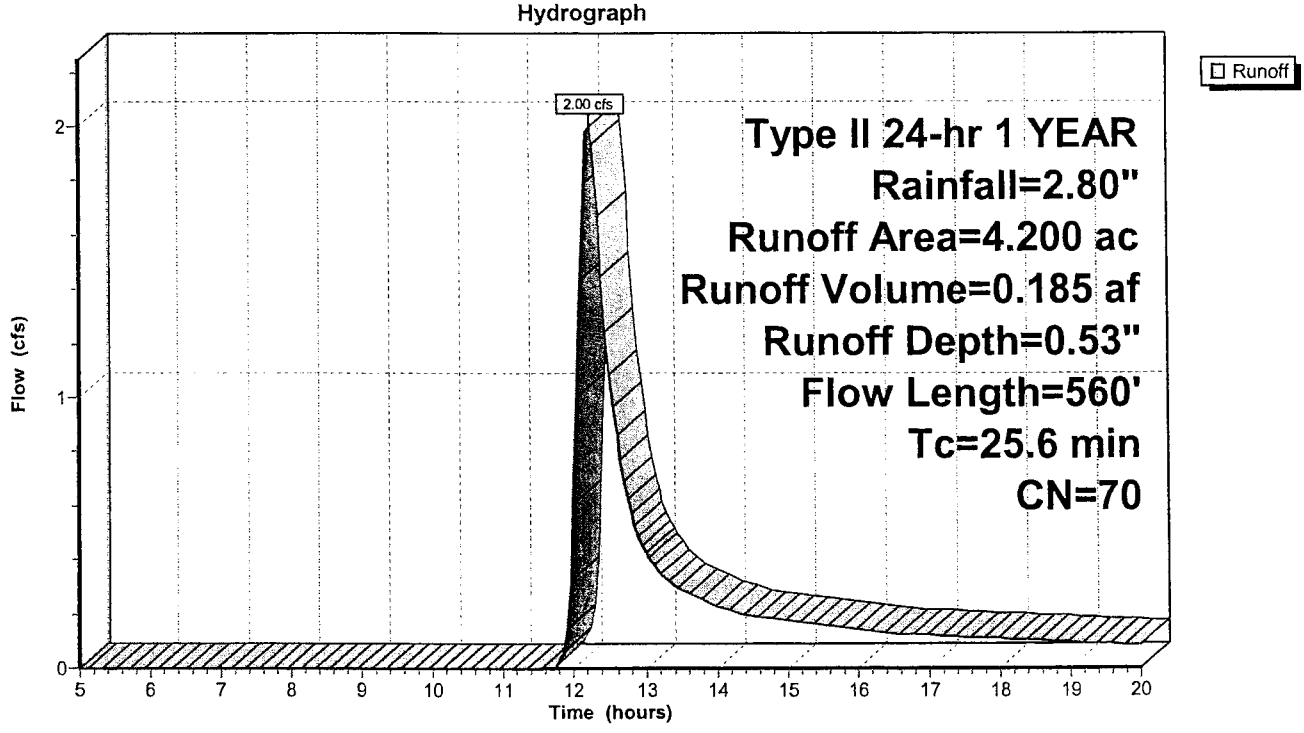
Runoff = 2.00 cfs @ 12.23 hrs, Volume= 0.185 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
4.200	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	100	0.0300	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
6.1	460	0.0630	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.6	560	Total			

Subcatchment C-3: UNDEVELOPED



Subcatchment C1-1 DA: DEVELOPED

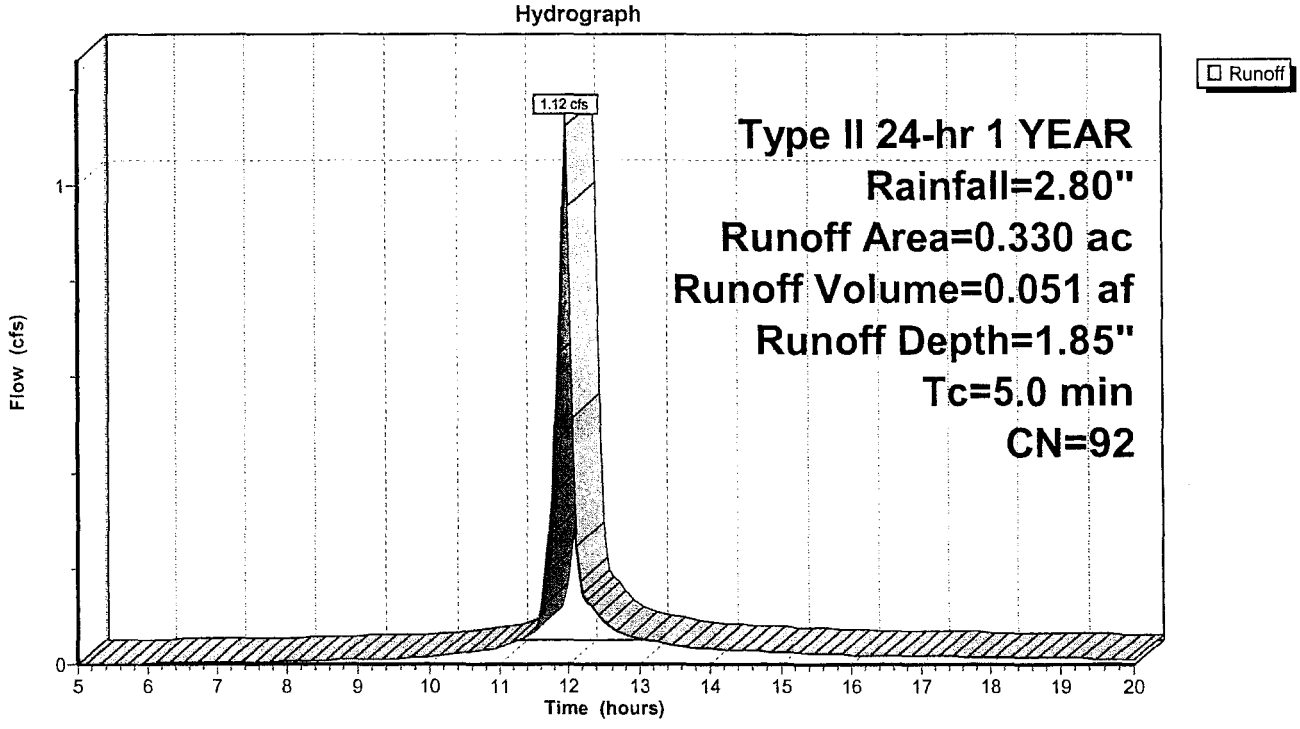
Runoff = 1.12 cfs @ 11.95 hrs, Volume= 0.051 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
0.330	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment C1-1 DA: DEVELOPED



Subcatchment C1-2 DA: DEVELOPED

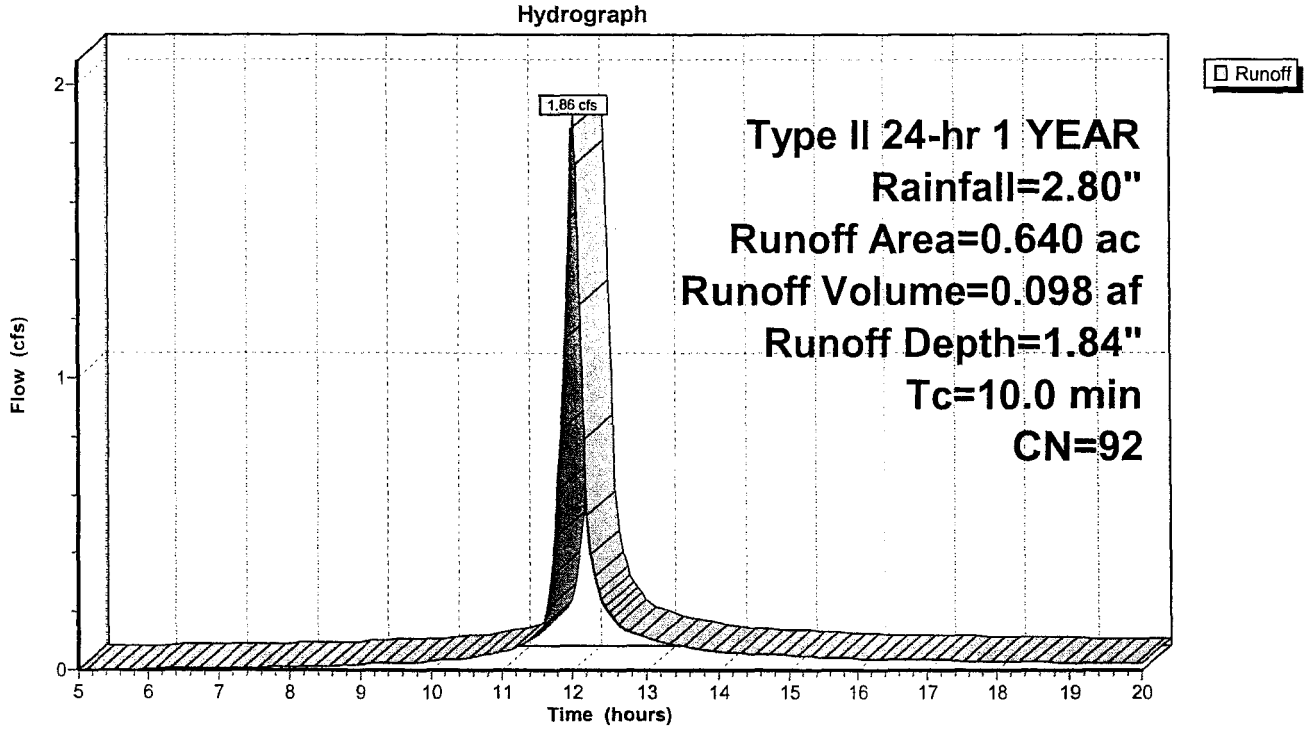
Runoff = 1.86 cfs @ 12.01 hrs, Volume= 0.098 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
0.640	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment C1-2 DA: DEVELOPED



Subcatchment C2-2 DA: UNDEVELOPED

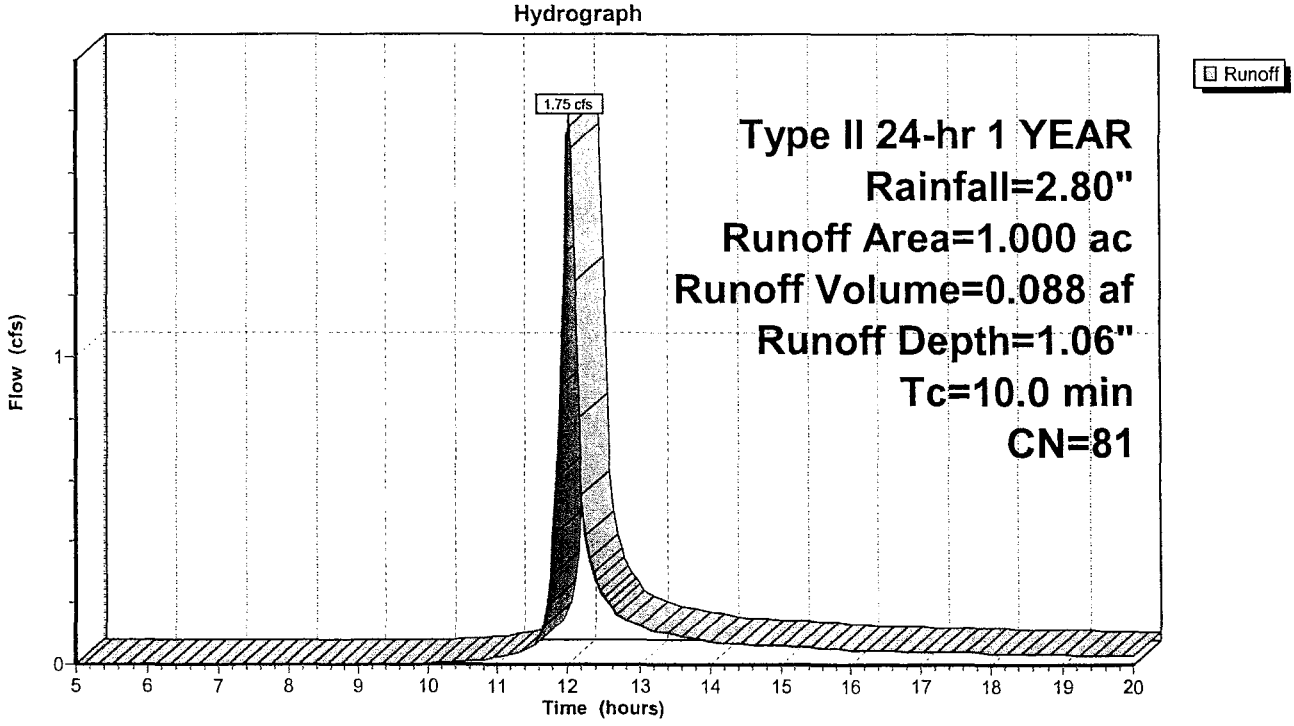
Runoff = 1.75 cfs @ 12.02 hrs, Volume= 0.088 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
0.500	70	Woods, Good, HSG C
0.500	92	Paved roads w/open ditches, HSG C
1.000	81	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment C2-2 DA: UNDEVELOPED



Subcatchment C2-2A DA: DEVELOPED

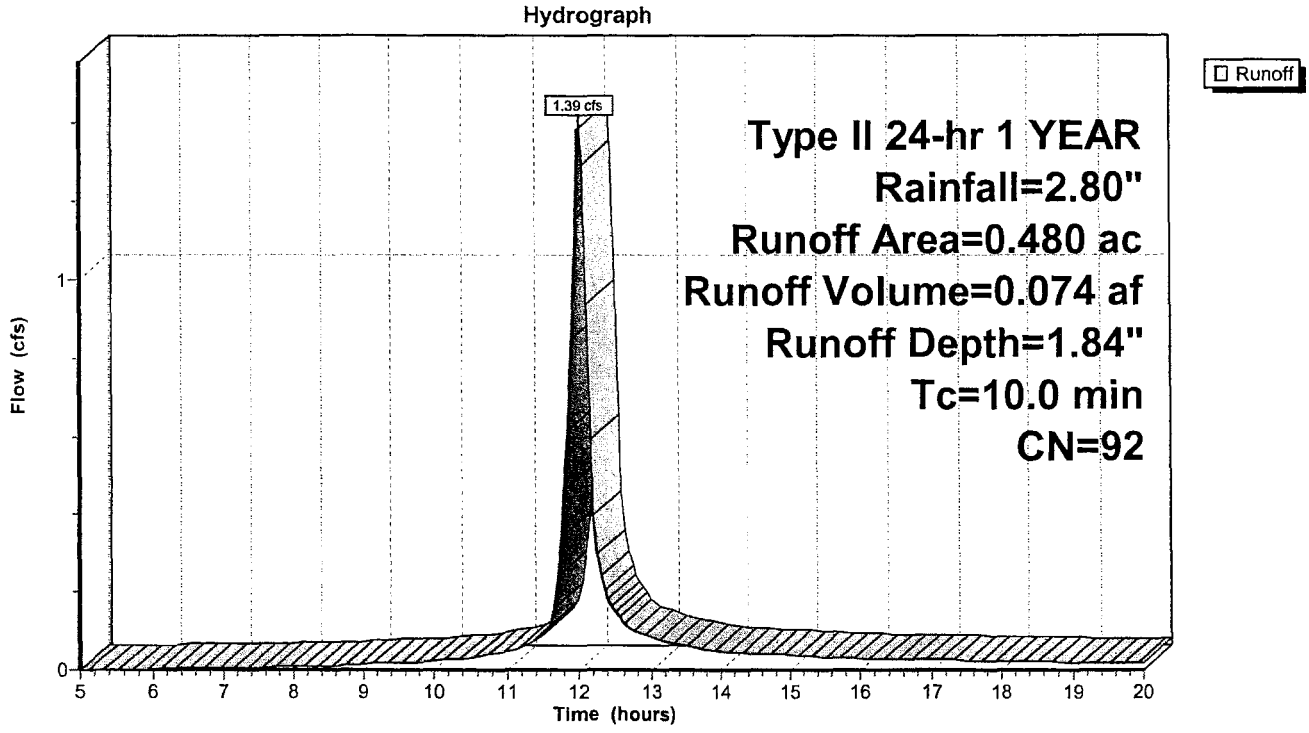
Runoff = 1.39 cfs @ 12.01 hrs, Volume= 0.074 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
0.480	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment C2-2A DA: DEVELOPED



Subcatchment C2-2B DA: POST DEVELOPMENT

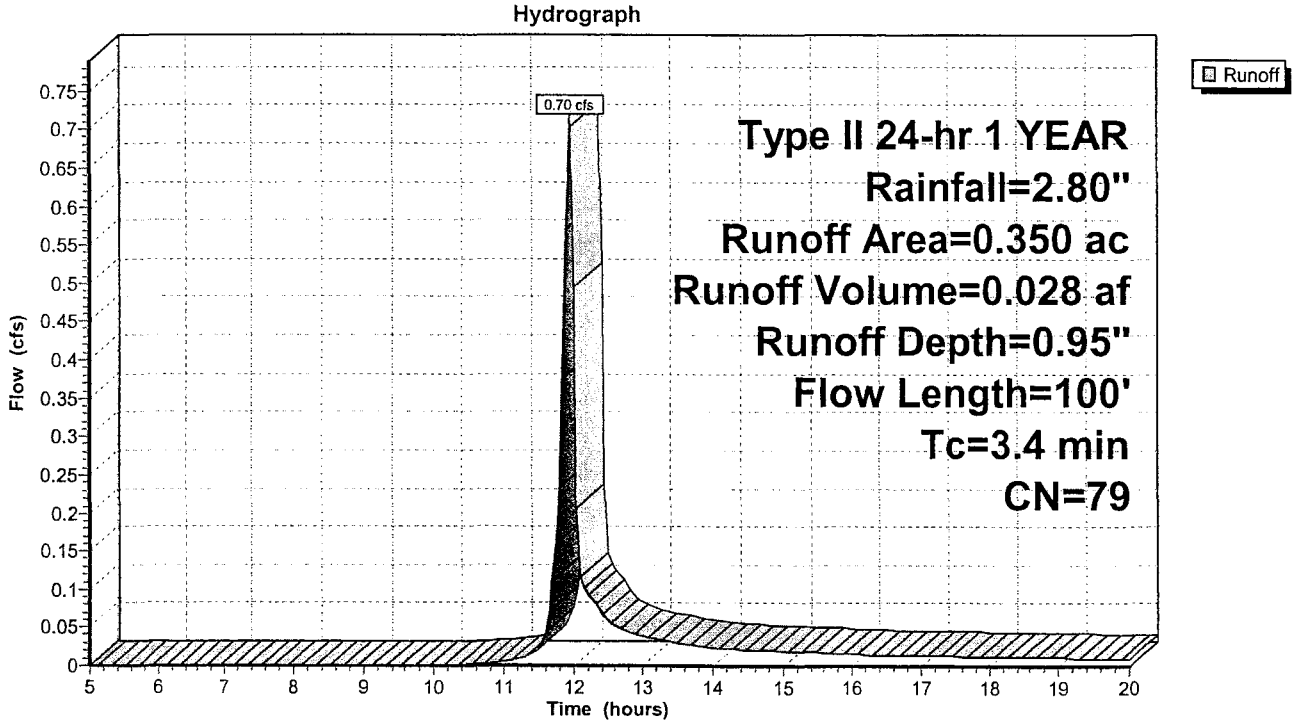
Runoff = 0.70 cfs @ 11.94 hrs, Volume= 0.028 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
0.350	79	50-75% Grass cover, Fair, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	100	0.3300	0.5		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Subcatchment C2-2B DA: POST DEVELOPMENT



Subcatchment C3-1 DA: DEVELOPED

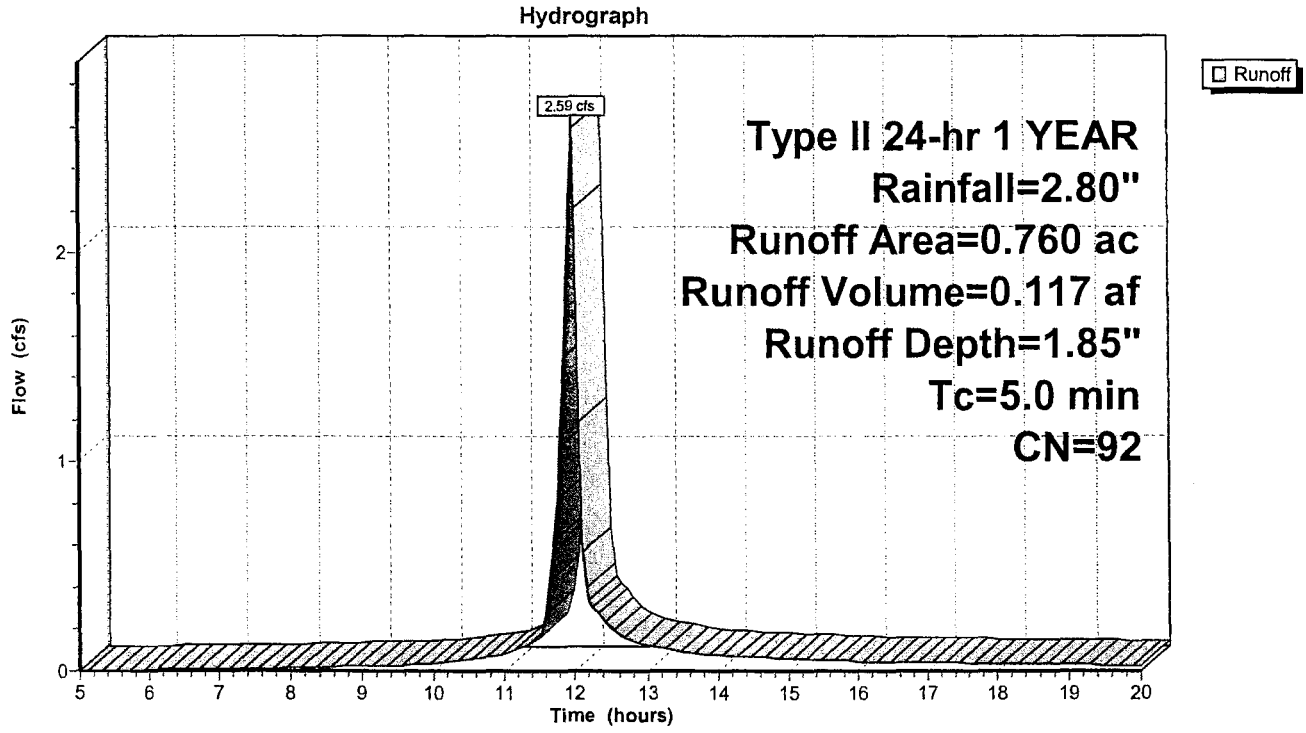
Runoff = 2.59 cfs @ 11.95 hrs, Volume= 0.117 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
0.760	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment C3-1 DA: DEVELOPED



Subcatchment C3-1A DA: DEVELOPED

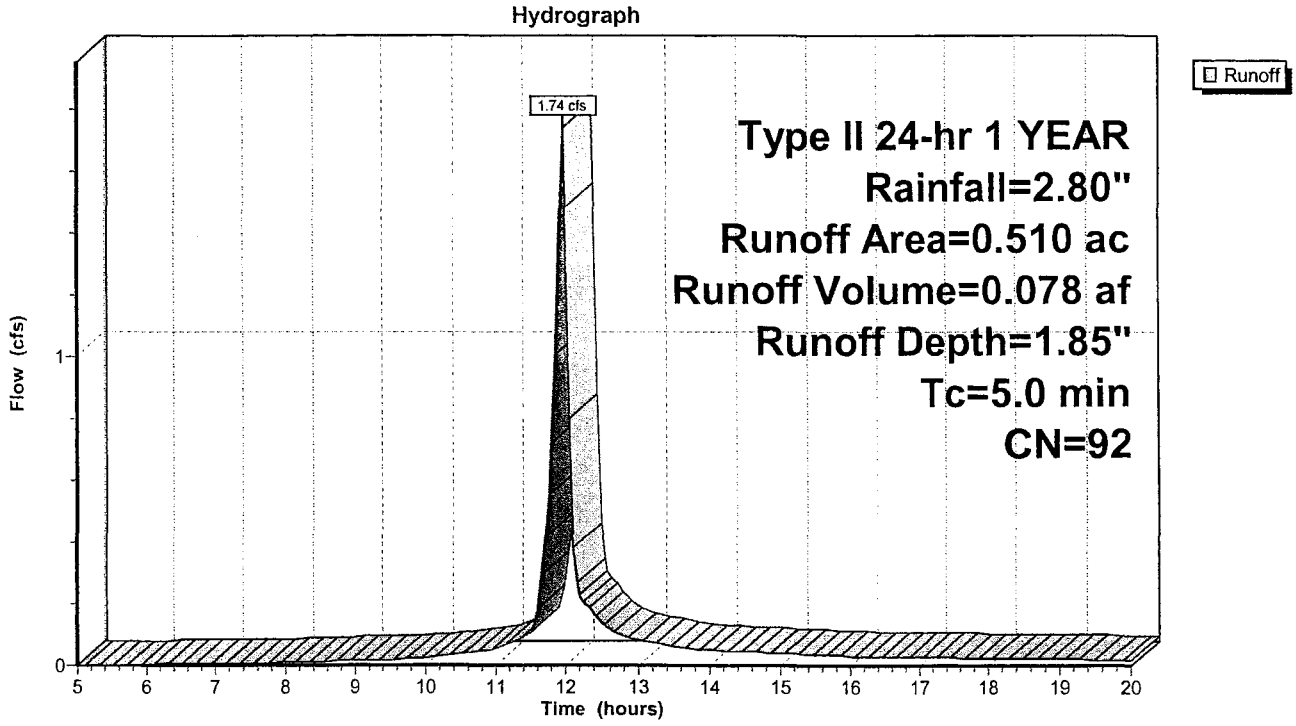
Runoff = 1.74 cfs @ 11.95 hrs, Volume= 0.078 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
0.510	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment C3-1A DA: DEVELOPED



Subcatchment D: POST DEV

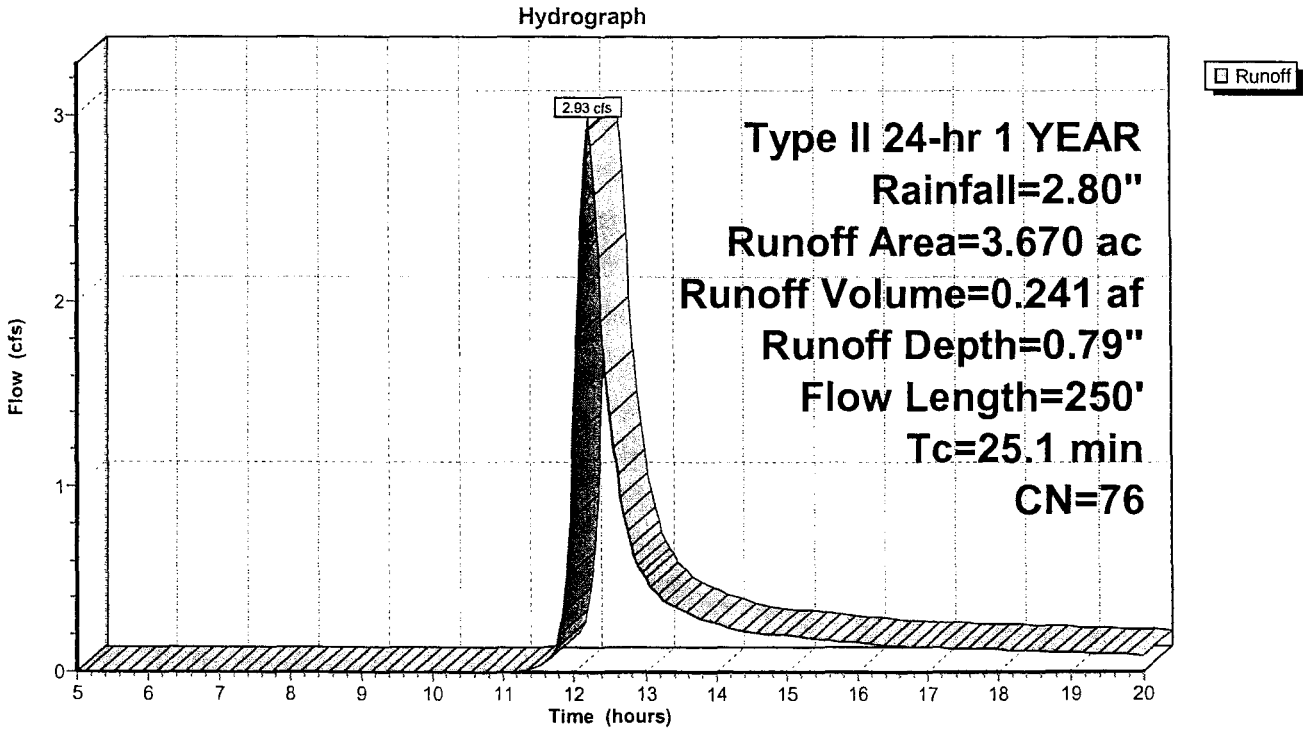
Runoff = 2.93 cfs @ 12.21 hrs, Volume= 0.241 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
2.600	70	Woods, Good, HSG C
1.070	92	Paved roads w/open ditches, HSG C
3.670	76	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	150	0.0560	1.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.0	100	0.0200	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
25.1	250	Total			

Subcatchment D: POST DEV



Subcatchment D2: POST DEV

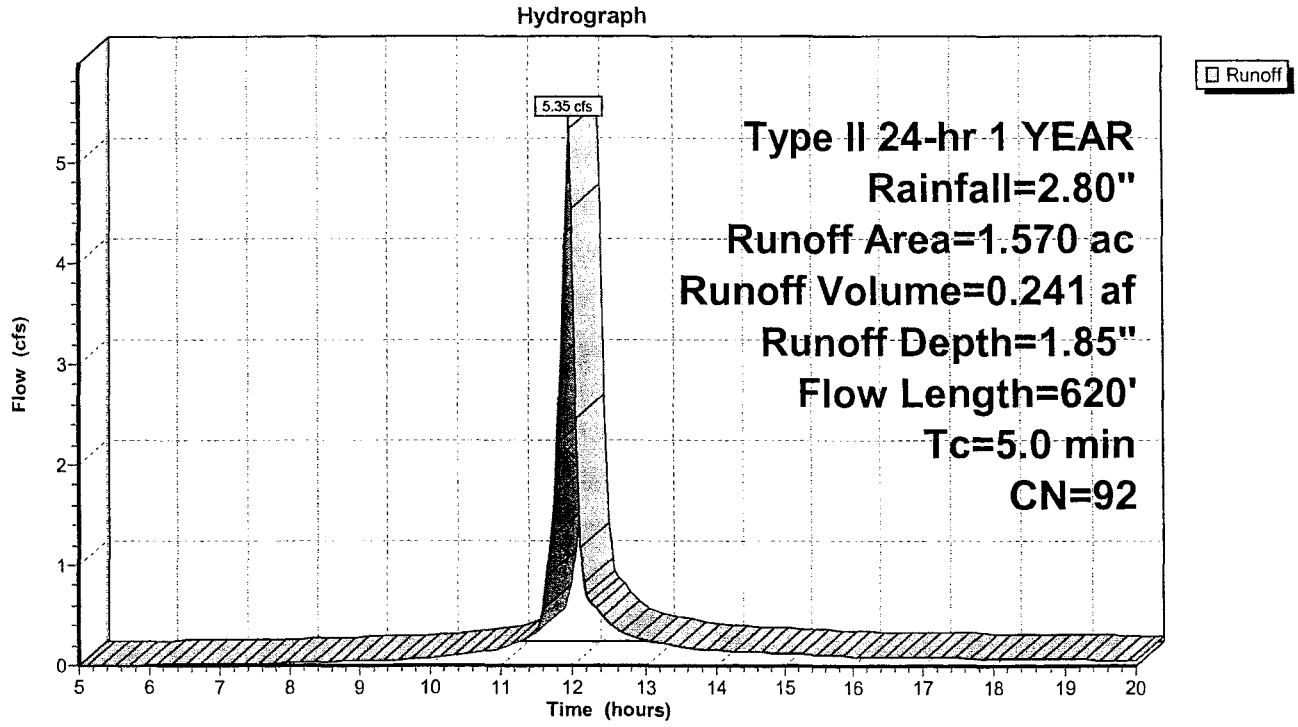
Runoff = 5.35 cfs @ 11.95 hrs, Volume= 0.241 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
1.570	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	40	0.3300	0.4		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.4	580	0.0232	2.8	14.07	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 6.0 & 4.0 '/' n= 0.050
5.0	620	Total			

Subcatchment D2: POST DEV



Subcatchment D3: POST DEV

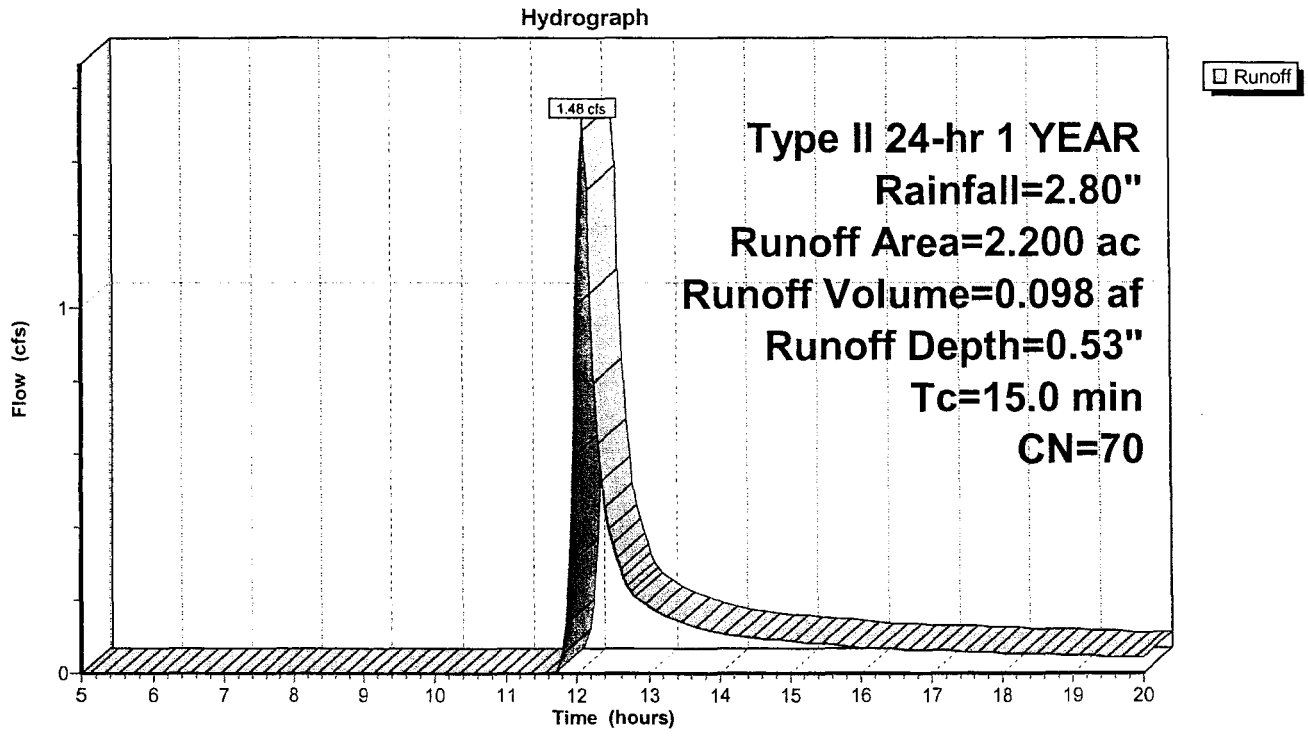
Runoff = 1.48 cfs @ 12.10 hrs, Volume= 0.098 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C
0.200	74	>75% Grass cover, Good, HSG C
2.200	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment D3: POST DEV



Subcatchment Post Dev: 1/3 Acre Lots

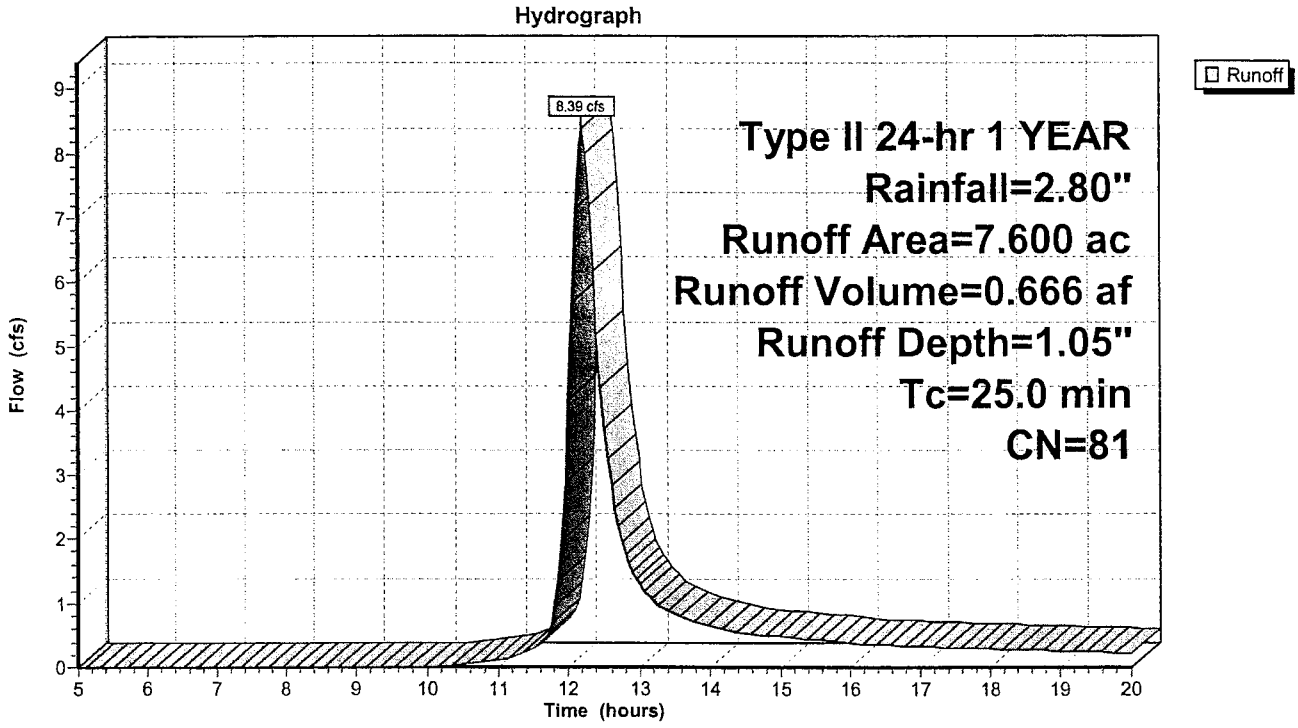
Runoff = 8.39 cfs @ 12.20 hrs, Volume= 0.666 af, Depth= 1.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
7.600	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Subcatchment S-1: S-1

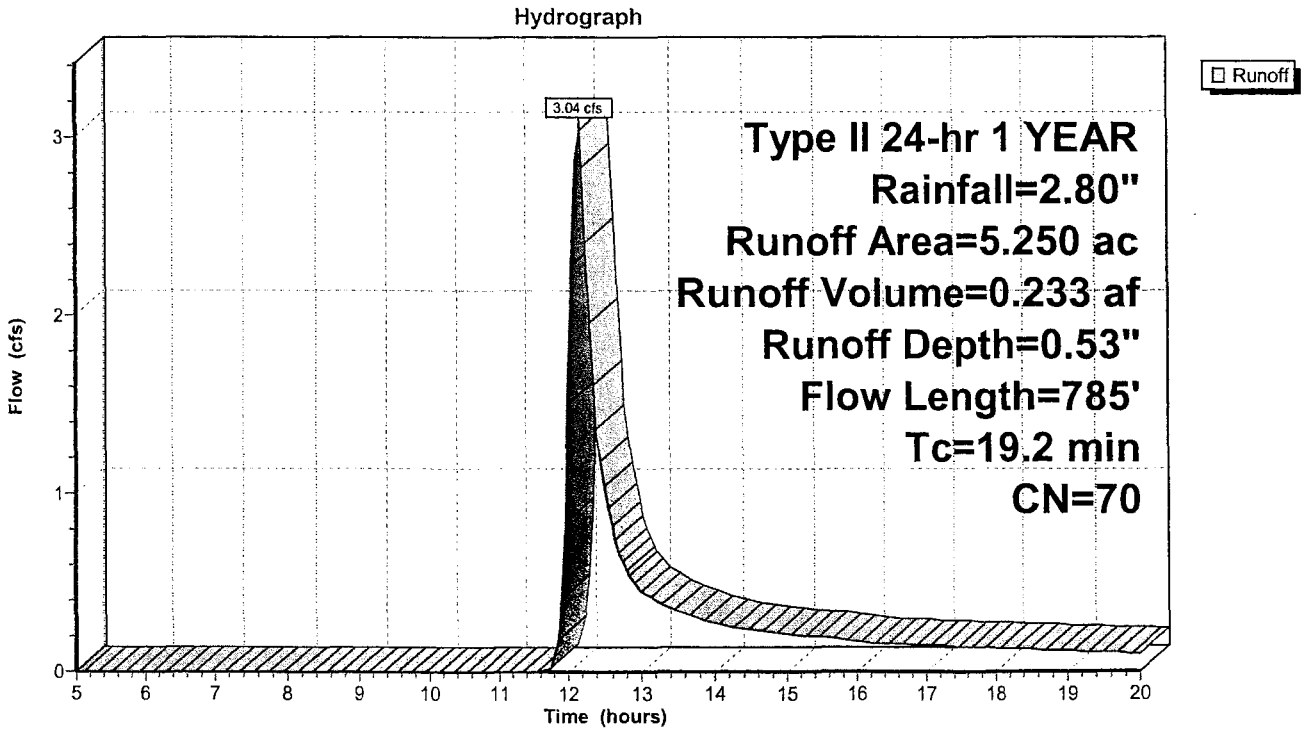
Runoff = 3.04 cfs @ 12.15 hrs, Volume= 0.233 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
5.100	70	Woods, Good, HSG C
0.150	81	1/3 acre lots, 30% imp, HSG C
5.250	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.0700	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
4.2	360	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	325	0.0800	5.0	33.64	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
19.2	785	Total			

Subcatchment S-1: S-1



Subcatchment S-2: POST DEVELOPED

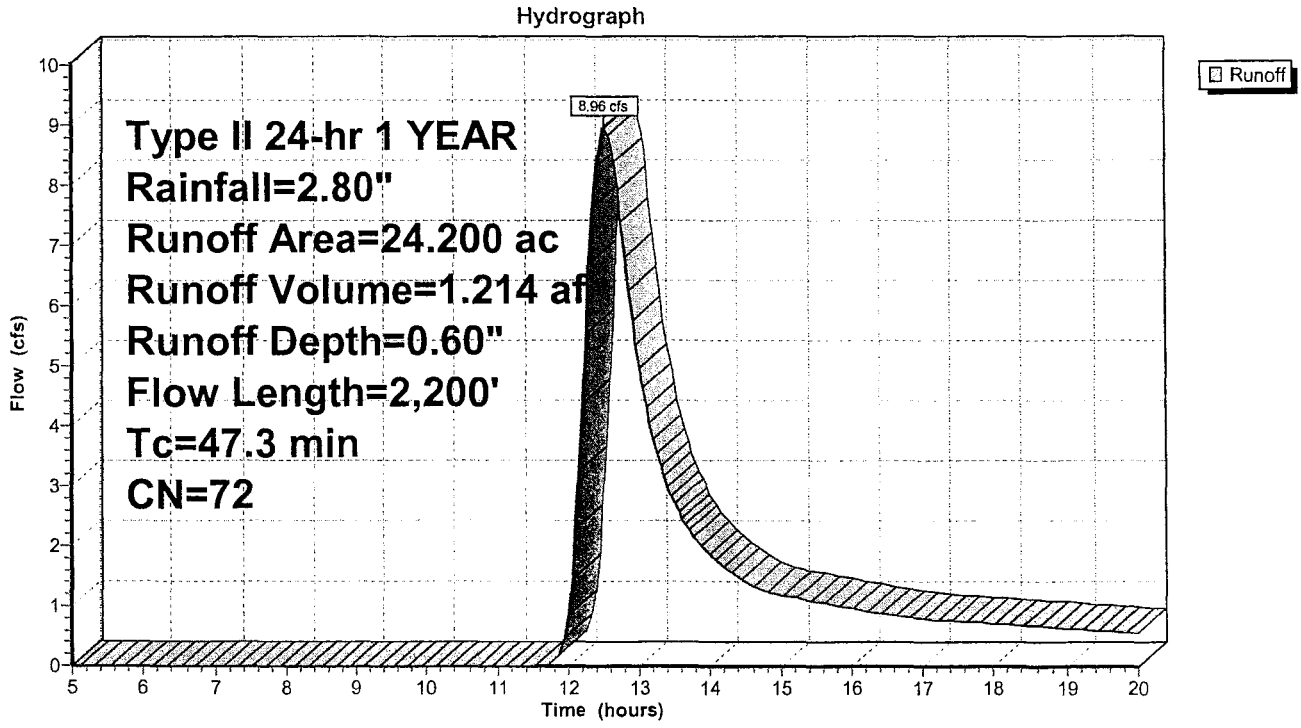
Runoff = 8.96 cfs @ 12.53 hrs, Volume= 1.214 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
20.100	70	Woods, Good, HSG C
4.100	81	1/3 acre lots, 30% imp, HSG C
24.200	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.1	300	0.0720	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
3.9	300	0.0670	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	1,600	0.0210	2.6	60.38	**Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040
47.3	2,200	Total			

Subcatchment S-2: POST DEVELOPED



Subcatchment S-3: POST DEVELOPED

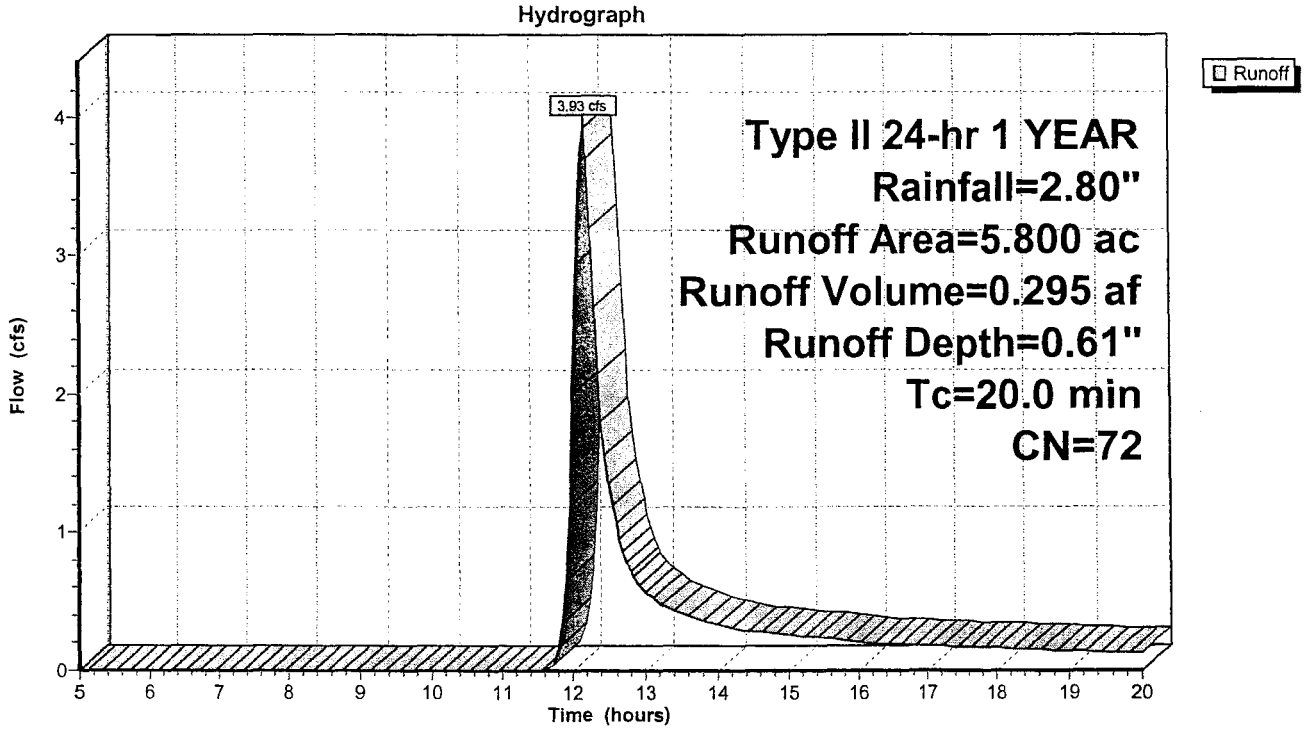
Runoff = 3.93 cfs @ 12.15 hrs, Volume= 0.295 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
4.600	70	Woods, Good, HSG C
1.200	81	1/3 acre lots, 30% imp, HSG C
5.800	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment S-3: POST DEVELOPED



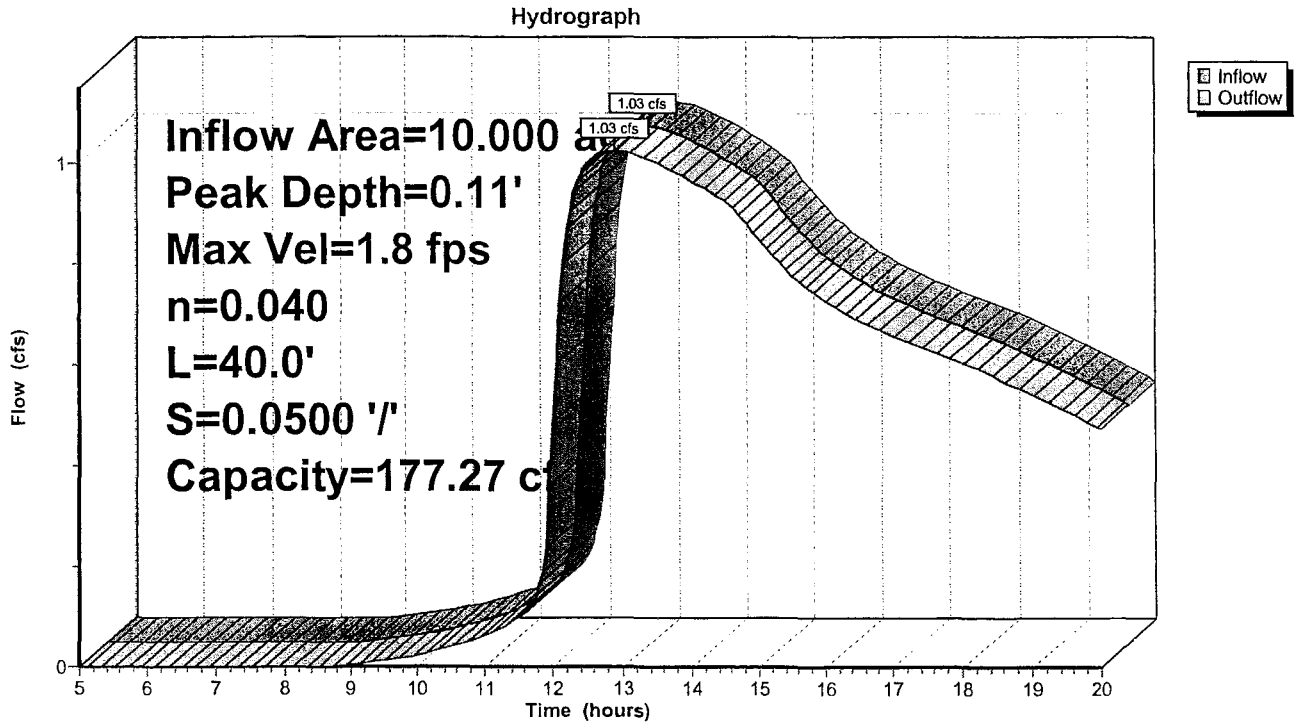
Reach C2-1A: RIPRAP CHANNEL

Inflow Area = 10.000 ac, Inflow Depth = 0.62" for 1 YEAR event
Inflow = 1.03 cfs @ 12.88 hrs, Volume= 0.517 af
Outflow = 1.03 cfs @ 12.90 hrs, Volume= 0.517 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 0.5 min

Peak Depth= 0.11' @ 12.89 hrs
Capacity at bank full= 177.27 cfs
Inlet Invert= 67.06', Outlet Invert= 65.06'
5.00' x 2.00' deep channel, n= 0.040 Length= 40.0' Slope= 0.0500 '/'
Side Slope Z-value= 2.0 '/'

Reach C2-1A: RIPRAP CHANNEL



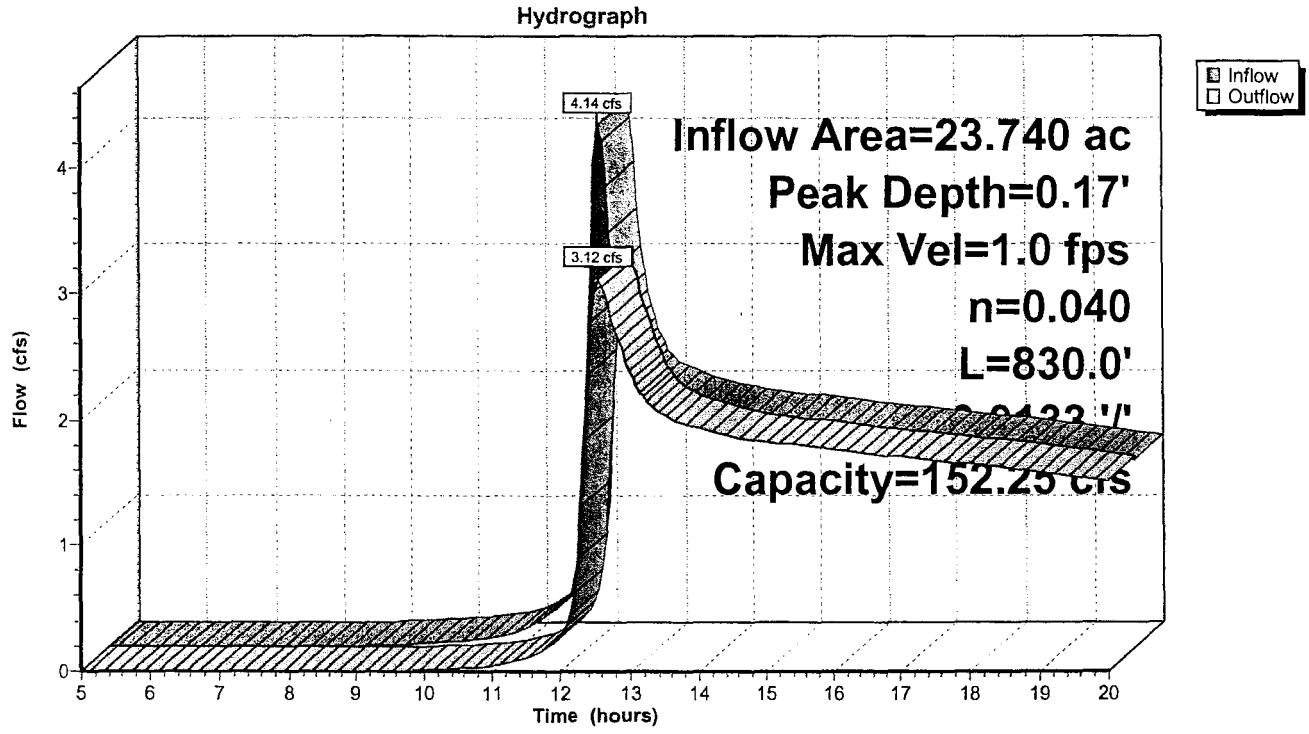
Reach R1: (new Reach)

Inflow Area = 23.740 ac, Inflow Depth = 0.64" for 1 YEAR event
Inflow = 4.14 cfs @ 12.16 hrs, Volume= 1.272 af
Outflow = 3.12 cfs @ 12.57 hrs, Volume= 1.206 af, Atten= 25%, Lag= 24.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.0 fps, Min. Travel Time= 14.0 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 21.4 min

Peak Depth= 0.17' @ 12.33 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

Reach R1: (new Reach)



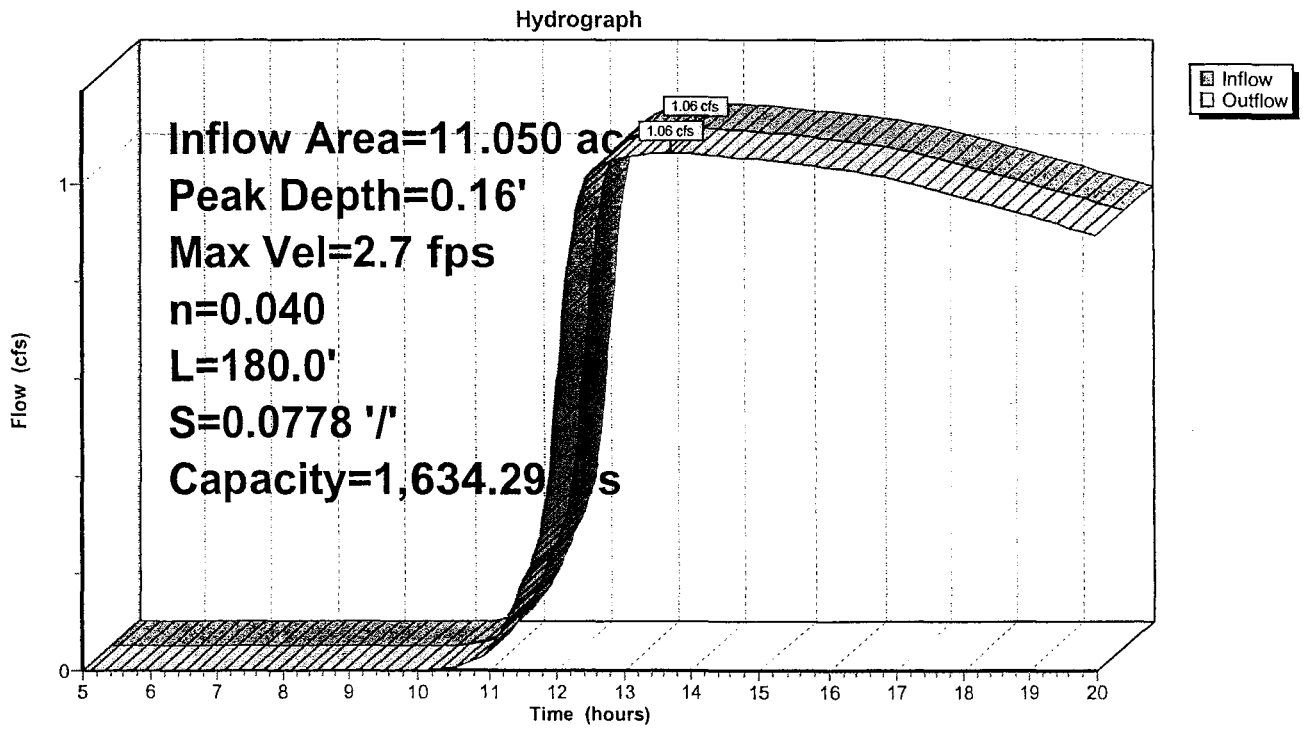
Reach R1A: (new Reach)

Inflow Area = 11.050 ac, Inflow Depth = 0.74" for 1 YEAR event
Inflow = 1.06 cfs @ 13.68 hrs, Volume= 0.684 af
Outflow = 1.06 cfs @ 13.71 hrs, Volume= 0.681 af, Atten= 0%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.4 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.16' @ 13.70 hrs
Capacity at bank full= 1,634.29 cfs
Inlet Invert= 68.00', Outlet Invert= 54.00'
2.00' x 5.00' deep channel, n= 0.040 Length= 180.0' Slope= 0.0778 '/'
Side Slope Z-value= 3.0 '/'

Reach R1A: (new Reach)



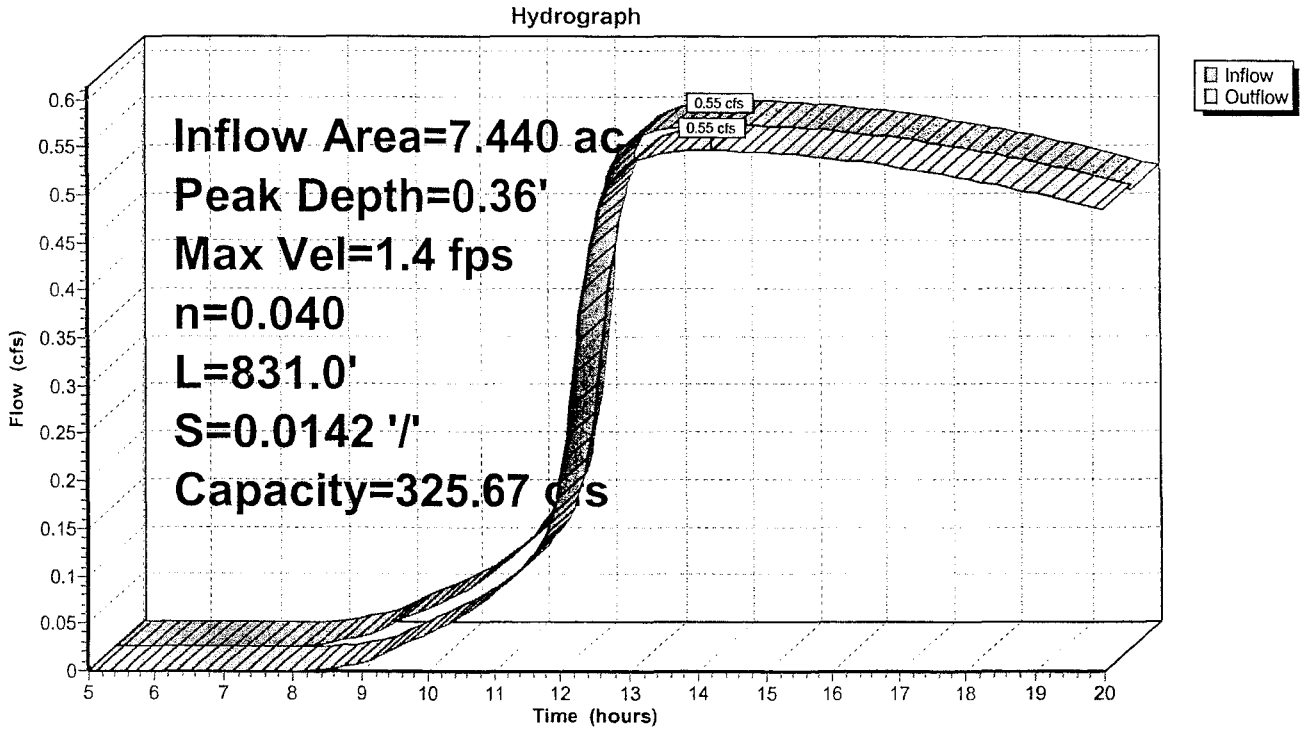
Reach R1B: (new Reach)

Inflow Area = 7.440 ac, Inflow Depth = 0.60" for 1 YEAR event
Inflow = 0.55 cfs @ 13.94 hrs, Volume= 0.372 af
Outflow = 0.55 cfs @ 14.23 hrs, Volume= 0.358 af, Atten= 0%, Lag= 17.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.4 fps, Min. Travel Time= 10.1 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 12.2 min

Peak Depth= 0.36' @ 14.07 hrs
Capacity at bank full= 325.67 cfs
Inlet Invert= 67.80', Outlet Invert= 56.00'
0.00' x 4.00' deep channel, n= 0.040 Length= 831.0' Slope= 0.0142 '/'
Side Slope Z-value= 3.0 '/'

Reach R1B: (new Reach)



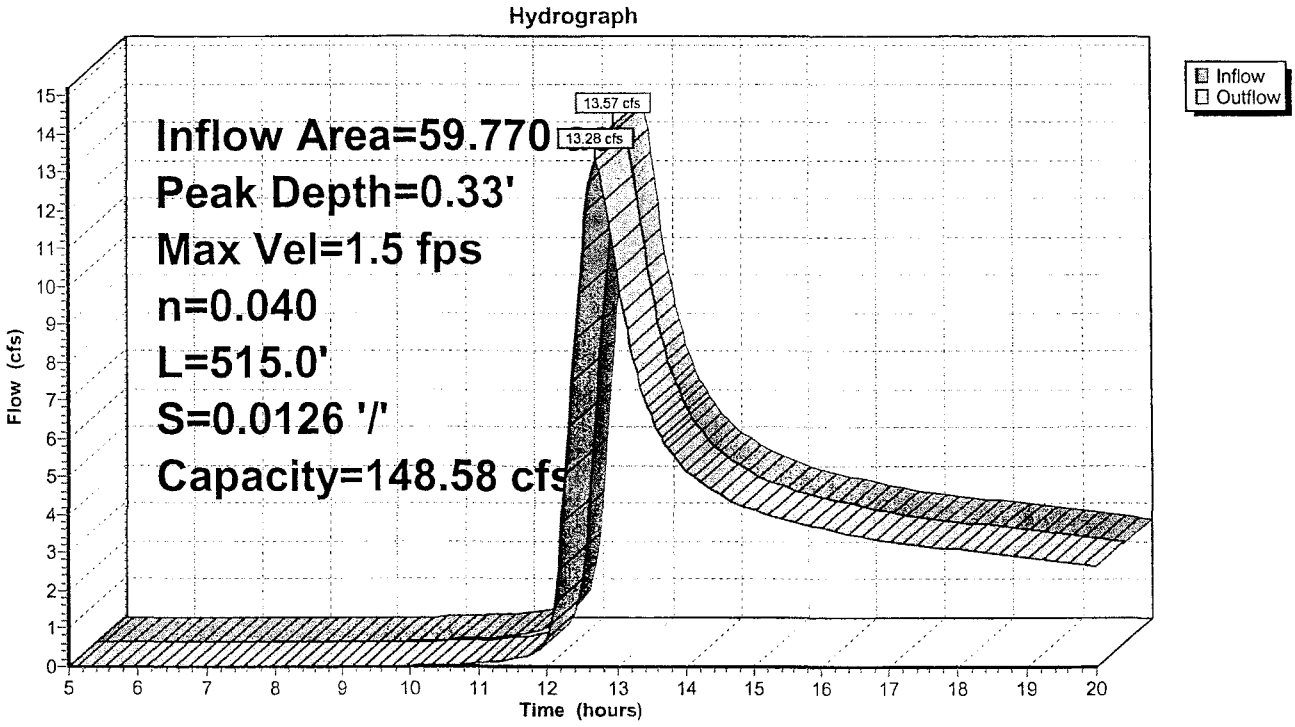
Reach R2: (new Reach)

Inflow Area = 59.770 ac, Inflow Depth = 0.63" for 1 YEAR event
Inflow = 13.57 cfs @ 12.53 hrs, Volume= 3.115 af
Outflow = 13.28 cfs @ 12.70 hrs, Volume= 3.061 af, Atten= 2%, Lag= 9.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.5 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 12.5 min

Peak Depth= 0.33' @ 12.60 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

Reach R2: (new Reach)



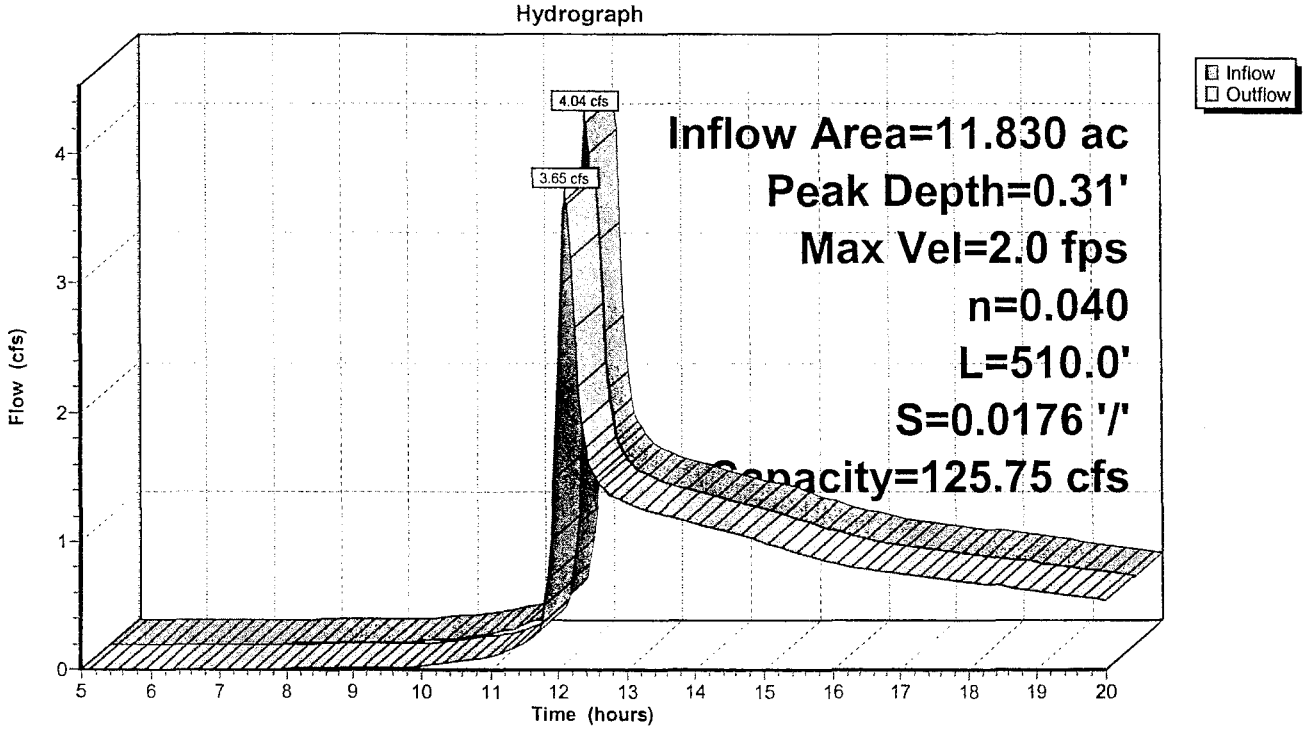
Reach R2A: (new Reach)

Inflow Area = 11.830 ac, Inflow Depth = 0.71" for 1 YEAR event
Inflow = 4.04 cfs @ 12.01 hrs, Volume= 0.705 af
Outflow = 3.65 cfs @ 12.13 hrs, Volume= 0.695 af, Atten= 10%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 9.7 min

Peak Depth= 0.31' @ 12.06 hrs
Capacity at bank full= 125.75 cfs
Inlet Invert= 52.00', Outlet Invert= 43.00'
5.00' x 2.00' deep channel, n= 0.040 Length= 510.0' Slope= 0.0176 '/'
Side Slope Z-value= 3.0 '/'

Reach R2A: (new Reach)



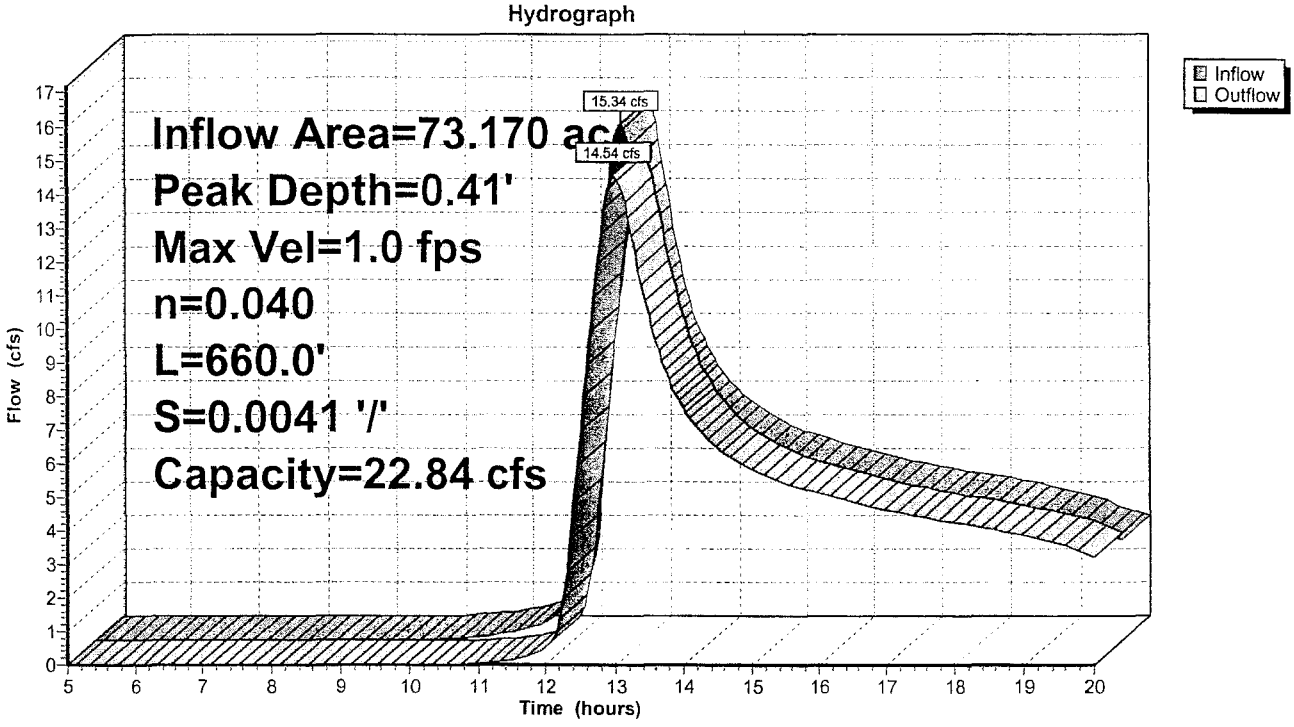
Reach R3: (new Reach)

Inflow Area = 73.170 ac, Inflow Depth = 0.66" for 1 YEAR event
Inflow = 15.34 cfs @ 12.68 hrs, Volume= 4.021 af
Outflow = 14.54 cfs @ 13.00 hrs, Volume= 3.897 af, Atten= 5%, Lag= 19.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.0 fps, Min. Travel Time= 11.1 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 23.6 min

Peak Depth= 0.41' @ 12.81 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

Reach R3: (new Reach)



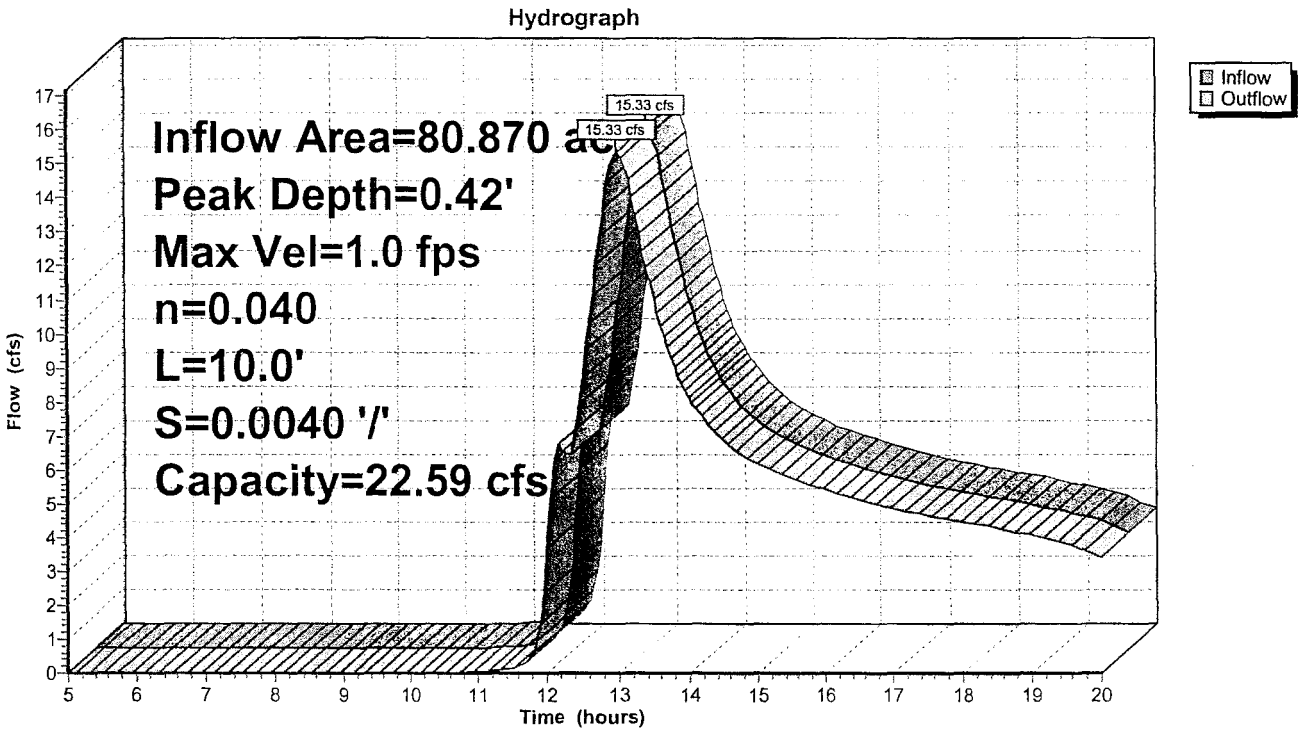
Reach R4: (new Reach)

Inflow Area = 80.870 ac, Inflow Depth = 0.64" for 1 YEAR event
Inflow = 15.33 cfs @ 12.99 hrs, Volume= 4.317 af
Outflow = 15.33 cfs @ 13.00 hrs, Volume= 4.315 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.0 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.42' @ 12.99 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

Reach R4: (new Reach)



Pond BMP - 1: BMP #1

Inflow Area = 11.050 ac, Inflow Depth = 1.05" for 1 YEAR event
Inflow = 13.96 cfs @ 12.14 hrs, Volume= 0.971 af
Outflow = 1.06 cfs @ 13.68 hrs, Volume= 0.684 af, Atten= 92%, Lag= 92.9 min
Primary = 1.06 cfs @ 13.68 hrs, Volume= 0.684 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 78.55' @ 13.68 hrs Surf.Area= 6,717 sf Storage= 23,005 cf
Plug-Flow detention time= 210.1 min calculated for 0.684 af (70% of inflow)
Center-of-Mass det. time= 140.6 min (948.8 - 808.1)

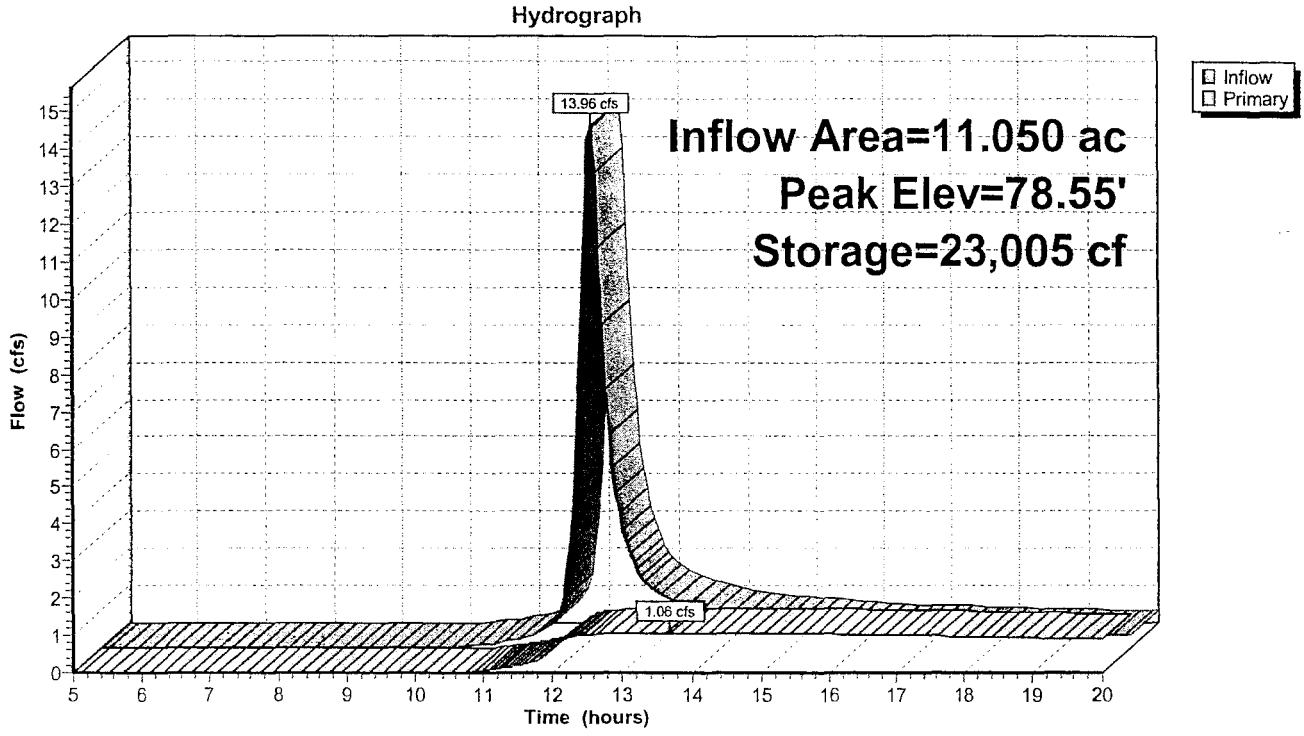
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	72.00'	**4.0" Vert. 4" Orifice** C= 0.600
3	Device 1	80.64'	**60.0" Horiz. Orifice** Limited to weir flow C= 0.600

Primary OutFlow Max=1.06 cfs @ 13.68 hrs HW=78.55' (Free Discharge)
└─**1=Culvert** (Passes 1.06 cfs of 72.70 cfs potential flow)
  ├─**2=4" Orifice** (Orifice Controls 1.06 cfs @ 12.2 fps)
  └─**3=Orifice** (Controls 0.00 cfs)

Pond BMP - 1: BMP #1



Pond BMP-3: Basin 3

Inflow Area =	7.600 ac,	Inflow Depth =	1.05"	for	1 YEAR event
Inflow =	8.39 cfs @	12.20 hrs,	Volume=	0.666 af	
Outflow =	1.19 cfs @	13.07 hrs,	Volume=	0.665 af,	Atten= 86%, Lag= 52.3 min
Primary =	1.19 cfs @	13.07 hrs,	Volume=	0.665 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 58.25' @ 13.07 hrs Surf.Area= 4,091 sf Storage= 12,831 cf
Plug-Flow detention time= 108.9 min calculated for 0.665 af (100% of inflow)
Center-of-Mass det. time= 108.0 min (920.0 - 811.9)

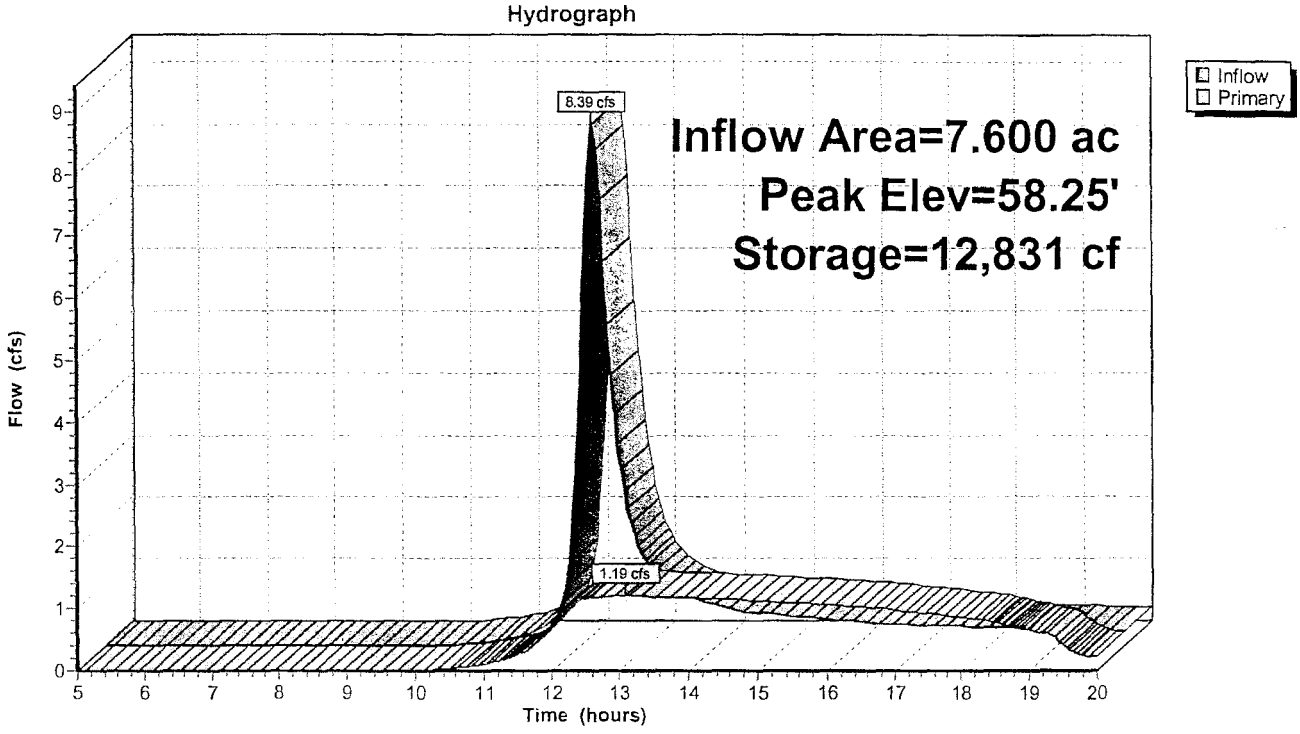
#	Invert	Avail.Storage	Storage Description
1	50.00'	34,833 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
50.00	0	0	0	0
52.00	450	300	300	458
54.00	1,230	1,616	1,916	1,270
56.00	2,375	3,543	5,459	2,463
58.00	3,858	6,173	11,632	4,011
60.00	5,710	9,508	21,140	5,943
62.00	8,050	13,693	34,833	8,374

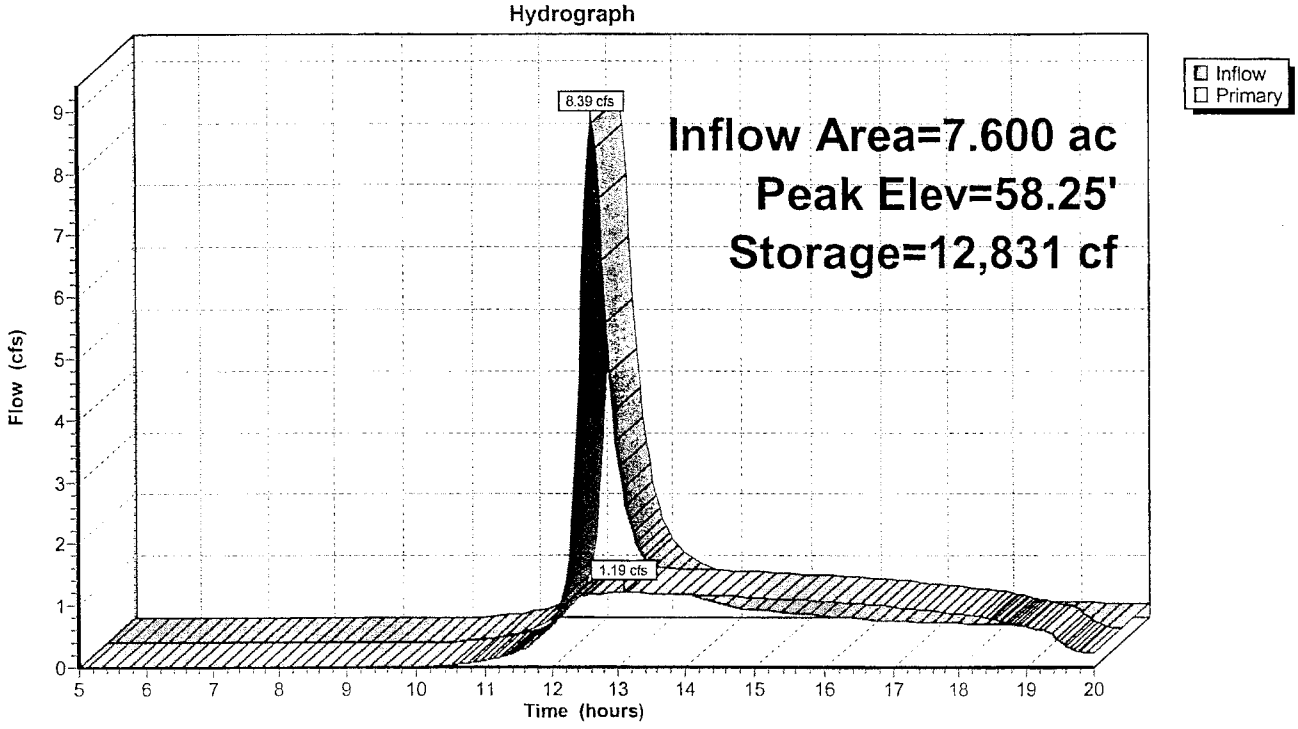
#	Routing	Invert	Outlet Devices
1	Primary	42.40'	**24.0" x 85.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 39.85' S= 0.0300 '/' n= 0.012 Cc= 0.900
2	Device 1	50.00'	**4.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	59.60'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.19 cfs @ 13.07 hrs HW=58.25' (Free Discharge)
└─**1=Culvert** (Passes 1.19 cfs of 58.30 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.19 cfs @ 13.7 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

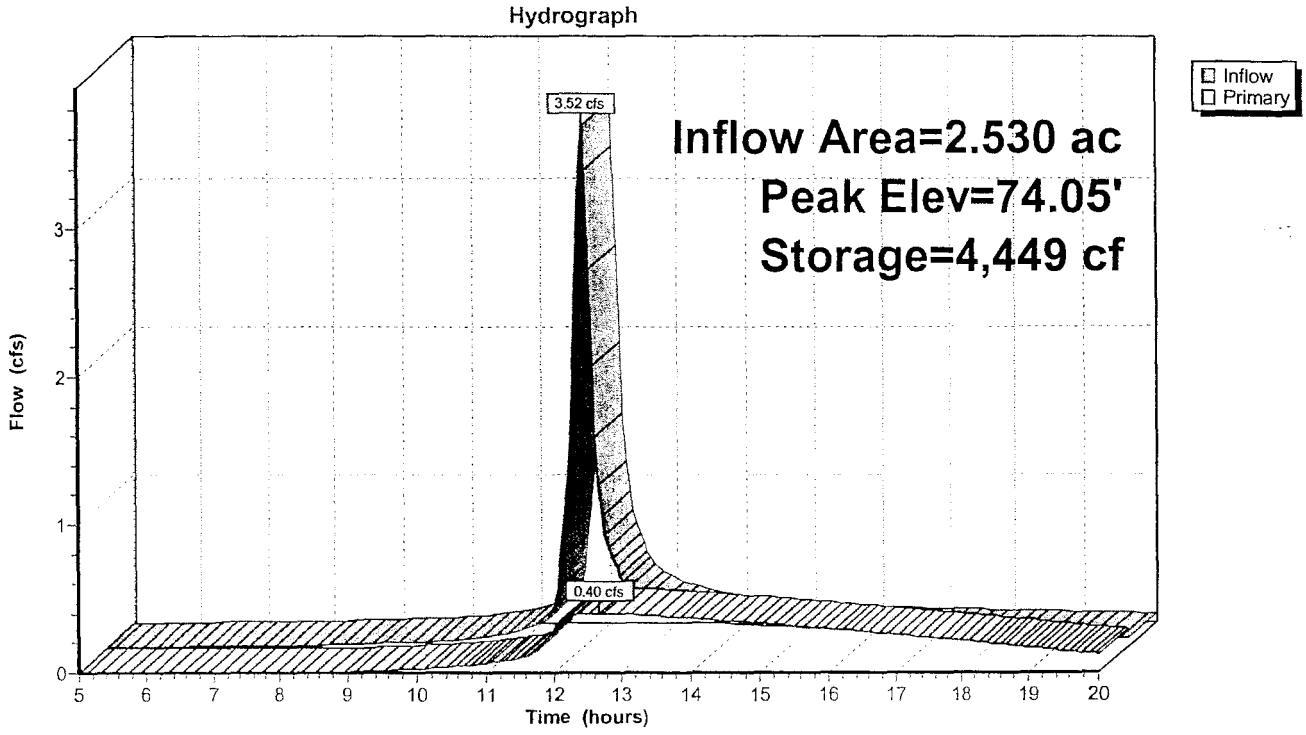
Pond BMP-3: Basin 3



Pond BMP-3: Basin 3



Pond C1: POND C1



Pond C2: POND C2

Inflow Area =	2.000 ac,	Inflow Depth =	0.53"	for	1 YEAR event
Inflow =	0.97 cfs @	12.22 hrs,	Volume=	0.088 af	
Outflow =	0.28 cfs @	12.77 hrs,	Volume=	0.086 af,	Atten= 71%, Lag= 33.2 min
Primary =	0.28 cfs @	12.77 hrs,	Volume=	0.086 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 72.62' @ 12.77 hrs Surf.Area= 993 sf Storage= 1,136 cf
Plug-Flow detention time= 45.3 min calculated for 0.086 af (97% of inflow)
Center-of-Mass det. time= 36.2 min (876.0 - 839.8)

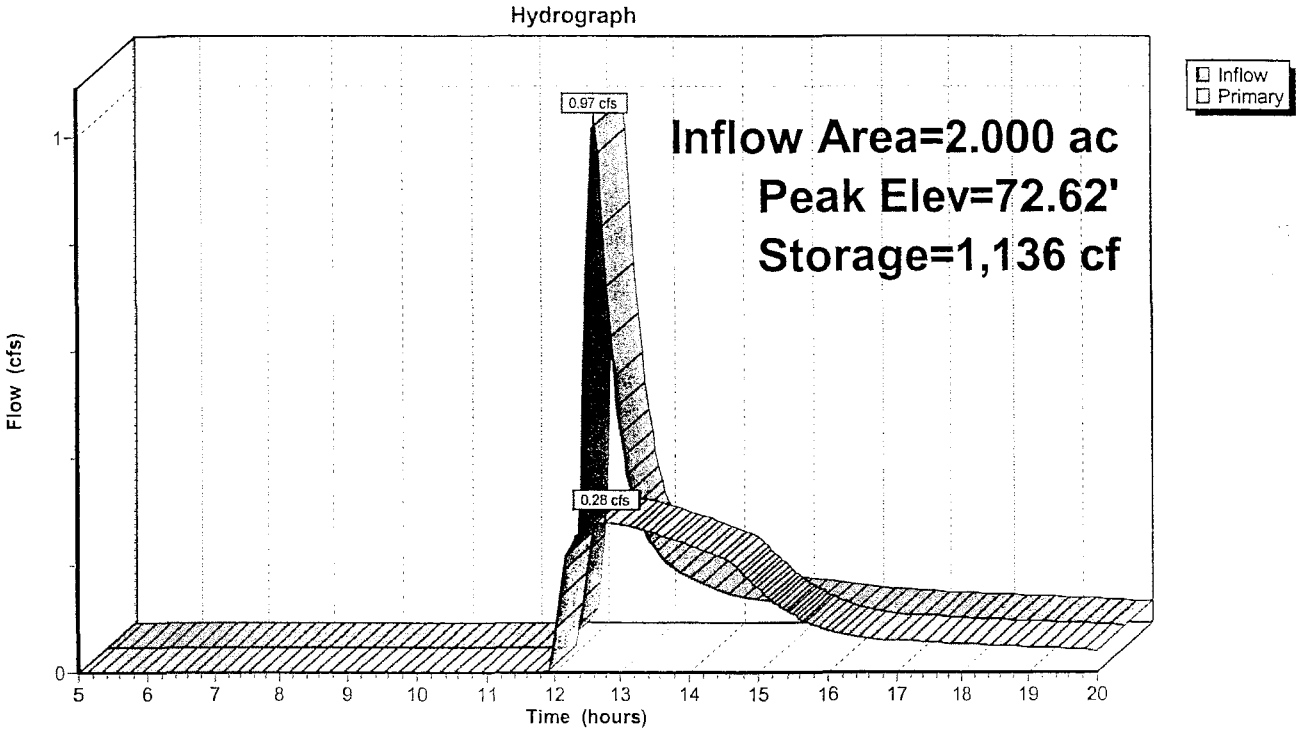
#	Invert	Avail.Storage	Storage Description
1	71.00'	26,524 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
71.00	117	0	0
72.00	685	401	401
74.00	1,670	2,355	2,756
76.00	3,000	4,670	7,426
78.00	4,667	7,667	15,093
80.00	6,764	11,431	26,524

#	Routing	Invert	Outlet Devices
1	Primary	68.06'	**24.0" x 45.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.31' S= 0.0167 '/' n= 0.013 Cc= 0.900
2	Device 1	71.10'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	77.00'	**2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.28 cfs @ 12.77 hrs HW=72.62' (Free Discharge)
└─**1=Culvert** (Passes 0.28 cfs of 28.56 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.28 cfs @ 5.7 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond C2: POND C2



Pond C2-2: 30" RCP

Inflow Area =	11.000 ac,	Inflow Depth =	0.66"	for	1 YEAR event
Inflow =	2.30 cfs @	12.03 hrs,	Volume=	0.605 af	
Outflow =	2.30 cfs @	12.04 hrs,	Volume=	0.603 af,	Atten= 0%, Lag= 0.5 min
Primary =	2.30 cfs @	12.04 hrs,	Volume=	0.603 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 65.65' @ 12.04 hrs Surf.Area= 260 sf Storage= 130 cf
Plug-Flow detention time= 1.7 min calculated for 0.601 af (99% of inflow)
Center-of-Mass det. time= 1.0 min (905.7 - 904.7)

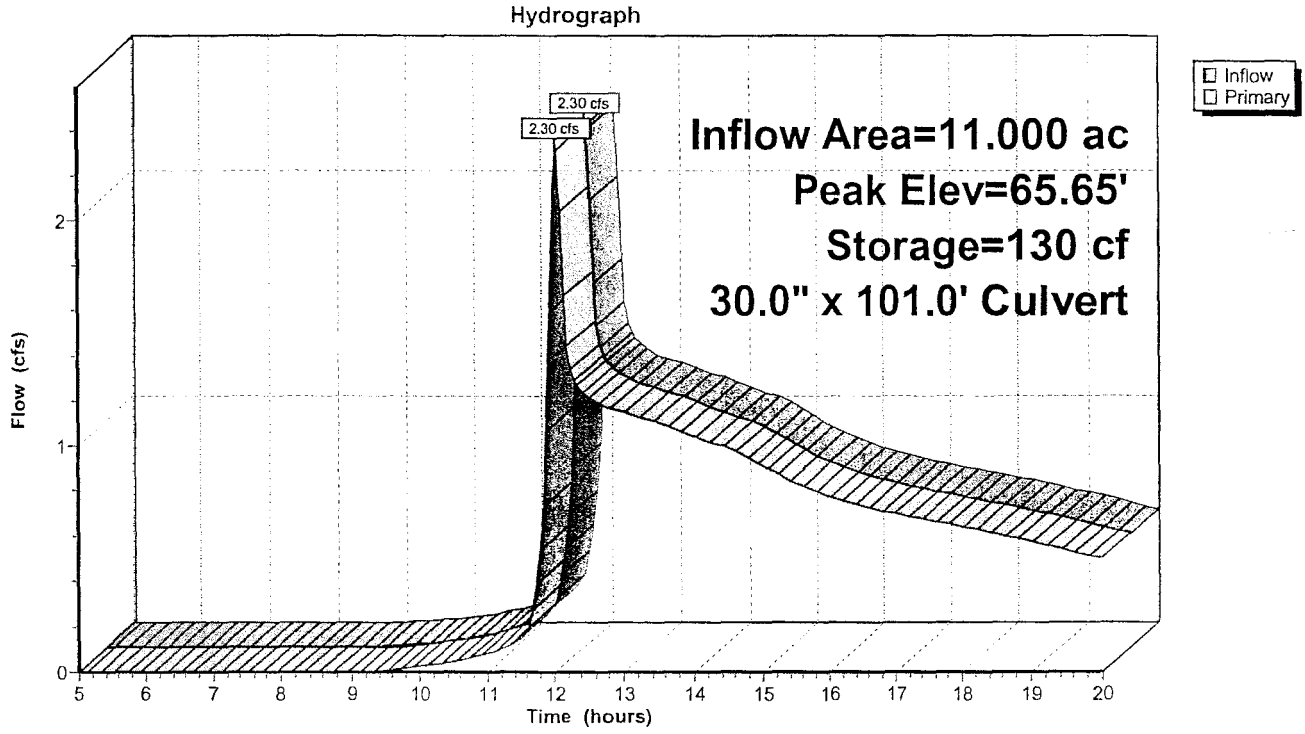
#	Invert	Avail.Storage	Storage Description
1	65.00'	13,000 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
65.00	0	0	0
66.00	400	200	200
68.00	2,400	2,800	3,000
70.00	7,600	10,000	13,000

#	Routing	Invert	Outlet Devices
1	Primary	65.06'	**30.0" x 101.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 64.00' S= 0.0105 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=2.28 cfs @ 12.04 hrs HW=65.65' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.28 cfs @ 2.6 fps)

Pond C2-2: 30" RCP



Pond C2-2B: MH C2-2B

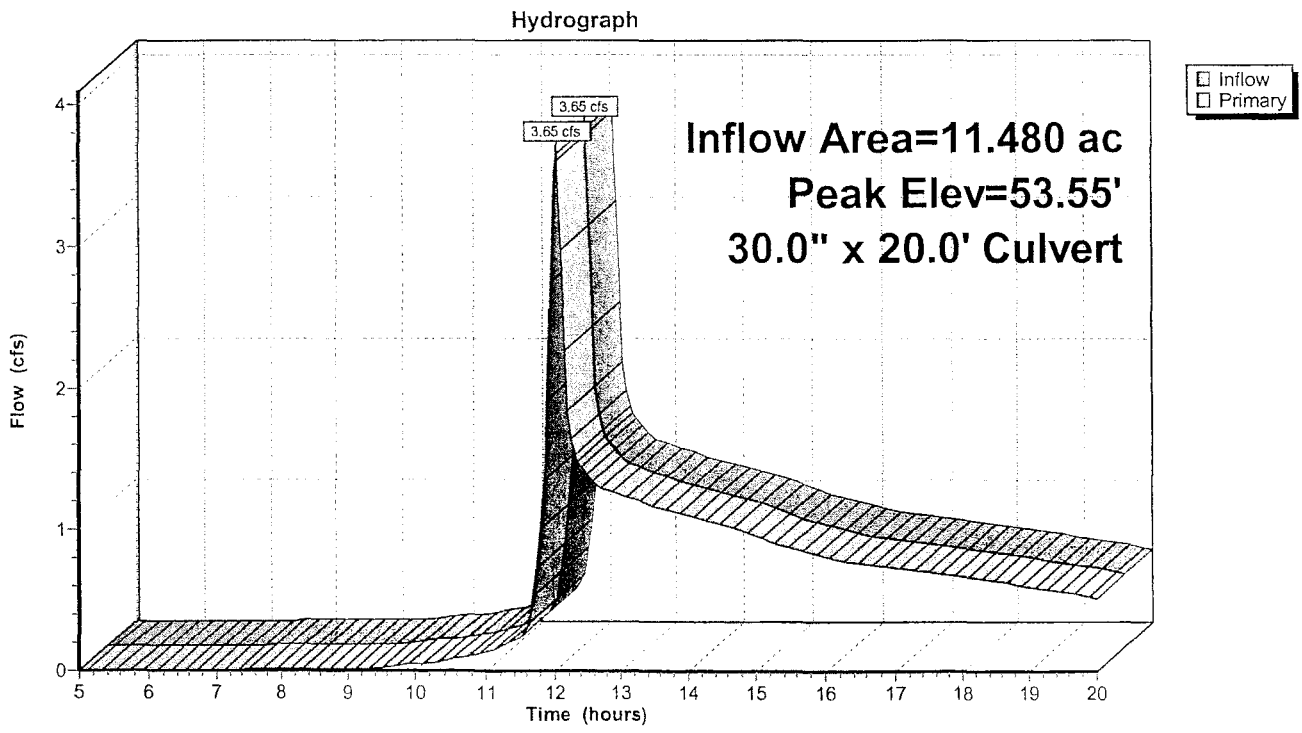
Inflow Area =	11.480 ac,	Inflow Depth =	0.71"	for 1 YEAR event	
Inflow =	3.65 cfs @	12.03 hrs,	Volume=	0.677 af	
Outflow =	3.65 cfs @	12.03 hrs,	Volume=	0.677 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.65 cfs @	12.03 hrs,	Volume=	0.677 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 53.55' @ 12.03 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	52.80'	**30.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 52.00' S= 0.0400 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=3.57 cfs @ 12.03 hrs HW=53.54' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.57 cfs @ 2.9 fps)

Pond C2-2B: MH C2-2B



Pond C3: POND C3

Inflow Area = 5.470 ac, Inflow Depth = 0.84" for 1 YEAR event
Inflow = 4.68 cfs @ 11.96 hrs, Volume= 0.381 af
Outflow = 0.36 cfs @ 13.99 hrs, Volume= 0.226 af, Atten= 92%, Lag= 121.4 min
Primary = 0.36 cfs @ 13.99 hrs, Volume= 0.226 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 72.54' @ 13.99 hrs Surf.Area= 3,918 sf Storage= 9,628 cf
Plug-Flow detention time= 242.5 min calculated for 0.225 af (59% of inflow)
Center-of-Mass det. time= 156.5 min (956.9 - 800.4)

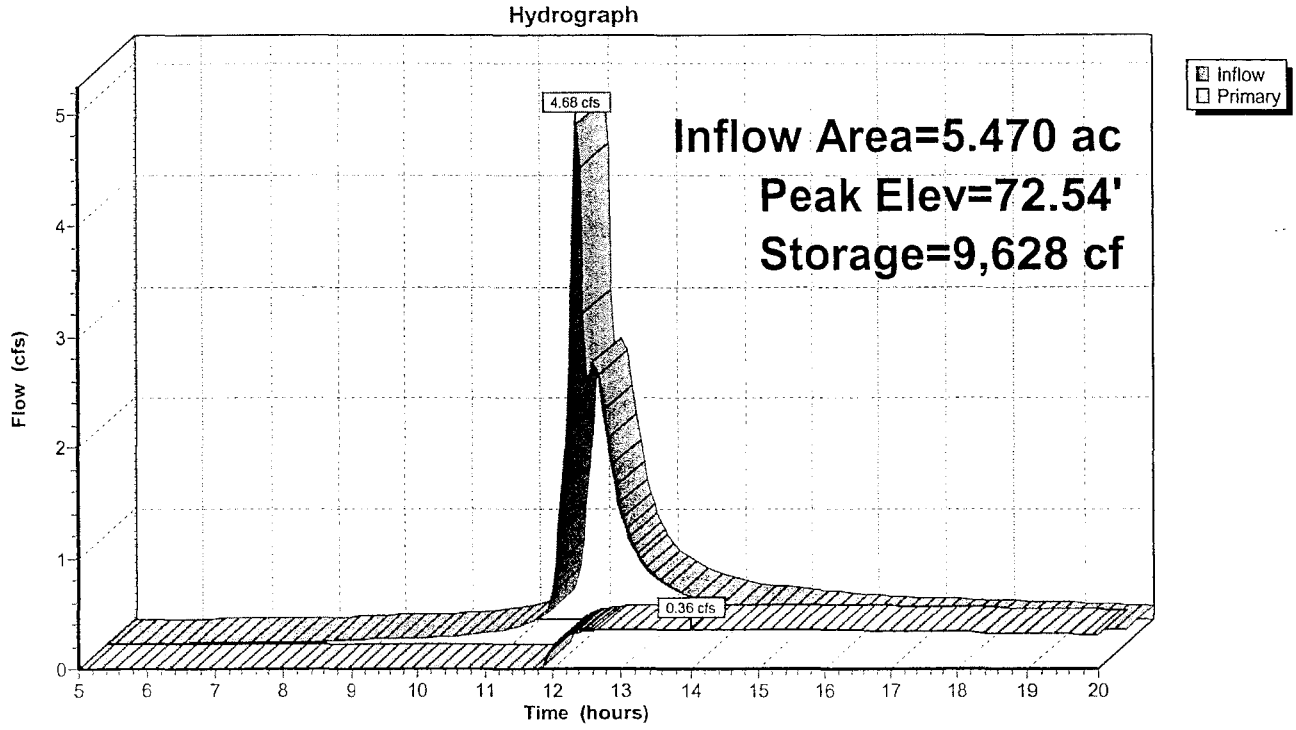
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,575 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	850	0	0
70.00	1,700	2,550	2,550
70.50	1,925	906	3,456
72.00	2,800	3,544	7,000
74.00	6,950	9,750	16,750
76.00	9,875	16,825	33,575

#	Routing	Invert	Outlet Devices
1	Primary	68.00'	**24.0" x 50.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.00' S= 0.0200 '/' n= 0.013 Cc= 0.900
2	Device 1	70.10'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.36 cfs @ 13.99 hrs HW=72.54' (Free Discharge)
└─**1=Culvert** (Passes 0.36 cfs of 28.46 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 7.3 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond C3: POND C3



Pond D-1: DI-5

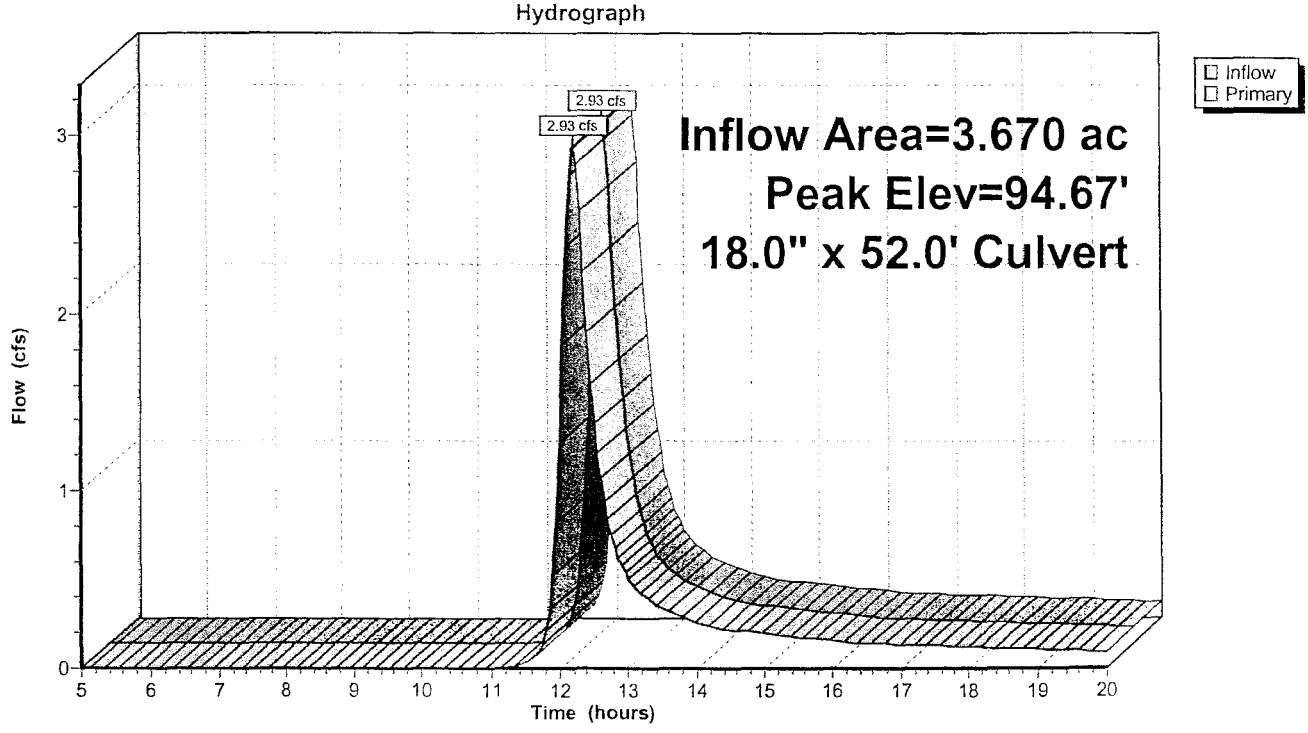
Inflow Area =	3.670 ac,	Inflow Depth =	0.79"	for	1 YEAR event
Inflow =	2.93 cfs @	12.21 hrs,	Volume=	0.241 af	
Outflow =	2.93 cfs @	12.21 hrs,	Volume=	0.241 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.93 cfs @	12.21 hrs,	Volume=	0.241 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 94.67' @ 12.21 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	93.87'	**18.0" x 52.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 90.94' S= 0.0563 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=2.92 cfs @ 12.21 hrs HW=94.67' (Free Discharge)
└**1=Culvert** (Inlet Controls 2.92 cfs @ 3.0 fps)

Pond D-1: DI-5



Pond D-2: DI-5

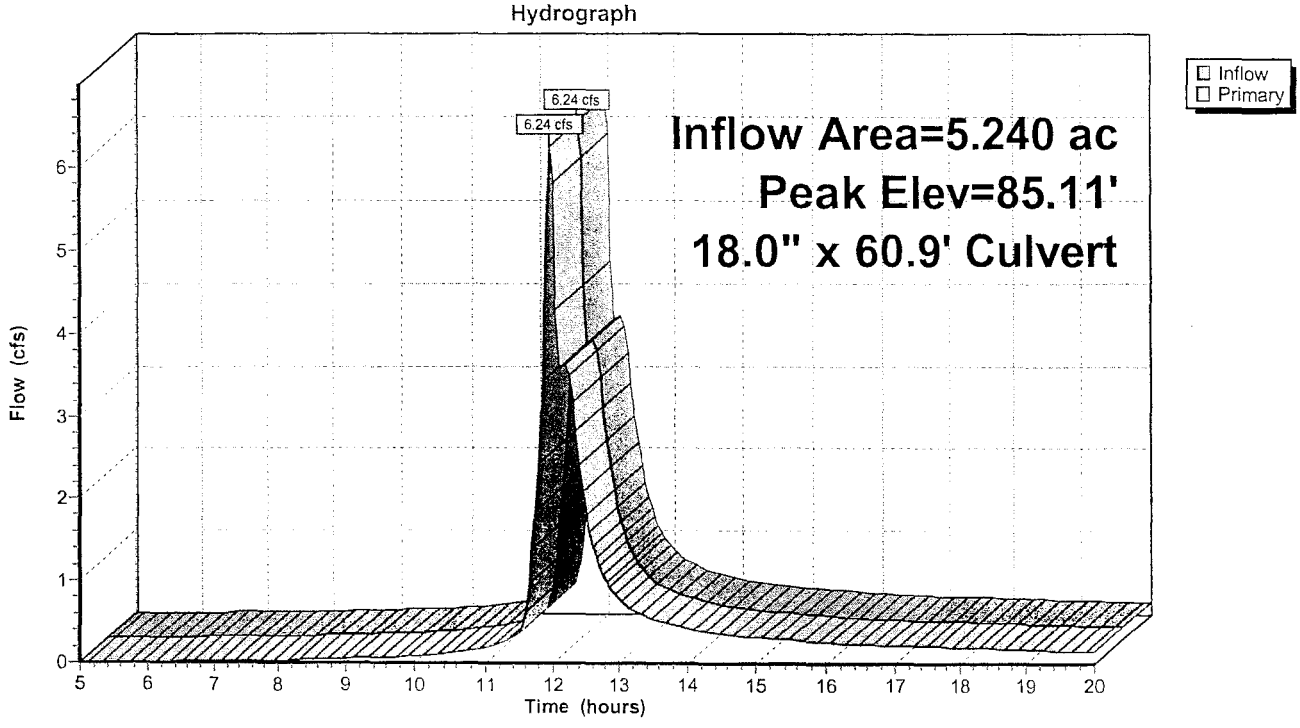
Inflow Area =	5.240 ac,	Inflow Depth =	1.10"	for	1 YEAR event
Inflow =	6.24 cfs @	11.96 hrs,	Volume=	0.482 af	
Outflow =	6.24 cfs @	11.96 hrs,	Volume=	0.482 af,	Atten= 0%, Lag= 0.0 min
Primary =	6.24 cfs @	11.96 hrs,	Volume=	0.482 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 85.11' @ 11.96 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	83.82'	**18.0" x 60.9' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 82.60' S= 0.0200 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=6.07 cfs @ 11.96 hrs HW=85.08' (Free Discharge)
└**1=Culvert** (Inlet Controls 6.07 cfs @ 3.8 fps)

Pond D-2: DI-5



Pond D-3: MH-1

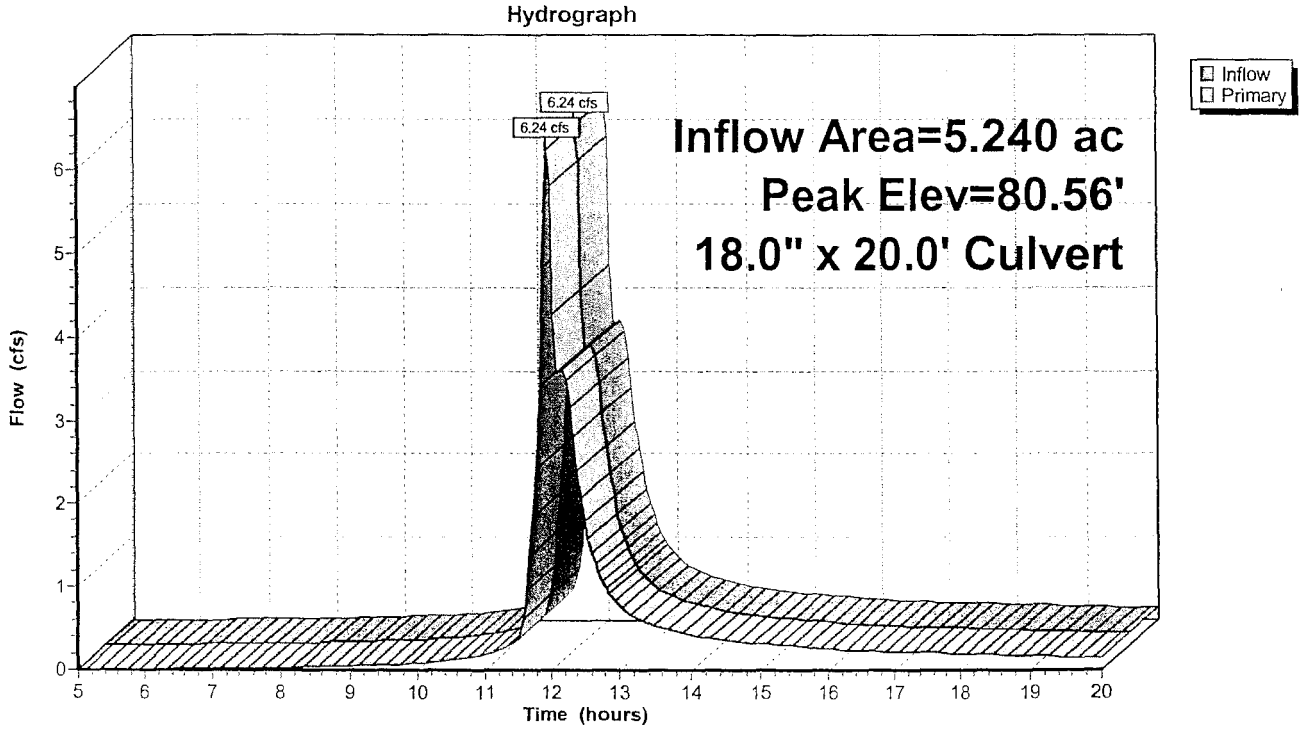
Inflow Area =	5.240 ac,	Inflow Depth =	1.10"	for	1 YEAR event
Inflow =	6.24 cfs @	11.96 hrs,	Volume=	0.482 af	
Outflow =	6.24 cfs @	11.96 hrs,	Volume=	0.482 af,	Atten= 0%, Lag= 0.0 min
Primary =	6.24 cfs @	11.96 hrs,	Volume=	0.482 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.56' @ 11.96 hrs
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	79.25'	**18.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 78.85' S= 0.0200 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=6.06 cfs @ 11.96 hrs HW=80.53' (Free Discharge)
└─**1=Culvert** (Barrel Controls 6.06 cfs @ 5.1 fps)

Pond D-3: MH-1



Pond P D: POND D

Inflow Area =	7.440 ac,	Inflow Depth =	0.94"	for	1 YEAR event
Inflow =	6.95 cfs @	11.98 hrs,	Volume=	0.580 af	
Outflow =	0.55 cfs @	13.94 hrs,	Volume=	0.372 af,	Atten= 92%, Lag= 117.6 min
Primary =	0.55 cfs @	13.94 hrs,	Volume=	0.372 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 78.57' @ 13.94 hrs Surf.Area= 4,677 sf Storage= 13,772 cf
Plug-Flow detention time= 216.9 min calculated for 0.370 af (64% of inflow)
Center-of-Mass det. time= 137.8 min (937.7 - 799.9)

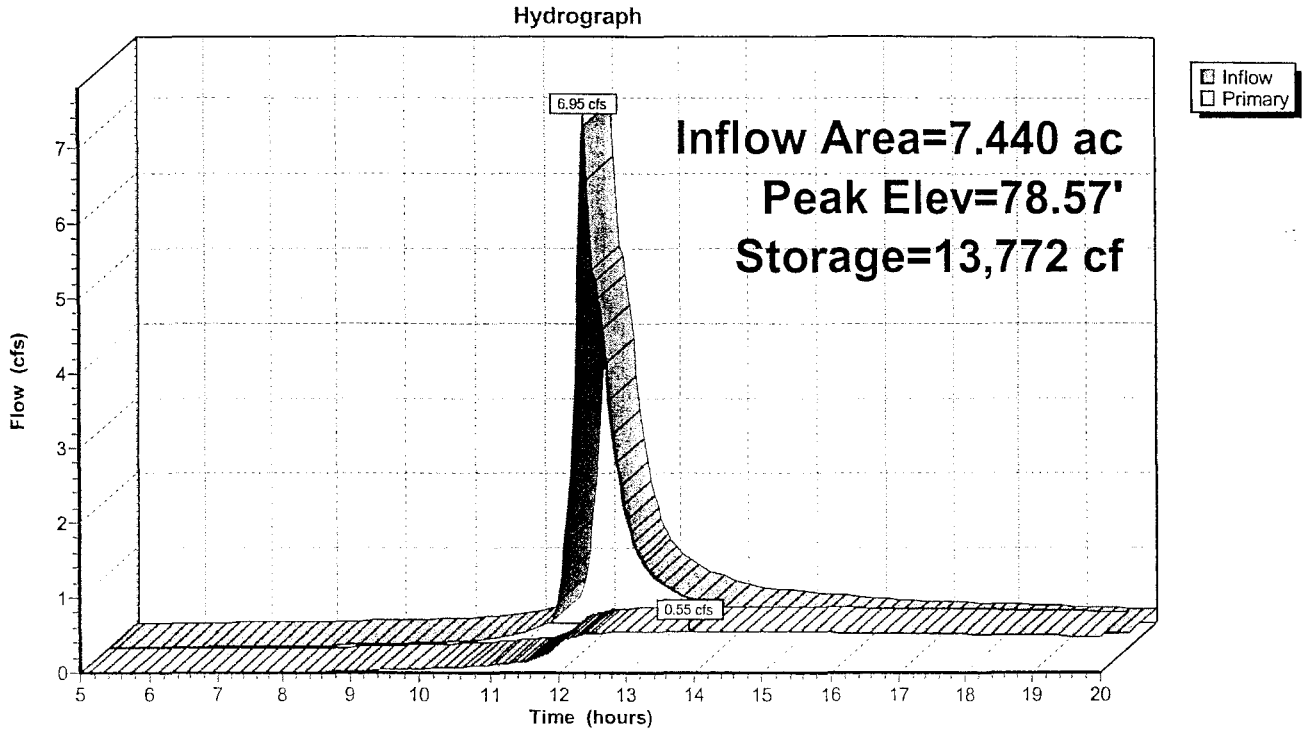
#	Invert	Avail.Storage	Storage Description
1	73.00'	36,249 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
73.00	963	0	0
74.00	1,391	1,177	1,177
76.00	2,465	3,856	5,033
76.50	2,775	1,310	6,343
78.00	3,821	4,947	11,290
78.25	4,010	979	12,269
78.85	5,241	2,775	15,044
80.00	6,284	6,627	21,671
82.00	8,294	14,578	36,249

#	Routing	Invert	Outlet Devices
1	Primary	71.00'	**24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 70.00' S= 0.0167 '/' n= 0.013 Cc= 0.900
2	Device 1	79.00'	**3.00' x 3.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Device 1	73.10'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.55 cfs @ 13.94 hrs HW=78.57' (Free Discharge)
└─**1=Culvert** (Passes 0.55 cfs of 38.79 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.55 cfs @ 11.1 fps)

Pond P D: POND D



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1/3 ac lots BMP: Post Development to SB 1 Runoff Area=11.050 ac Runoff Depth=1.56"
Tc=20.0 min CN=81 Runoff=20.80 cfs 1.439 af

Subcatchment 8S: (new Subcat) Runoff Area=7.700 ac Runoff Depth=1.06"
Flow Length=680' Tc=18.9 min CN=73 Runoff=9.90 cfs 0.680 af

Subcatchment C-1: UNDEVELOPED Runoff Area=1.560 ac Runoff Depth=0.90"
Tc=15.0 min CN=70 Runoff=1.90 cfs 0.117 af

Subcatchment C-2: C-2 UNDEVELOPED Runoff Area=2.000 ac Runoff Depth=0.90"
Tc=25.0 min CN=70 Runoff=1.79 cfs 0.149 af

Subcatchment C-3: UNDEVELOPED Runoff Area=4.200 ac Runoff Depth=0.90"
Flow Length=560' Tc=25.6 min CN=70 Runoff=3.69 cfs 0.313 af

Subcatchment C1-1 DA: DEVELOPED Runoff Area=0.330 ac Runoff Depth=2.47"
Tc=5.0 min CN=92 Runoff=1.48 cfs 0.068 af

Subcatchment C1-2 DA: DEVELOPED Runoff Area=0.640 ac Runoff Depth=2.47"
Tc=10.0 min CN=92 Runoff=2.45 cfs 0.132 af

Subcatchment C2-2 DA: UNDEVELOPED Runoff Area=1.000 ac Runoff Depth=1.57"
Tc=10.0 min CN=81 Runoff=2.59 cfs 0.131 af

Subcatchment C2-2A DA: DEVELOPED Runoff Area=0.480 ac Runoff Depth=2.47"
Tc=10.0 min CN=92 Runoff=1.83 cfs 0.099 af

Subcatchment C2-2B DA: POST DEVELOPMENT Runoff Area=0.350 ac Runoff Depth=1.44"
Flow Length=100' Tc=3.4 min CN=79 Runoff=1.05 cfs 0.042 af

Subcatchment C3-1 DA: DEVELOPED Runoff Area=0.760 ac Runoff Depth=2.47"
Tc=5.0 min CN=92 Runoff=3.40 cfs 0.157 af

Subcatchment C3-1A DA: DEVELOPED Runoff Area=0.510 ac Runoff Depth=2.47"
Tc=5.0 min CN=92 Runoff=2.28 cfs 0.105 af

Subcatchment D: POST DEV Runoff Area=3.670 ac Runoff Depth=1.23"
Flow Length=250' Tc=25.1 min CN=76 Runoff=4.71 cfs 0.377 af

Subcatchment D2: POST DEV Runoff Area=1.570 ac Runoff Depth=2.47"
Flow Length=620' Tc=5.0 min CN=92 Runoff=7.02 cfs 0.323 af

Subcatchment D3: POST DEV Runoff Area=2.200 ac Runoff Depth=0.90"
Tc=15.0 min CN=70 Runoff=2.67 cfs 0.165 af

Subcatchment Post Dev: 1/3 Acre Lots Runoff Area=7.600 ac Runoff Depth=1.56"
Tc=25.0 min CN=81 Runoff=12.53 cfs 0.988 af

Subcatchment S-1: S-1 Runoff Area=5.250 ac Runoff Depth=0.90"
Flow Length=785' Tc=19.2 min CN=70 Runoff=5.54 cfs 0.393 af

Subcatchment S-2: POST DEVELOPED Runoff Area=24.200 ac Runoff Depth=0.99"
Flow Length=2,200' Tc=47.3 min CN=72 Runoff=15.75 cfs 1.998 af

Subcatchment S-3: POST DEVELOPED Runoff Area=5.800 ac Runoff Depth=1.00"
Tc=20.0 min CN=72 Runoff=6.80 cfs 0.485 af

Reach C2-1A: RIPRAP CHANNEL Peak Depth=0.17' Max Vel=2.4 fps Inflow=2.22 cfs 0.755 af
n=0.040 L=40.0' S=0.0500 '/' Capacity=177.27 cfs Outflow=2.22 cfs 0.755 af

Reach R1: (new Reach) Peak Depth=0.21' Max Vel=1.2 fps Inflow=6.85 cfs 1.766 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=5.41 cfs 1.695 af

Reach R1A: (new Reach) Peak Depth=0.17' Max Vel=2.8 fps Inflow=1.20 cfs 0.817 af
n=0.040 L=180.0' S=0.0778 '/' Capacity=1,634.29 cfs Outflow=1.20 cfs 0.814 af

Reach R1B: (new Reach) Peak Depth=0.71' Max Vel=2.1 fps Inflow=3.77 cfs 0.572 af
n=0.040 L=831.0' S=0.0142 '/' Capacity=325.67 cfs Outflow=3.20 cfs 0.559 af

Reach R2: (new Reach) Peak Depth=0.42' Max Vel=1.8 fps Inflow=23.16 cfs 4.705 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=22.69 cfs 4.642 af

Reach R2A: (new Reach) Peak Depth=0.38' Max Vel=2.3 fps Inflow=5.81 cfs 1.024 af
n=0.040 L=510.0' S=0.0176 '/' Capacity=125.75 cfs Outflow=5.37 cfs 1.013 af

Reach R3: (new Reach) Peak Depth=0.52' Max Vel=1.2 fps Inflow=26.24 cfs 6.017 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=25.23 cfs 5.856 af

Reach R4: (new Reach) Peak Depth=0.54' Max Vel=1.2 fps Inflow=26.53 cfs 6.536 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=26.52 cfs 6.534 af

Pond BMP - 1: BMP #1 Peak Elev=80.35' Storage=37,151 cf Inflow=20.80 cfs 1.439 af
Outflow=1.20 cfs 0.817 af

Pond BMP-3: Basin 3 Peak Elev=59.70' Storage=19,736 cf Inflow=12.53 cfs 0.988 af
Outflow=2.79 cfs 0.889 af

Pond C1: POND C1 Peak Elev=75.14' Storage=6,865 cf Inflow=5.11 cfs 0.317 af
Outflow=0.47 cfs 0.279 af

Pond C2: POND C2 Peak Elev=73.74' Storage=2,449 cf Inflow=1.79 cfs 0.149 af
Outflow=0.37 cfs 0.147 af

Pond C2-2: 30" RCP Peak Elev=65.78' Storage=157 cf Inflow=3.41 cfs 0.885 af
30.0" x 101.0' Culvert Outflow=3.41 cfs 0.884 af

Pond C2-2B: MH C2-2B Peak Elev=53.71' Inflow=5.20 cfs 0.982 af
30.0" x 20.0' Culvert Outflow=5.20 cfs 0.982 af

Pond C3: POND C3 Peak Elev=73.34' Storage=13,541 cf Inflow=6.69 cfs 0.575 af
Outflow=1.38 cfs 0.330 af

Pond D-1: DI-5 Peak Elev=94.93' Inflow=4.71 cfs 0.377 af
18.0" x 52.0' Culvert Outflow=4.71 cfs 0.377 af

Pond D-2: DI-5 Peak Elev=85.61' Inflow=8.70 cfs 0.700 af
18.0" x 60.9' Culvert Outflow=8.70 cfs 0.700 af

Pond D-3: MH-1 Peak Elev=81.04' Inflow=8.70 cfs 0.700 af
18.0" x 20.0' Culvert Outflow=8.70 cfs 0.700 af

Pond P D: POND D Peak Elev=79.19' Storage=16,977 cf Inflow=10.29 cfs 0.865 af
Outflow=3.77 cfs 0.572 af

Total Runoff Area = 80.870 ac Runoff Volume = 8.161 af Average Runoff Depth = 1.21"

Subcatchment 1/3 ac lots BMP: Post Development to SB 1

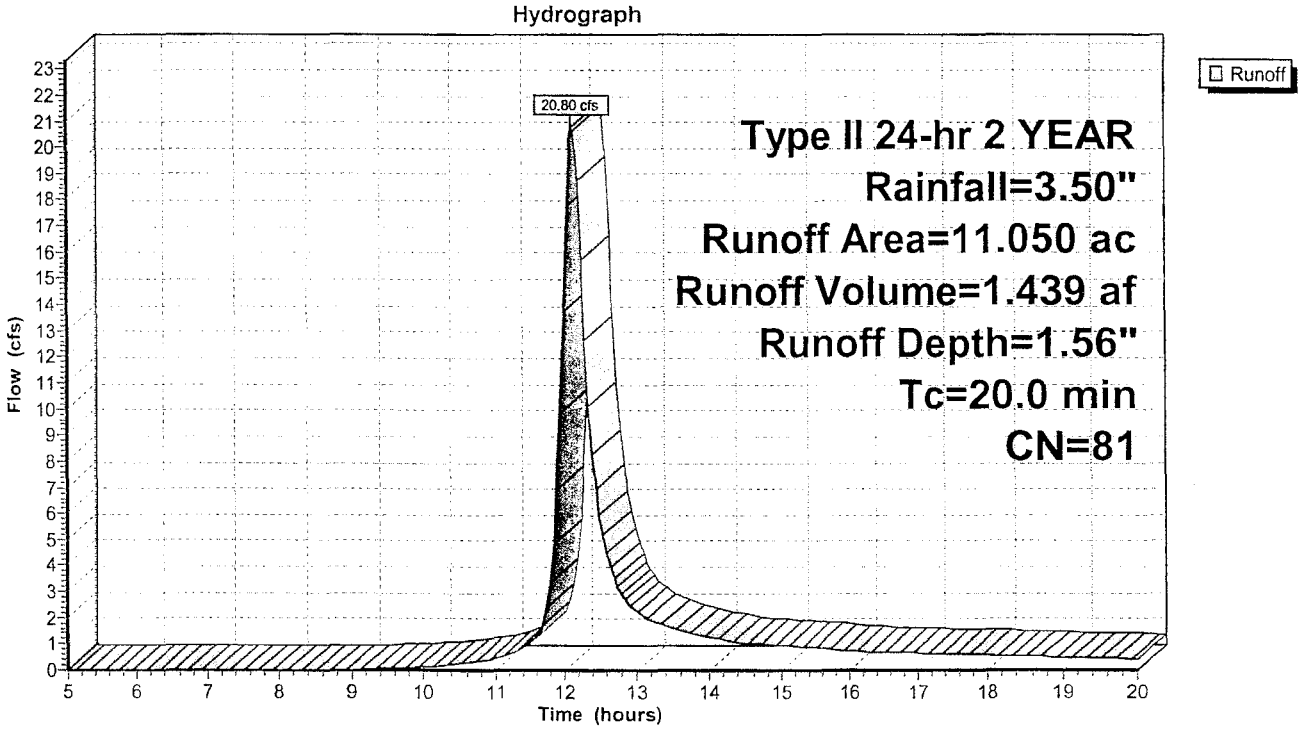
Runoff = 20.80 cfs @ 12.13 hrs, Volume= 1.439 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
11.050	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment 1/3 ac lots BMP: Post Development to SB 1



Subcatchment 8S: (new Subcat)

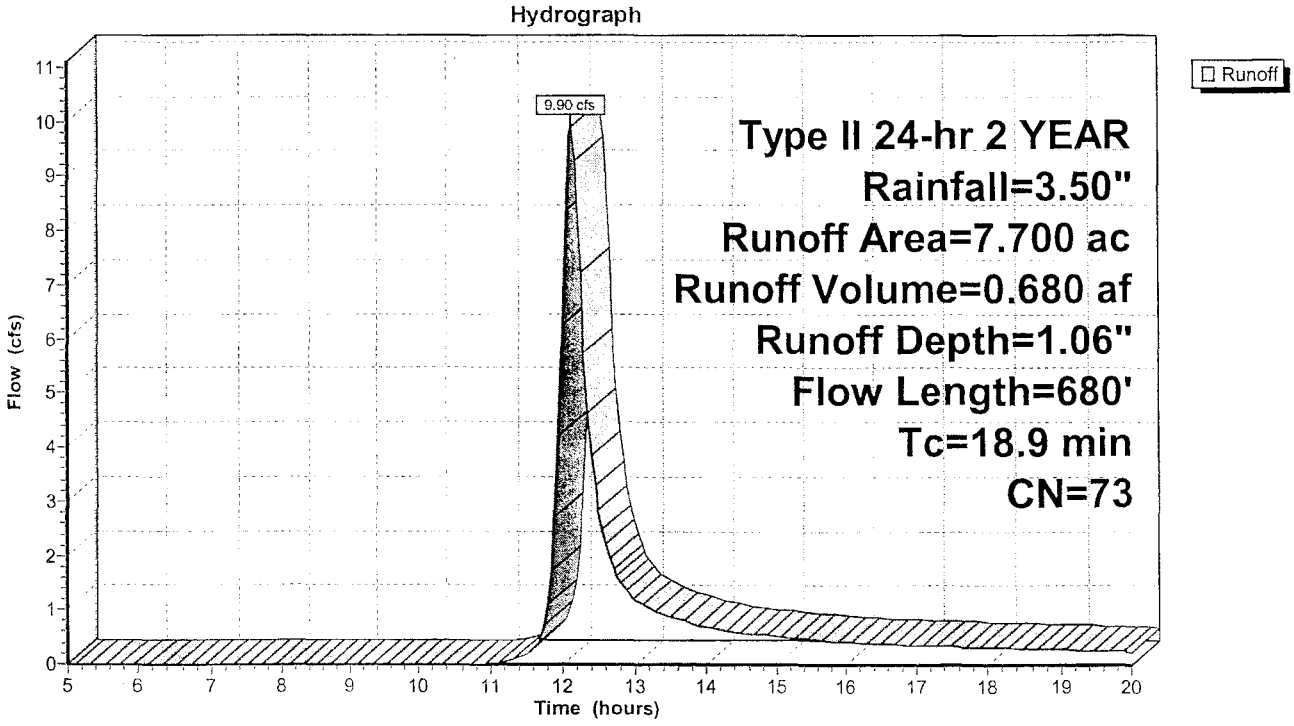
Runoff = 9.90 cfs @ 12.13 hrs, Volume= 0.680 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
5.400	70	Woods, Good, HSG C
2.300	81	1/3 acre lots, 30% imp, HSG C
7.700	73	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	130	0.1080	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.4	200	0.2250	2.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	350	0.0110	1.9	37.46	**Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040
18.9	680	Total			

Subcatchment 8S: (new Subcat)



Subcatchment C-1: UNDEVELOPED

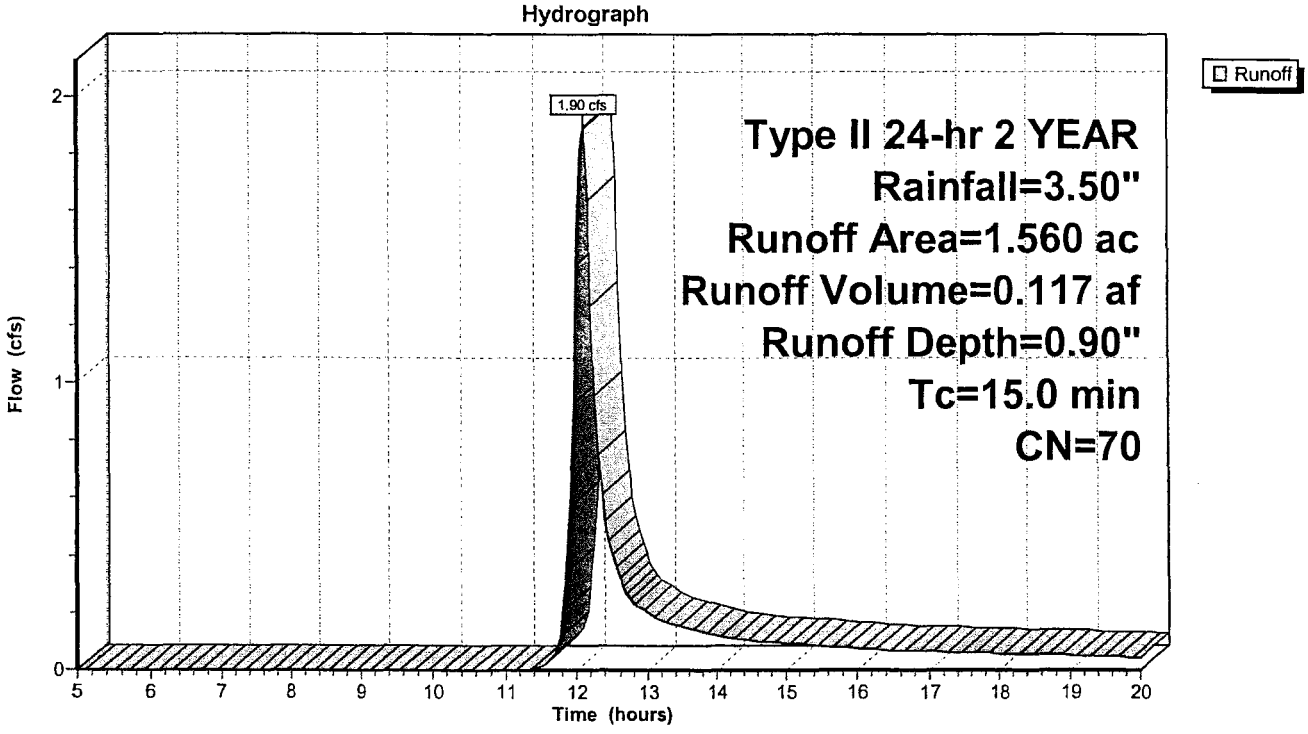
Runoff = 1.90 cfs @ 12.09 hrs, Volume= 0.117 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
1.560	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment C-1: UNDEVELOPED



Subcatchment C-2: C-2 UNDEVELOPED

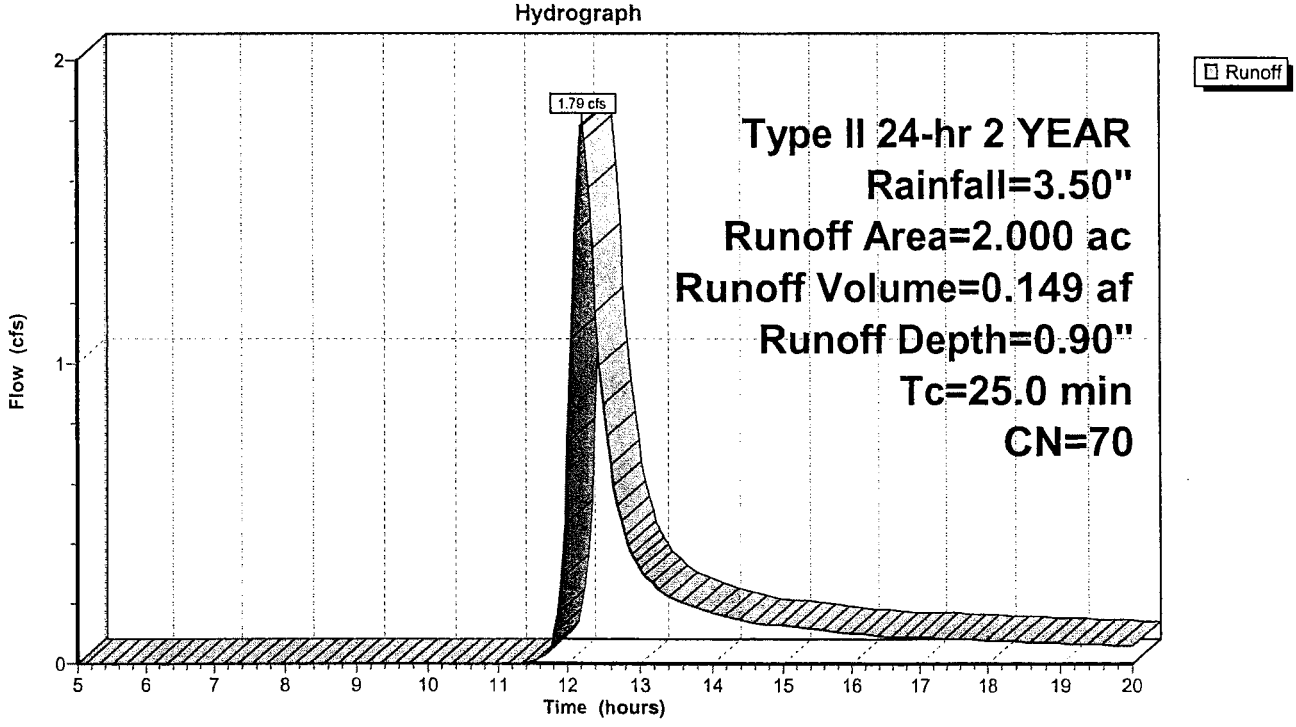
Runoff = 1.79 cfs @ 12.21 hrs, Volume= 0.149 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment C-2: C-2 UNDEVELOPED



Subcatchment C-3: UNDEVELOPED

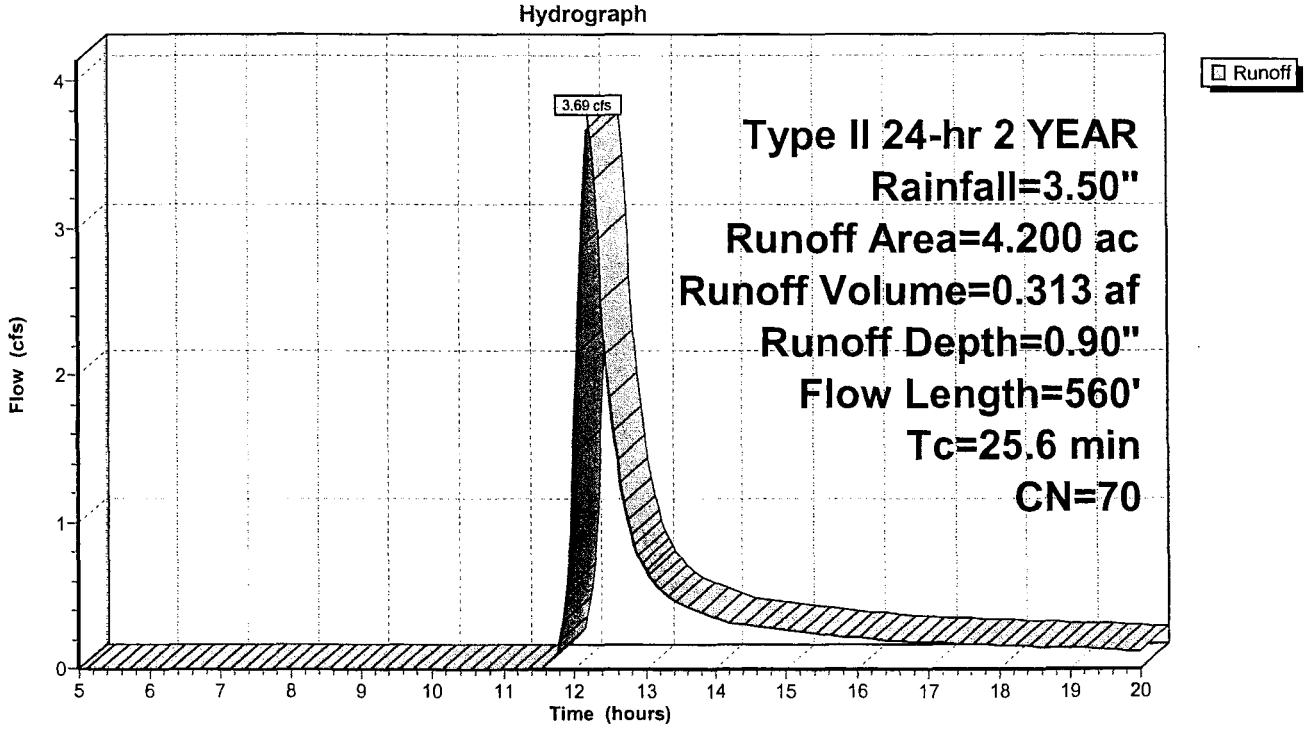
Runoff = 3.69 cfs @ 12.22 hrs, Volume= 0.313 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
4.200	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	100	0.0300	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
6.1	460	0.0630	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
25.6	560	Total			

Subcatchment C-3: UNDEVELOPED



Subcatchment C1-1 DA: DEVELOPED

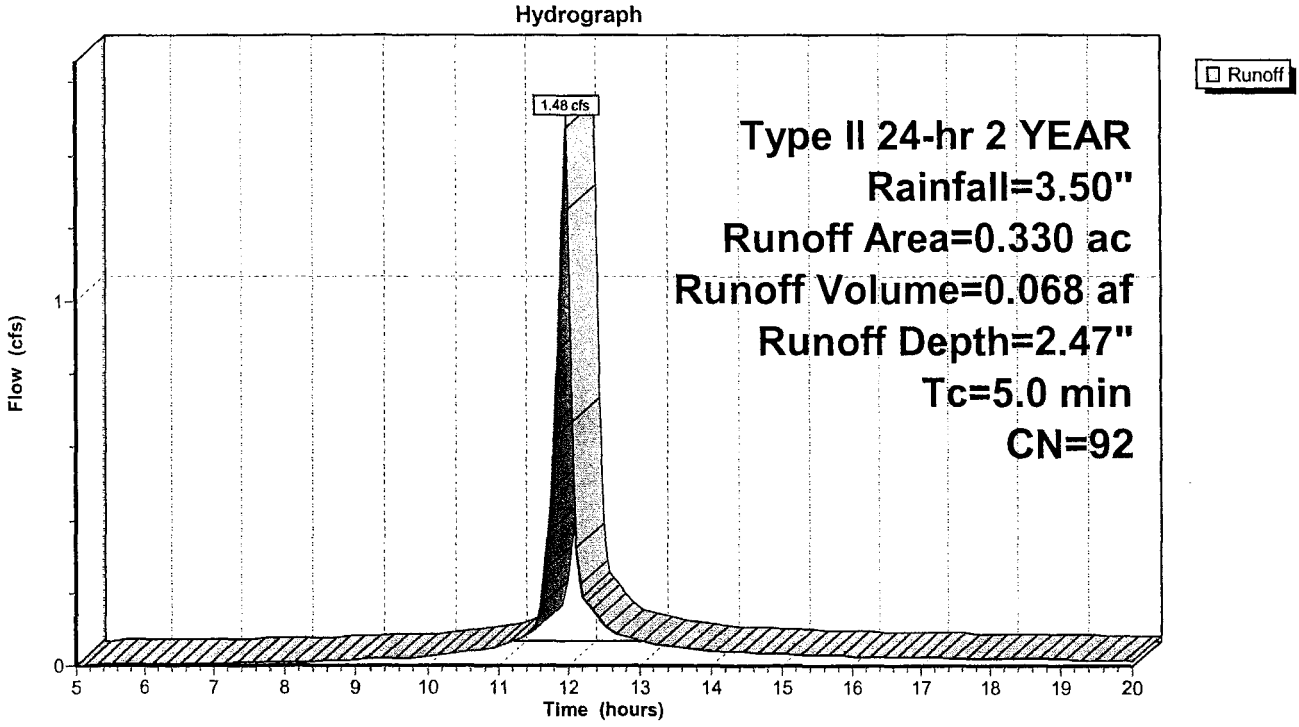
Runoff = 1.48 cfs @ 11.95 hrs, Volume= 0.068 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
0.330	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment C1-1 DA: DEVELOPED



Subcatchment C1-2 DA: DEVELOPED

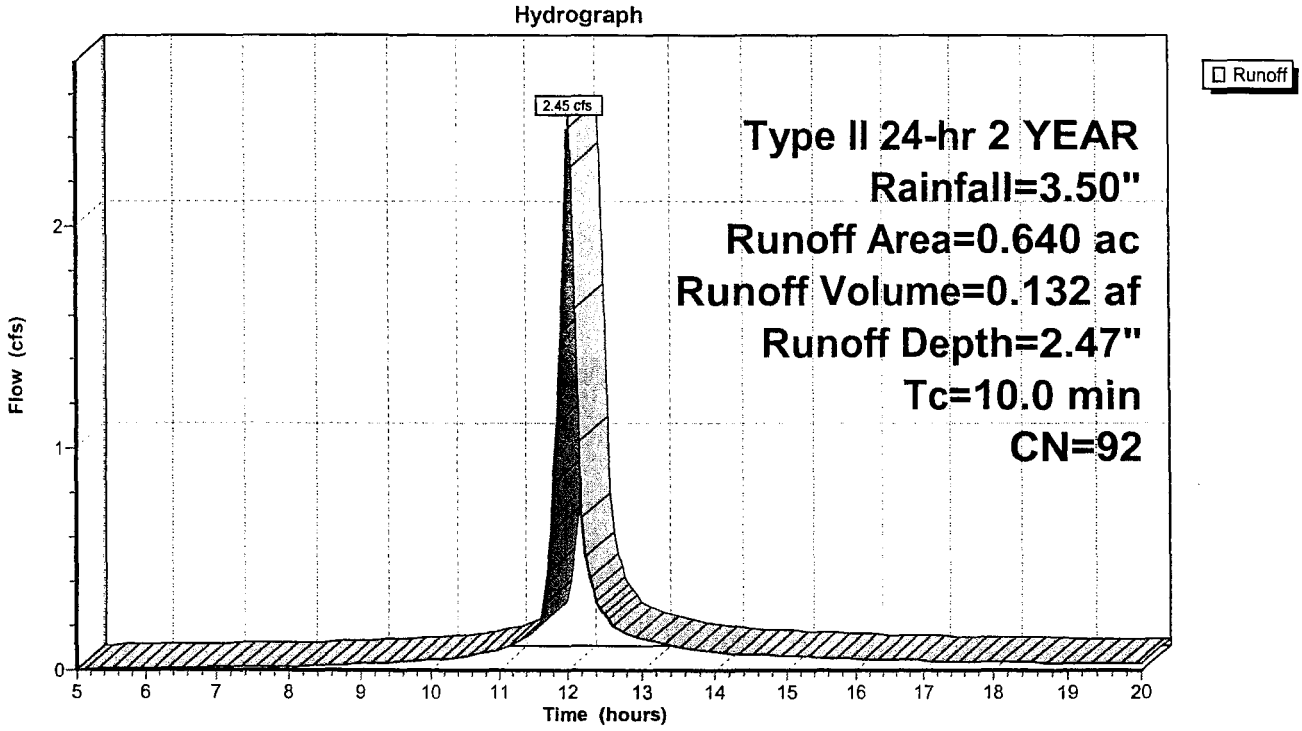
Runoff = 2.45 cfs @ 12.01 hrs, Volume= 0.132 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
0.640	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment C1-2 DA: DEVELOPED



Subcatchment C2-2 DA: UNDEVELOPED

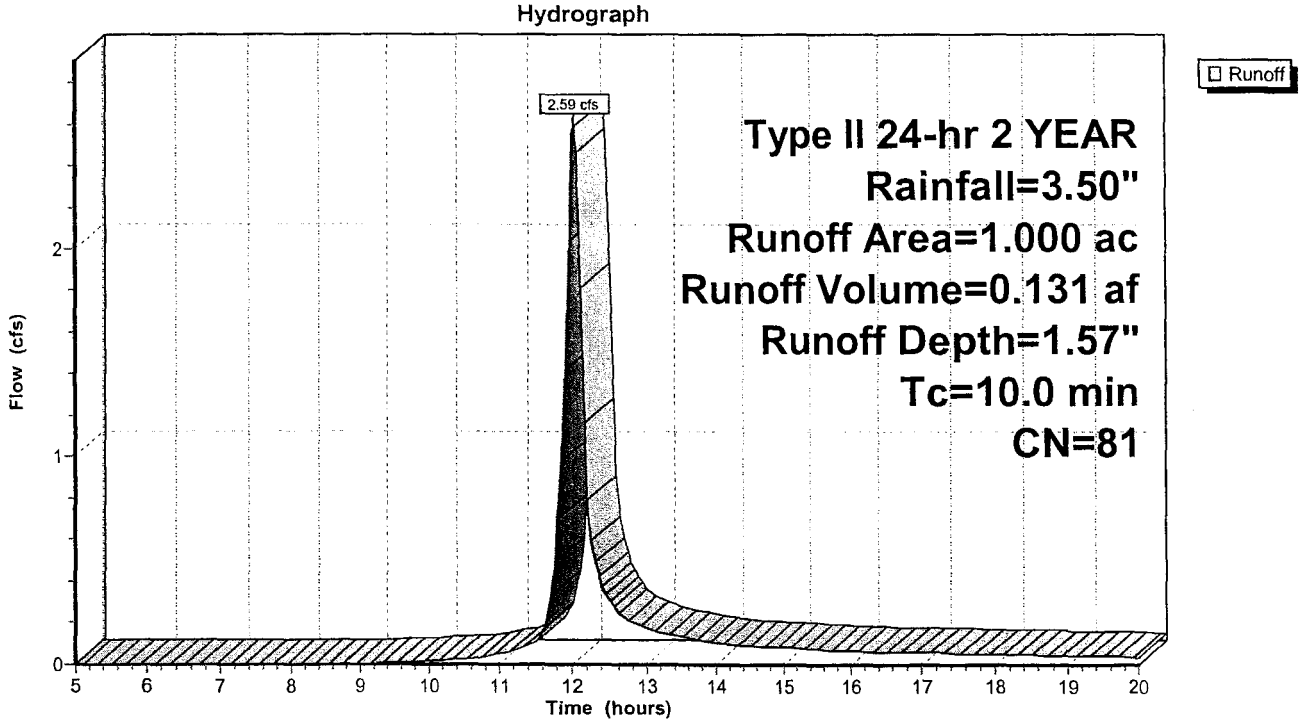
Runoff = 2.59 cfs @ 12.02 hrs, Volume= 0.131 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
0.500	70	Woods, Good, HSG C
0.500	92	Paved roads w/open ditches, HSG C
1.000	81	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment C2-2 DA: UNDEVELOPED



Subcatchment C2-2A DA: DEVELOPED

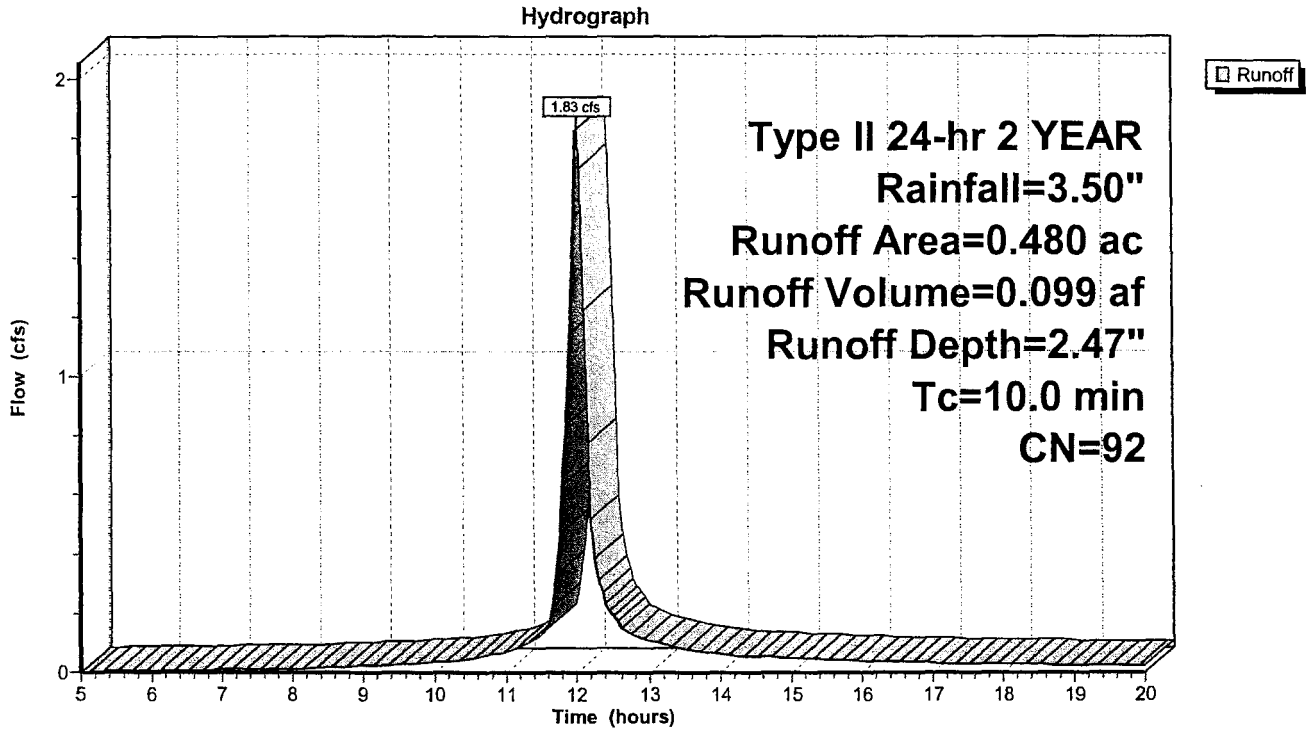
Runoff = 1.83 cfs @ 12.01 hrs, Volume= 0.099 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
0.480	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment C2-2A DA: DEVELOPED



Subcatchment C2-2B DA: POST DEVELOPMENT

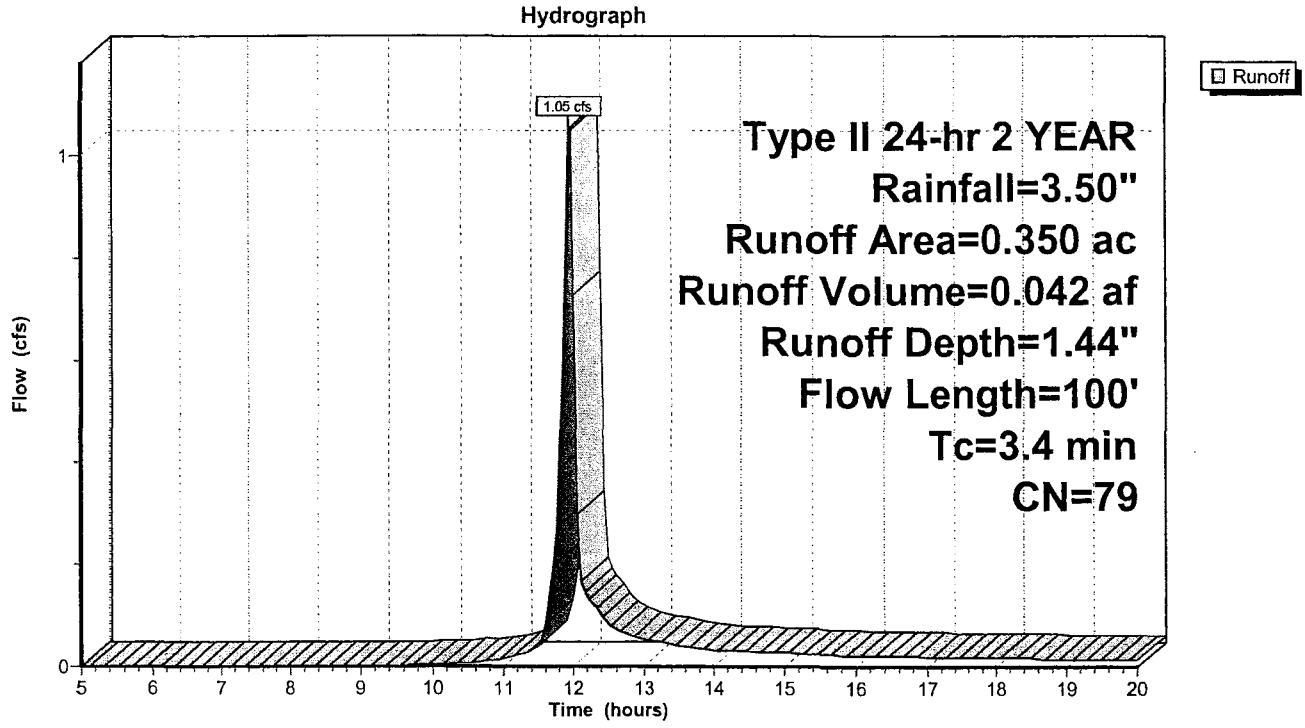
Runoff = 1.05 cfs @ 11.94 hrs, Volume= 0.042 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
0.350	79	50-75% Grass cover, Fair, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	100	0.3300	0.5		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Subcatchment C2-2B DA: POST DEVELOPMENT



Subcatchment C3-1 DA: DEVELOPED

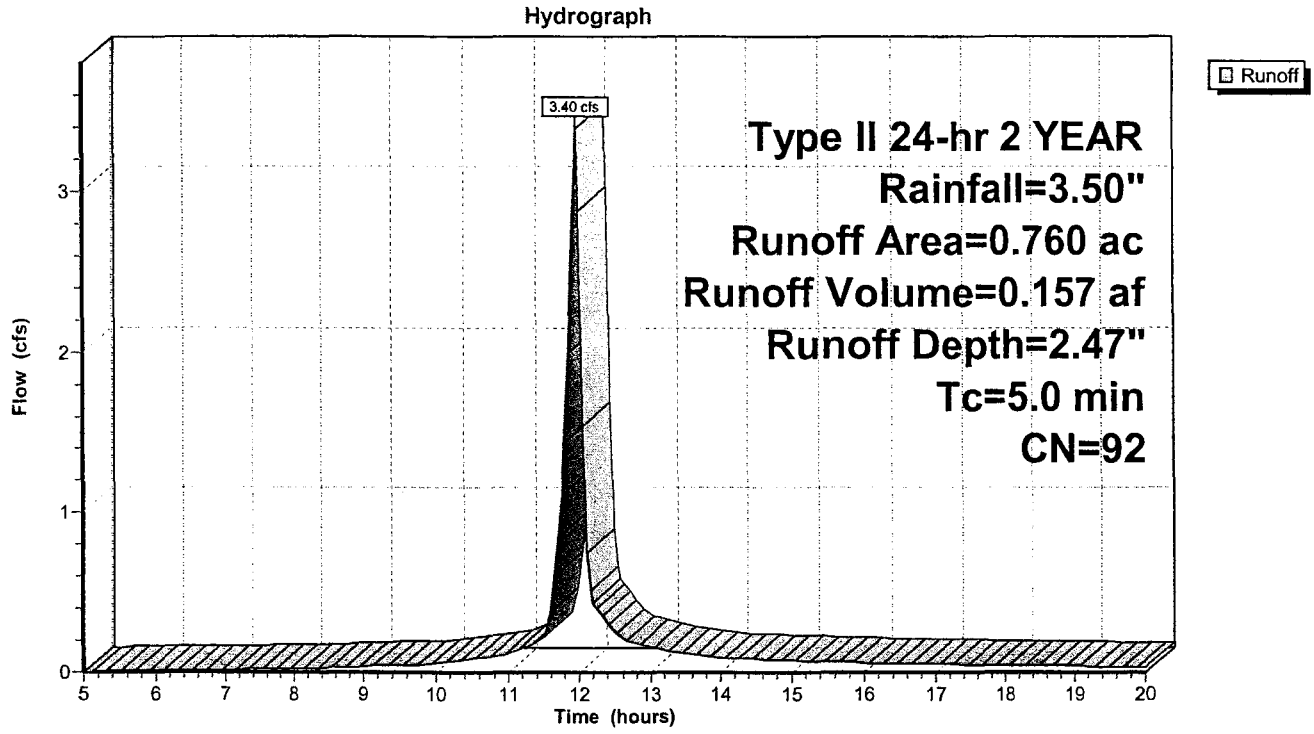
Runoff = 3.40 cfs @ 11.95 hrs, Volume= 0.157 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
0.760	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment C3-1 DA: DEVELOPED



Subcatchment C3-1A DA: DEVELOPED

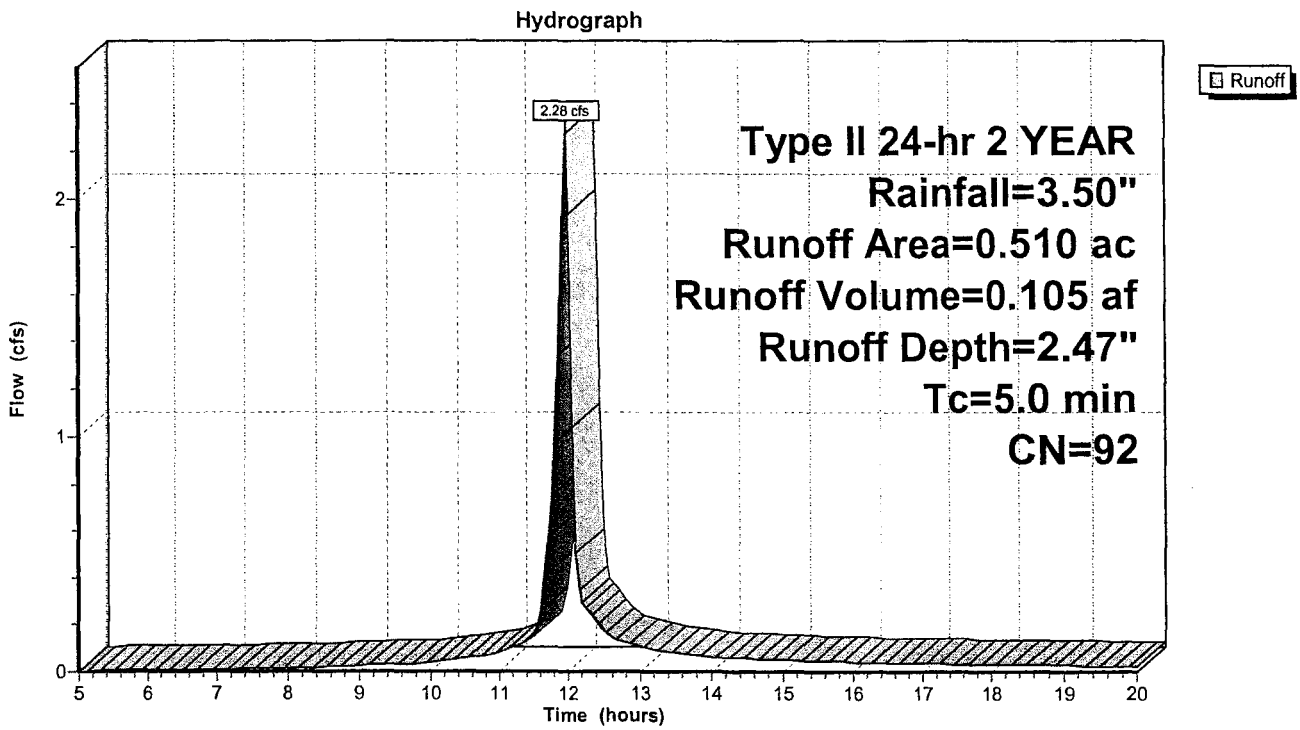
Runoff = 2.28 cfs @ 11.95 hrs, Volume= 0.105 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
0.510	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment C3-1A DA: DEVELOPED



Subcatchment D: POST DEV

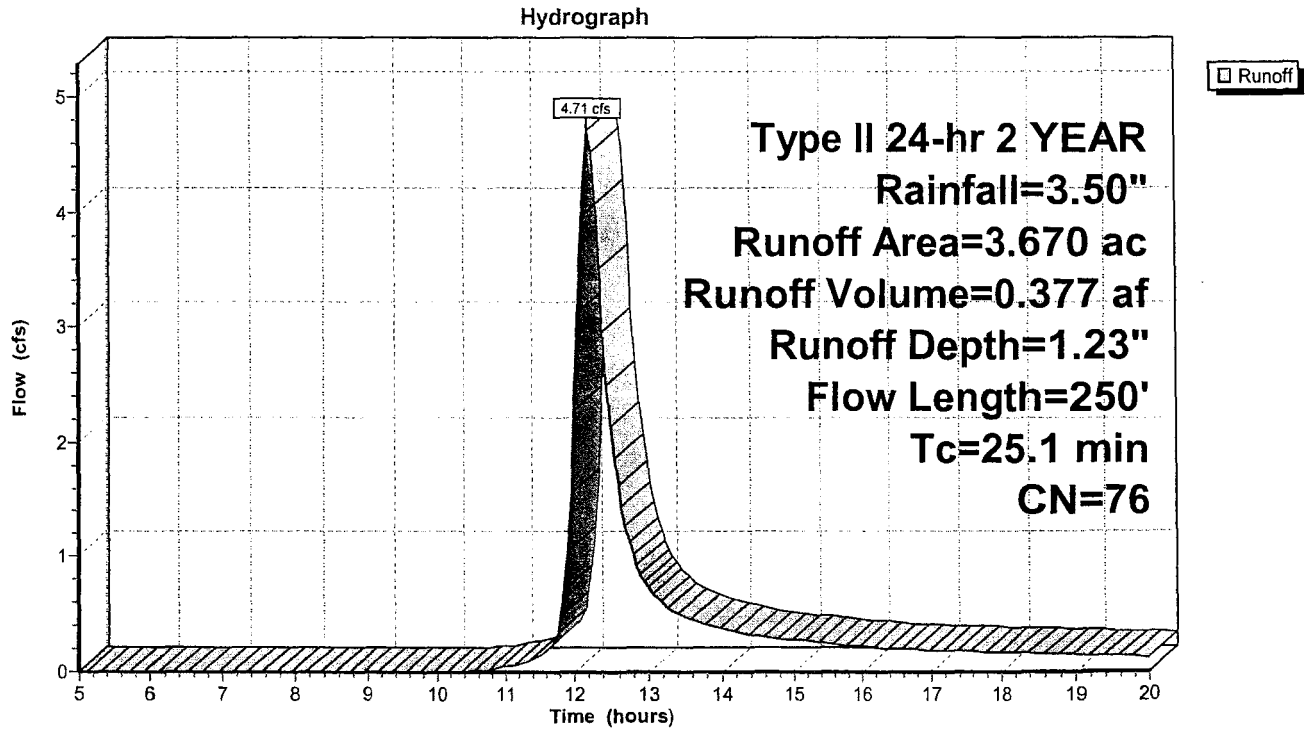
Runoff = 4.71 cfs @ 12.20 hrs, Volume= 0.377 af, Depth= 1.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
2.600	70	Woods, Good, HSG C
1.070	92	Paved roads w/open ditches, HSG C
3.670	76	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	150	0.0560	1.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.0	100	0.0200	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
25.1	250	Total			

Subcatchment D: POST DEV



Subcatchment D2: POST DEV

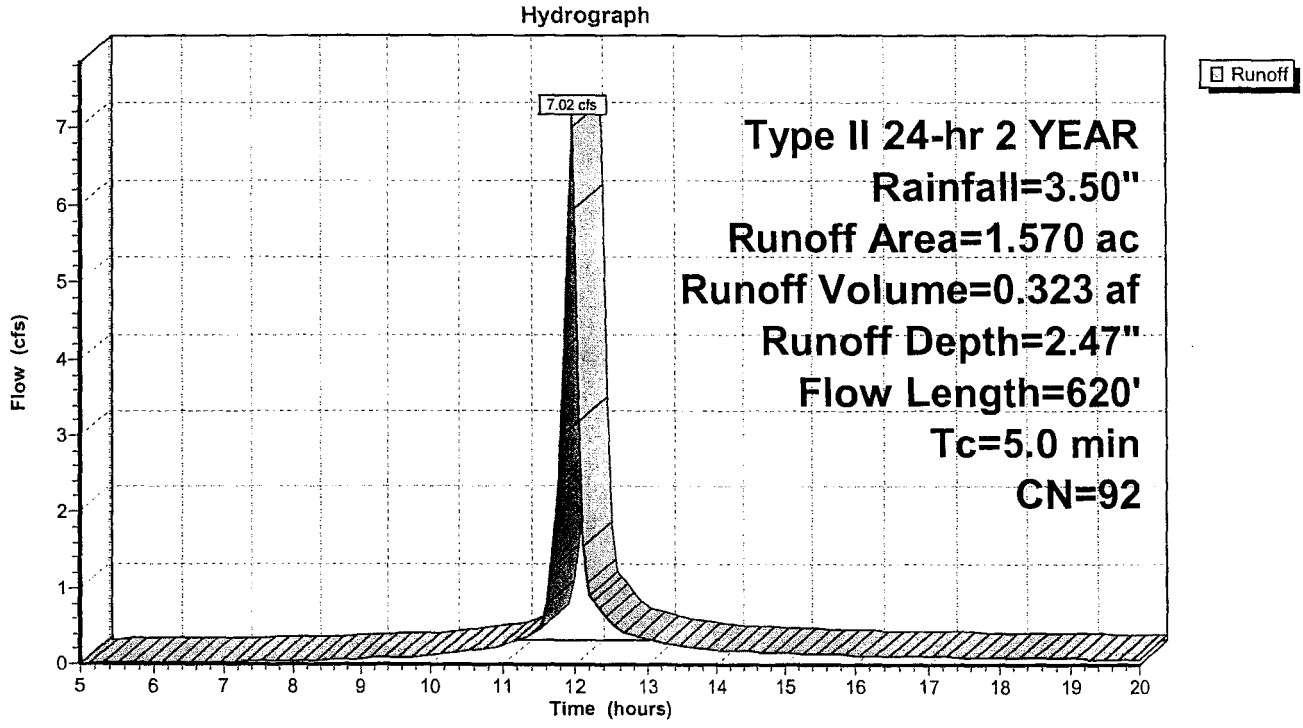
Runoff = 7.02 cfs @ 11.95 hrs, Volume= 0.323 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
1.570	92	Paved roads w/open ditches, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	40	0.3300	0.4		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.4	580	0.0232	2.8	14.07	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 6.0 & 4.0 '/' n= 0.050
5.0	620	Total			

Subcatchment D2: POST DEV



Subcatchment D3: POST DEV

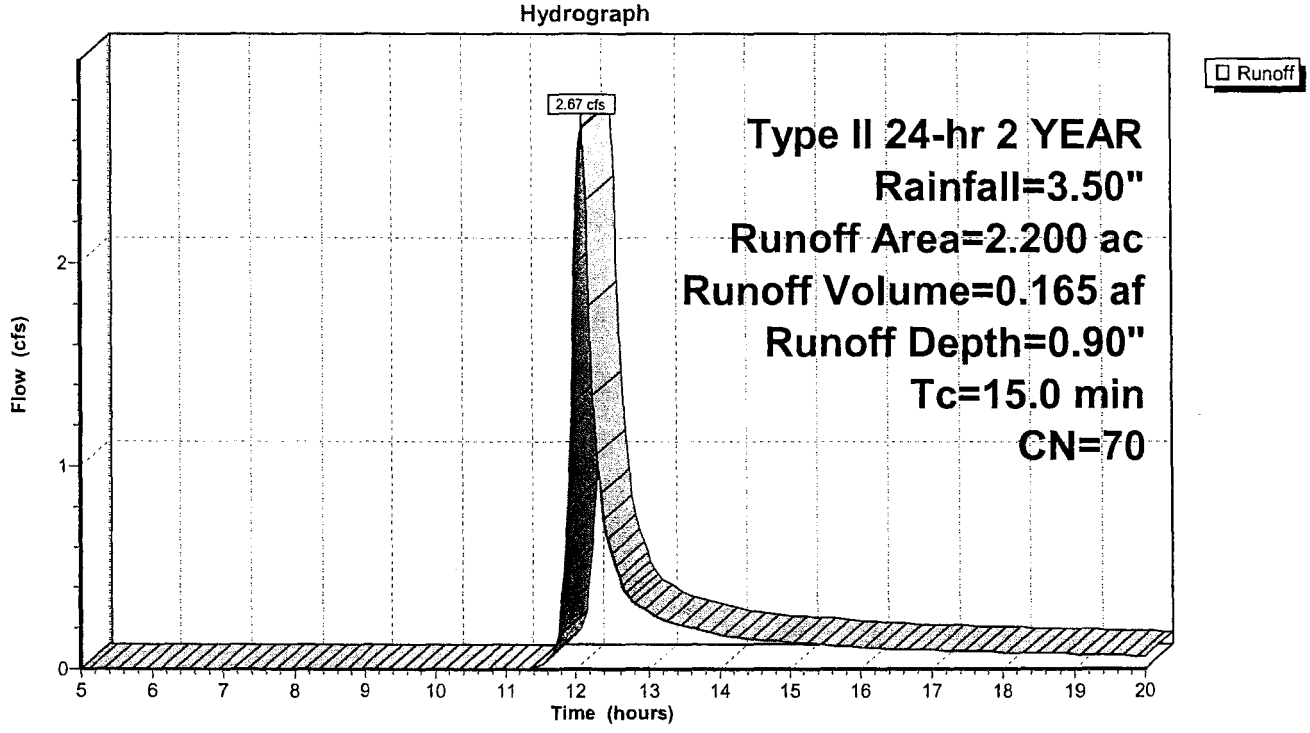
Runoff = 2.67 cfs @ 12.09 hrs, Volume= 0.165 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C
0.200	74	>75% Grass cover, Good, HSG C
2.200	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment D3: POST DEV



Subcatchment Post Dev: 1/3 Acre Lots

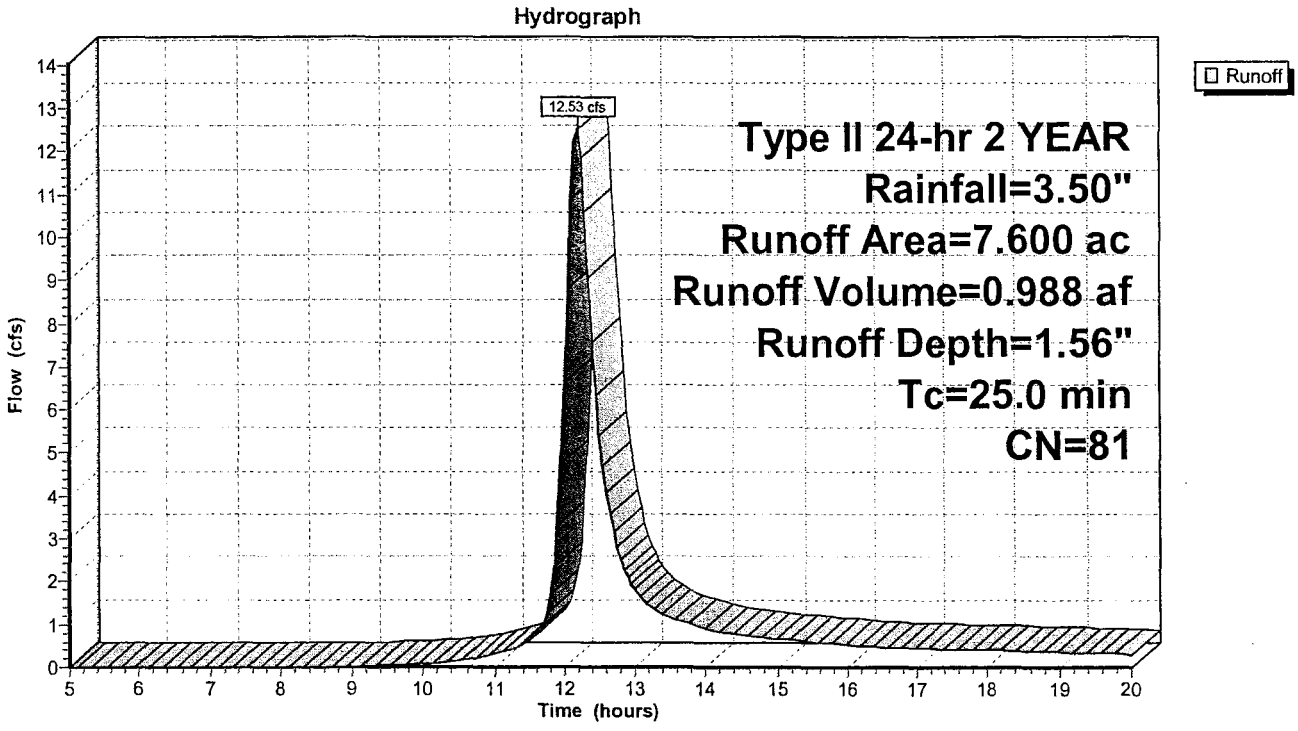
Runoff = 12.53 cfs @ 12.19 hrs, Volume= 0.988 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
7.600	81	1/3 acre lots, 30% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment Post Dev: 1/3 Acre Lots



Subcatchment S-1: S-1

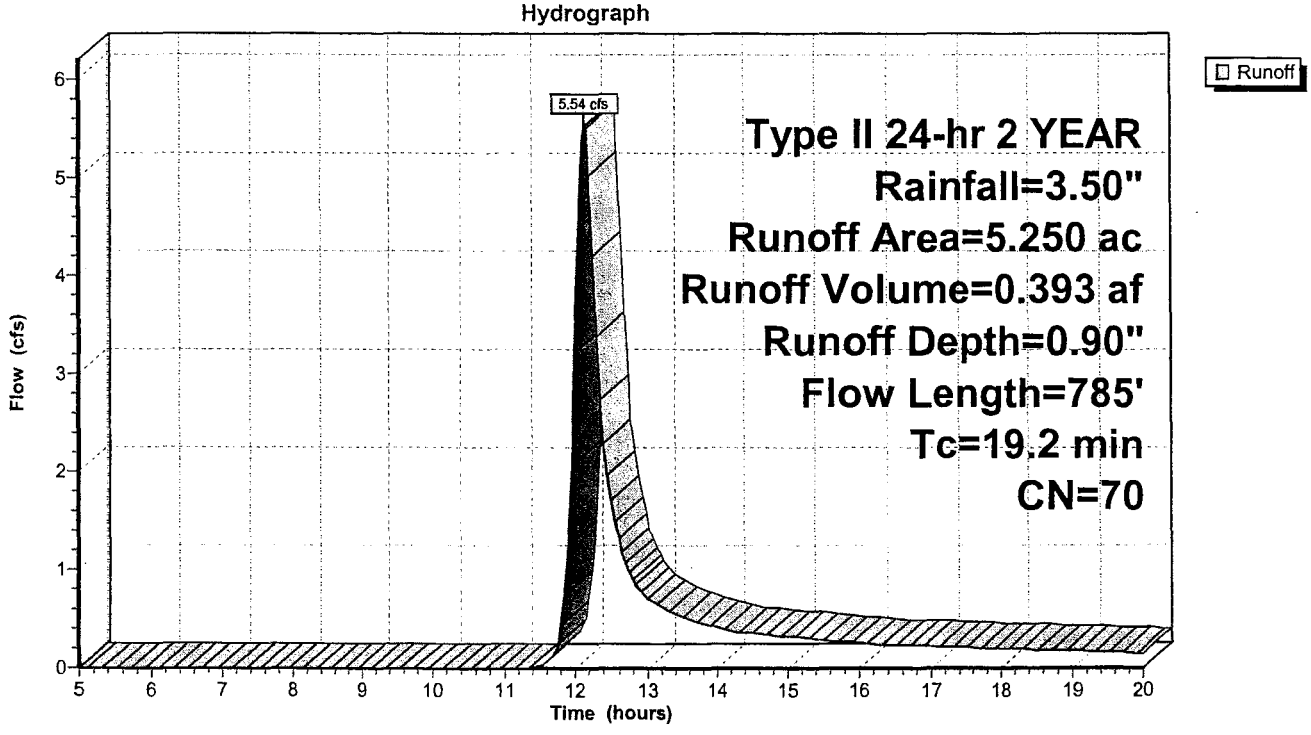
Runoff = 5.54 cfs @ 12.14 hrs, Volume= 0.393 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
5.100	70	Woods, Good, HSG C
0.150	81	1/3 acre lots, 30% imp, HSG C
5.250	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.0700	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
4.2	360	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	325	0.0800	5.0	33.64	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
19.2	785	Total			

Subcatchment S-1: S-1



Subcatchment S-2: POST DEVELOPED

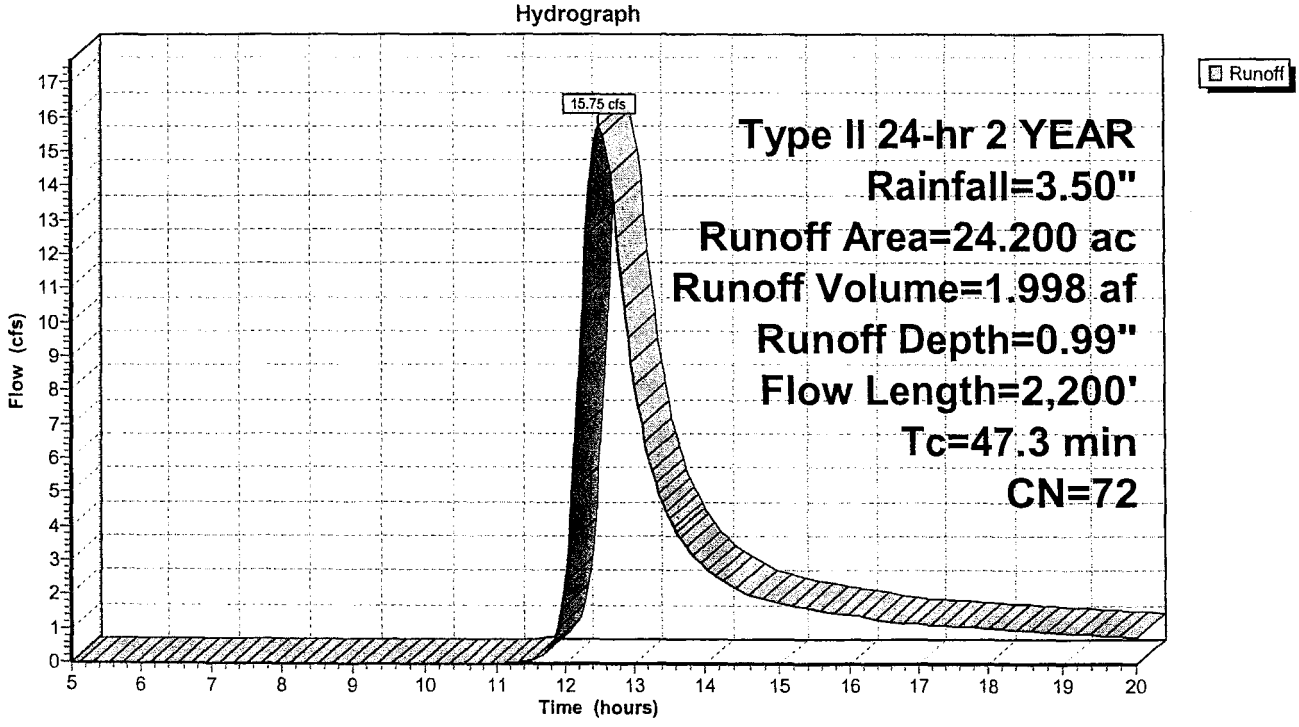
Runoff = 15.75 cfs @ 12.50 hrs, Volume= 1.998 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
20.100	70	Woods, Good, HSG C
4.100	81	1/3 acre lots, 30% imp, HSG C
24.200	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.1	300	0.0720	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
3.9	300	0.0670	1.3		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.3	1,600	0.0210	2.6	60.38	**Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040
47.3	2,200	Total			

Subcatchment S-2: POST DEVELOPED



Subcatchment S-3: POST DEVELOPED

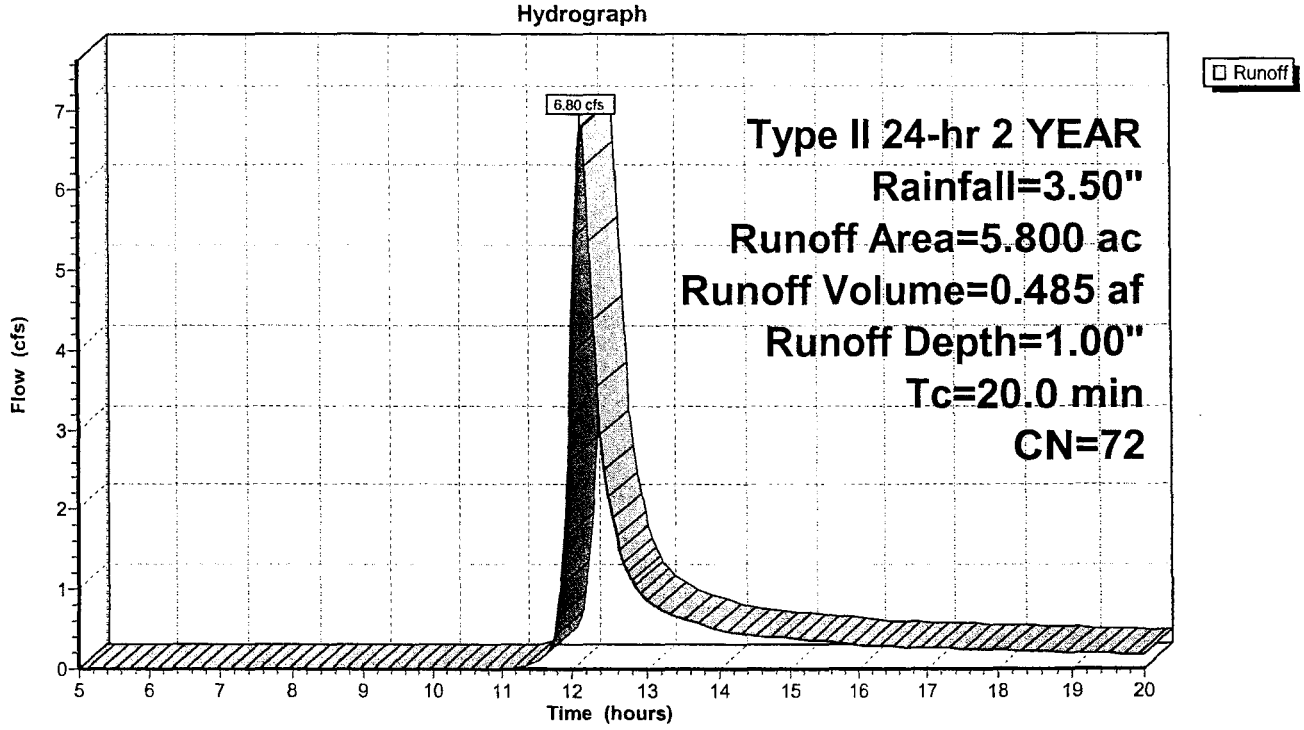
Runoff = 6.80 cfs @ 12.14 hrs, Volume= 0.485 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
4.600	70	Woods, Good, HSG C
1.200	81	1/3 acre lots, 30% imp, HSG C
5.800	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment S-3: POST DEVELOPED



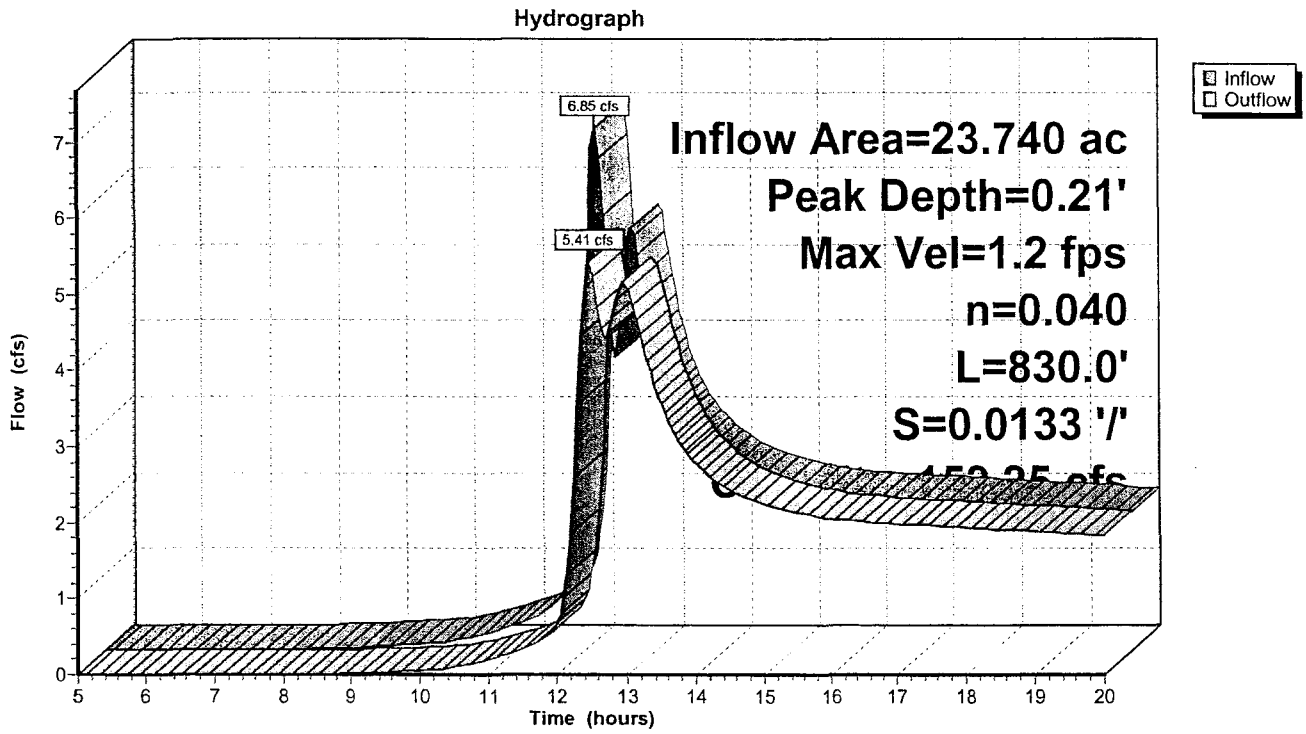
Reach R1: (new Reach)

Inflow Area = 23.740 ac, Inflow Depth = 0.89" for 2 YEAR event
Inflow = 6.85 cfs @ 12.14 hrs, Volume= 1.766 af
Outflow = 5.41 cfs @ 12.47 hrs, Volume= 1.695 af, Atten= 21%, Lag= 19.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 11.8 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 20.3 min

Peak Depth= 0.21' @ 12.27 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

Reach R1: (new Reach)



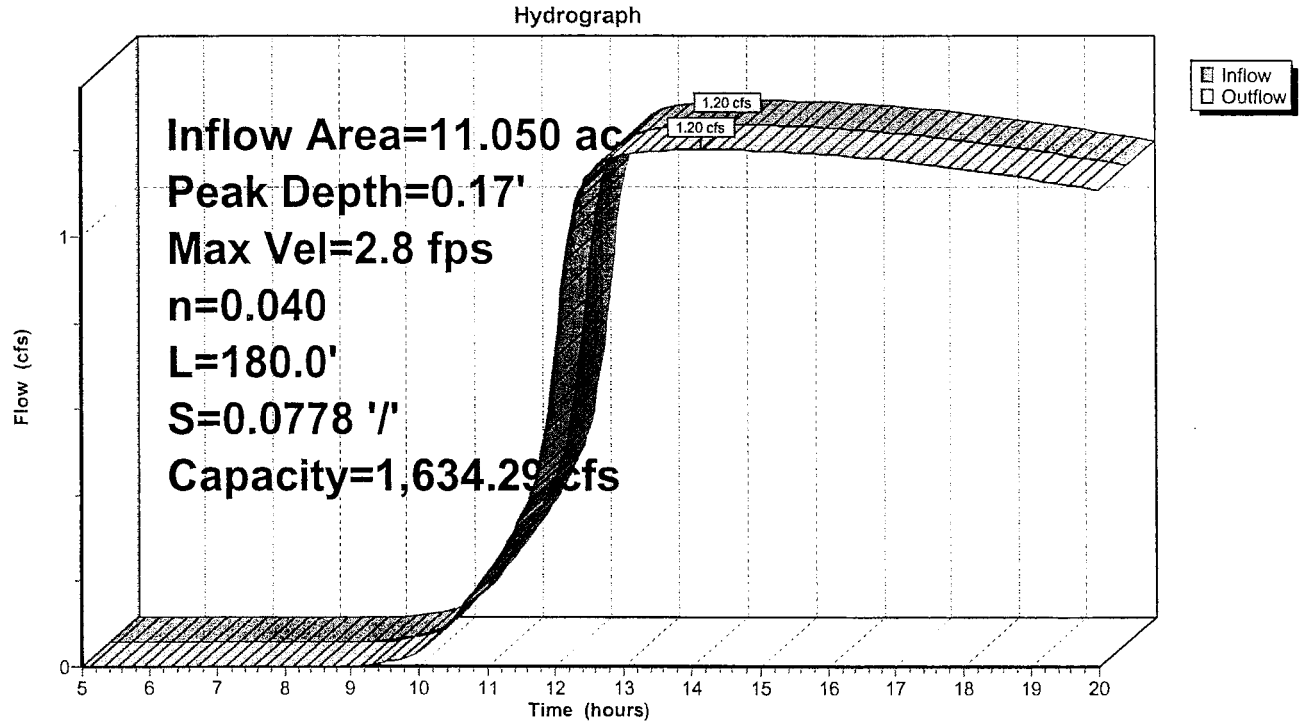
Reach R1A: (new Reach)

Inflow Area = 11.050 ac, Inflow Depth = 0.89" for 2 YEAR event
Inflow = 1.20 cfs @ 14.12 hrs, Volume= 0.817 af
Outflow = 1.20 cfs @ 14.15 hrs, Volume= 0.814 af, Atten= 0%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.4 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.17' @ 14.13 hrs
Capacity at bank full= 1,634.29 cfs
Inlet Invert= 68.00', Outlet Invert= 54.00'
2.00' x 5.00' deep channel, n= 0.040 Length= 180.0' Slope= 0.0778 '/'
Side Slope Z-value= 3.0 '/'

Reach R1A: (new Reach)



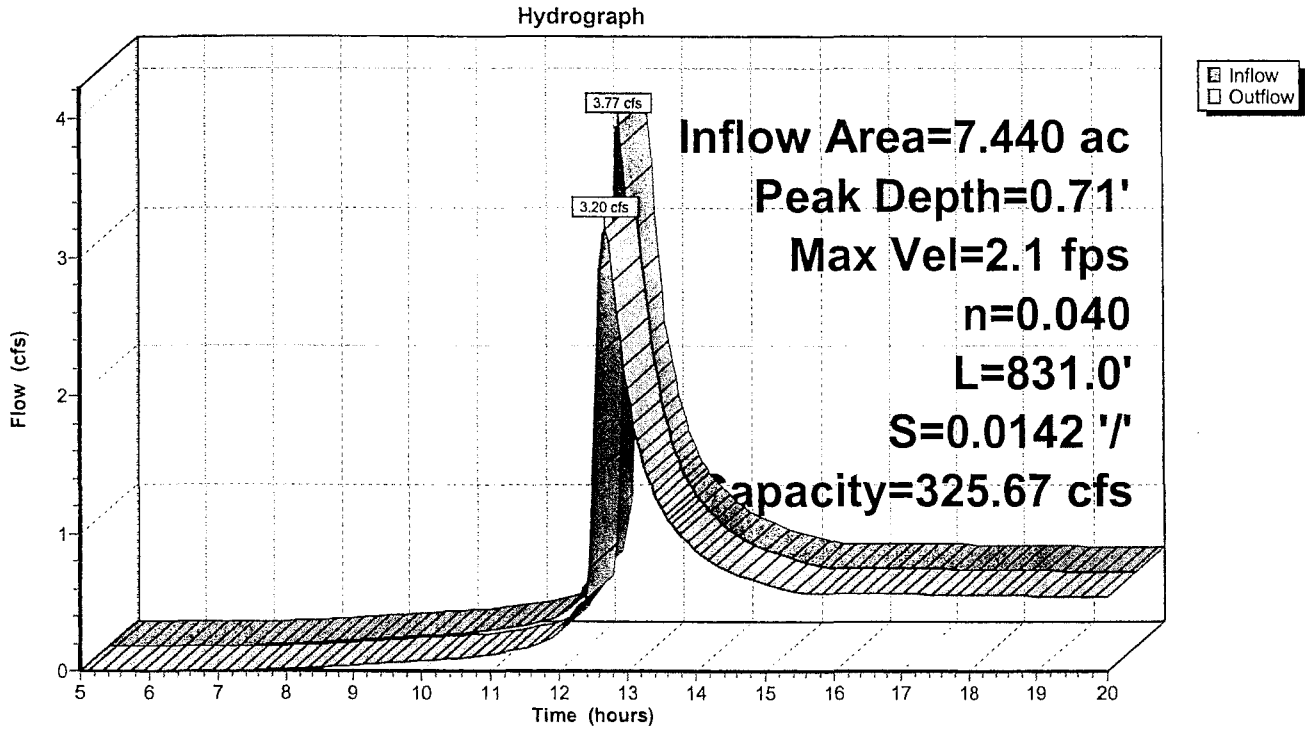
Reach R1B: (new Reach)

Inflow Area = 7.440 ac, Inflow Depth = 0.92" for 2 YEAR event
Inflow = 3.77 cfs @ 12.46 hrs, Volume= 0.572 af
Outflow = 3.20 cfs @ 12.68 hrs, Volume= 0.559 af, Atten= 15%, Lag= 13.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.1 fps, Min. Travel Time= 6.5 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 11.6 min

Peak Depth= 0.71' @ 12.57 hrs
Capacity at bank full= 325.67 cfs
Inlet Invert= 67.80', Outlet Invert= 56.00'
0.00' x 4.00' deep channel, n= 0.040 Length= 831.0' Slope= 0.0142 '/'
Side Slope Z-value= 3.0 '/'

Reach R1B: (new Reach)



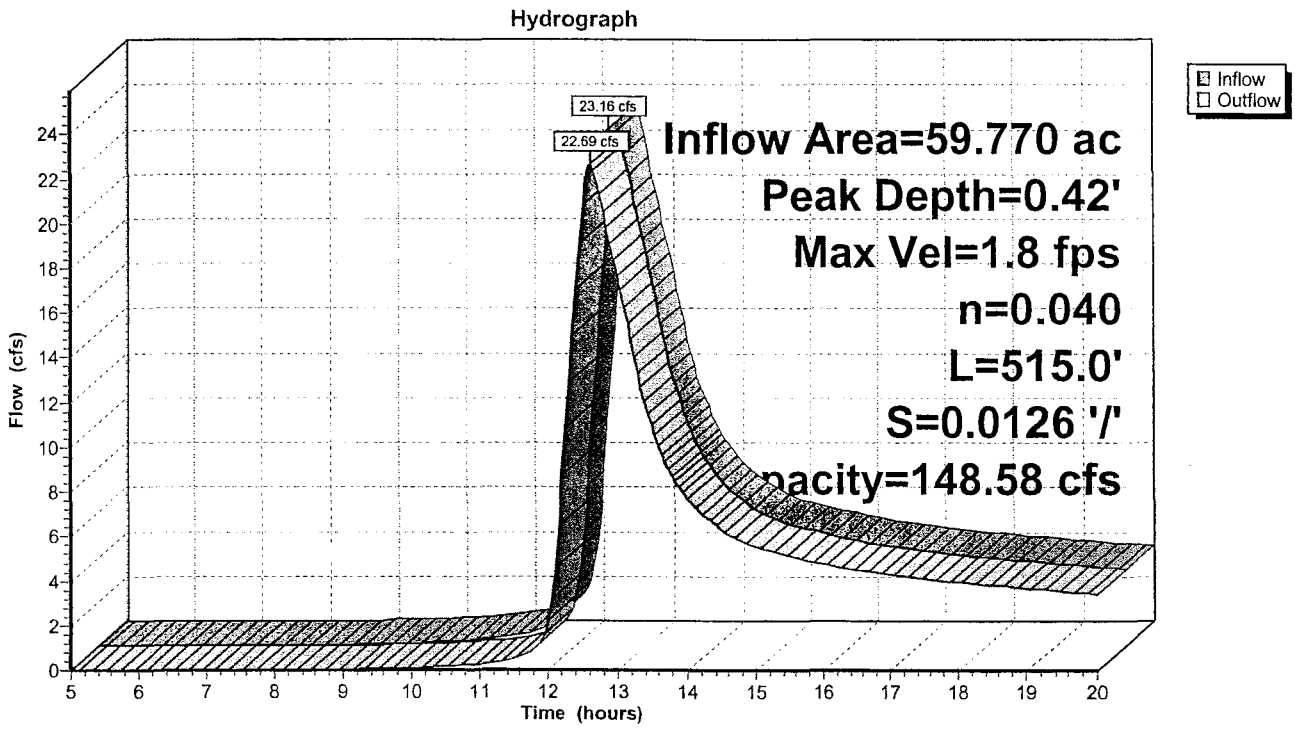
Reach R2: (new Reach)

Inflow Area = 59.770 ac, Inflow Depth = 0.94" for 2 YEAR event
Inflow = 23.16 cfs @ 12.47 hrs, Volume= 4.705 af
Outflow = 22.69 cfs @ 12.62 hrs, Volume= 4.642 af, Atten= 2%, Lag= 8.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 4.8 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 11.1 min

Peak Depth= 0.42' @ 12.54 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

Reach R2: (new Reach)



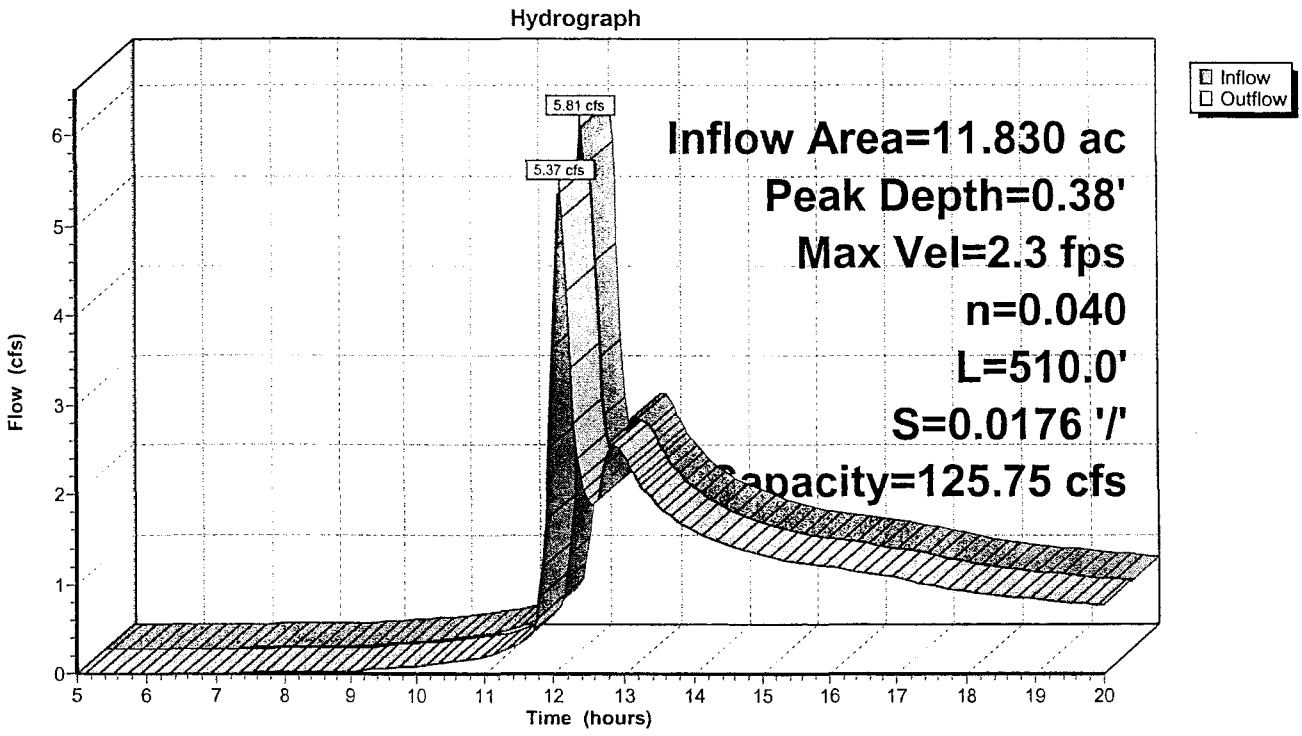
Reach R2A: (new Reach)

Inflow Area = 11.830 ac, Inflow Depth = 1.04" for 2 YEAR event
Inflow = 5.81 cfs @ 12.01 hrs, Volume= 1.024 af
Outflow = 5.37 cfs @ 12.11 hrs, Volume= 1.013 af, Atten= 8%, Lag= 6.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.3 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 8.6 min

Peak Depth= 0.38' @ 12.05 hrs
Capacity at bank full= 125.75 cfs
Inlet Invert= 52.00', Outlet Invert= 43.00'
5.00' x 2.00' deep channel, n= 0.040 Length= 510.0' Slope= 0.0176 '/'
Side Slope Z-value= 3.0 '/'

Reach R2A: (new Reach)



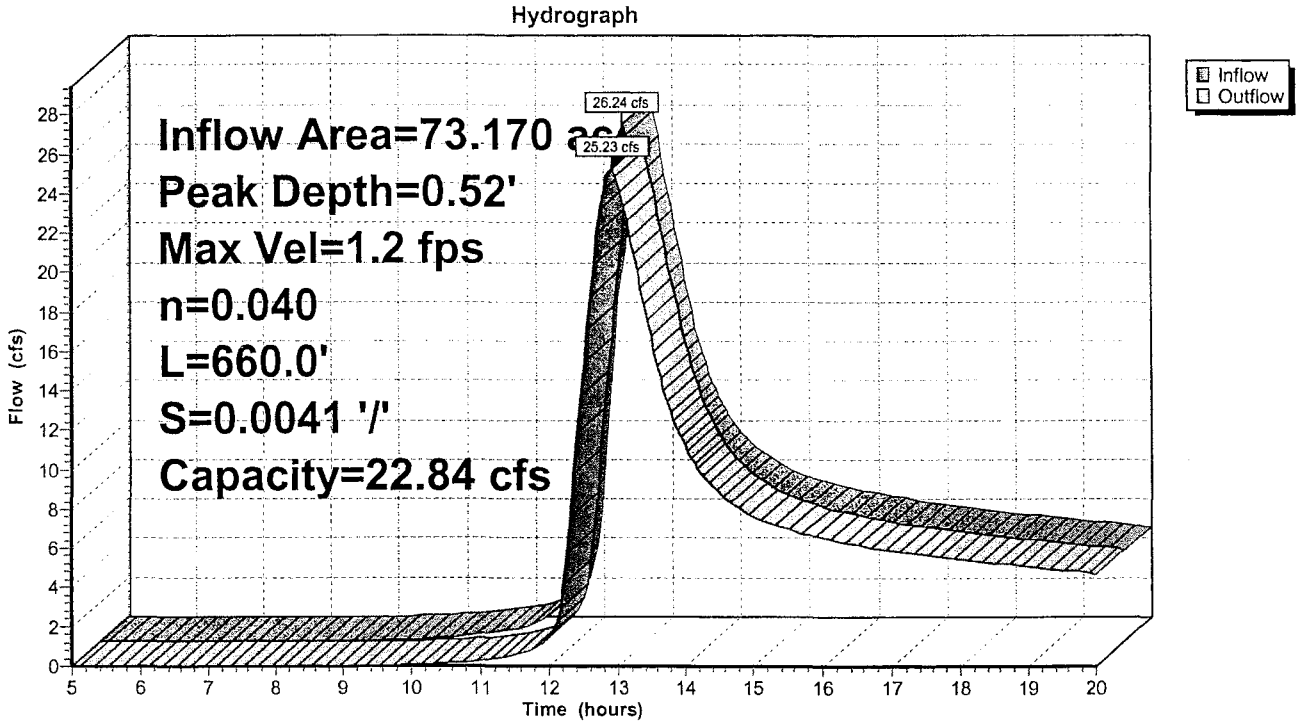
Reach R3: (new Reach)

Inflow Area = 73.170 ac, Inflow Depth = 0.99" for 2 YEAR event
Inflow = 26.24 cfs @ 12.67 hrs, Volume= 6.017 af
Outflow = 25.23 cfs @ 12.92 hrs, Volume= 5.856 af, Atten= 4%, Lag= 14.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 9.4 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 20.9 min

Peak Depth= 0.52' @ 12.76 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

Reach R3: (new Reach)



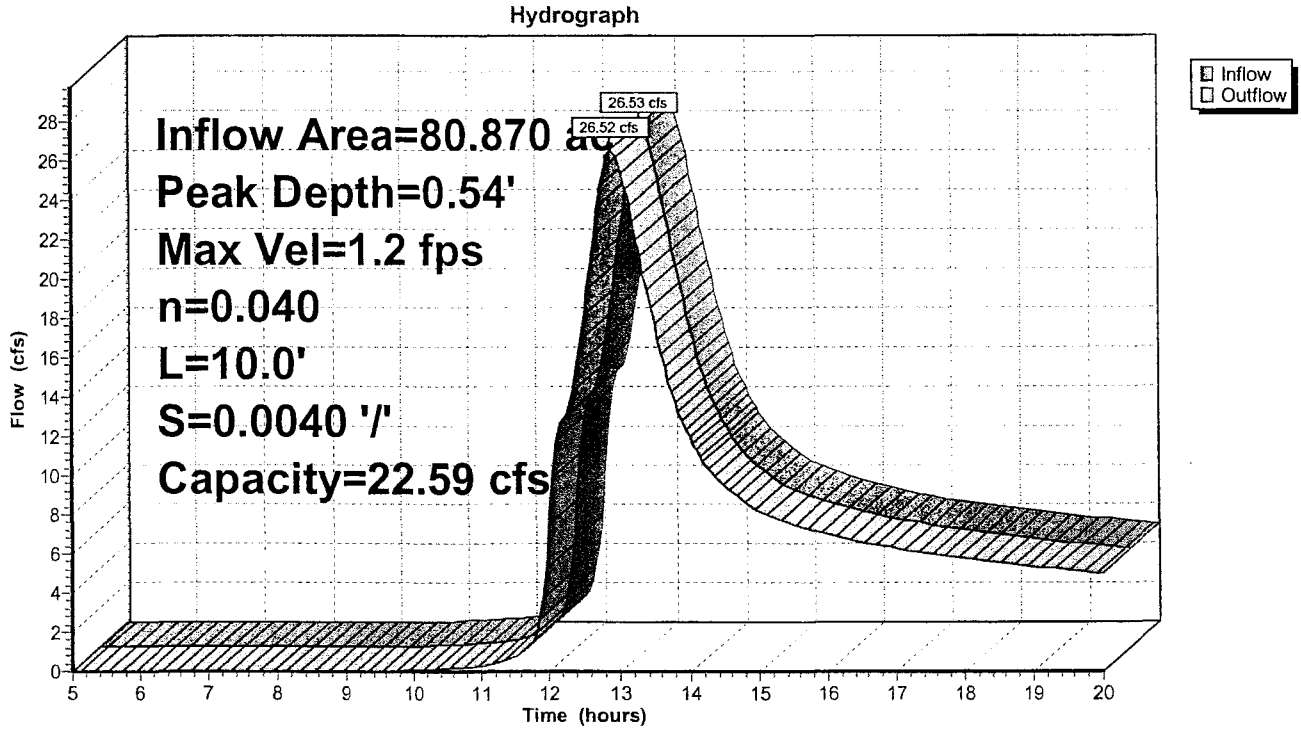
Reach R4: (new Reach)

Inflow Area = 80.870 ac, Inflow Depth = 0.97" for 2 YEAR event
Inflow = 26.53 cfs @ 12.91 hrs, Volume= 6.536 af
Outflow = 26.52 cfs @ 12.91 hrs, Volume= 6.534 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.54' @ 12.91 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

Reach R4: (new Reach)



Pond BMP - 1: BMP #1

Inflow Area = 11.050 ac, Inflow Depth = 1.56" for 2 YEAR event
Inflow = 20.80 cfs @ 12.13 hrs, Volume= 1.439 af
Outflow = 1.20 cfs @ 14.12 hrs, Volume= 0.817 af, Atten= 94%, Lag= 119.1 min
Primary = 1.20 cfs @ 14.12 hrs, Volume= 0.817 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.35' @ 14.12 hrs Surf.Area= 9,195 sf Storage= 37,151 cf
Plug-Flow detention time= 221.8 min calculated for 0.817 af (57% of inflow)
Center-of-Mass det. time= 144.6 min (944.6 - 800.0)

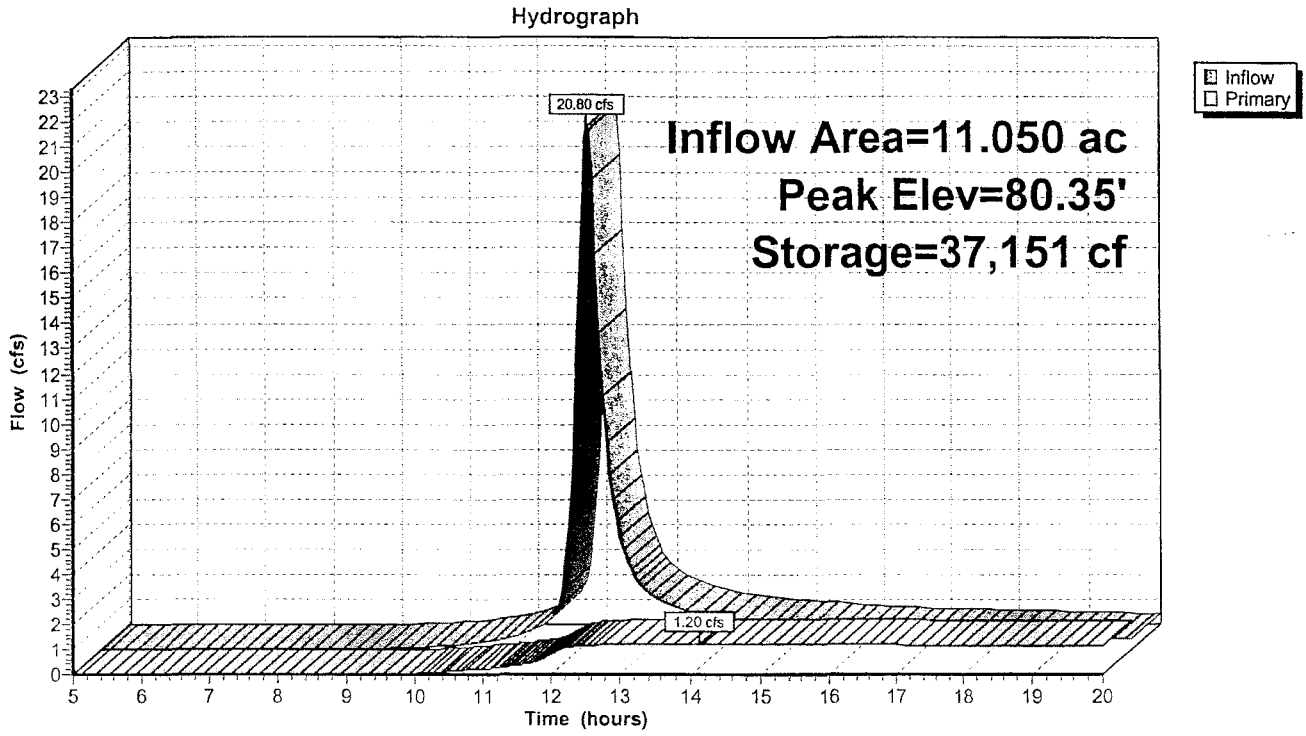
#	Invert	Avail.Storage	Storage Description
1	72.00'	67,503 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
72.00	978	0	0
74.00	2,170	3,148	3,148
76.00	3,836	6,006	9,154
78.00	5,977	9,813	18,967
80.00	8,661	14,638	33,605
82.00	11,732	20,393	53,998
83.00	15,277	13,505	67,503

#	Routing	Invert	Outlet Devices
1	Primary	67.84'	**30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900
2	Device 1	72.00'	**4.0" Vert. 4" Orifice** C= 0.600
3	Device 1	80.64'	**60.0" Horiz. Orifice** Limited to weir flow C= 0.600

Primary OutFlow Max=1.20 cfs @ 14.12 hrs HW=80.35' (Free Discharge)
└─**1=Culvert** (Passes 1.20 cfs of 79.30 cfs potential flow)
  ├─**2=4" Orifice** (Orifice Controls 1.20 cfs @ 13.8 fps)
  └─**3=Orifice** (Controls 0.00 cfs)

Pond BMP - 1: BMP #1



Pond BMP-3: Basin 3

Inflow Area = 7.600 ac, Inflow Depth = 1.56" for 2 YEAR event
Inflow = 12.53 cfs @ 12.19 hrs, Volume= 0.988 af
Outflow = 2.79 cfs @ 12.76 hrs, Volume= 0.889 af, Atten= 78%, Lag= 34.3 min
Primary = 2.79 cfs @ 12.76 hrs, Volume= 0.889 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 59.70' @ 12.76 hrs Surf.Area= 5,437 sf Storage= 19,736 cf
Plug-Flow detention time= 153.4 min calculated for 0.889 af (90% of inflow)
Center-of-Mass det. time= 120.6 min (924.5 - 803.9)

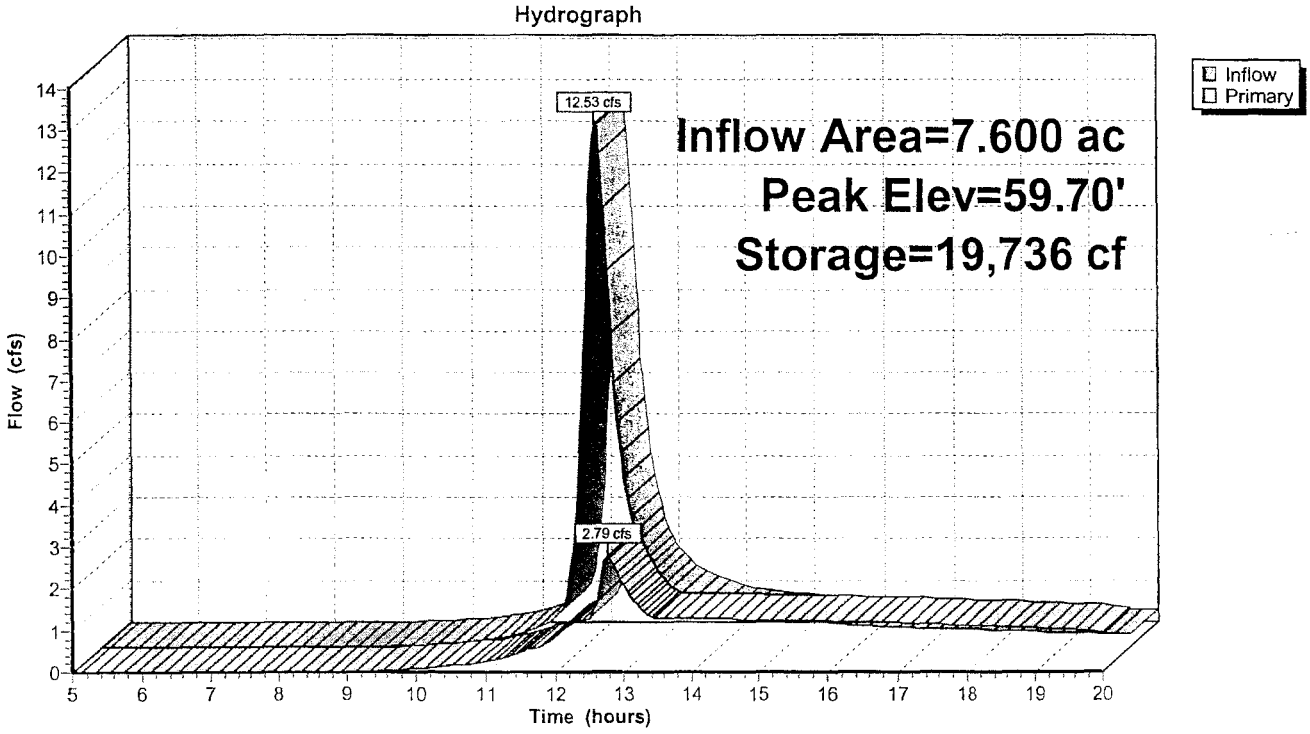
#	Invert	Avail.Storage	Storage Description
1	50.00'	34,833 cf	**Custom Stage Data (Pyramidal)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
50.00	0	0	0	0
52.00	450	300	300	458
54.00	1,230	1,616	1,916	1,270
56.00	2,375	3,543	5,459	2,463
58.00	3,858	6,173	11,632	4,011
60.00	5,710	9,508	21,140	5,943
62.00	8,050	13,693	34,833	8,374

#	Routing	Invert	Outlet Devices
1	Primary	42.40'	**24.0" x 85.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 39.85' S= 0.0300 '/' n= 0.012 Cc= 0.900
2	Device 1	50.00'	**4.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	59.60'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=2.67 cfs @ 12.76 hrs HW=59.70' (Free Discharge)
└─**1=Culvert** (Passes 2.67 cfs of 61.08 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.30 cfs @ 14.9 fps)
  └─**3=Orifice/Grate** (Weir Controls 1.37 cfs @ 1.1 fps)

Pond BMP-3: Basin 3



Pond C1: POND C1

Inflow Area =	2.530 ac,	Inflow Depth =	1.50"	for	2 YEAR event
Inflow =	5.11 cfs @	12.01 hrs,	Volume=	0.317 af	
Outflow =	0.47 cfs @	12.85 hrs,	Volume=	0.279 af,	Atten= 91%, Lag= 50.6 min
Primary =	0.47 cfs @	12.85 hrs,	Volume=	0.279 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 75.14' @ 12.85 hrs Surf.Area= 2,363 sf Storage= 6,865 cf
Plug-Flow detention time= 171.5 min calculated for 0.279 af (88% of inflow)
Center-of-Mass det. time= 131.7 min (913.2 - 781.4)

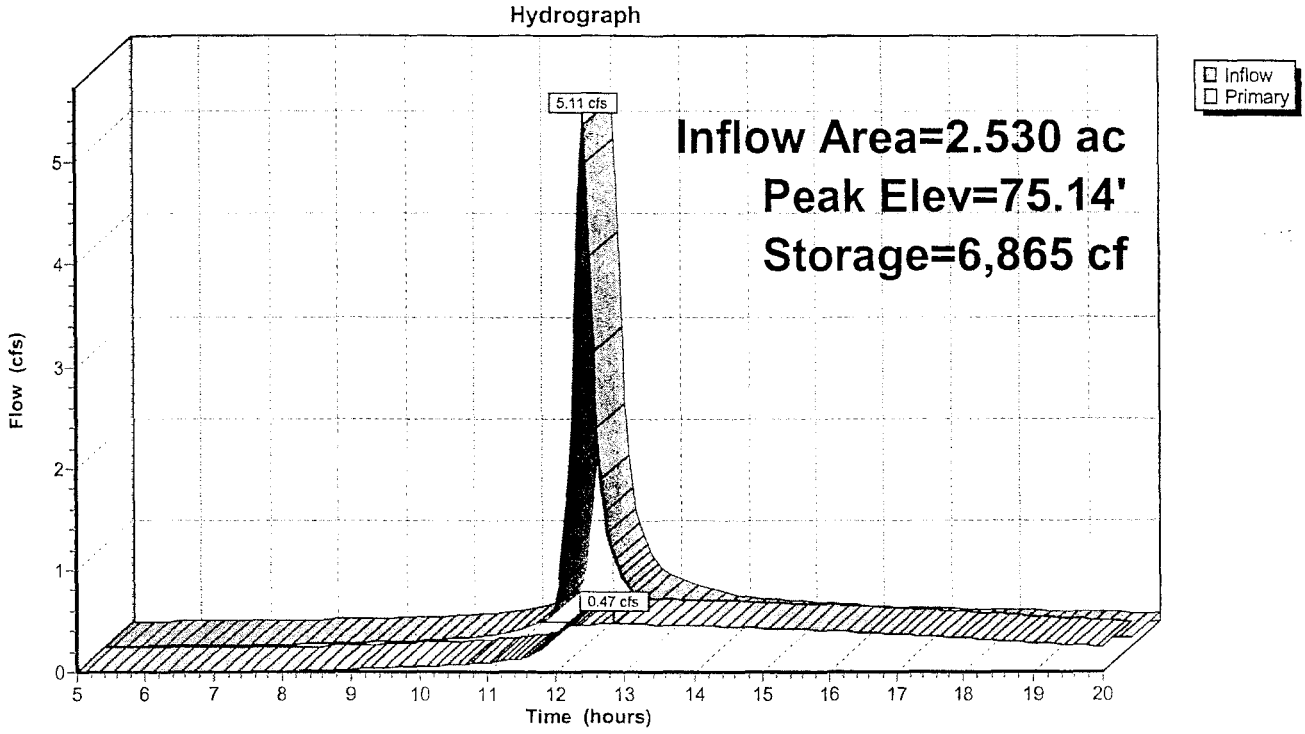
#	Invert	Avail.Storage	Storage Description
1	71.00'	15,442 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
71.00	1,007	0	0
72.00	1,285	1,146	1,146
74.00	1,915	3,200	4,346
75.50	2,505	3,315	7,661
76.00	2,780	1,321	8,982
78.00	3,680	6,460	15,442

#	Routing	Invert	Outlet Devices
1	Primary	71.00'	**24.0" x 47.0' long Culvert** RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 70.50' S= 0.0106 '/' n= 0.013 Cc= 0.900
2	Device 1	75.25'	**2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Device 1	71.10'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.47 cfs @ 12.85 hrs HW=75.14' (Free Discharge)
└─**1=Culvert** (Passes 0.47 cfs of 23.65 cfs potential flow)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.47 cfs @ 9.5 fps)

Pond C1: POND C1



Pond C2: POND C2

Inflow Area =	2.000 ac,	Inflow Depth =	0.90"	for	2 YEAR event
Inflow =	1.79 cfs @	12.21 hrs,	Volume=	0.149 af	
Outflow =	0.37 cfs @	12.88 hrs,	Volume=	0.147 af,	Atten= 79%, Lag= 40.5 min
Primary =	0.37 cfs @	12.88 hrs,	Volume=	0.147 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.74' @ 12.88 hrs Surf.Area= 1,542 sf Storage= 2,449 cf
Plug-Flow detention time= 72.2 min calculated for 0.146 af (98% of inflow)
Center-of-Mass det. time= 65.4 min (893.2 - 827.8)

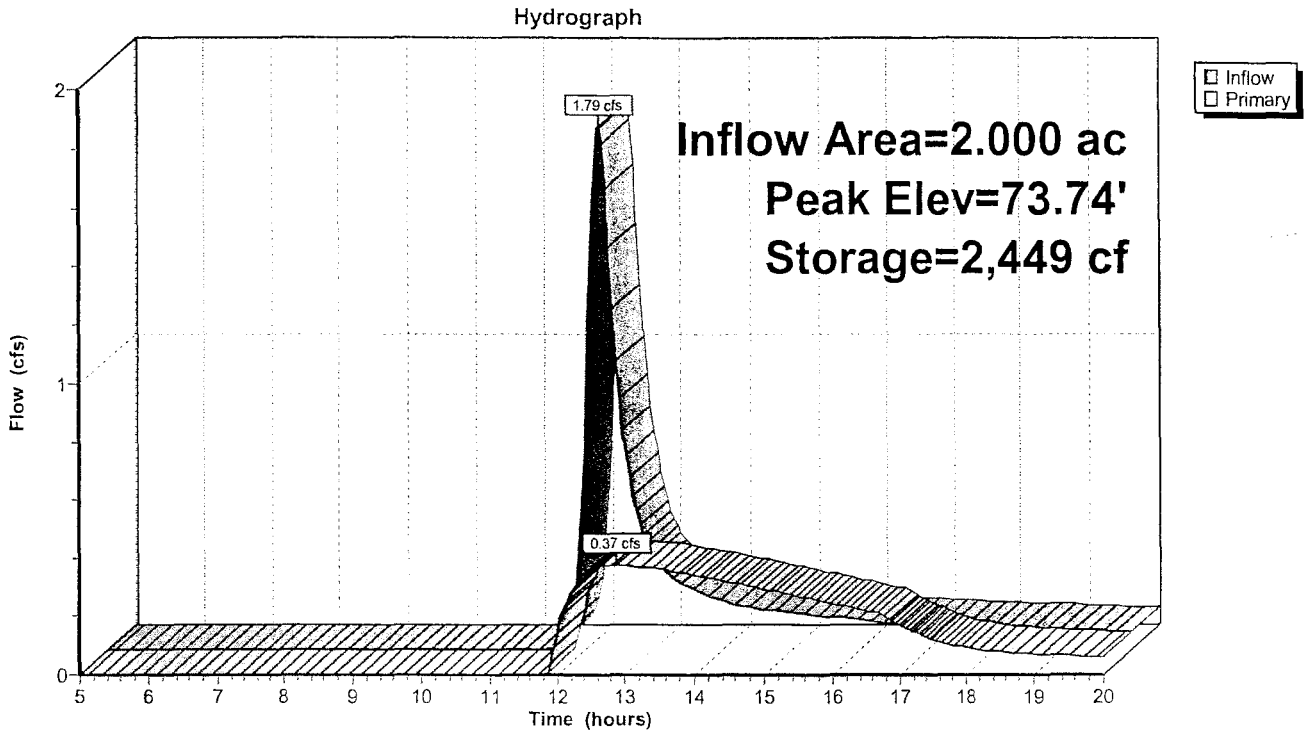
#	Invert	Avail.Storage	Storage Description
1	71.00'	26,524 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
71.00	117	0	0
72.00	685	401	401
74.00	1,670	2,355	2,756
76.00	3,000	4,670	7,426
78.00	4,667	7,667	15,093
80.00	6,764	11,431	26,524

#	Routing	Invert	Outlet Devices
1	Primary	68.06'	**24.0" x 45.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.31' S= 0.0167 '/' n= 0.013 Cc= 0.900
2	Device 1	71.10'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	77.00'	**2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.37 cfs @ 12.88 hrs HW=73.74' (Free Discharge)
└─**1=Culvert** (Passes 0.37 cfs of 32.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.37 cfs @ 7.6 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond C2: POND C2



Pond C2-2: 30" RCP

Inflow Area =	11.000 ac,	Inflow Depth =	0.97"	for	2 YEAR event
Inflow =	3.41 cfs @	12.03 hrs,	Volume=	0.885 af	
Outflow =	3.41 cfs @	12.04 hrs,	Volume=	0.884 af,	Atten= 0%, Lag= 0.5 min
Primary =	3.41 cfs @	12.04 hrs,	Volume=	0.884 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 65.78' @ 12.04 hrs Surf.Area= 313 sf Storage= 157 cf
Plug-Flow detention time= 1.4 min calculated for 0.884 af (100% of inflow)
Center-of-Mass det. time= 0.8 min (897.7 - 896.9)

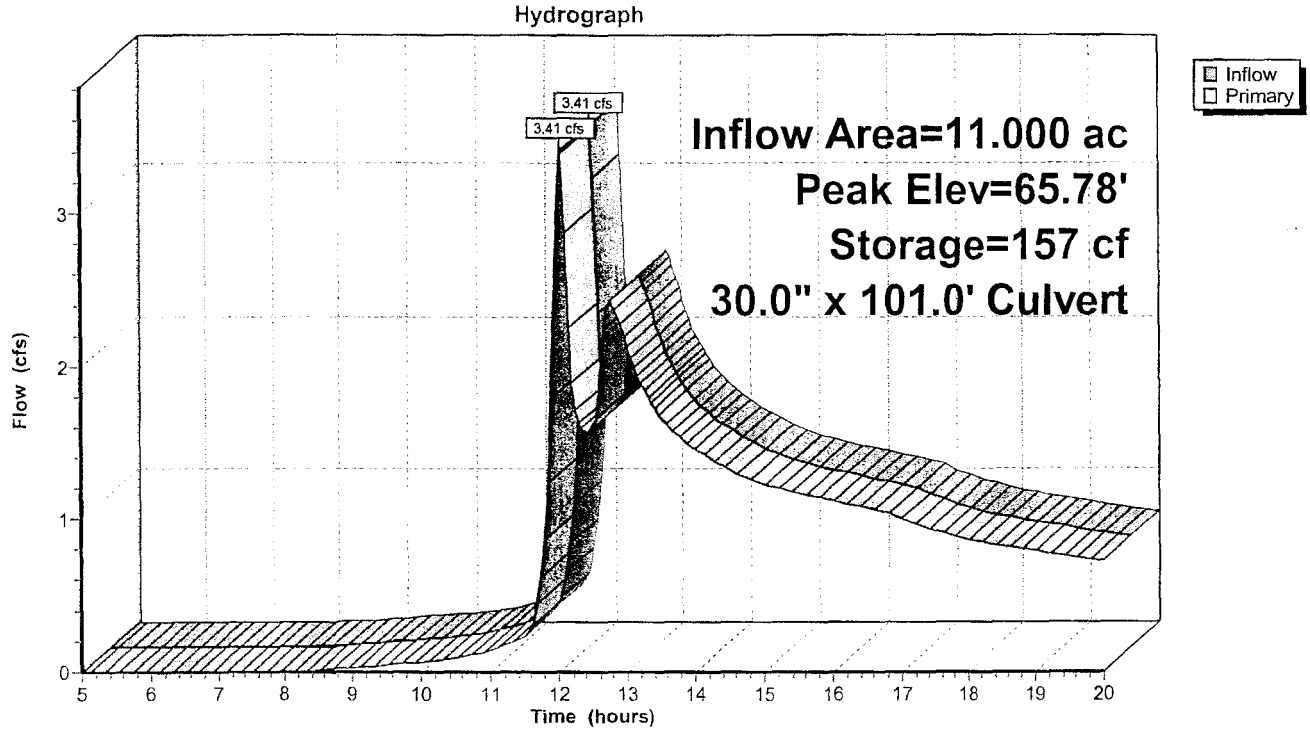
#	Invert	Avail.Storage	Storage Description
1	65.00'	13,000 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
65.00	0	0	0
66.00	400	200	200
68.00	2,400	2,800	3,000
70.00	7,600	10,000	13,000

#	Routing	Invert	Outlet Devices
1	Primary	65.06'	**30.0" x 101.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 64.00' S= 0.0105 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=3.34 cfs @ 12.04 hrs HW=65.78' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.34 cfs @ 2.9 fps)

Pond C2-2: 30" RCP



Pond C2-2B: MH C2-2B

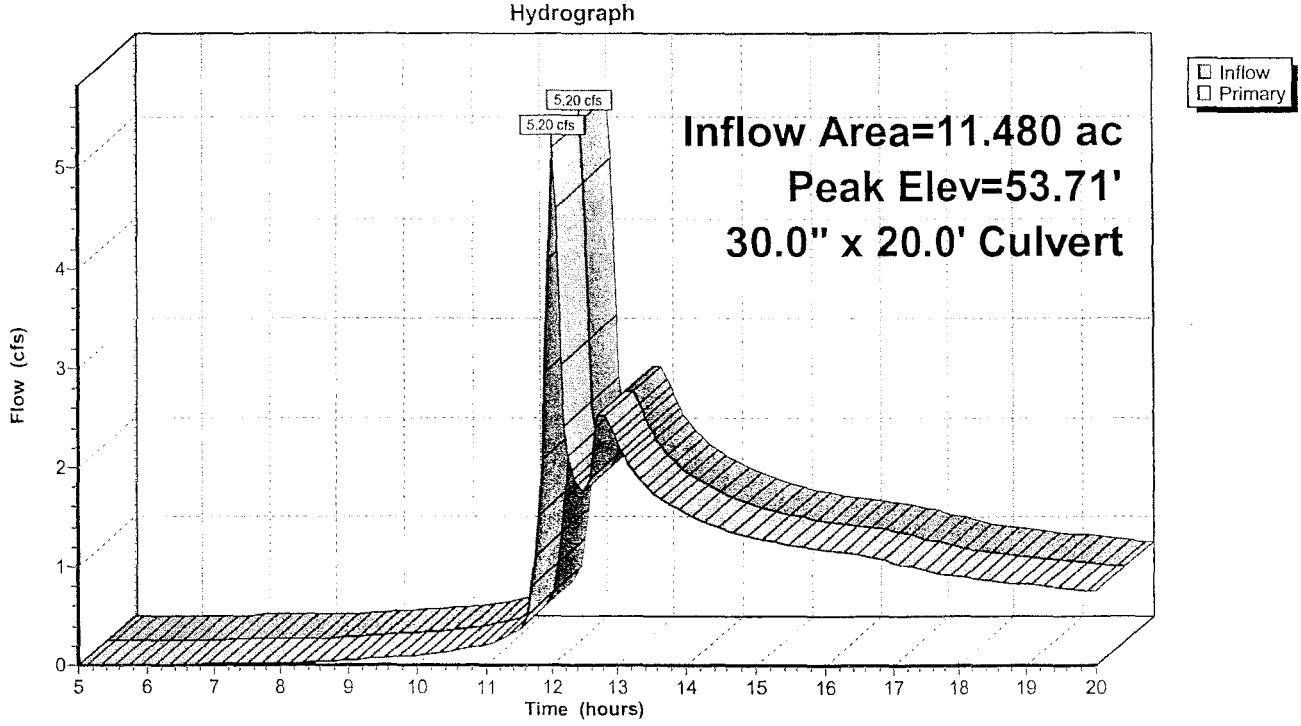
Inflow Area =	11.480 ac,	Inflow Depth =	1.03"	for	2 YEAR event
Inflow =	5.20 cfs @	12.03 hrs,	Volume=	0.982 af	
Outflow =	5.20 cfs @	12.03 hrs,	Volume=	0.982 af,	Atten= 0%, Lag= 0.0 min
Primary =	5.20 cfs @	12.03 hrs,	Volume=	0.982 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 53.71' @ 12.03 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	52.80'	**30.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 52.00' S= 0.0400 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=5.08 cfs @ 12.03 hrs HW=53.69' (Free Discharge)
└**1=Culvert** (Inlet Controls 5.08 cfs @ 3.2 fps)

Pond C2-2B: MH C2-2B



Pond C3: POND C3

Inflow Area = 5.470 ac, Inflow Depth = 1.26" for 2 YEAR event
Inflow = 6.69 cfs @ 11.97 hrs, Volume= 0.575 af
Outflow = 1.38 cfs @ 12.75 hrs, Volume= 0.330 af, Atten= 79%, Lag= 46.8 min
Primary = 1.38 cfs @ 12.75 hrs, Volume= 0.330 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.34' @ 12.75 hrs Surf.Area= 5,584 sf Storage= 13,541 cf
Plug-Flow detention time= 215.2 min calculated for 0.330 af (57% of inflow)
Center-of-Mass det. time= 129.9 min (925.3 - 795.4)

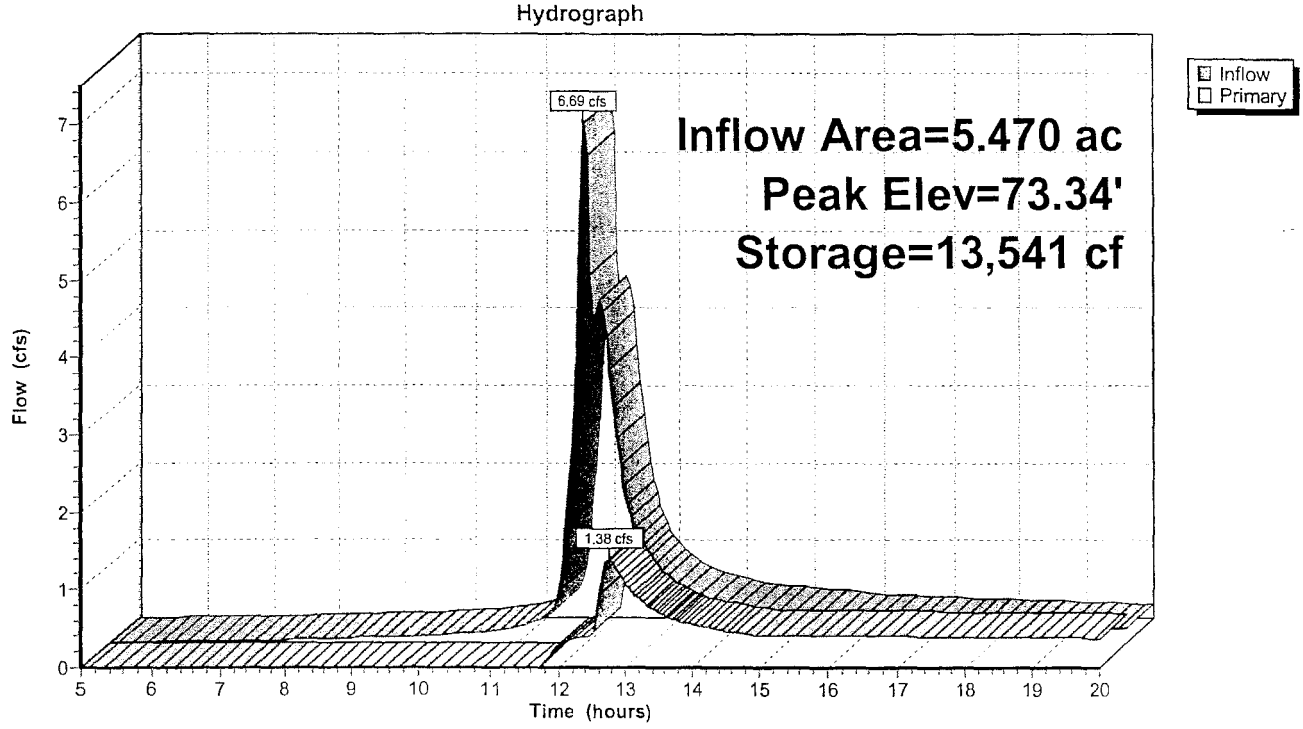
#	Invert	Avail.Storage	Storage Description
1	68.00'	33,575 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
68.00	850	0	0
70.00	1,700	2,550	2,550
70.50	1,925	906	3,456
72.00	2,800	3,544	7,000
74.00	6,950	9,750	16,750
76.00	9,875	16,825	33,575

#	Routing	Invert	Outlet Devices
1	Primary	68.00'	**24.0" x 50.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 67.00' S= 0.0200 '/' n= 0.013 Cc= 0.900
2	Device 1	70.10'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=1.32 cfs @ 12.75 hrs HW=73.34' (Free Discharge)
└─**1=Culvert** (Passes 1.32 cfs of 31.52 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.42 cfs @ 8.5 fps)
  └─**3=Orifice/Grate** (Weir Controls 0.90 cfs @ 1.0 fps)

Pond C3: POND C3



Pond D-1: DI-5

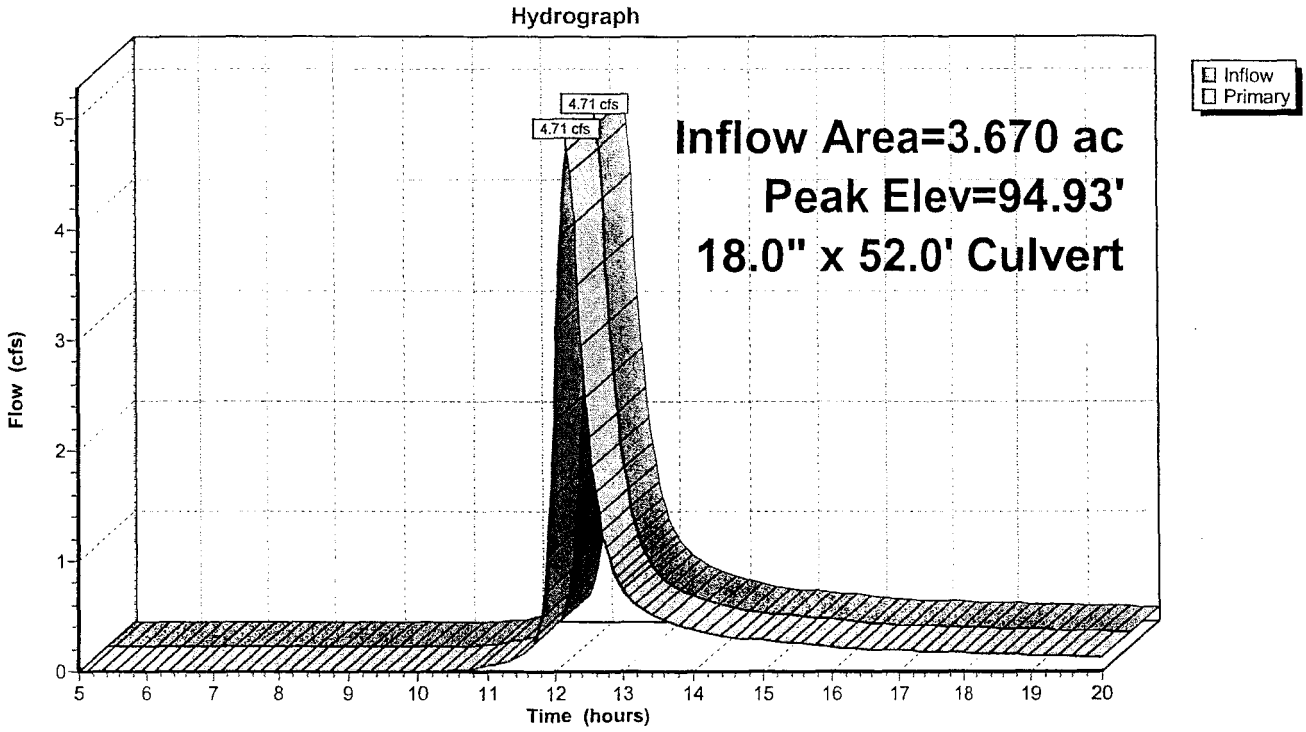
Inflow Area =	3.670 ac,	Inflow Depth =	1.23"	for	2 YEAR event
Inflow =	4.71 cfs @	12.20 hrs,	Volume=	0.377 af	
Outflow =	4.71 cfs @	12.20 hrs,	Volume=	0.377 af,	Atten= 0%, Lag= 0.0 min
Primary =	4.71 cfs @	12.20 hrs,	Volume=	0.377 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 94.93' @ 12.20 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	93.87'	**18.0" x 52.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 90.94' S= 0.0563 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=4.71 cfs @ 12.20 hrs HW=94.93' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.71 cfs @ 3.5 fps)

Pond D-1: DI-5



Pond D-2: DI-5

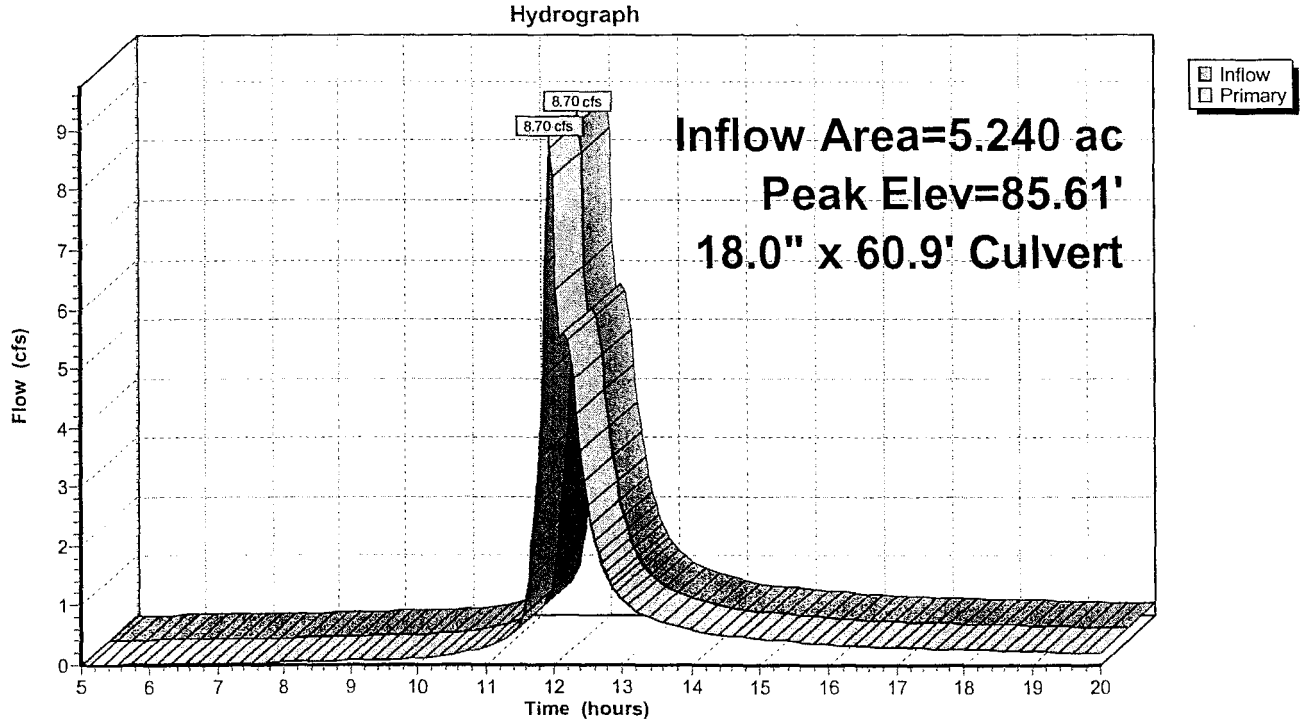
Inflow Area =	5.240 ac,	Inflow Depth =	1.60"	for	2 YEAR event
Inflow =	8.70 cfs @	11.97 hrs,	Volume=	0.700 af	
Outflow =	8.70 cfs @	11.97 hrs,	Volume=	0.700 af,	Atten= 0%, Lag= 0.0 min
Primary =	8.70 cfs @	11.97 hrs,	Volume=	0.700 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 85.61' @ 11.97 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	83.82'	**18.0" x 60.9' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 82.60' S= 0.0200 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=8.46 cfs @ 11.97 hrs HW=85.56' (Free Discharge)
└**1=Culvert** (Inlet Controls 8.46 cfs @ 4.8 fps)

Pond D-2: DI-5



Pond D-3: MH-1

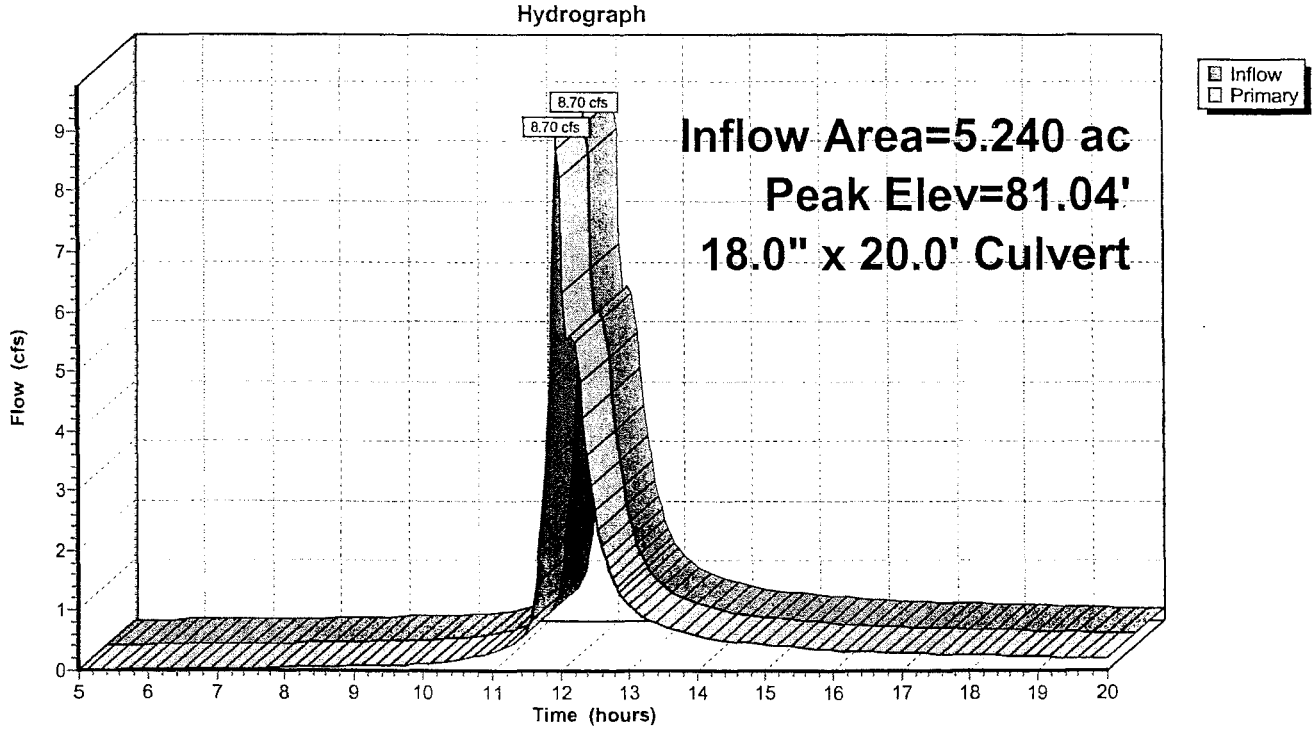
Inflow Area =	5.240 ac,	Inflow Depth =	1.60"	for	2 YEAR event
Inflow =	8.70 cfs @	11.97 hrs,	Volume=	0.700 af	
Outflow =	8.70 cfs @	11.97 hrs,	Volume=	0.700 af,	Atten= 0%, Lag= 0.0 min
Primary =	8.70 cfs @	11.97 hrs,	Volume=	0.700 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 81.04' @ 11.97 hrs
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

#	Routing	Invert	Outlet Devices
1	Primary	79.25'	**18.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 78.85' S= 0.0200 '/' n= 0.013 Cc= 0.900

Primary OutFlow Max=8.46 cfs @ 11.97 hrs HW=80.99' (Free Discharge)
└─**1=Culvert** (Inlet Controls 8.46 cfs @ 4.8 fps)

Pond D-3: MH-1



Pond P D: POND D

Inflow Area = 7.440 ac, Inflow Depth = 1.40" for 2 YEAR event
Inflow = 10.29 cfs @ 11.98 hrs, Volume= 0.865 af
Outflow = 3.77 cfs @ 12.46 hrs, Volume= 0.572 af, Atten= 63%, Lag= 28.5 min
Primary = 3.77 cfs @ 12.46 hrs, Volume= 0.572 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.19' @ 12.46 hrs Surf.Area= 5,545 sf Storage= 16,977 cf
Plug-Flow detention time= 166.2 min calculated for 0.570 af (66% of inflow)
Center-of-Mass det. time= 91.7 min (885.6 - 793.9)

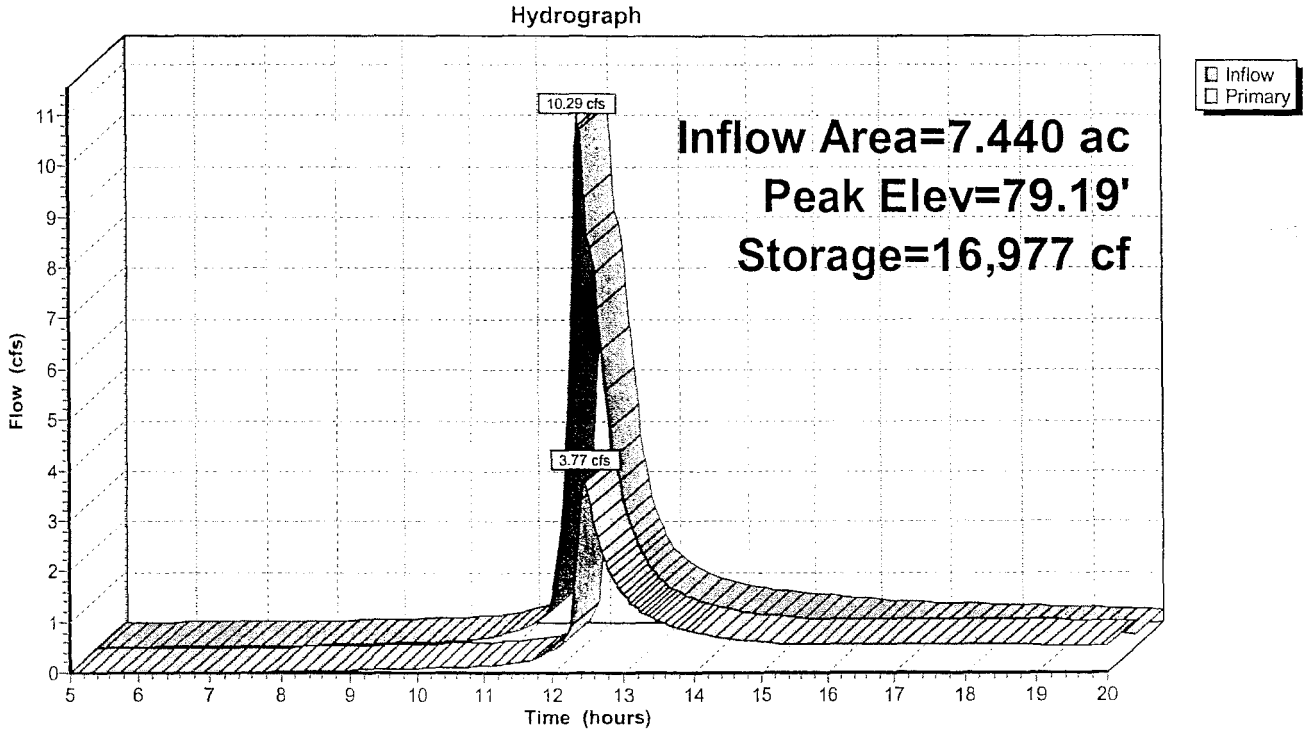
#	Invert	Avail.Storage	Storage Description
1	73.00'	36,249 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
73.00	963	0	0
74.00	1,391	1,177	1,177
76.00	2,465	3,856	5,033
76.50	2,775	1,310	6,343
78.00	3,821	4,947	11,290
78.25	4,010	979	12,269
78.85	5,241	2,775	15,044
80.00	6,284	6,627	21,671
82.00	8,294	14,578	36,249

#	Routing	Invert	Outlet Devices
1	Primary	71.00'	**24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 70.00' S= 0.0167 '/' n= 0.013 Cc= 0.900
2	Device 1	79.00'	**3.00' x 3.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600
3	Device 1	73.10'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=3.67 cfs @ 12.46 hrs HW=79.18' (Free Discharge)
└─**1=Culvert** (Passes 3.67 cfs of 40.54 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 3.09 cfs @ 1.4 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.58 cfs @ 11.8 fps)

Pond P D: POND D



CHANNELS A, B & C
PRE & POST DEVELOPMENT

N value Determination

Project: Stonehouse Glen Phase 1 **Project No.** 2002261-500.04

Date: 7/29/2004 **Prepared By:** AJR

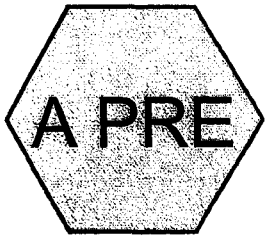
Date Of Field Survey 5/17/2004
Crew: wp/sw

Conditions Noted: All three natural channels have defined slopes, minor debris from fallen trees

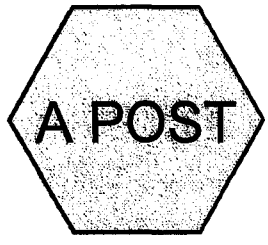
Channels A,B, and C

	Reference	n	Description
Basic n Value	Table 5-16	0.02	Channel cut into earth
Surface irregularity	Table 5-17	0.01	Moderate
Shape variations	Table 5-18	0	Occasional
Obstructions	Table 5-19	0.01	minor
Vegetation	Table 5-20	0.015	Dense Growth of Grasses and tree seedlings along outside edge of flow pattern.
Sinuosity	Table 5-21	0	Ratio 156/150 = 1.04 Minor
	Total	0.055	

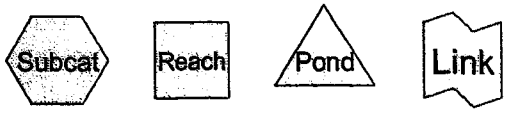
Permissible Velociy Based upon Field Observation 2.5'/sec sandy loam



CHANNEL A PRE DEVELOPMENT



CHANNEL A POST DEVELOPMENT



Drainage Diagram for channel ADEQUACY
Prepared by LANDMARK DESIGN GROUP 11/2/2004
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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A POST: CHANNEL A POST DEVELOPMENT Runoff Area=6.650 ac Runoff Depth=1.12"
Flow Length=784' Tc=17.3 min CN=74 Runoff=9.57 cfs 0.619 af

Subcatchment A PRE: CHANNEL A PRE DEVELOPMENT Runoff Area=7.860 ac Runoff Depth=0.89"
Flow Length=1,004' Tc=30.6 min CN=70 Runoff=6.10 cfs 0.585 af

Total Runoff Area = 14.510 ac Runoff Volume = 1.204 af Average Runoff Depth = 1.00"

Subcatchment A POST: CHANNEL A POST DEVELOPMENT

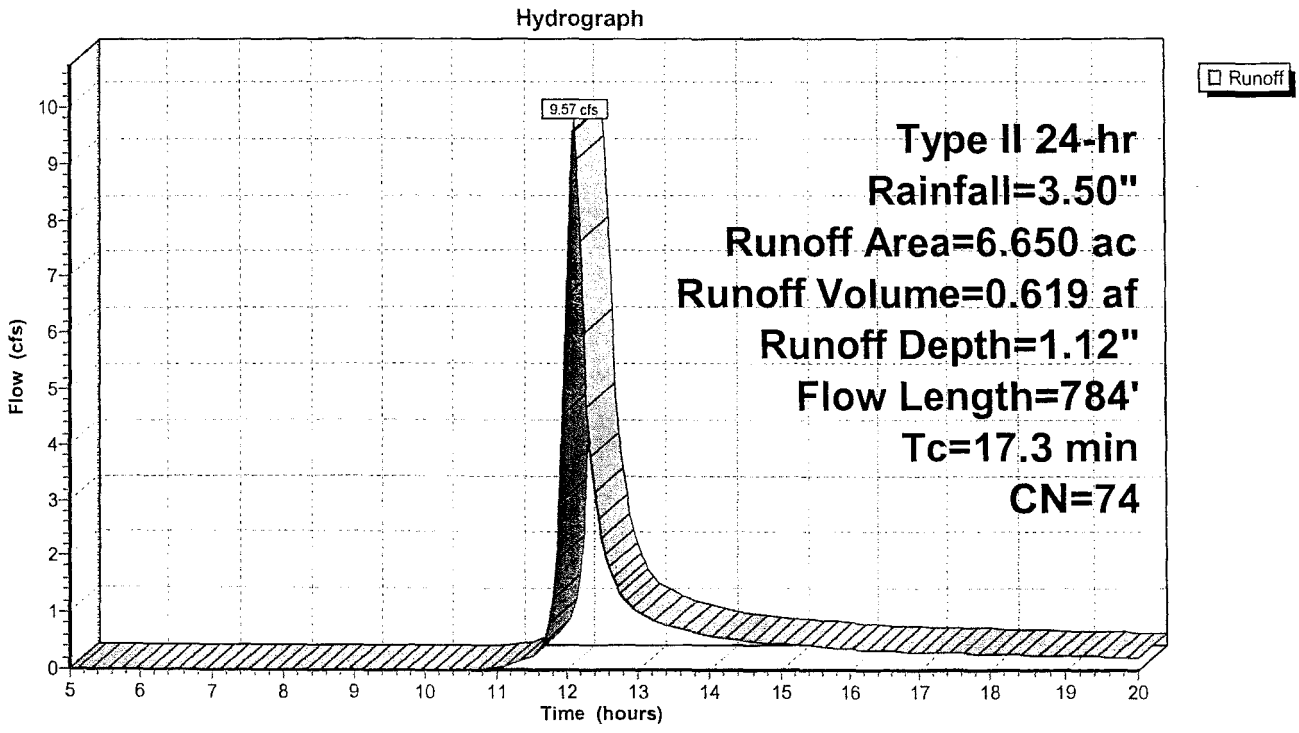
Runoff = 9.57 cfs @ 12.11 hrs, Volume= 0.619 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
0.780	98	Paved parking & roofs
4.870	70	Woods, Good, HSG C
1.000	74	>75% Grass cover, Good, HSG C
6.650	74	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.1400	0.2		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
5.9	216	0.0150	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.9	468	0.0430	8.6	412.14	**Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055
17.3	784	Total			

Subcatchment A POST: CHANNEL A POST DEVELOPMENT



Subcatchment A PRE: CHANNEL A PRE DEVELOPMENT

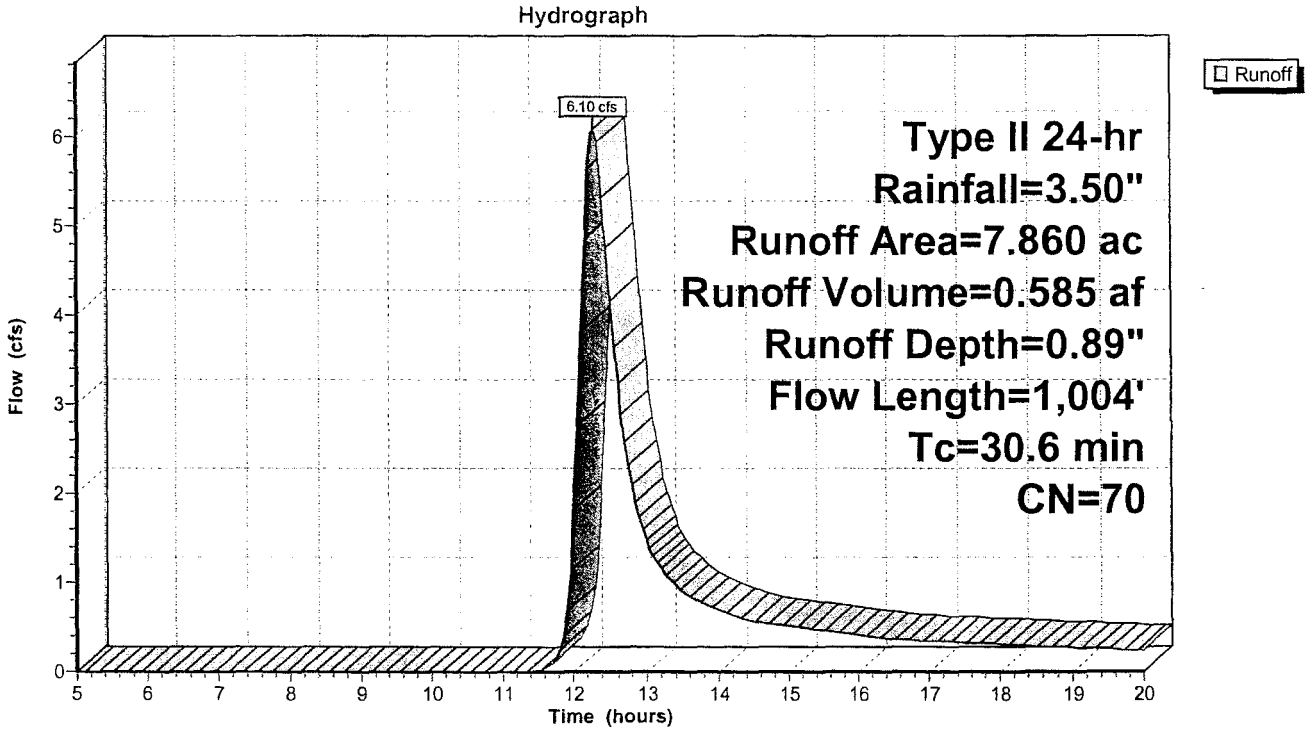
Runoff = 6.10 cfs @ 12.28 hrs, Volume= 0.585 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
7.860	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.8	100	0.0150	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
3.9	436	0.1420	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.9	468	0.0430	8.6	412.14	**Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055
30.6	1,004	Total			

Subcatchment A PRE: CHANNEL A PRE DEVELOPMENT



CHANNEL A POST DEVELOPMENT
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	channel A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.041000	ft/ft

Elevation range: 33.90 ft to 41.60 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	38.70	0.00	69.10	0.055
8.70	34.40			
9.50	33.90			
13.20	34.30			
16.00	35.00			
23.50	34.90			
34.90	35.40			
37.90	34.70			
40.20	34.10			
42.10	34.10			
44.40	34.30			
52.70	36.10			
61.80	38.90			
69.10	41.60			

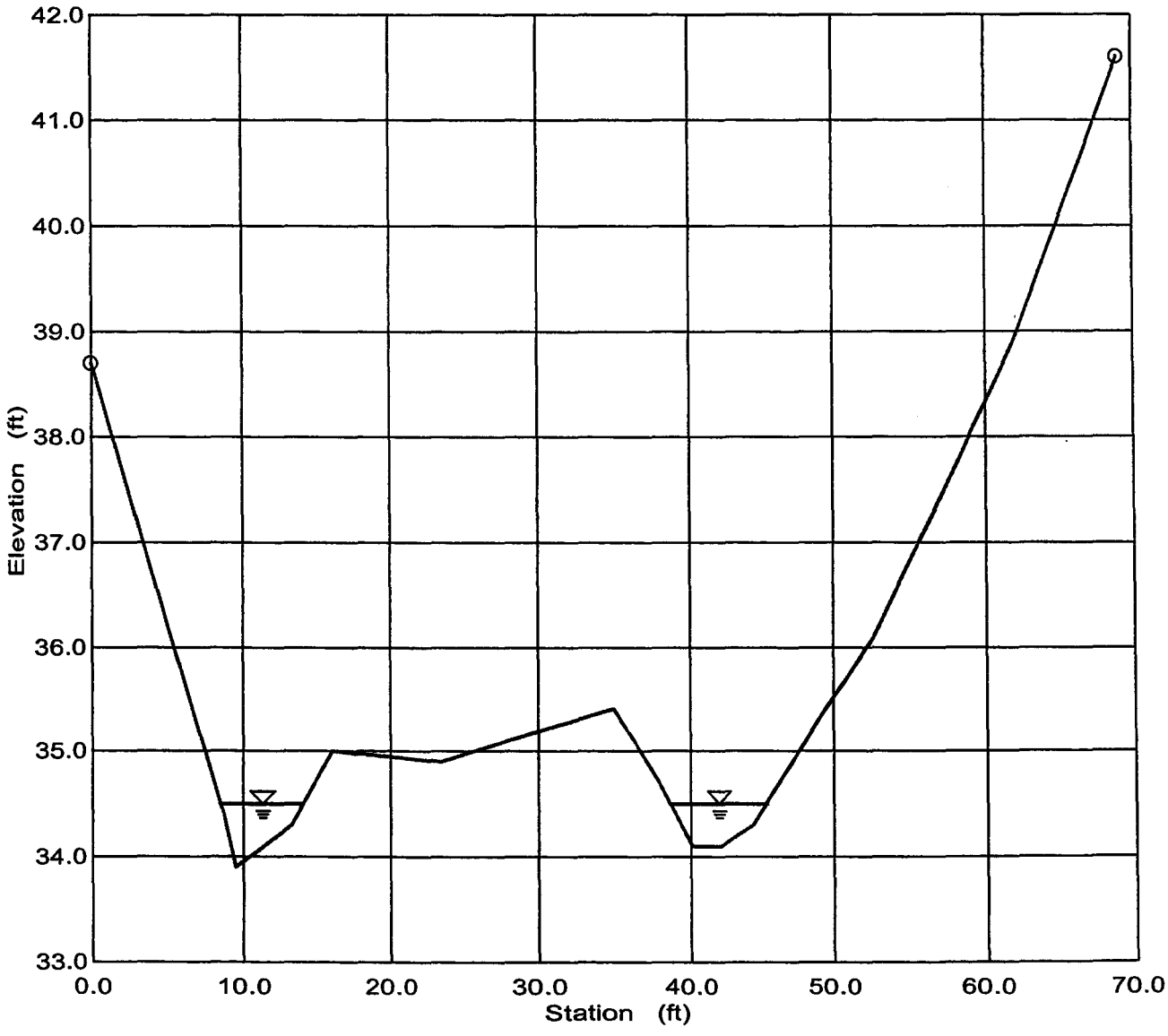
Discharge	9.57	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	34.51	ft
Flow Area	3.86	ft²
Wetted Perimeter	12.65	ft
Top Width	12.35	ft
Height	0.61	ft
Critical Depth	34.46	ft
Critical Slope	0.069704	ft/ft
Velocity	2.48	ft/s
Velocity Head	0.10	ft
Specific Energy	34.61	ft
Froude Number	0.78	
Flow is subcritical.		
Flow is divided.		

Cross Section
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	channel A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.041000	ft/ft
Water Surface Elevation	34.51	ft
Discharge	9.57	cfs



CHANNEL A PRE DEVELOPMENT
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	channel A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

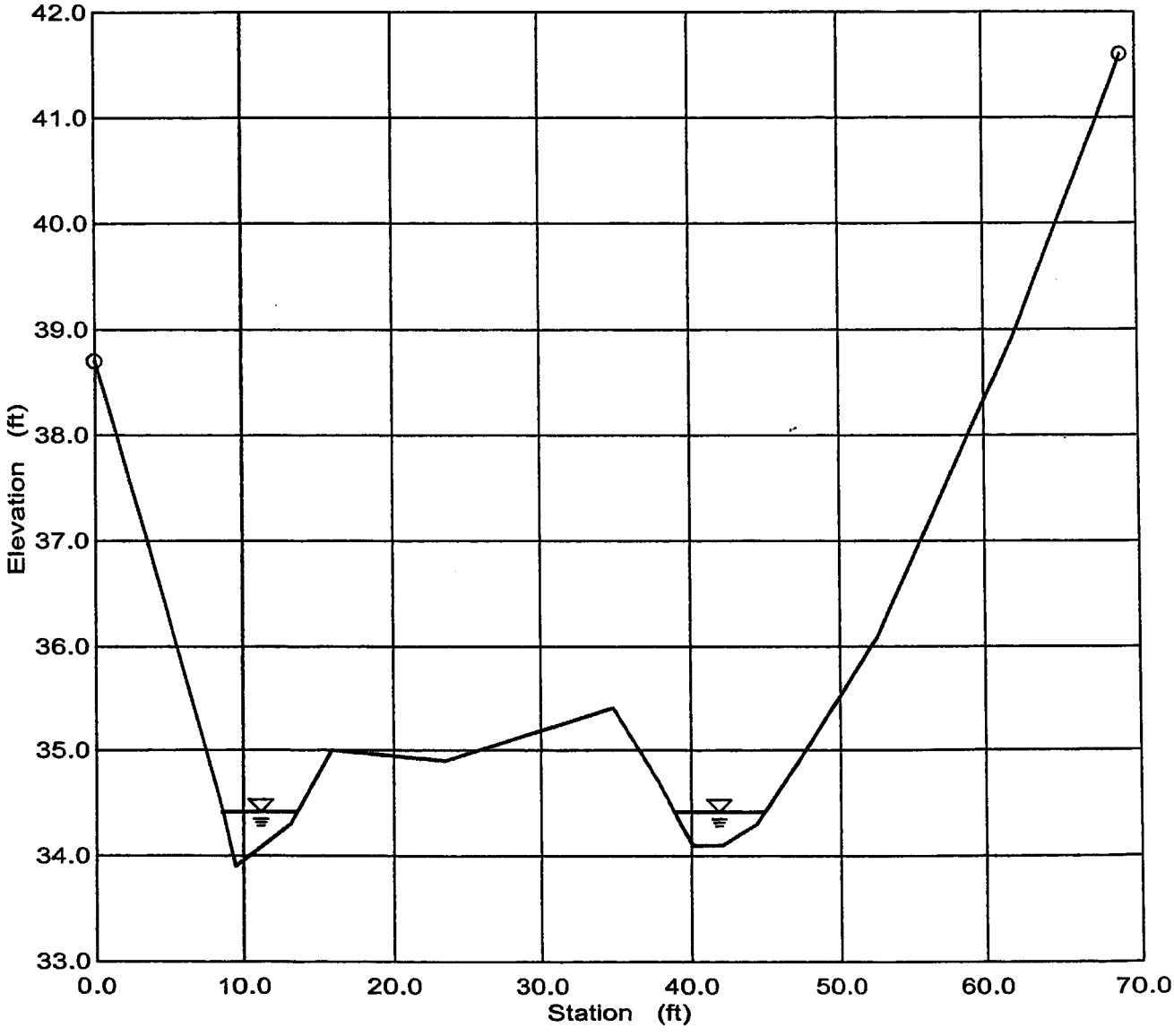
Input Data				
Channel Slope	0.041000 ft/ft			
Elevation range: 33.90 ft to 41.60 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	38.70	0.00	69.10	0.055
8.70	34.40			
9.50	33.90			
13.20	34.30			
16.00	35.00			
23.50	34.90			
34.90	35.40			
37.90	34.70			
40.20	34.10			
42.10	34.10			
44.40	34.30			
52.70	36.10			
61.80	38.90			
69.10	41.60			
Discharge	6.10	cfs		

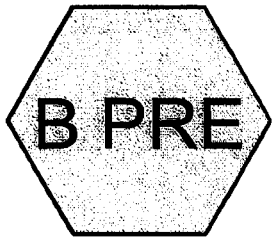
Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	34.42	ft
Flow Area	2.82	ft^2
Wetted Perimeter	11.31	ft
Top Width	11.06	ft
Height	0.52	ft
Critical Depth	34.37	ft
Critical Slope	0.074967	ft/ft
Velocity	2.17	ft/s
Velocity Head	0.07	ft
Specific Energy	34.50	ft
Froude Number	0.76	
Flow is subcritical.		
Flow is divided.		

CHANNEL A PRE DEVELOPMENT
Cross Section for Irregular Channel

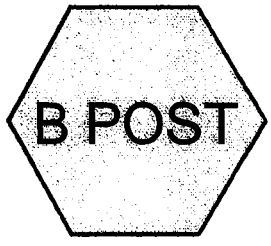
Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	channel A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.041000	ft/ft
Water Surface Elevation	34.42	ft
Discharge	6.10	cfs

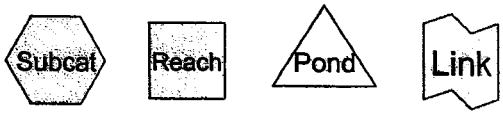




channel B pre development



channel B post development



Drainage Diagram for channel ADEQUACY
Prepared by LANDMARK DESIGN GROUP 11/2/2004
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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment B POST: channel B post development Runoff Area=7.700 ac Runoff Depth=1.12"
Flow Length=762' Tc=17.8 min CN=74 Runoff=10.91 cfs 0.717 af

Subcatchment B PRE: channel B pre development Runoff Area=7.540 ac Runoff Depth=0.90"
Flow Length=890' Tc=25.4 min CN=70 Runoff=6.66 cfs 0.563 af

Total Runoff Area = 15.240 ac Runoff Volume = 1.280 af Average Runoff Depth = 1.01"

Subcatchment B POST: channel B post development

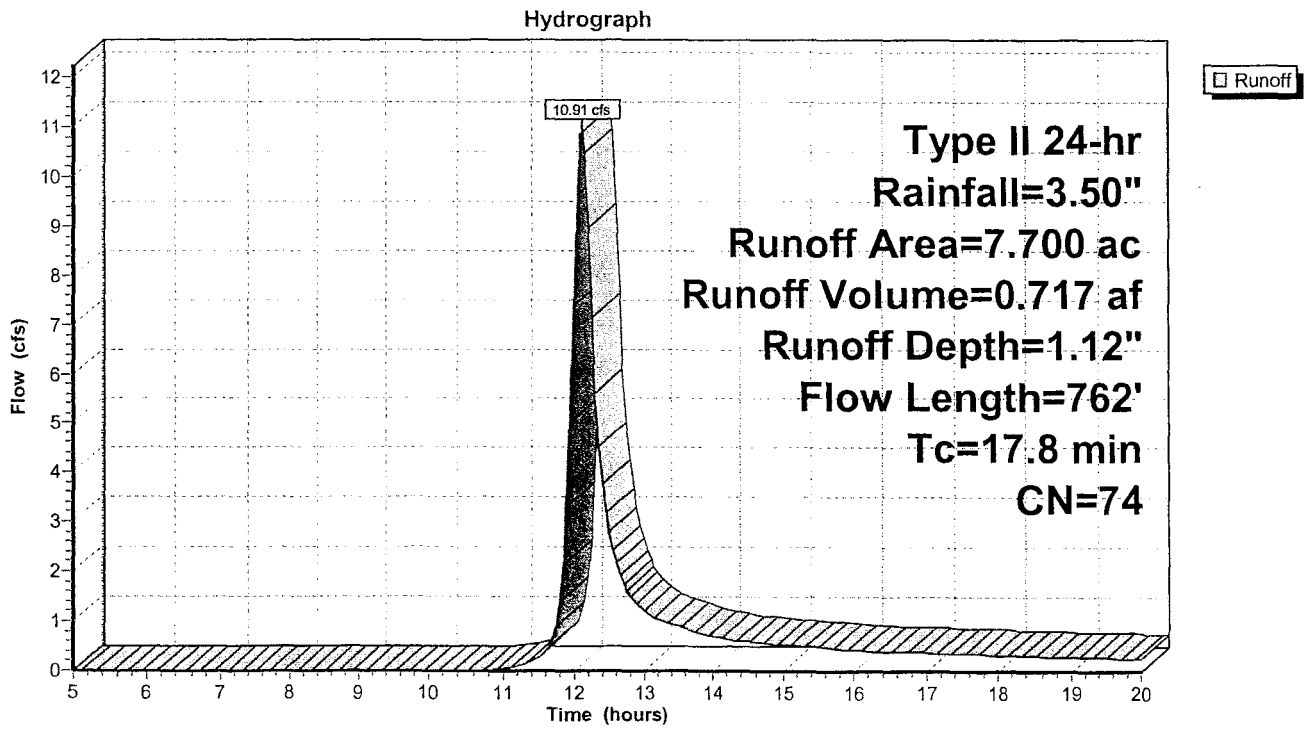
Runoff = 10.91 cfs @ 12.11 hrs, Volume= 0.717 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
0.900	98	Paved parking & roofs
5.900	70	Woods, Good, HSG C
0.900	74	>75% Grass cover, Good, HSG C
7.700	74	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	100	0.0600	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
2.4	217	0.0920	1.5		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	445	0.0850	12.1	579.46	**Channel Flow, natural channel** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055
17.8	762	Total			

Subcatchment B POST: channel B post development



Subcatchment B PRE: channel B pre development

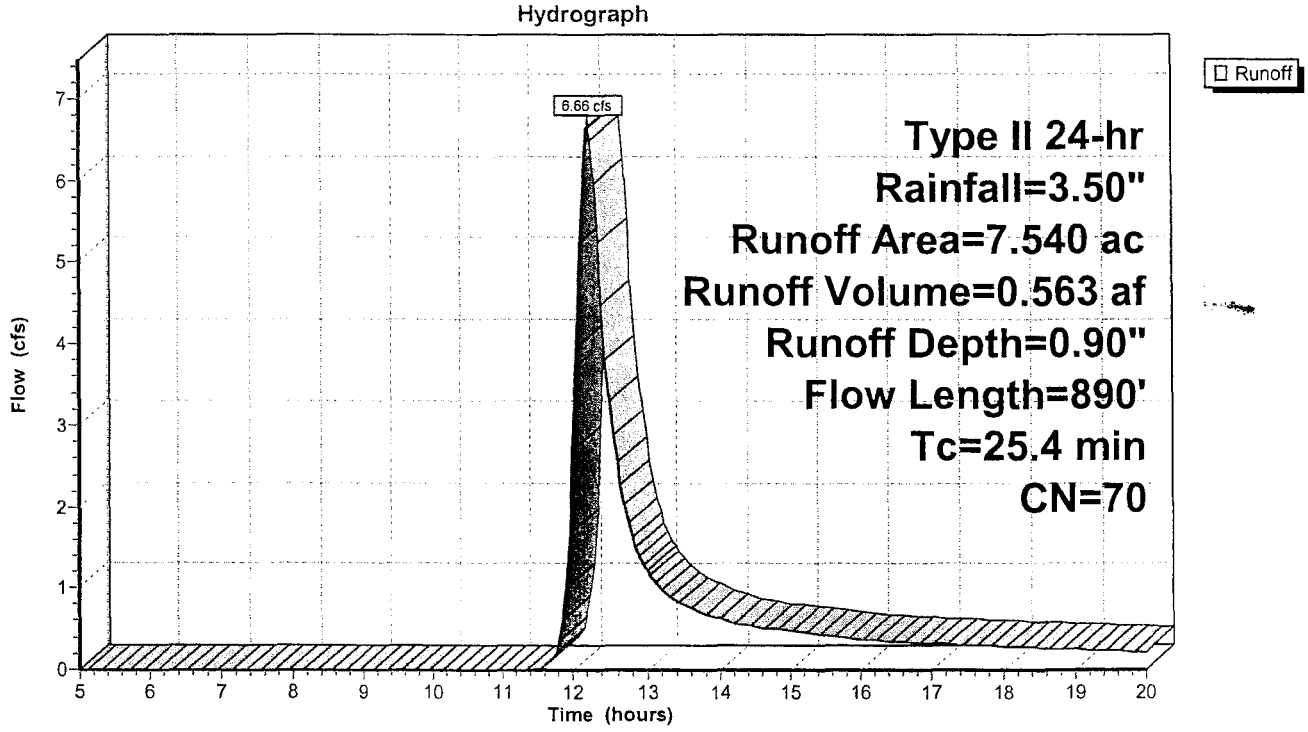
Runoff = 6.66 cfs @ 12.21 hrs, Volume= 0.563 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
7.540	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0	100	0.0250	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
3.8	345	0.0930	1.5		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	445	0.0850	11.6	520.36	**Channel Flow,** Area= 45.0 sf Perim= 25.3' r= 1.78' n= 0.055
25.4	890	Total			

Subcatchment B PRE: channel B pre development



CHANNEL B POST DEVELOPMENT
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.033000	ft/ft

Elevation range: 35.10 ft to 43.60 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	43.60	0.00	68.40	0.055
10.10	41.00			
18.40	38.10			
32.40	36.80			
36.40	35.80			
40.90	35.70			
41.70	35.90			
43.80	35.70			
44.60	35.20			
45.00	35.10			
45.75	35.10			
48.50	36.40			
58.00	37.00			
60.80	39.10			
68.40	42.30			

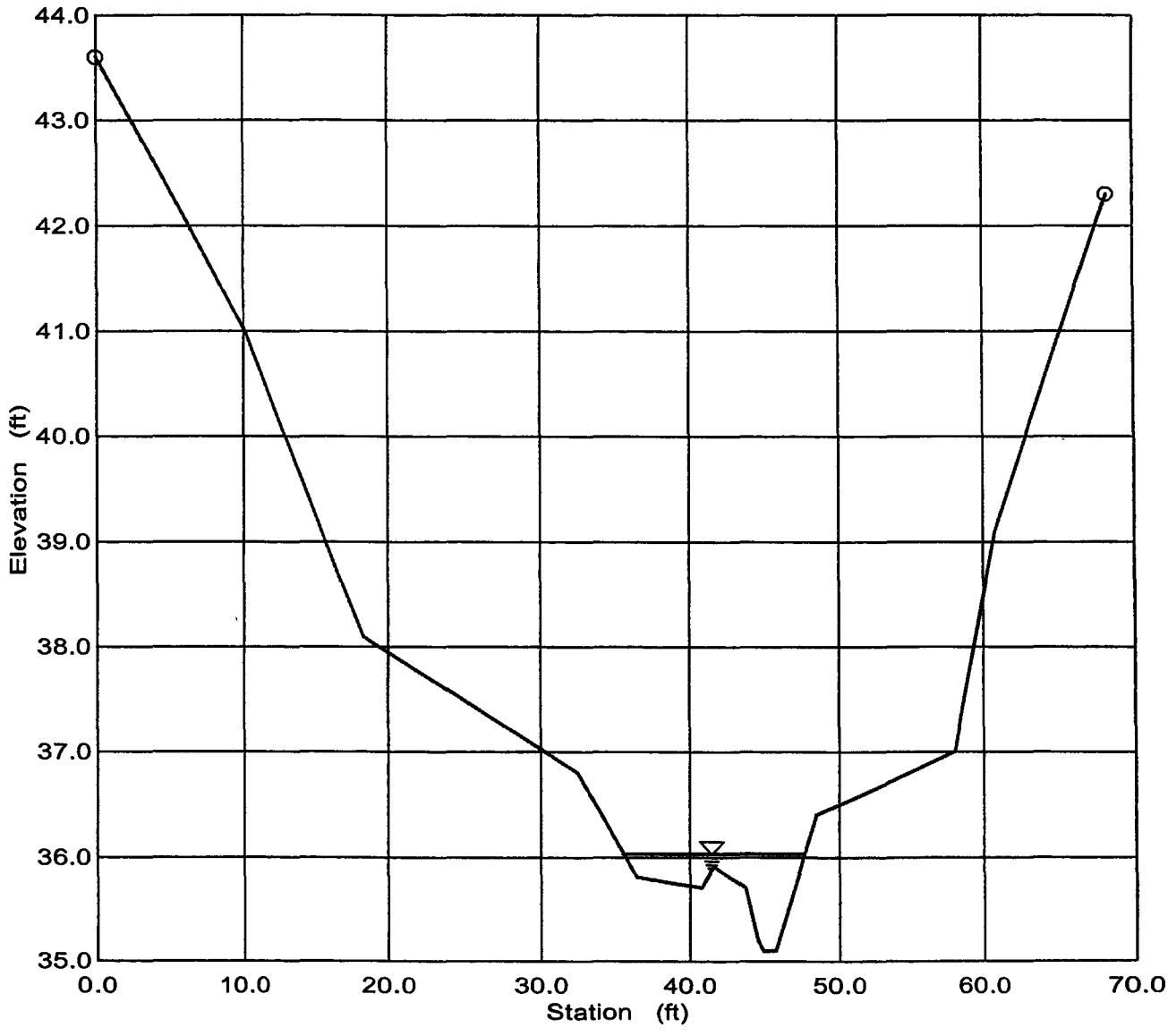
Discharge	10.91	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	36.03	ft
Flow Area	4.46	ft²
Wetted Perimeter	12.66	ft
Top Width	12.24	ft
Height	0.93	ft
Critical Depth	35.95	ft
Critical Slope	0.068918	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	36.12	ft
Froude Number	0.71	
Flow is subcritical.		

CHANNEL B POST DEVELOPMENT
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.033000	ft/ft
Water Surface Elevation	36.03	ft
Discharge	10.91	cfs



CHANNEL B PRE DEVELOPMENT
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.033000	ft/ft

Elevation range: 35.10 ft to 43.60 ft.

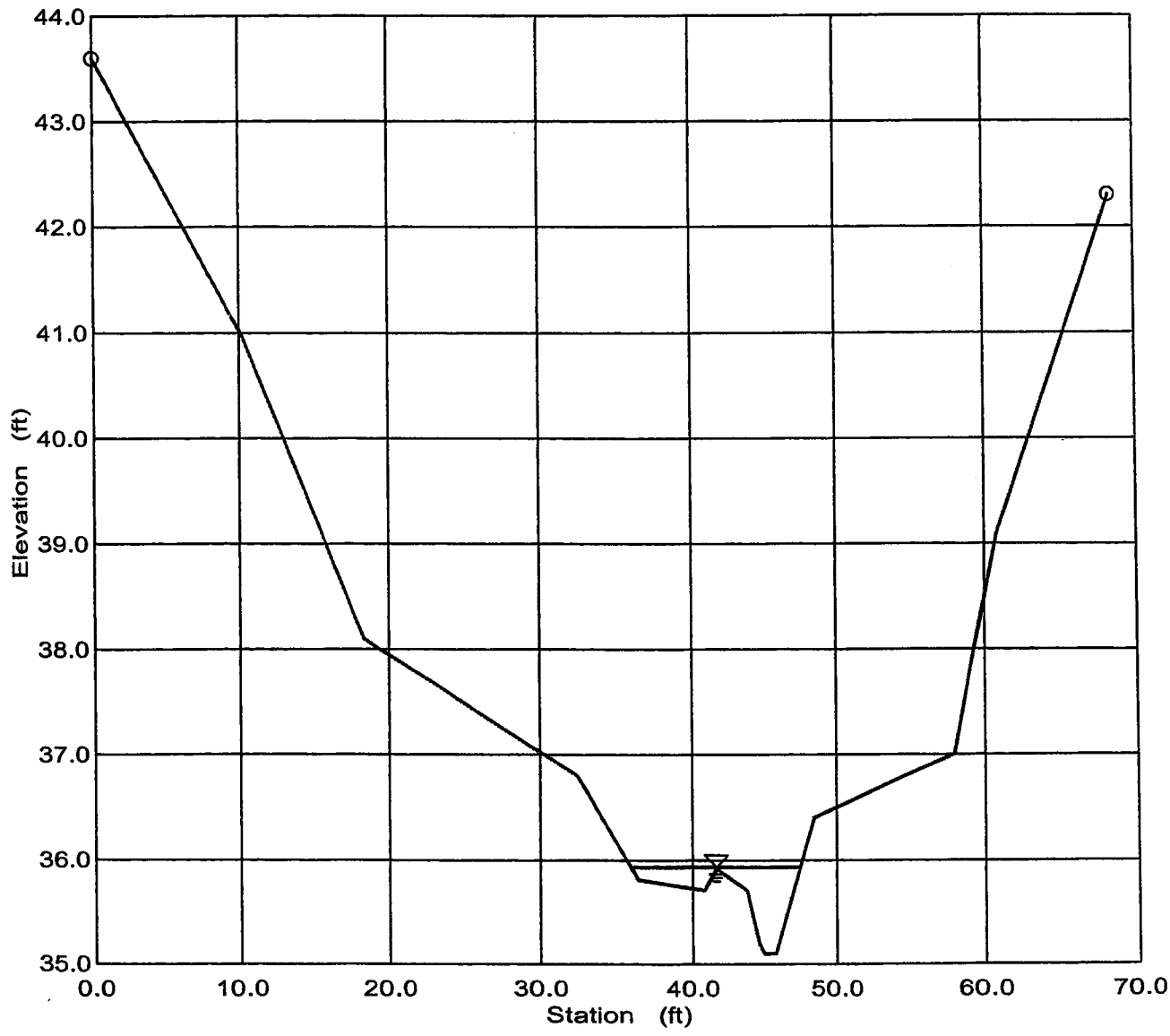
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	43.60	0.00	68.40	0.055
10.10	41.00			
18.40	38.10			
32.40	36.80			
36.40	35.80			
40.90	35.70			
41.70	35.90			
43.80	35.70			
44.60	35.20			
45.00	35.10			
45.75	35.10			
48.50	36.40			
58.00	37.00			
60.80	39.10			
68.40	42.30			
Discharge	6.66	cfs		

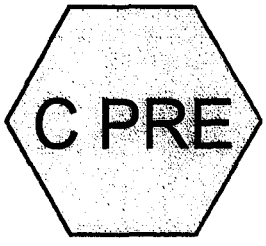
Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	35.93	ft
Flow Area	3.25	ft²
Wetted Perimeter	12.01	ft
Top Width	11.61	ft
Height	0.83	ft
Critical Depth	35.86	ft
Critical Slope	0.075069	ft/ft
Velocity	2.05	ft/s
Velocity Head	0.07	ft
Specific Energy	35.99	ft
Froude Number	0.68	
Flow is subcritical.		

CHANNEL B PRE DEVELOPMENT
Cross Section for Irregular Channel

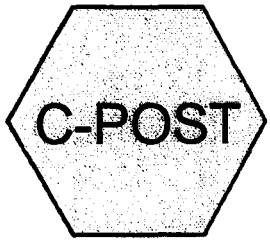
Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.033000	ft/ft
Water Surface Elevation	35.93	ft
Discharge	6.66	cfs

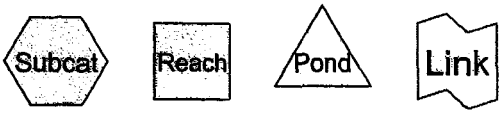




CHANNEL C PRE DEVELOPMENT



CHANNEL C POST DEVELOPMENT



Drainage Diagram for channel ADEQUACY
Prepared by LANDMARK DESIGN GROUP 11/2/2004
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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment C PRE: CHANNEL C PRE DEVELOPMENT Runoff Area=3.950 ac Runoff Depth=0.90"
Flow Length=582' Tc=23.4 min CN=70 Runoff=3.68 cfs 0.295 af

Subcatchment C-POST: CHANNEL C POST DEVELOPMENT Runoff Area=3.780 ac Runoff Depth=1.17"
Flow Length=553' Tc=20.8 min CN=75 Runoff=5.16 cfs 0.370 af

Total Runoff Area = 7.730 ac Runoff Volume = 0.665 af Average Runoff Depth = 1.03"

Subcatchment C PRE: CHANNEL C PRE DEVELOPMENT

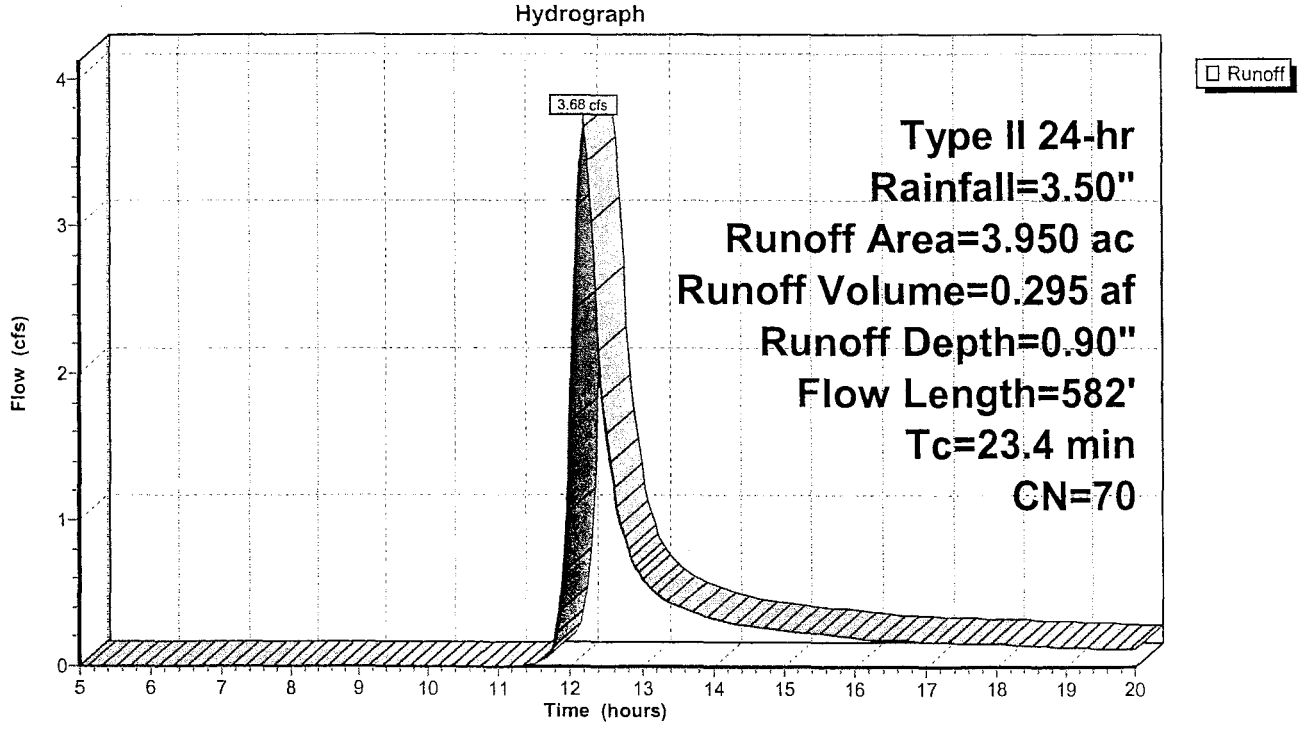
Runoff = 3.68 cfs @ 12.19 hrs, Volume= 0.295 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
3.950	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0	100	0.0250	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
2.1	259	0.1620	2.0		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	223	0.0825	11.9	570.87	**Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055
23.4	582	Total			

Subcatchment C PRE: CHANNEL C PRE DEVELOPMENT



Subcatchment C-POST: CHANNEL C POST DEVELOPMENT

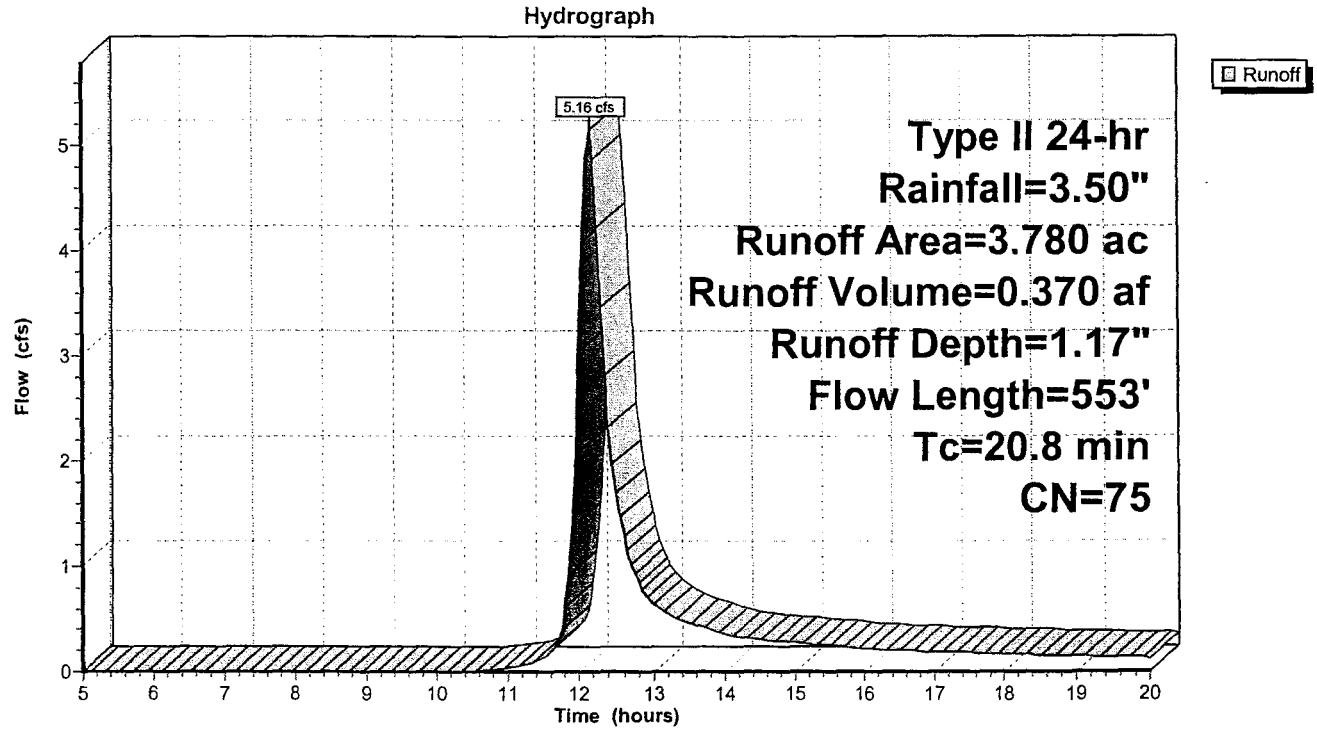
Runoff = 5.16 cfs @ 12.15 hrs, Volume= 0.370 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

Area (ac)	CN	Description
2.680	70	Woods, Good, HSG C
0.550	98	Paved parking & roofs
0.550	74	>75% Grass cover, Good, HSG C
3.780	75	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	75	0.0400	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
6.7	256	0.0162	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.3	222	0.0825	11.9	570.87	**Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055
20.8	553	Total			

Subcatchment C-POST: CHANNEL C POST DEVELOPMENT



CHANNEL C PRE DEVELOPMENT
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.030000	ft/ft

Elevation range: 53.50 ft to 62.10 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	60.20	0.00	42.00	0.055
18.00	56.20			
21.00	54.20			
24.00	53.60			
25.00	53.50			
32.00	57.30			
42.00	62.10			

Discharge	3.68	cfs

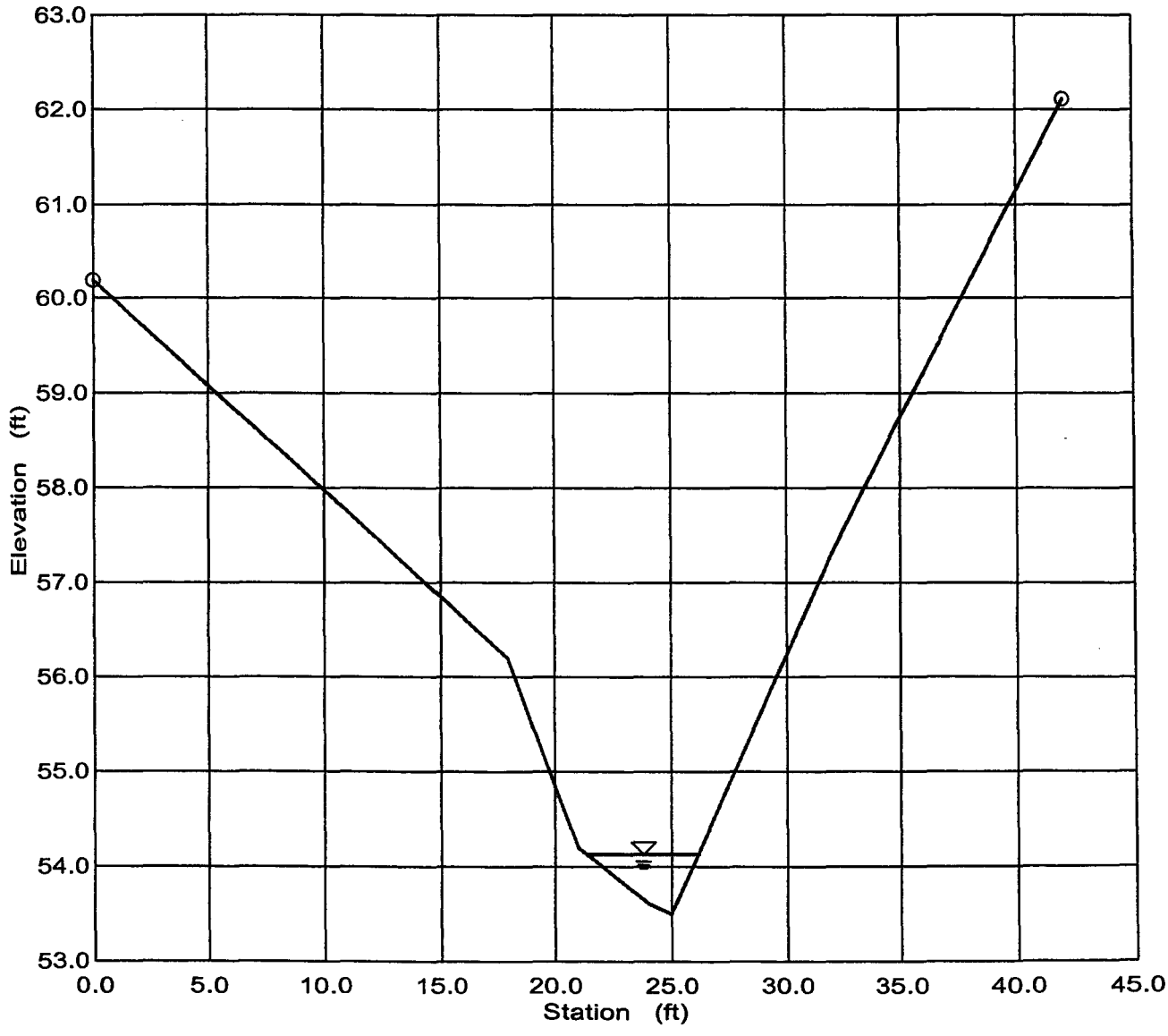
Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	54.13	ft
Flow Area	1.65	ft^2
Wetted Perimeter	5.04	ft
Top Width	4.82	ft
Height	0.63	ft
Critical Depth	54.03	ft
Critical Slope	0.070445	ft/ft
Velocity	2.23	ft/s
Velocity Head	0.08	ft
Specific Energy	54.21	ft
Froude Number	0.67	

Flow is subcritical.

CHANNEL C PRE DEVELOPMENT
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.030000	ft/ft
Water Surface Elevation	54.13	ft
Discharge	3.68	cfs



CHANNEL C POST DEVELOPMENT
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.030000	ft/ft

Elevation range: 53.50 ft to 62.10 ft.

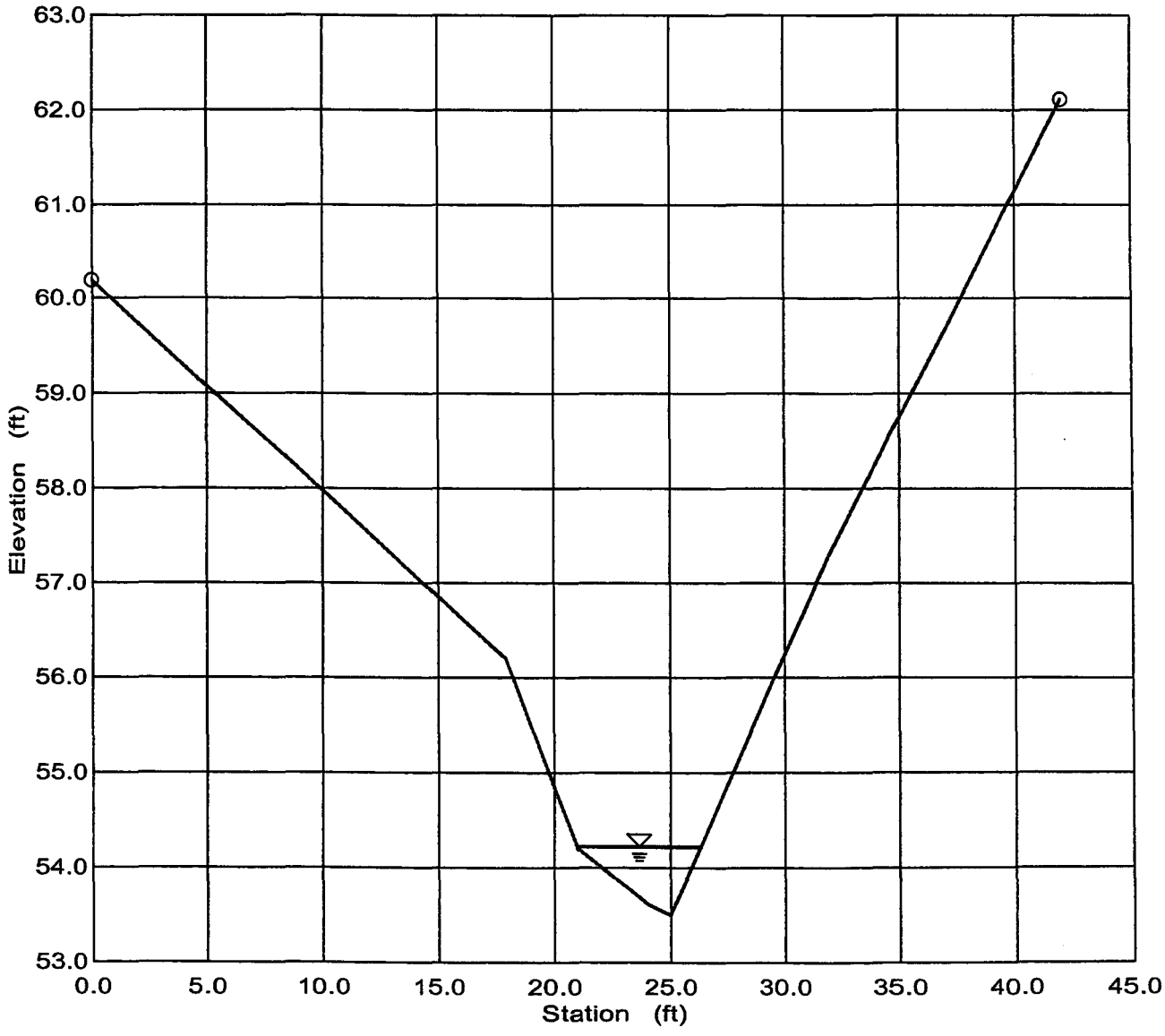
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	60.20	0.00	42.00	0.055
18.00	56.20			
21.00	54.20			
24.00	53.60			
25.00	53.50			
32.00	57.30			
42.00	62.10			
Discharge	5.16	cfs		

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	54.22	ft
Flow Area	2.11	ft²
Wetted Perimeter	5.61	ft
Top Width	5.36	ft
Height	0.72	ft
Critical Depth	54.11	ft
Critical Slope	0.067347	ft/ft
Velocity	2.44	ft/s
Velocity Head	0.09	ft
Specific Energy	54.31	ft
Froude Number	0.69	
Flow is subcritical.		

CHANNEL C POST DEVELOPMENT
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\channel .fm2
Worksheet	CHANNEL C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.030000	ft/ft
Water Surface Elevation	54.22	ft
Discharge	5.16	cfs



BMP 1, 2, AND 3
CHANNEL PROTECTION
VOLUME CALCULATIONS

CHANNEL PROTECTION STORAGE VOLUME COMPUTATION SHEET

PROJECT Stonehouse glen 1 BMP1
JOB NO: 2002261-504.02
DATE: 2/23/2005

Pre Developed Condition

Cover Description	Soil Name/type	CN	Area
woods(good)	C	70	4.10

WEIGHTED CN	TOTAL AREA
70	4.10

Time of Concentration

sheet	
shallow	
channel	
total	0.35

Post Developed Condition

Cover Description	Soil Name/type	CN	Area
1/3 ACRE LOTS	C	81	11.05

WEIGHTED CN	TOTAL AREA
81	11.05

Time of Concentration

sheet	
shallow	
channel	
total	0.33

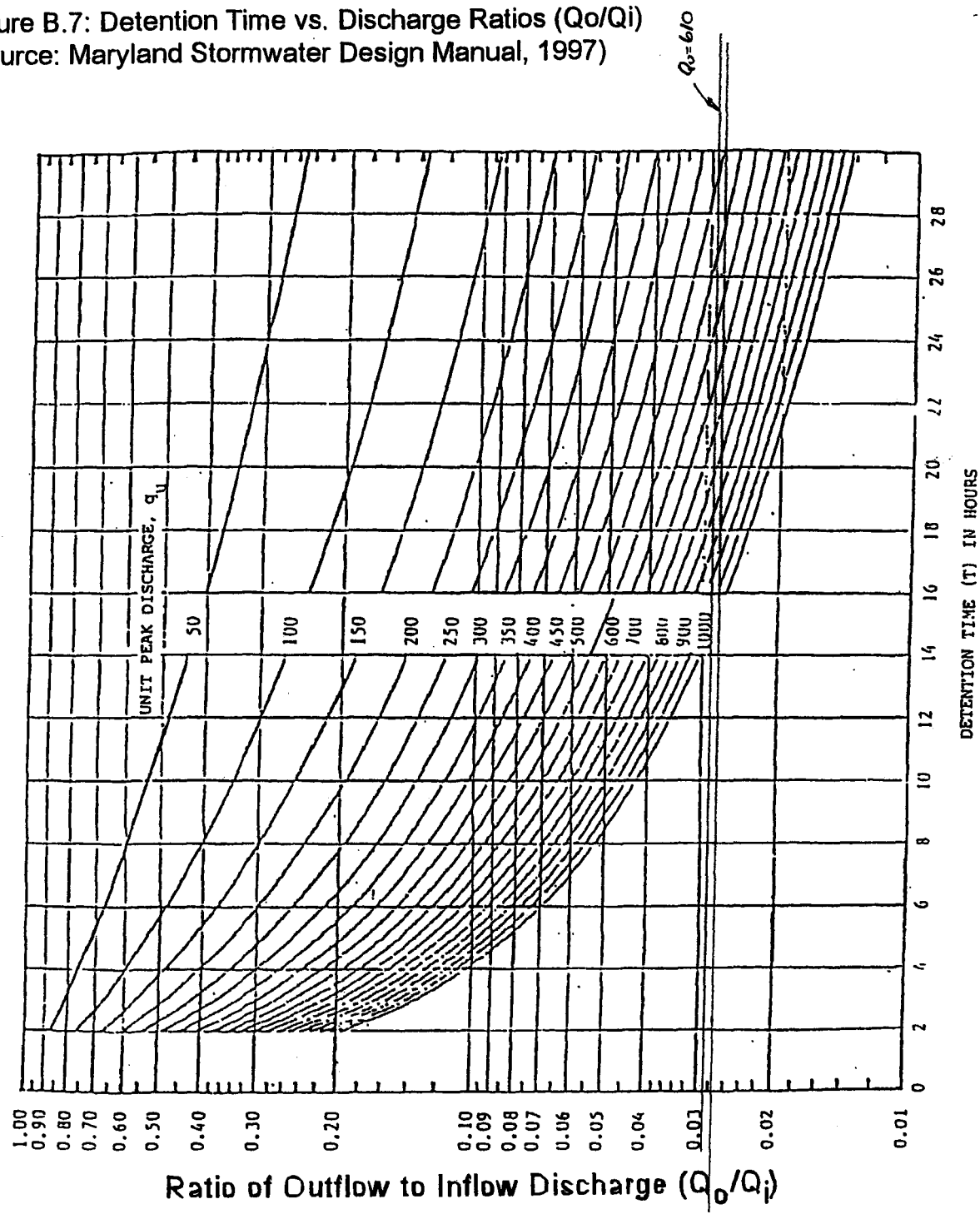
condition	CN	Tc	Qa 1 yr storm	Q 1 year	Q 2 year	Q 10 year	Q 100 year
		hrs	inches	cfs	cfs	cfs	cfs
pre-developed	70	0.35	0.60	0.00	0.00	0.00	0.00
post developed	81	0.33	1.20	12.64	0.00	0.00	0.00

Storm	P
1 Year	2.8
2 Year	3.6
10 Year	5.8
100 Year	8

Pre-dev.		Post Dev	
Ia	0.9	Ia	0.47
Ia/P	qu	Ia/P	qu
		0.17	610
	0	0.00	
	0	0.00	
	0	0.00	

Qo/Qi 0.029
Qo 1yr 0.37 cfs
Vs/Vr 0.64
Vs 1yr 0.71 ac-ft 30945 cu ft

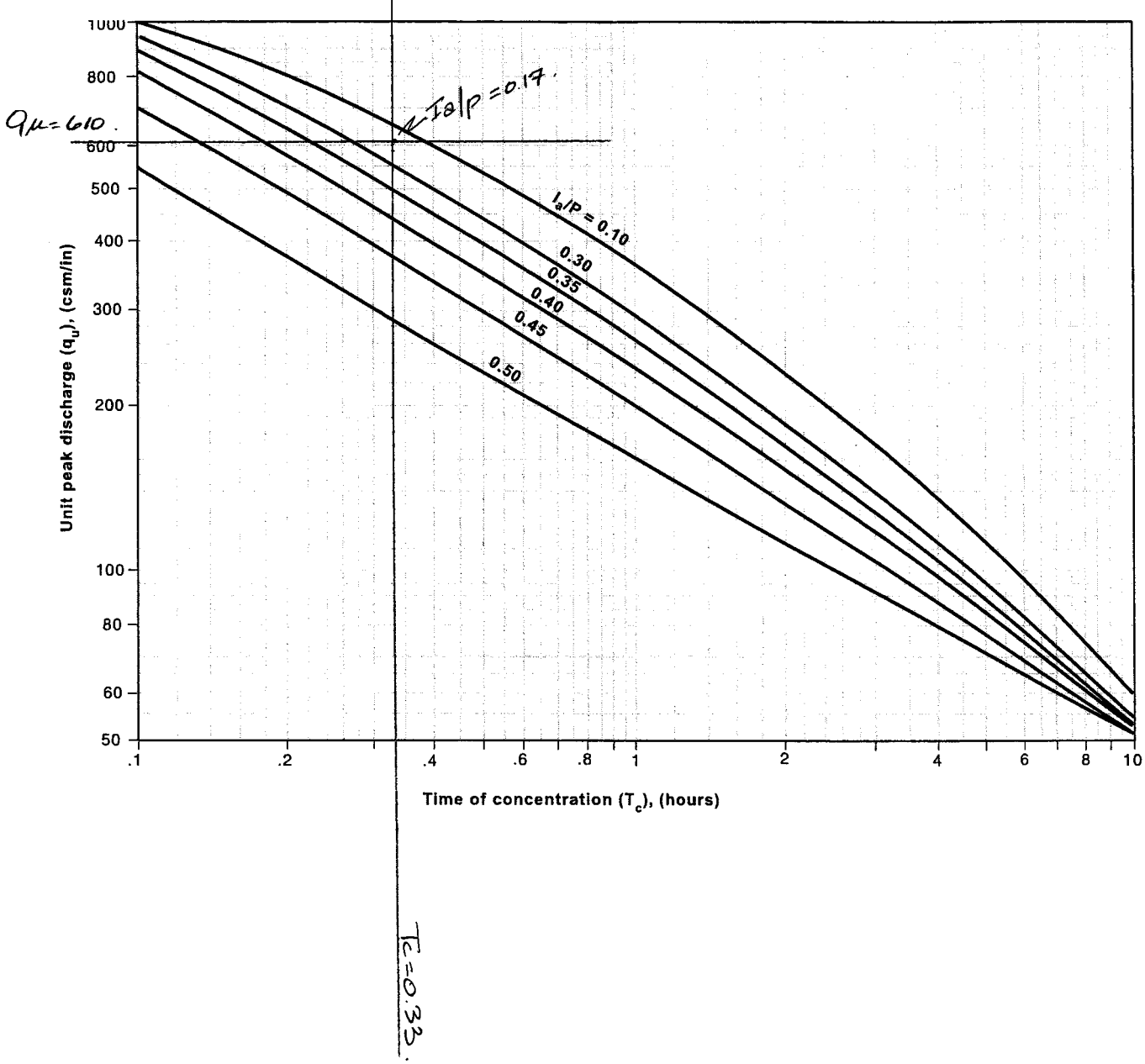
Figure B.7: Detention Time vs. Discharge Ratios (Qo/Qi)
(Source: Maryland Stormwater Design Manual, 1997)



$Q_o/Q_i = 0.20$

BMP #1

Exhibit 4-II Unit peal discharge (q_u) for NRCS (SCS) type II rainfall distribution



BMP #1.

Hydrograph for Pond BMP - 1: BMP #1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	72.00	0.00
1.00	0.00	0	72.00	0.00
2.00	0.00	0	72.00	0.00
3.00	0.00	0	72.00	0.00
4.00	0.00	0	72.00	0.00
5.00	0.00	0	72.00	0.00
6.00	0.00	0	72.00	0.00
7.00	0.00	0	72.00	0.00
8.00	0.00	0	72.00	0.00
9.00	0.00	0	72.00	0.00
10.00	0.00	0	72.00	0.00
11.00	0.03	13	72.01	0.00
12.00	**5.56**	2,413	73.53	0.49
13.00	**1.16**	**13,852**	**76.96**	**0.92**
14.00	0.66	**13,632**	**76.91**	**0.92**
15.00	0.51	12,413	76.66	0.89
16.00	0.40	10,899	76.36	0.86
17.00	0.35	9,195	76.01	0.82
18.00	0.31	7,521	75.46	0.76
19.00	0.27	5,939	74.93	0.70
20.00	0.23	4,449	74.43	0.63
21.00	0.21	3,085	73.96	0.56
22.00	0.21	2,035	73.29	0.45
23.00	0.20	1,346	72.85	0.35
24.00	0.19	939	72.60	0.27
25.00	0.00	394	72.25	0.12
26.00	0.00	171	72.11	0.03
27.00	0.00	95	72.06	0.02
28.00	0.00	53	72.03	0.01
29.00	0.00	29	72.02	0.00
30.00	0.00	16	72.01	0.00
31.00	0.00	9	72.01	0.00
32.00	0.00	5	72.00	0.00
33.00	0.00	3	72.00	0.00
34.00	0.00	2	72.00	0.00
35.00	0.00	1	72.00	0.00
36.00	0.00	0	72.00	0.00
37.00	0.00	0	72.00	0.00
38.00	0.00	0	72.00	0.00
39.00	0.00	0	72.00	0.00
40.00	0.00	0	72.00	0.00

24 Hrs.

17 Hrs.

Stage-Discharge for Pond BMP - 1: BMP #1

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
72.00	0.00	75.12	0.72	78.24	1.04	81.36	32.65
72.06	0.01	75.18	0.73	78.30	1.04	81.42	36.66
72.12	0.03	75.24	0.74	78.36	1.05	81.48	40.82
72.18	0.07	75.30	0.74	78.42	1.05	81.54	45.14
72.24	0.11	75.36	0.75	78.48	1.06	81.60	49.60
72.30	0.15	75.42	0.76	78.54	1.06	81.66	54.20
72.36	0.18	75.48	0.76	78.60	1.07	81.72	58.94
72.42	0.21	75.54	0.77	78.66	1.07	81.78	63.82
72.48	0.24	75.60	0.78	78.72	1.08	81.84	68.82
72.54	0.26	75.66	0.79	78.78	1.08	81.90	73.95
72.60	0.28	75.72	0.79	78.84	1.09	81.96	79.20
72.66	0.30	75.78	0.80	78.90	1.09	82.02	84.58
72.72	0.31	75.84	0.81	78.96	1.10	82.08	85.19
72.78	0.33	75.90	0.81	79.02	1.10	82.14	85.38
72.84	0.34	75.96	0.82	79.08	1.10	82.20	85.58
72.90	0.36	76.02	0.82	79.14	1.11	82.26	85.77
72.96	0.37	76.08	0.83	79.20	1.11	82.32	85.97
73.02	0.39	76.14	0.84	79.26	1.12	82.38	86.16
73.08	0.40	76.20	0.84	79.32	1.12	82.44	86.36
73.14	0.41	76.26	0.85	79.38	1.13	82.50	86.55
73.20	0.43	76.32	0.86	79.44	1.13	82.56	86.75
73.26	0.44	76.38	0.86	79.50	1.14	82.62	86.94
73.32	0.45	76.44	0.87	79.56	1.14	82.68	87.13
73.38	0.46	76.50	0.87	79.62	1.15	82.74	87.32
73.44	0.47	76.56	0.88	79.68	1.15	82.80	87.52
73.50	0.49	76.62	0.89	79.74	1.16	82.86	87.71
73.56	0.50	76.68	0.89	79.80	1.16	82.92	87.90
73.62	0.51	76.74	0.90	79.86	1.17	82.98	**88.09**
73.68	0.52	76.80	0.90	79.92	1.17		
73.74	0.53	76.86	0.91	79.98	1.17		
73.80	0.54	76.92	0.92	80.04	1.18		
73.86	0.55	76.98	0.92	80.10	1.18		
73.92	0.56	77.04	0.93	80.16	1.19		
73.98	0.57	77.10	0.93	80.22	1.19		
74.04	0.58	77.16	0.94	80.28	1.20		
74.10	0.58	77.22	0.94	80.34	1.20		
74.16	0.59	77.28	0.95	80.40	1.21		
74.22	0.60	77.34	0.96	80.46	1.21		
74.28	0.61	77.40	0.96	80.52	1.21		
74.34	0.62	77.46	0.97	80.58	1.22		
74.40	0.63	77.52	0.97	80.64	1.22		
74.46	0.64	77.58	0.98	80.70	1.98		
74.52	0.64	77.64	0.98	80.76	3.37		
74.58	0.65	77.70	0.99	80.82	5.16		
74.64	0.66	77.76	0.99	80.88	7.28		
74.70	0.67	77.82	1.00	80.94	9.68		
74.76	0.68	77.88	1.00	81.00	12.34		
74.82	0.68	77.94	1.01	81.06	15.23		
74.88	0.69	78.00	1.01	81.12	18.34		
74.94	0.70	78.06	1.02	81.18	21.64		
75.00	0.71	78.12	1.03	81.24	25.14		
75.06	0.71	78.18	1.03	81.30	28.81		

Stage-Discharge for Pond BMP-3: Basin 3

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
56.00	0.00	60.16	0.75	64.32	1.04	68.48	53.44
56.08	0.02	60.24	0.75	64.40	1.05	68.56	53.61
56.16	0.06	60.32	0.76	64.48	1.05	68.64	53.78
56.24	0.11	60.40	0.77	64.56	1.06	68.72	53.95
56.32	0.17	60.48	0.77	64.64	1.06	68.80	54.12
56.40	0.20	60.56	0.78	64.72	1.07	68.88	54.29
56.48	0.24	60.64	0.79	64.80	1.07	68.96	54.46
56.56	0.26	60.72	0.79	64.88	1.08	69.04	54.62
56.64	0.29	60.80	0.80	64.96	1.08	69.12	54.79
56.72	0.31	60.88	0.81	65.04	1.09	69.20	54.96
56.80	0.33	60.96	0.81	65.12	1.09	69.28	55.12
56.88	0.35	61.04	0.82	65.20	1.10	69.36	55.29
56.96	0.37	61.12	0.82	65.28	1.10	69.44	55.46
57.04	0.39	61.20	0.83	65.36	1.11	69.52	55.62
57.12	0.41	61.28	0.84	65.44	1.11	69.60	55.78
57.20	0.42	61.36	0.84	65.52	1.12	69.68	55.95
57.28	0.43	61.44	0.85	65.60	1.12	69.76	56.11
57.36	0.44	61.52	0.86	65.68	1.13	69.84	56.27
57.44	0.45	61.60	0.86	65.76	1.13	69.92	56.44
57.52	0.47	61.68	0.87	65.84	1.13	70.00	56.60
57.60	0.48	61.76	0.87	65.92	1.14	70.08	56.76
57.68	0.49	61.84	0.88	66.00	1.14	70.16	56.92
57.76	0.50	61.92	0.88	66.08	1.15	70.24	57.08
57.84	0.51	62.00	0.89	66.16	1.15	70.32	57.24
57.92	0.52	62.08	0.90	66.24	1.16	70.40	57.40
58.00	0.53	62.16	0.90	66.32	1.16	70.48	57.56
58.08	0.54	62.24	0.91	66.40	1.17	70.56	57.72
58.16	0.55	62.32	0.91	66.48	1.17	70.64	57.88
58.24	0.56	62.40	0.92	66.56	1.78	70.72	58.04
58.32	0.57	62.48	0.92	66.64	3.33	70.80	58.19
58.40	0.57	62.56	0.93	66.72	5.42	70.88	58.35
58.48	0.58	62.64	0.94	66.80	7.94	70.96	58.51
58.56	0.59	62.72	0.94	66.88	10.82	71.04	58.66
58.64	0.60	62.80	0.95	66.96	14.02	71.12	58.82
58.72	0.61	62.88	0.95	67.04	17.51	71.20	58.97
58.80	0.62	62.96	0.96	67.12	21.27	71.28	59.13
58.88	0.63	63.04	0.96	67.20	25.27	71.36	59.28
58.96	0.63	63.12	0.97	67.28	29.52	71.44	59.44
59.04	0.64	63.20	0.97	67.36	33.99	71.52	59.59
59.12	0.65	63.28	0.98	67.44	38.67	71.60	59.75
59.20	0.66	63.36	0.98	67.52	43.56	71.68	59.90
59.28	0.67	63.44	0.99	67.60	48.64	71.76	60.05
59.36	0.67	63.52	0.99	67.68	51.70	71.84	60.20
59.44	0.68	63.60	1.00	67.76	51.87	71.92	60.36
59.52	0.69	63.68	1.00	67.84	52.05	72.00	**60.51**
59.60	0.70	63.76	1.01	67.92	52.23		
59.68	0.70	63.84	1.01	68.00	52.40		
59.76	0.71	63.92	1.02	68.08	52.57		
59.84	0.72	64.00	1.02	68.16	52.75		
59.92	0.72	64.08	1.03	68.24	52.92		
60.00	0.73	64.16	1.03	68.32	53.09		
60.08	0.74	64.24	1.04	68.40	53.27		

CHANNEL PROTECTION STORAGE VOLUME COMPUTATION SHEET

PROJECT Stonehouse glen 1 BMP 2
JOB NO: 2002261-504.02
DATE: 9/30/2004

Pre Developed Condition

Cover Description	Soil Name/type	CN	Area
woods(good)	C	70	2.00
woods (good	B	55	2.70
		WEIGHTED CN	TOTAL AREA
		61	4.70

Time of Concentration

sheet	0.32
shallow	0.01
channel	0.01
total	0.33

Post Developed Condition

Cover Description	Soil Name/type	CN	Area
woods good	B	55	1.90
1/3 ACRE LOTS	C	81	4.20
		WEIGHTED CN	TOTAL AREA
		73	6.10

Time of Concentration

sheet	0.23
shallow	0.01
channel	0.01
total	0.25

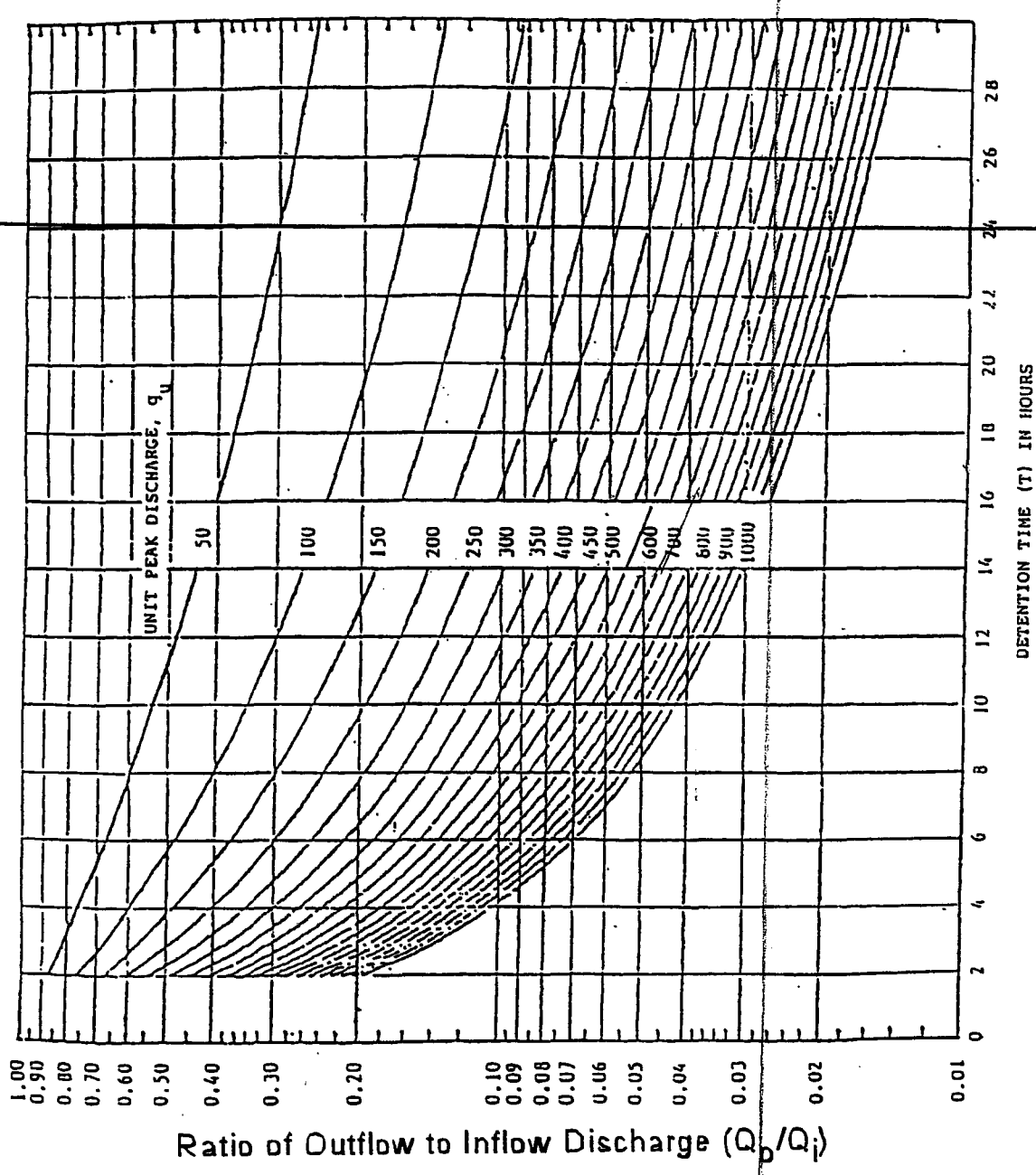
condition	CN	Tc	Qa 1 yr storm	Q 1 year	Q 2 year	Q 10 year	Q 100 year
		hrs	inches	cfs	cfs	cfs	cfs
pre-developed	61	0.33	0.30	1.42	0.00	0.00	0.00
post developed	73	0.25	0.70	3.30	0.00	0.00	0.00

Storm	P
1 Year	2.8
2 Year	3.6
10 Year	5.8
100 Year	8

Pre-dev.		Post Dev	
Ia	1.3	Ia	0.74
Ia/P	qu	Ia/P	qu
0.45	495	0.27	495
0.35	0	0.00	
0.22	0	0.00	
0.16	0	0.00	

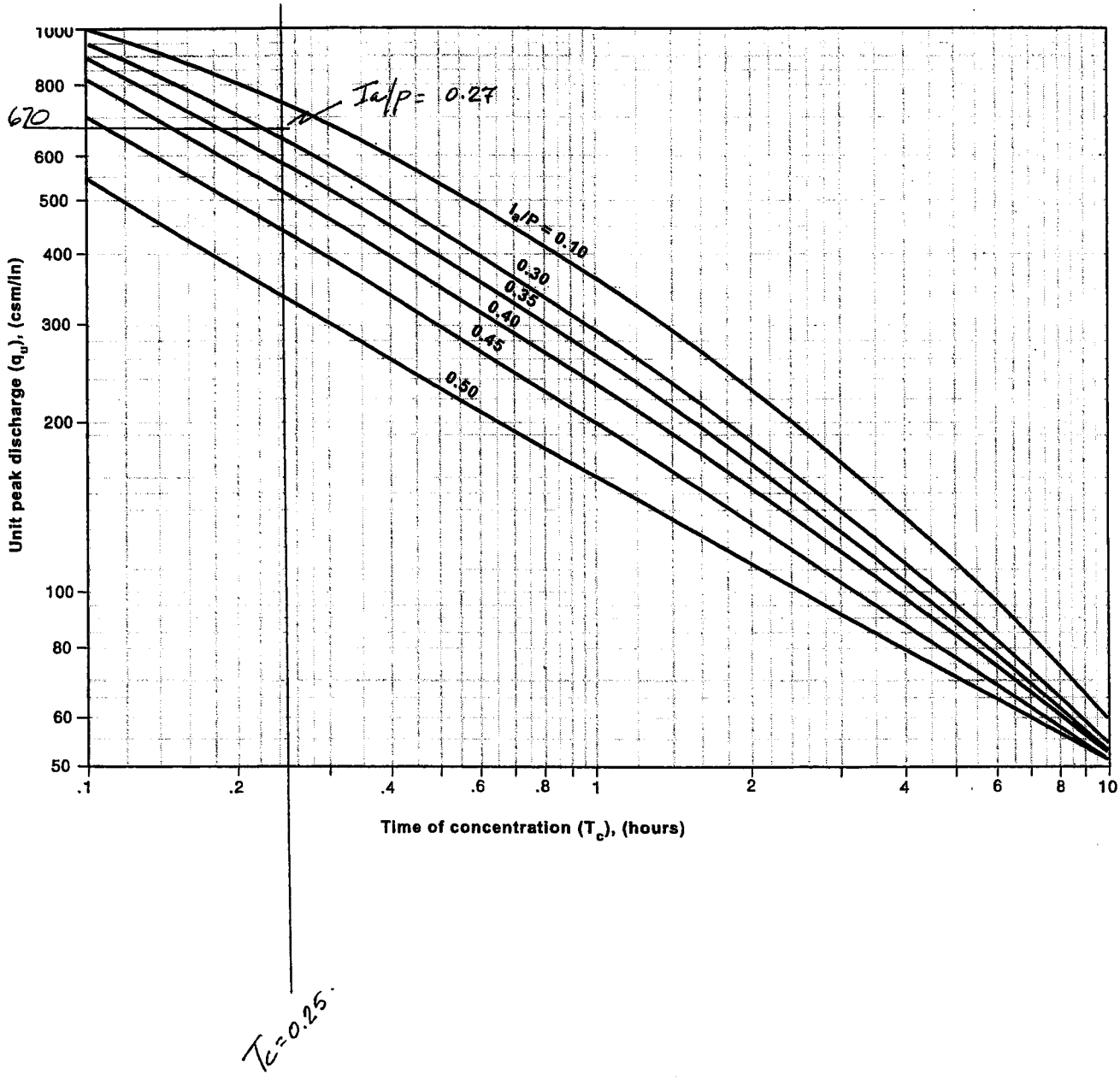
Qo/Qi 0.027
Qo 1yr 0.09 cfs
Vs/Vr 0.65
Vs 1yr 0.23 ac-ft

Figure B.7: Detention Time vs. Discharge Ratios (Qo/Qi)
(Source: Maryland Stormwater Design Manual, 1997)



0.027

Exhibit 4-II Unit peal discharge (q_u) for NRCS (SCS) type II rainfall distribution



Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.18	0.00	0.00
5.25	0.19	0.00	0.00
5.50	0.20	0.00	0.00
5.75	0.21	0.00	0.00
6.00	0.22	0.00	0.00
6.25	0.24	0.00	0.00
6.50	0.25	0.00	0.00
6.75	0.26	0.00	0.00
7.00	0.28	0.00	0.00
7.25	0.29	0.00	0.00
7.50	0.31	0.00	0.00
7.75	0.32	0.00	0.00
8.00	0.34	0.00	0.00
8.25	0.35	0.00	0.00
8.50	0.37	0.00	0.00
8.75	0.39	0.00	0.00
9.00	0.41	0.00	0.00
9.25	0.43	0.00	0.00
9.50	0.46	0.00	0.00
9.75	0.48	0.00	0.00
10.00	0.51	0.00	0.00
10.25	0.54	0.00	0.00
10.50	0.57	0.00	0.00
10.75	0.61	0.00	0.00
11.00	0.66	0.00	0.00
11.25	0.72	0.00	0.00
11.50	0.79	0.00	0.00
11.75	1.08	0.03	0.16
12.00	1.86	0.26	**2.88**
12.25	1.98	0.31	**3.34**
12.50	2.06	0.35	1.37
12.75	2.11	0.37	0.81
13.00	2.16	0.39	0.62
13.25	2.20	0.41	0.52
13.50	2.24	0.43	0.46
13.75	2.27	0.45	0.41
14.00	2.30	0.46	0.37
14.25	2.32	0.47	0.33
14.50	2.35	0.49	0.31
14.75	2.37	0.50	0.30
15.00	2.39	0.51	0.28
15.25	2.41	0.52	0.27
15.50	2.43	0.53	0.26
15.75	2.45	0.54	0.24
16.00	2.46	0.55	0.23
16.25	2.48	0.56	0.21
16.50	2.50	0.57	0.21
16.75	2.51	0.57	0.20
17.00	2.52	0.58	0.20
17.25	2.54	0.59	0.19
17.50	2.55	0.60	0.19
17.75	2.57	0.60	0.18
18.00	2.58	0.61	0.18
18.25	2.59	0.62	0.17
18.50	2.60	0.62	0.17
18.75	2.61	0.63	0.16
19.00	2.63	0.64	0.16
19.25	2.64	0.64	0.15
19.50	2.65	0.65	0.14
19.75	2.66	0.65	0.14
20.00	2.67	0.66	0.13
20.25	2.67	0.66	0.13
20.50	2.68	0.67	0.13
20.75	2.69	0.67	0.13
21.00	2.70	0.68	0.12
21.25	2.71	0.68	0.12
21.50	2.72	0.69	0.12
21.75	2.73	0.69	0.12
22.00	2.74	0.70	0.12
22.25	2.74	0.70	0.12
22.50	2.75	0.71	0.12
22.75	2.76	0.71	0.12
23.00	2.77	0.72	0.12
23.25	2.78	0.72	0.12
23.50	2.78	0.73	0.11
23.75	2.79	0.73	0.11
24.00	**2.80**	**0.74**	0.11
24.25	2.80	0.74	0.06
24.50	2.80	0.74	0.01
24.75	2.80	0.74	0.00
25.00	2.80	0.74	0.00

CHANNEL PROTECTION STORAGE VOLUME COMPUTATION SHEET

PROJECT Stonehouse glen 1 BMP3
JOB NO: 2002261-504.02
DATE: 2/23/2005

Pre Developed Condition

Cover Description	Soil Name/type	CN	Area
woods(good)	C	70	2.10

WEIGHTED CN	TOTAL AREA
70	2.10

Time of Concentration

sheet	
shallow	
channel	
total	0.47

Post Developed Condition

Cover Description	Soil Name/type	CN	Area
1/3 ACRE LOTS	C	81	7.20

WEIGHTED CN	TOTAL AREA
81	7.20

Time of Concentration

sheet	
shallow	
channel	
total	0.42

condition	CN	Tc	Qa 1 yr storm	Q 1 year	Q 2 year	Q 10 year	Q 100 year
		hrs	inches	cfs	cfs	cfs	cfs
pre-developed	70	0.47	0.60	3.24	0.00	0.00	0.00
post developed	81	0.42	1.20	7.43	0.00	0.00	0.00

Storm	P
1 Year	2.8
2 Year	3.6
10 Year	5.8
100 Year	8

Pre-dev.		Post Dev	
Ia	0.9	Ia	0.47
Ia/P	qu	Ia/P	qu
0.31	480	0.17	550
0.24	0	0.00	
0.15	0	0.00	
0.11	0	0.00	

Qo/Qi 0.031
Qo 1yr 0.23 cfs
Vs/Vr 0.64
Vs 1yr 0.46 ac-ft 20079 cu ft

Qi = 6.11
Qo = 0.47

Figure B.7: Detention Time vs. Discharge Ratios (Qo/Qi)
(Source: Maryland Stormwater Design Manual, 1997)

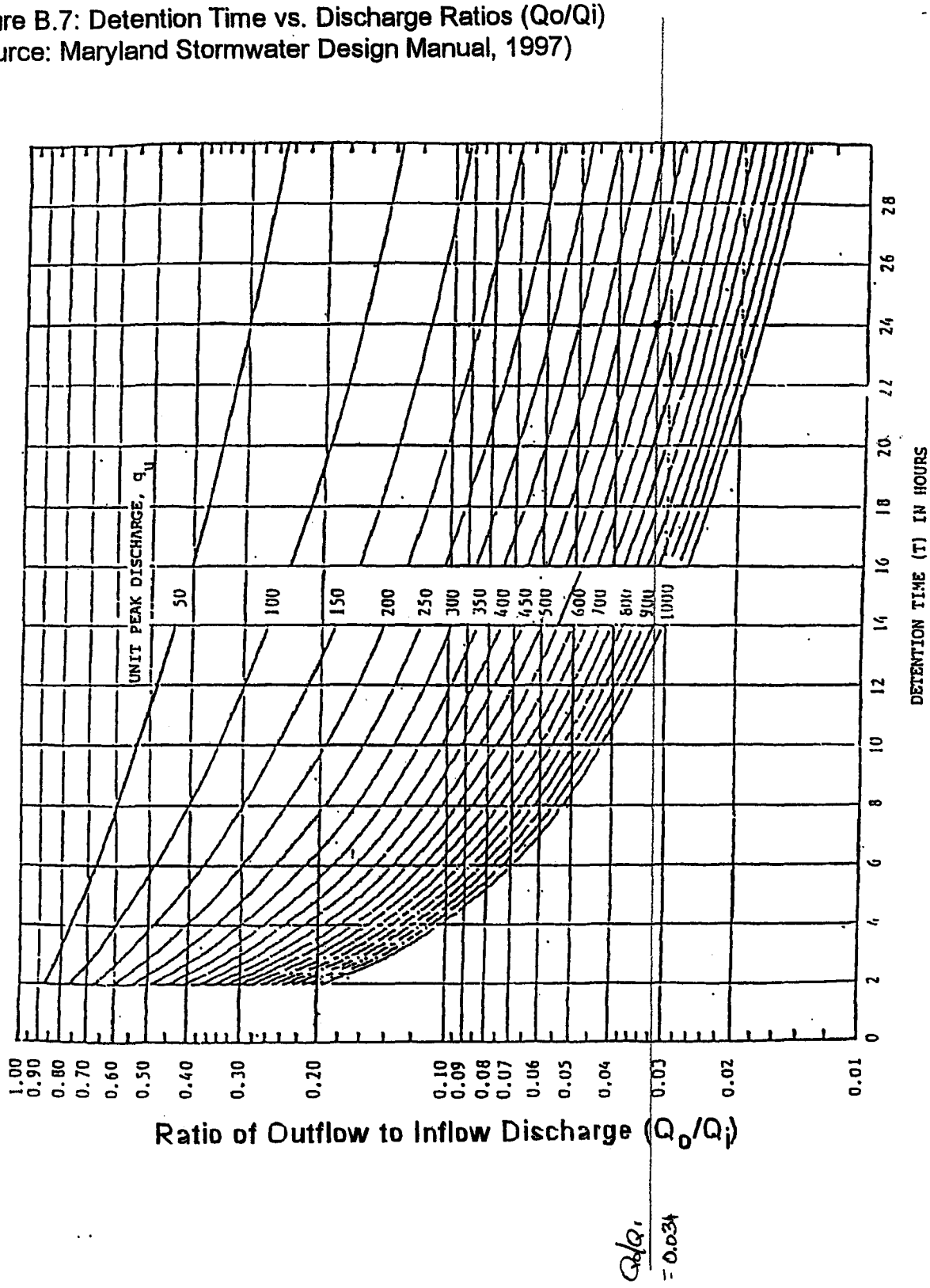
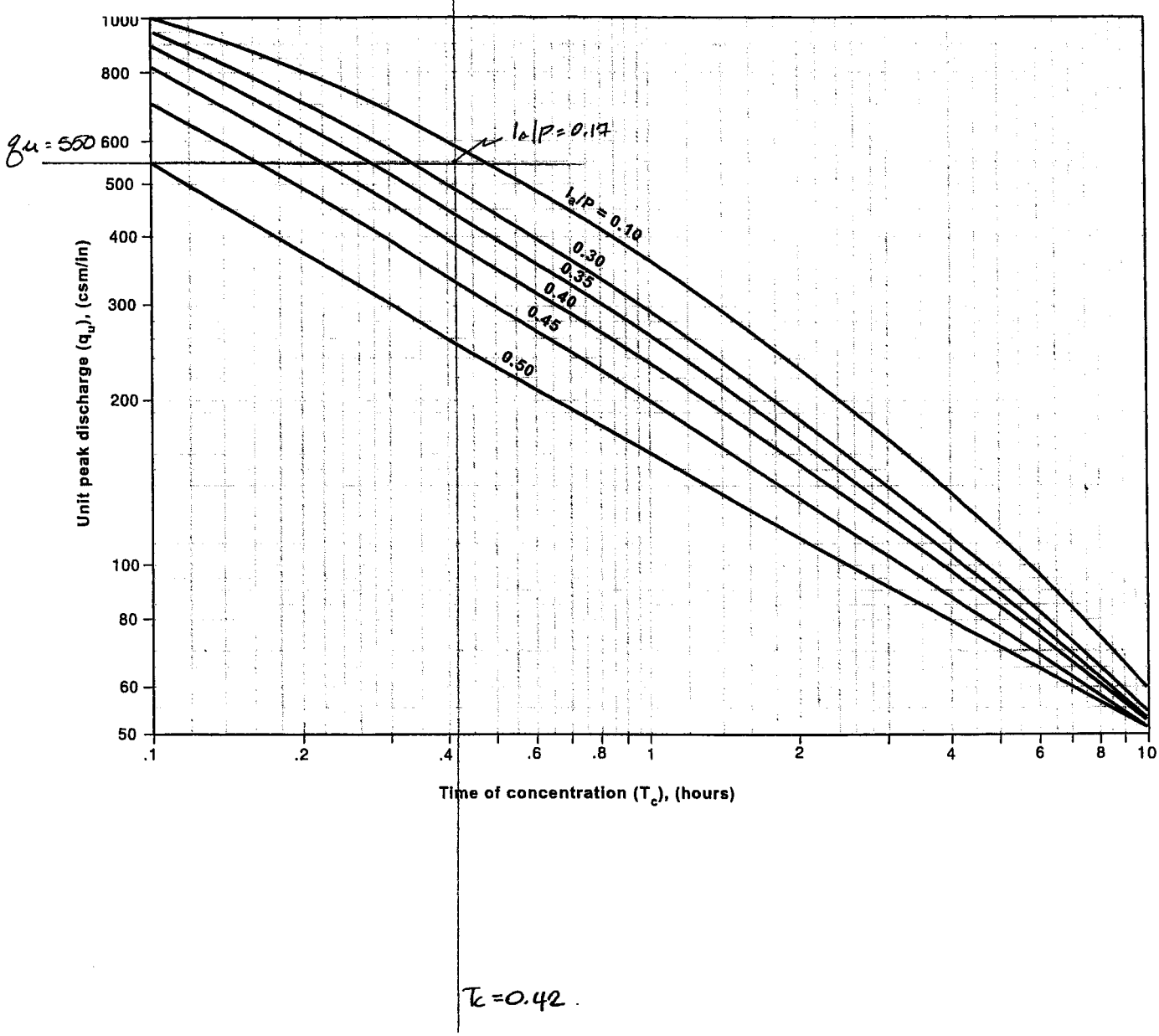


Exhibit 4-II Unit peal discharge (q_u) for NRCS (SCS) type II rainfall distribution



BMP #3

Hydrograph for Pond BMP-3: Basin 3

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	56.00	0.00
5.50	0.00	0	56.00	0.00
6.00	0.00	0	56.00	0.00
6.50	0.00	0	56.00	0.00
7.00	0.00	0	56.00	0.00
7.50	0.00	0	56.00	0.00
8.00	0.00	0	56.00	0.00
8.50	0.00	0	56.00	0.00
9.00	0.00	0	56.00	0.00
9.50	0.00	0	56.00	0.00
10.00	0.00	1	56.00	0.00
10.50	0.04	28	56.02	0.01
11.00	0.11	120	56.10	0.04
11.50	0.29	317	56.28	0.14
12.00	**3.95**	1,858	57.62	0.48
12.50	**3.54**	11,408	62.39	0.92
13.00	1.22	**13,376**	**62.93**	**0.95**
13.50	0.80	**13,391**	**62.93**	**0.96**
14.00	0.62	12,940	62.81	0.95
14.50	0.51	12,251	62.62	0.93
15.00	0.46	11,456	62.40	0.92
15.50	0.41	10,605	62.17	0.90
16.00	0.37	9,702	61.88	0.88
16.50	0.33	8,763	61.51	0.85
17.00	0.31	7,827	61.14	0.83
17.50	0.29	6,912	60.77	0.80
18.00	0.28	6,018	60.42	0.77
18.50	0.26	5,147	60.07	0.74
19.00	0.24	4,304	59.65	0.70
19.50	0.23	3,510	59.06	0.64
20.00	0.21	2,799	58.44	0.58
20.50	0.19	2,174	57.90	0.52
21.00	0.19	1,648	57.44	0.45
21.50	0.19	1,221	57.07	0.40
22.00	0.18	901	56.79	0.33
22.50	0.18	685	56.60	0.27
23.00	0.18	550	56.48	0.24
23.50	0.17	472	56.41	0.21
24.00	0.17	427	56.37	0.19
24.50	0.04	326	56.28	0.14
25.00	0.00	180	56.16	0.06
25.50	0.00	104	56.09	0.03
26.00	0.00	60	56.05	0.02
26.50	0.00	34	56.03	0.01
27.00	0.00	20	56.02	0.01
27.50	0.00	11	56.01	0.00
28.00	0.00	7	56.01	0.00
28.50	0.00	4	56.00	0.00
29.00	0.00	2	56.00	0.00
29.50	0.00	1	56.00	0.00
30.00	0.00	1	56.00	0.00

20 hrs.
note.
MIN. 4" ϕ ORIFICE
USED.

5

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LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: Sept 17, 2004 PROJ: STONEHOUSE GLEN SECT. I
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:

SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPA-CITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT / ACCUMULATED (17)	REMARKS (18)
1	2	0.74	0.65	–	0.48	14	5.3	2.54	101.88	101.58	40'	0.0076	15"	5.63	4.47	0.15 / –	
2	3	0.31	0.85	0.26	0.74	14.1	5.3	3.92	101.48	101.07	70'	0.0059	15"	4.96	4.48	0.25 / 0.40	
FUTURE SECT. II to 3A					0.96	15.18	5.99										
3A	3	0.62	0.65	0.40	1.36	15.51	5.20	7.14	100.94	100.75	40'	0.0048	18"	7.28	4.09	0.14 / 1.65	
3	4	0.13	0.9	0.12	2.22	15.65	5.18	11.49	100.45	99.88	151'	0.0038	24"	13.94	4.96	0.51 / 2.16	
4	5	0.09	0.9	0.08	2.3	16.16	5.12	11.78	99.78	98.77	268'	0.0038	24"	13.94	4.98	0.89 / 3.05	
5	6	0.13	0.9	0.12	2.42	17.05	5.02	12.15	98.67	97.96	168'	0.0042	24"	14.66	5.22	0.54 / 3.58	
6A	6	0.92	0.45	–	0.41	12	5.5	2.26	100.68	100.33	38'	0.0092	15"	6.20	4.66	0.13 / –	
6	7	0.66	0.45	0.30	3.13	17.58	4.97	15.56	93.34	92.53	44'	0.0184	24"	30.68	9.80	0.07 / 3.65	
7	8	0.38	0.85	0.32	3.45	17.10	4.96	17.11	87.87	86.21	93'	0.0178	24"	30.18	9.90	0.14 / 3.79	
3B	3A	From	Future	Sec	0.96	15.18	5.2	4.99	101.20	104.87	128'	0.0287	15"	10.94	8.71		

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 1
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.92	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	8.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	8.32	ft
Throat Incline Angle	90.00	degrees
Depth	0.44	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 1 - R
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.65	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	5.80	ft
Flow Area	0.4	ft^2
Depth	0.23	ft
Gutter Depression	1.3	in
Velocity	1.49	ft/s

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 1 - L
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	1.27	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	8.07	ft
Flow Area	0.8	ft^2
Depth	0.27	ft
Gutter Depression	1.3	in
Velocity	1.66	ft/s

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	1 to 2
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.007600	ft/ft
Diameter	15	in
Discharge	2.54	cfs

Results		
Depth	0.59	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.89	ft
Top Width	1.25	ft
Critical Depth	0.64	ft
Percent Full	47.1	%
Critical Slope	0.005750	ft/ft
Velocity	4.47	ft/s
Velocity Head	0.31	ft
Specific Energy	0.90	ft
Froude Number	1.17	
Maximum Discharg	6.06	cfs
Discharge Full	5.63	cfs
Slope Full	0.001546	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 2
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.05	cfs
Gutter Width	2.00	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	6.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	6.31	ft
Throat Incline Angle	90.00	degrees
Depth	0.42	ft
Gutter Depression	1.5	in
Total Depression	3.5	in

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 2 - R
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.10	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	1.46	ft
Flow Area	0.1	ft^2
Depth	0.12	ft
Gutter Depression	1.3	in
Velocity	1.15	ft/s

Notes: Sta 14+00 Rt. Ottoway Court

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 2 - L
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.95	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	7.04	ft
Flow Area	0.6	ft^2
Depth	0.25	ft
Gutter Depression	1.3	in
Velocity	1.58	ft/s

Notes: Sta 14+00 Rt. Ottoway Court

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	2 to 3
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005900	ft/ft
Diameter	15	in
Discharge	3.92	cfs

Results		
Depth	0.84	ft
Flow Area	0.9	ft²
Wetted Perimeter	2.40	ft
Top Width	1.18	ft
Critical Depth	0.80	ft
Percent Full	67.0	%
Critical Slope	0.006705	ft/ft
Velocity	4.48	ft/s
Velocity Head	0.31	ft
Specific Energy	1.15	ft
Froude Number	0.92	
Maximum Discharg	5.34	cfs
Discharge Full	4.96	cfs
Slope Full	0.003683	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3 - B to 3 - A
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.028700	ft/ft
Diameter	15	in
Discharge	4.99	cfs

Results		
Depth	0.59	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.90	ft
Top Width	1.25	ft
Critical Depth	0.91	ft
Percent Full	47.4	%
Critical Slope	0.007797	ft/ft
Velocity	8.71	ft/s
Velocity Head	1.18	ft
Specific Energy	1.77	ft
Froude Number	2.27	
Maximum Discharg	11.77	cfs
Discharge Full	10.94	cfs
Slope Full	0.005968	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 3A
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.61	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	8.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	7.40	ft
Throat Incline Angle	90.00	degrees
Depth	0.42	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 3A - R
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.23	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	2.89	ft
Flow Area	0.2	ft^2
Depth	0.16	ft
Gutter Depression	1.3	in
Velocity	1.34	ft/s

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 3A - L
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	1.38	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	8.38	ft
Flow Area	0.8	ft^2
Depth	0.28	ft
Gutter Depression	1.3	in
Velocity	1.69	ft/s

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3A to 3
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004800	ft/ft
Diameter	18	in
Discharge	7.14	cfs

Results		
Depth	1.20	ft
Flow Area	1.5	ft²
Wetted Perimeter	3.33	ft
Top Width	1.19	ft
Critical Depth	1.03	ft
Percent Full	80.3	%
Critical Slope	0.006848	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energy	1.55	ft
Froude Number	0.73	
Maximum Discharg	7.83	cfs
Discharge Full	7.28	cfs
Slope Full	0.004621	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 3
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.57	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	5.68	ft
Throat Incline Angle	90.00	degrees
Depth	0.39	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 3 - R
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.42	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	4.50	ft
Flow Area	0.3	ft^2
Depth	0.20	ft
Gutter Depression	1.3	in
Velocity	1.41	ft/s

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 3 - L
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.14	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	1.64	ft
Flow Area	0.1	ft^2
Depth	0.14	ft
Gutter Depression	1.3	in
Velocity	1.25	ft/s

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3 to 4
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003800	ft/ft
Diameter	24	in
Discharge	11.49	cfs

Results		
Depth	1.38	ft
Flow Area	2.3	ft²
Wetted Perimeter	3.93	ft
Top Width	1.85	ft
Critical Depth	1.22	ft
Percent Full	69.2	%
Critical Slope	0.005480	ft/ft
Velocity	4.96	ft/s
Velocity Head	0.38	ft
Specific Energy	1.77	ft
Froude Number	0.78	
Maximum Discharg	15.00	cfs
Discharge Full	13.94	cfs
Slope Full	0.002580	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 4
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.32	cfs
Slope	0.036600	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	2.50	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.69	
Intercepted Flow	0.22	cfs
Bypass Flow	0.10	cfs
Spread	1.49	ft
Depth	0.12	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.52	ft/s
Equivalent Cross Slope	0.156348	ft/ft
Length Factor	0.48	
Total Interception Length	5.24	ft

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 4
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.036600	ft/ft
Discharge	0.32	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	1.48	ft
Flow Area	0.1	ft^2
Depth	0.12	ft
Gutter Depression	1.3	in
Velocity	3.51	ft/s

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	4 to 5
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003800	ft/ft
Diameter	24	in
Discharge	11.78	cfs

Results		
Depth	1.41	ft
Flow Area	2.4	ft²
Wetted Perimeter	3.99	ft
Top Width	1.82	ft
Critical Depth	1.23	ft
Percent Full	70.5	%
Critical Slope	0.005539	ft/ft
Velocity	4.98	ft/s
Velocity Head	0.39	ft
Specific Energy	1.79	ft
Froude Number	0.77	
Maximum Discharg	15.00	cfs
Discharge Full	13.94	cfs
Slope Full	0.002712	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 5
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.48	cfs
Slope	0.036000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	4.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.85	
Intercepted Flow	0.41	cfs
Bypass Flow	0.07	cfs
Spread	1.90	ft
Depth	0.14	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.85	ft/s
Equivalent Cross Slope	0.156289	ft/ft
Length Factor	0.65	
Total Interception Length	6.15	ft

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 5
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.036000	ft/ft
Discharge	0.48	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	1.90	ft
Flow Area	0.1	ft^2
Depth	0.14	ft
Gutter Depression	1.3	in
Velocity	3.85	ft/s

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	5 to 6
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004200	ft/ft
Diameter	24	in
Discharge	12.15	cfs

Results		
Depth	1.39	ft
Flow Area	2.3	ft^2
Wetted Perimeter	3.94	ft
Top Width	1.84	ft
Critical Depth	1.25	ft
Percent Full	69.5	%
Critical Slope	0.005617	ft/ft
Velocity	5.22	ft/s
Velocity Head	0.42	ft
Specific Energy	1.81	ft
Froude Number	0.82	
Maximum Discharg	15.77	cfs
Discharge Full	14.66	cfs
Slope Full	0.002885	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 6A
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	1.66	cfs
Slope	0.017700	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	6.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.81	
Intercepted Flow	1.34	cfs
Bypass Flow	0.32	cfs
Spread	6.42	ft
Depth	0.24	ft
Flow Area	0.5	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.22	ft/s
Equivalent Cross Slope	0.115898	ft/ft
Length Factor	0.60	
Total Interception Length	10.02	ft

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 6A
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.017700	ft/ft
Discharge	1.66	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	6.42	ft
Flow Area	0.5	ft^2
Depth	0.24	ft
Gutter Depression	1.3	in
Velocity	3.22	ft/s

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	6A to 6
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.009200	ft/ft
Diameter	15	in
Discharge	2.26	cfs

Results		
Depth	0.52	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.76	ft
Top Width	1.23	ft
Critical Depth	0.60	ft
Percent Full	41.8	%
Critical Slope	0.005616	ft/ft
Velocity	4.65	ft/s
Velocity Head	0.34	ft
Specific Energy	0.86	ft
Froude Number	1.31	
Maximum Discharg	6.66	cfs
Discharge Full	6.20	cfs
Slope Full	0.001224	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 6
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.58	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	6.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	8.29	ft
Throat Incline Angle	90.00	degrees
Depth	0.44	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 6 - R
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.43	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	4.57	ft
Flow Area	0.3	ft^2
Depth	0.20	ft
Gutter Depression	1.3	in
Velocity	1.41	ft/s

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 6 - L
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	1.15	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	7.71	ft
Flow Area	0.7	ft^2
Depth	0.26	ft
Gutter Depression	1.3	in
Velocity	1.63	ft/s

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	6 to 7
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.018400	ft/ft
Diameter	24	in
Discharge	15.56	cfs

Results		
Depth	1.01	ft
Flow Area	1.6	ft²
Wetted Perimeter	3.16	ft
Top Width	2.00	ft
Critical Depth	1.42	ft
Percent Full	50.4	%
Critical Slope	0.006480	ft/ft
Velocity	9.80	ft/s
Velocity Head	1.49	ft
Specific Energy	2.50	ft
Froude Number	1.94	
Maximum Discharg	33.01	cfs
Discharge Full	30.68	cfs
Slope Full	0.004731	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 7
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.29	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	8.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	6.38	ft
Throat Incline Angle	90.00	degrees
Depth	0.40	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 7 - R
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.65	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	5.80	ft
Flow Area	0.4	ft^2
Depth	0.23	ft
Gutter Depression	1.3	in
Velocity	1.49	ft/s

Worksheet
Worksheet for Gutter Section

Project Description	
Worksheet	Gutter Section - 7 - L
Type	Gutter Section
Solve For	Spread

Input Data		
Slope	0.004000	ft/ft
Discharge	0.65	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	

Results		
Spread	5.80	ft
Flow Area	0.4	ft^2
Depth	0.23	ft
Gutter Depression	1.3	in
Velocity	1.49	ft/s

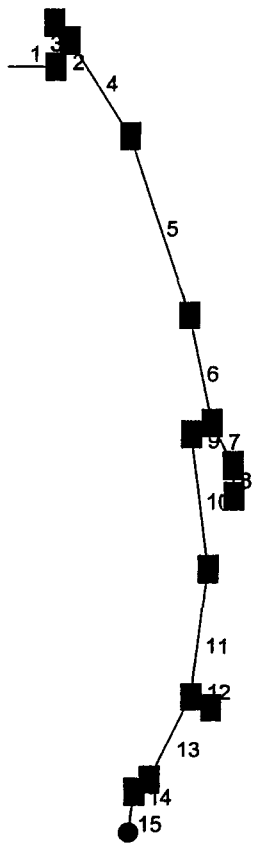
Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	7 to 8
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.017800	ft/ft
Diameter	24	in
Discharge	17.08	cfs

Results		
Depth	1.08	ft
Flow Area	1.7	ft²
Wetted Perimeter	3.30	ft
Top Width	1.99	ft
Critical Depth	1.49	ft
Percent Full	53.9	%
Critical Slope	0.006964	ft/ft
Velocity	9.90	ft/s
Velocity Head	1.52	ft
Specific Energy	2.60	ft
Froude Number	1.88	
Maximum Discharg	32.47	cfs
Discharge Full	30.18	cfs
Slope Full	0.005701	ft/ft
Flow Type	Supercritical	

Hydraflow Plan View



Project file: Stonehouse Glen System 1.stm	IDF file: Norfolk.IDF	No. Lines: 15	10-18-2004

Hydraflow Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	86.0	0.0	Curb	17.11	0.00	0.00	0.0	86.59	1.78	88.12	24	Cir	0.013	1.10	104.15	7 to 8
2	1	43.0	-53.0	Curb	15.56	0.00	0.00	0.0	92.53	1.88	93.34	24	Cir	0.013	1.50	104.15	6 to 7
3	2	37.0	-87.0	Curb	2.26	0.00	0.00	0.0	100.33	0.95	100.68	15	Cir	0.013	1.00	104.60	6A to 6
4	2	169.0	101.0	Curb	12.15	0.00	0.00	0.0	97.96	0.42	98.67	24	Cir	0.013	0.70	109.55	5 to 6
5	4	267.0	17.0	Curb	11.78	0.00	0.00	0.0	98.77	0.38	99.78	24	Cir	0.013	0.50	109.46	4 to 5
6	5	151.0	9.0	Curb	5.18	0.00	0.00	0.0	99.88	0.38	100.45	24	Cir	0.013	1.50	105.12	4 to 3
7	6	68.0	-20.0	Curb	3.92	0.00	0.00	0.0	101.07	0.60	101.48	15	Cir	0.013	0.70	105.80	2 to 3
8	7	40.0	33.0	Curb	2.54	0.00	0.00	0.0	101.58	0.75	101.88	15	Cir	0.013	1.00	105.80	1 to 2
9	6	40.0	84.0	Curb	7.14	0.00	0.00	0.0	100.75	0.48	100.94	18	Cir	0.013	1.50	105.12	3 to 3A
10	9	179.0	-78.0	Curb	4.99	0.00	0.00	0.0	101.20	2.88	106.35	15	Cir	0.013	0.70	110.45	3A to 6(2)
11	10	173.0	20.0	Curb	4.52	0.00	0.00	0.0	106.45	1.46	108.98	15	Cir	0.013	1.50	113.30	5 to6 (2)
12	11	40.0	-78.0	Curb	1.21	0.00	0.00	0.0	109.08	0.60	109.32	15	Cir	0.013	1.00	113.30	4 to 5 (2)
13	11	136.0	24.0	Curb	2.97	0.00	0.00	0.0	109.25	0.82	110.36	15	Cir	0.013	0.70	114.65	3 to 5 (2)
14	13	32.0	27.0	Curb	2.49	0.00	0.00	0.0	110.46	0.66	110.67	15	Cir	0.013	1.10	114.65	2 to 3 (2)
15	14	56.0	-50.0	MH	1.27	0.00	0.00	0.0	110.77	3.61	112.79	15	Cir	0.013	1.00	116.75	1 to 2 (2)

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Date: 10-18-2004

Hydraflow Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	Dns line No.
1	7 to 8	17.11	24 c	86.0	86.59	88.12	1.779	88.59	89.59	0.82	End
2	6 to 7	15.56	24 c	43.0	92.53	93.34	1.884	93.53	95.10	0.66	1
3	6A to 6	2.26	15 c	37.0	100.33	100.68	0.946	100.85	101.28	0.23	2
4	5 to 6	12.15	24 c	169.0	97.96	98.67	0.420	99.35	100.06	0.30	2
5	4 to 5	11.78	24 c	267.0	98.77	99.78	0.378	100.35	101.17	0.20	4
6	4 to 3	5.18	24 c	151.0	99.88	100.45	0.377	101.37	101.47	0.24	5
7	2 to 3	3.92	15 c	68.0	101.07	101.48	0.603	101.91	102.31	0.23	6
8	1 to 2	2.54	15 c	40.0	101.58	101.88	0.750	102.53	102.54	0.24	7
9	3 to 3A	7.14	18 c	40.0	100.75	100.94	0.475	101.97	102.16	0.50	6
10	3A to 6(2)	4.99	15 c	179.0	101.20	106.35	2.877	102.66	107.24	0.31	9
11	5 to6 (2)	4.52	15 c	173.0	106.45	108.98	1.462	107.55	109.83	0.60	10
12	4 to 5 (2)	1.21	15 c	40.0	109.08	109.32	0.600	110.43	110.44	0.02	11
13	3 to 5 (2)	2.97	15 c	136.0	109.25	110.36	0.816	110.43	111.05	0.20	11
14	2 to 3 (2)	2.49	15 c	32.0	110.46	110.67	0.656	111.25	111.30	0.27	13
15	1 to 2 (2)	1.27	15 c	56.0	110.77	112.79	3.607	111.58	113.24	0.16	14

Project File: Stonehouse Glen System 1l-D-F File: Norfolk.IDF | Total No. Lines: 15 | Run Date: 10-18-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

Hydraflow Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	86.0	0.00	0.00	0.00	0.00	0.00	0.0	6.9	0.0	17.11	30.17	6.19	24	1.78	88.12	86.59	89.59	88.59	104.15	0.00	7 to 8
2	1	43.0	0.00	0.00	0.00	0.00	0.00	0.0	6.7	0.0	15.56	31.04	7.59	24	1.88	93.34	92.53	95.10	93.53	104.15	104.15	6 to 7
3	2	37.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.26	6.28	4.27	15	0.95	100.68	100.33	101.28	100.85	104.60	104.15	6A to 6
4	2	169.0	0.00	0.00	0.00	0.00	0.00	0.0	5.7	0.0	12.15	14.66	5.21	24	0.42	98.67	97.96	100.06	99.35	109.55	104.15	5 to 6
5	4	267.0	0.00	0.00	0.00	0.00	0.00	0.0	4.3	0.0	11.78	13.91	4.73	24	0.38	99.78	98.77	101.17	100.35	109.46	109.55	4 to 5
6	5	151.0	0.00	0.00	0.00	0.00	0.00	0.0	3.4	0.0	5.18	13.90	2.64	24	0.38	100.45	99.88	101.47	101.37	105.12	109.46	4 to 3
7	6	68.0	0.00	0.00	0.00	0.00	0.00	0.0	0.2	0.0	3.92	5.01	4.51	15	0.60	101.48	101.07	102.31	101.91	105.80	105.12	2 to 3
8	7	40.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.54	5.59	3.21	15	0.75	101.88	101.58	102.54	102.53	105.80	105.80	1 to 2
9	6	40.0	0.00	0.00	0.00	0.00	0.00	0.0	3.2	0.0	7.14	7.24	4.64	18	0.48	100.94	100.75	102.16	101.97	105.12	105.12	3 to 3A
10	9	179.0	0.00	0.00	0.00	0.00	0.00	0.0	2.2	0.0	4.99	10.95	4.69	15	2.88	106.35	101.20	107.24	102.66	110.45	105.12	3A to 6(2)
11	10	173.0	0.00	0.00	0.00	0.00	0.00	0.0	1.2	0.0	4.52	7.81	4.51	15	1.46	108.98	106.45	109.83	107.55	113.30	110.45	5 to6 (2)
12	11	40.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.21	5.00	1.01	15	0.60	109.32	109.08	110.44	110.43	113.30	113.30	4 to 5 (2)
13	11	136.0	0.00	0.00	0.00	0.00	0.00	0.0	0.5	0.0	2.97	5.83	3.37	15	0.82	110.36	109.25	111.05	110.43	114.65	113.30	3 to 5 (2)
14	13	32.0	0.00	0.00	0.00	0.00	0.00	0.0	0.3	0.0	2.49	5.23	3.52	15	0.66	110.67	110.46	111.30	111.25	114.65	114.65	2 to 3 (2)
15	14	56.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.27	12.26	2.35	15	3.61	112.79	110.77	113.24	111.58	116.75	114.65	1 to 2 (2)

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Run Date: 10-18-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 88.59 (ft)

Hydraflow Inlet Report

Line No	Line ID	A (ac)	Inlet time (min)	I (in/hr)	C	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet Ht (in)	Curb Inlet L (ft)	Grate Inlet area (sqft)	Grate Inlet L (ft)	Grate Inlet W (ft)	Gutter So (ft/ft)	Gutter W (ft)	Gutter Sw (ft/ft)	Gutter Sx (ft/ft)	Flow depth (ft)	Flow spread (ft)	Byp line No
1	7 to 8	0.00	0.0	0.00	0.00	17.11*	26.41	43.52	0.00	Curb	0.4	8.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	1.78	83.76	Offsite
2	6 to 7	0.00	0.0	0.00	0.00	15.56*	0.00	15.56	0.00	Curb	0.4	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	1.08	48.93	1
3	6A to 6	0.00	0.0	0.00	0.00	2.26*	0.00	1.27	0.99	Curb	0.4	6.00	0.00	0.00	0.00	0.018	1.67	0.083	0.020	0.27	8.24	1
4	5 to 6	0.00	0.0	0.00	0.00	12.15*	0.00	1.71	10.44	Curb	0.4	4.00	0.00	0.00	0.00	0.035	1.67	0.083	0.020	0.39	14.24	1
5	4 to 5	0.00	0.0	0.00	0.00	11.78*	0.00	1.07	10.71	Curb	0.4	2.50	0.00	0.00	0.00	0.036	1.67	0.083	0.020	0.39	14.24	1
6	4 to 3	0.00	0.0	0.00	0.00	5.18*	0.00	5.18	0.00	Curb	0.4	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.93	41.36	1
7	2 to 3	0.00	0.0	0.00	0.00	3.92*	0.00	3.92	0.00	Curb	0.4	4.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.56	22.97	1
8	1 to 2	0.00	0.0	0.00	0.00	2.54*	0.00	2.54	0.00	Curb	0.4	8.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.27	8.01	1
9	3 to 3A	0.00	0.0	0.00	0.00	7.14*	0.00	7.14	0.00	Curb	0.4	8.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.53	21.26	1
10	3A to 6(2)	0.00	0.0	0.00	0.00	4.99*	0.00	0.72	4.27	Curb	0.4	2.50	0.00	0.00	0.00	0.035	1.67	0.083	0.020	0.30	9.74	1
11	5 to6 (2)	0.00	0.0	0.00	0.00	4.52*	0.00	4.52	0.00	Curb	0.4	4.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.62	25.80	10
12	4 to 5 (2)	0.00	0.0	0.00	0.00	1.21*	0.00	1.21	0.00	Curb	0.4	4.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.26	7.58	10
13	3 to 5 (2)	0.00	0.0	0.00	0.00	2.97*	0.00	2.97	0.00	Curb	0.4	4.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.47	18.18	10
14	2 to 3 (2)	0.00	0.0	0.00	0.00	2.49*	1.27	3.76	0.00	Curb	0.4	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.42	15.66	10
15	1 to 2 (2)	0.00	0.0	0.00	0.00	1.27*	0.00	0.00	1.27	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	14

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Run Date: 10-18-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraflow Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	24	17.11	86.59	88.59	2.00	3.14	5.45	0.46	89.05	0.573	86.0	88.12	89.59	1.47**	2.47	6.94	0.75	90.33	0.728	0.650	N/A	1.10	0.82
2	24	15.56	92.53	93.53	1.00*	1.58	9.85	1.51	95.04	1.866	43.0	93.34	95.10	1.76	2.92	5.32	0.44	95.54	0.427	1.147	0.493	1.50	0.66
3	15	2.26	100.33	100.85	0.52*	0.48	4.69	0.34	101.19	0.943	37.0	100.68	101.28	0.60	0.59	3.84	0.23	101.51	0.548	0.746	0.276	1.00	0.23
4	24	12.15	97.96	99.35	1.39*	2.34	5.20	0.42	99.77	0.417	169	98.67	100.06	1.39	2.32	5.23	0.42	100.48	0.422	0.420	0.709	0.70	0.30
5	24	11.78	98.77	100.35	1.58	2.67	4.41	0.30	100.66	0.290	267	99.78	101.17	1.39	2.33	5.05	0.40	101.57	0.393	0.341	0.912	0.50	0.20
6	24	5.18	99.88	101.37	1.49	2.51	2.06	0.07	101.44	0.064	151	100.45	101.47	1.02	1.61	3.22	0.16	101.63	0.196	0.130	0.197	1.50	0.24
7	15	3.92	101.07	101.91	0.84*	0.88	4.46	0.31	102.22	0.583	68.0	101.48	102.31	0.83	0.86	4.56	0.32	102.63	0.616	0.600	0.408	0.70	0.23
8	15	2.54	101.58	102.53	0.95	1.00	2.53	0.10	102.63	0.180	40.0	101.88	102.54	0.66	0.65	3.89	0.24	102.77	0.524	0.352	0.141	1.00	0.24
9	18	7.14	100.75	101.97	1.22*	1.54	4.63	0.33	102.31	0.468	40.0	100.94	102.16	1.22	1.54	4.65	0.34	102.49	0.471	0.469	0.188	1.50	0.50
10	15	4.99	101.20	102.66	1.25	1.23	4.07	0.26	102.92	0.597	179	106.35	107.24	0.89**	0.94	5.31	0.44	107.68	0.806	0.702	N/A	0.70	0.31
11	15	4.52	106.45	107.55	1.10	1.14	3.95	0.24	107.79	0.440	173	108.98	109.83	0.85**	0.89	5.08	0.40	110.23	0.753	0.597	N/A	1.50	0.60
12	15	1.21	109.08	110.43	1.25	1.23	0.99	0.02	110.45	0.035	40.0	109.32	110.44	1.12	1.16	1.04	0.02	110.46	0.031	0.033	0.013	1.00	0.02
13	15	2.97	109.25	110.43	1.18	1.20	2.47	0.09	110.53	0.183	136	110.36	111.05	0.69**	0.69	4.28	0.28	111.33	0.610	0.397	N/A	0.70	0.20
14	15	2.49	110.46	111.25	0.79	0.82	3.05	0.14	111.39	0.283	32.0	110.67	111.30	0.63	0.63	3.98	0.25	111.55	0.565	0.424	0.136	1.10	0.27
15	15	1.27	110.77	111.58	0.81	0.84	1.52	0.04	111.61	0.069	56.0	112.79	113.24	0.45**	0.40	3.18	0.16	113.40	0.499	0.284	N/A	1.00	0.16

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Run Date: 10-18-2004

NOTES: Initial tailwater elevation = 88.59 (ft) , * Normal depth assumed., ** Critical depth assumed.

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: Oct. 1, 2004 PROJ: STONEHOUSE GLEN SECTION I
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:
SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT (17)	FLOW TIME MINUTES ACCUMULATED (17)	REMARKS (18)
10-C	10-B	0.40	0.80	–	0.32	12	5.5	1.76	90.38	89.31	296'	0.0036	15"	3.88	3.08	1.60	–	
10-B	10-A-1	0.14	0.65	0.09	0.41	13.6	5.4	2.21	89.21	88.56	180'	0.0036	15"	3.88	3.26	0.92	2.52	
10-A-1	10	0.19	0.80	0.15	0.56	14.52	5.3	2.97	88.46	88.22	66'	0.0036	15"	3.88	3.48	0.31	2.83	
10-A-2	10	0.33	0.90	–	0.30	12	5.5	1.65	88.54	88.22	33'	0.01	15"	6.46	4.40	0.09	–	
10	11	0.15	0.90	0.14	1.00	14.83	5.27	5.27	88.12	86.76	189'	0.0072	15"	5.48	5.09	0.61	3.44	
11	12	0.08	0.90	0.07	1.07	15.59	5.19	5.55	86.66	85.35	173'	0.0076	15"	5.63	5.23	0.68	4.27	
12-C	12-A	0.39	0.7	–	0.27	12	5.5	1.49	96.50	94.47	75'	0.0271	15"	10.63	6.11	0.20	–	
12-B	12-A	0.25	0.9	–	0.23	12	5.5	1.27	94.41	94.09	32'	0.01	15"	6.46	4.09	0.13	–	
12-A	12	0.07	0.9	0.06	0.56	12.20	5.5	3.08	93.09	91.90	30'	0.0397	15"	12.87	8.61	0.11	0.31	
12	13	–	–	–	1.63	16.27	5.12	8.34	85.10	82.72	244'	0.0097	18"	10.35	6.51	0.62	4.89	
13-C-1	13-C	0.09	0.9	–	0.08	10	5.75	0.46	84.00	83.41	74'	0.0080	15"	5.78	2.82	0.44	–	
13-C	13-B	0.16	0.7	0.11	0.19	10.44	5.71	1.08	83.31	83.13	51'	0.0036	15"	3.88	2.71	0.31	0.75	
13-B-1	13-B	0.22	0.9	–	0.20	10	5.75	1.15	84.91	84.59	32'	0.01	15"	3.50	2.55	0.21	–	

Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN COMPUTATIONS

ROUTE: _____ PROJ: Stonehouse Glen Section I
COUNTY: _____ DISTRICT: _____
DESCRIPTION: _____
SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT / ACCUMULATED (17)	REMARKS (18)
13-B	13	0.10	0.7	0.07	0.46	12	5.5	2.53	83.03	82.72	87'	0.0036	15"	3.88	3.43	0.42 / 0.63	
13	14	0.27	0.6	0.16	2.25	16.81	5.07	11.41	81.00	70.00	199	0.0553	18"	24.70	13.70	0.24 / 5.05	
14	15	—	—	—	—			11.41	66.50	65.78	30'	0.0240	18"	16.27	9.97	0.06 / 5.11	
15	16	—	—	—	—			11.41	61.58	61.00	24'	0.0240	18"	16.27	9.97		
25	26	0.72	0.45	—	0.32	14	5.3	1.70	78.75	68.5	128'	0.08	15"	5.78	4.09	0.52 / —	
26-A	26	0.17	0.9	—	0.15	12	5.5	0.82	71.39	71.08	31'	0.01	15"	6.46	3.61	0.14 / —	
26	27	—	—	—	0.47	14.5	5.3	2.49	68.4	68.18	45	0.0048	15"	4.48	3.74	0.20 / 0.72	
27	28	1.33	0.45	0.60	1.07	14.7	5.29	5.66	68.08	66.16	240	0.0080	15"	5.48	5.09	0.63 / 1.33	
28	29	—	—	—	—			5.66	61.87	61.00	33'	0.0380	15"	12.59	9.99	0.11 / 1.44	

Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: _____ PROJ: STONEHOUSE GLEN SECTION I
COUNTY: _____ DISTRICT: CURB & GUTTER
DESCRIPTION: _____
SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT / ACCUMULATED (17)	REMARKS (18)
13	14	0.27	0.6	0.16	2.25	16.81	5.07	11.41	81.00	70.62	173'	0.060	18"	25.73	14.12	0.8d	
14A	14	0.73	0.35	0.26	—	12	5.54	1.44	76.17	72.88	28'	0.113	15"	21.71	10.03		
14	15	–	–	–	2.51	16.81	5.07	12.73	65.38	62.66	34'	0.080	18"	29.71	16.16		
15	16	–	–	–	–			12.73	56.39	56.25	31'	0.0045	24"	15.17	5.41		
~~27~~	~~28~~	~~1.33~~	~~0.45~~	~~0.60~~	~~1.07~~	~~14.7~~	~~5.29~~	~~5.66~~	~~66.67~~	~~65.08~~	~~199'~~	~~0.0080~~	~~15"~~	~~5.78~~	~~9.54~~		
28	29	–	–	–	–			~~5.66~~	~~64.00~~	60.40	45'	0.08	15"	18.27	13.13		
~~29~~	~~29A~~	–	–	–	–	–	–	5.66	56.40	56.25	30'	0.005	18"	7.43	~~2.09~~		

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	10-C to 10-B
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003600	ft/ft
Diameter	15	in
Discharge	1.76	cfs

Results		
Depth	0.59	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.90	ft
Top Width	1.25	ft
Critical Depth	0.53	ft
Percent Full	47.3	%
Critical Slope	0.005397	ft/ft
Velocity	3.08	ft/s
Velocity Head	0.15	ft
Specific Energy	0.74	ft
Froude Number	0.80	
Maximum Discharg	4.17	cfs
Discharge Full	3.88	cfs
Slope Full	0.000742	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	10-B to 10-A - 1
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003600	ft/ft
Diameter	15	in
Discharge	2.21	cfs

Results		
Depth	0.68	ft
Flow Area	0.7	ft²
Wetted Perimeter	2.07	ft
Top Width	1.25	ft
Critical Depth	0.59	ft
Percent Full	54.1	%
Critical Slope	0.005579	ft/ft
Velocity	3.26	ft/s
Velocity Head	0.17	ft
Specific Energy	0.84	ft
Froude Number	0.78	
Maximum Discharg	4.17	cfs
Discharge Full	3.88	cfs
Slope Full	0.001171	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	10 - A - 1 to 10
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003600	ft/ft
Diameter	15	in
Discharge	2.97	cfs

Results		
Depth	0.82	ft
Flow Area	0.9	ft²
Wetted Perimeter	2.36	ft
Top Width	1.19	ft
Critical Depth	0.69	ft
Percent Full	65.6	%
Critical Slope	0.006006	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	1.01	ft
Froude Number	0.72	
Maximum Discharg	4.17	cfs
Discharge Full	3.88	cfs
Slope Full	0.002114	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	10 - A - 2 to 10
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.010000	ft/ft
Diameter	15	in
Discharge	1.65	cfs

Results		
Depth	0.43	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.57	ft
Top Width	1.19	ft
Critical Depth	0.51	ft
Percent Full	34.5	%
Critical Slope	0.005356	ft/ft
Velocity	4.40	ft/s
Velocity Head	0.30	ft
Specific Energy	0.73	ft
Froude Number	1.38	
Maximum Discharg	6.95	cfs
Discharge Full	6.46	cfs
Slope Full	0.000652	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	10 to 11
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.007200	ft/ft
Diameter	15	in
Discharge	5.27	cfs

Results		
Depth	0.98	ft
Flow Area	1.0	ft²
Wetted Perimeter	2.73	ft
Top Width	1.02	ft
Critical Depth	0.93	ft
Percent Full	78.7	%
Critical Slope	0.008141	ft/ft
Velocity	5.09	ft/s
Velocity Head	0.40	ft
Specific Energy	1.39	ft
Froude Number	0.89	
Maximum Discharg	5.90	cfs
Discharge Full	5.48	cfs
Slope Full	0.006656	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	11 - 12
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.007600	ft/ft
Diameter	15	in
Discharge	5.55	cfs

Results		
Depth	1.01	ft
Flow Area	1.1	ft²
Wetted Perimeter	2.79	ft
Top Width	0.99	ft
Critical Depth	0.95	ft
Percent Full	80.7	%
Critical Slope	0.008516	ft/ft
Velocity	5.23	ft/s
Velocity Head	0.43	ft
Specific Energy	1.43	ft
Froude Number	0.89	
Maximum Discharg	6.06	cfs
Discharge Full	5.63	cfs
Slope Full	0.007382	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	12 - C to 12 - A
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.027100	ft/ft
Diameter	15	in
Discharge	1.49	cfs

Results		
Depth	0.32	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.32	ft
Top Width	1.09	ft
Critical Depth	0.48	ft
Percent Full	25.3	%
Critical Slope	0.005302	ft/ft
Velocity	6.11	ft/s
Velocity Head	0.58	ft
Specific Energy	0.90	ft
Froude Number	2.27	
Maximum Discharg	11.44	cfs
Discharge Full	10.63	cfs
Slope Full	0.000532	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	12 - B to 12 - A
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.010000	ft/ft
Diameter	15	in
Discharge	1.27	cfs

Results		
Depth	0.38	ft
Flow Area	0.3	ft²
Wetted Perimeter	1.45	ft
Top Width	1.15	ft
Critical Depth	0.44	ft
Percent Full	30.1	%
Critical Slope	0.005255	ft/ft
Velocity	4.09	ft/s
Velocity Head	0.26	ft
Specific Energy	0.64	ft
Froude Number	1.39	
Maximum Discharg	6.95	cfs
Discharge Full	6.46	cfs
Slope Full	0.000387	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	12 - A to 12
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.039700	ft/ft
Diameter	15	in
Discharge	3.08	cfs

Results		
Depth	0.42	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.54	ft
Top Width	1.18	ft
Critical Depth	0.71	ft
Percent Full	33.3	%
Critical Slope	0.006077	ft/ft
Velocity	8.61	ft/s
Velocity Head	1.15	ft
Specific Energy	1.57	ft
Froude Number	2.76	
Maximum Discharg	13.84	cfs
Discharge Full	12.87	cfs
Slope Full	0.002274	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	12 to 13
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.009700	ft/ft
Diameter	18	in
Discharge	8.34	cfs

Results		
Depth	1.02	ft
Flow Area	1.3	ft²
Wetted Perimeter	2.91	ft
Top Width	1.40	ft
Critical Depth	1.12	ft
Percent Full	68.0	%
Critical Slope	0.007679	ft/ft
Velocity	6.51	ft/s
Velocity Head	0.66	ft
Specific Energy	1.68	ft
Froude Number	1.20	
Maximum Discharg	11.13	cfs
Discharge Full	10.35	cfs
Slope Full	0.006304	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	13 - C - 1 to 13 - C
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.008000	ft/ft
Diameter	15	in
Discharge	0.46	cfs

Results		
Depth	0.24	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.13	ft
Top Width	0.98	ft
Critical Depth	0.26	ft
Percent Full	19.1	%
Critical Slope	0.005342	ft/ft
Velocity	2.82	ft/s
Velocity Head	0.12	ft
Specific Energy	0.36	ft
Froude Number	1.22	
Maximum Discharg	6.21	cfs
Discharge Full	5.78	cfs
Slope Full	0.000051	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	13 - C to 13 - B
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003600	ft/ft
Diameter	15	in
Discharge	1.08	cfs

Results		
Depth	0.45	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.61	ft
Top Width	1.20	ft
Critical Depth	0.41	ft
Percent Full	36.1	%
Critical Slope	0.005226	ft/ft
Velocity	2.71	ft/s
Velocity Head	0.11	ft
Specific Energy	0.56	ft
Froude Number	0.83	
Maximum Discharg	4.17	cfs
Discharge Full	3.88	cfs
Slope Full	0.000280	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	13 - B - 1 to 13 - B
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Slope	0.010000	ft/ft
Diameter	15	in
Discharge	1.15	cfs

Results		
Depth	0.49	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.70	ft
Top Width	1.22	ft
Critical Depth	0.42	ft
Percent Full	39.5	%
Critical Slope	0.017835	ft/ft
Velocity	2.55	ft/s
Velocity Head	0.10	ft
Specific Energy	0.59	ft
Froude Number	0.74	
Maximum Discharg	3.76	cfs
Discharge Full	3.50	cfs
Slope Full	0.001080	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	13 - B to 13
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003600	ft/ft
Diameter	15	in
Discharge	2.75	cfs

Results		
Depth	0.78	ft
Flow Area	0.8	ft²
Wetted Perimeter	2.27	ft
Top Width	1.21	ft
Critical Depth	0.67	ft
Percent Full	62.2	%
Critical Slope	0.005874	ft/ft
Velocity	3.43	ft/s
Velocity Head	0.18	ft
Specific Energy	0.96	ft
Froude Number	0.74	
Maximum Discharg	4.17	cfs
Discharge Full	3.88	cfs
Slope Full	0.001812	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	13 to 14
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.060000	ft/ft
Diameter	18	in
Discharge	11.41	cfs

Results		
Depth	0.70	ft
Flow Area	0.8	ft²
Wetted Perimeter	2.26	ft
Top Width	1.50	ft
Critical Depth	1.29	ft
Percent Full	46.6	%
Critical Slope	0.010938	ft/ft
Velocity	14.12	ft/s
Velocity Head	3.10	ft
Specific Energy	3.80	ft
Froude Number	3.39	
Maximum Discharg	27.68	cfs
Discharge Full	25.73	cfs
Slope Full	0.011800	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	14 - A to 14
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.113000	ft/ft
Diameter	15	in
Discharge	1.44	cfs

Results		
Depth	0.22	ft
Flow Area	0.1	ft²
Wetted Perimeter	1.08	ft
Top Width	0.95	ft
Critical Depth	0.47	ft
Percent Full	17.4	%
Critical Slope	0.005288	ft/ft
Velocity	10.03	ft/s
Velocity Head	1.56	ft
Specific Energy	1.78	ft
Froude Number	4.54	
Maximum Discharg	23.36	cfs
Discharge Full	21.71	cfs
Slope Full	0.000497	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	14 to 15
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.080000	ft/ft
Diameter	18	in
Discharge	12.73	cfs

Results		
Depth	0.69	ft
Flow Area	0.8	ft²
Wetted Perimeter	2.23	ft
Top Width	1.49	ft
Critical Depth	1.34	ft
Percent Full	45.7	%
Critical Slope	0.012997	ft/ft
Velocity	16.16	ft/s
Velocity Head	4.06	ft
Specific Energy	4.75	ft
Froude Number	3.93	
Maximum Discharg	31.96	cfs
Discharge Full	29.71	cfs
Slope Full	0.014688	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	15 to 16
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004500	ft/ft
Diameter	24	in
Discharge	12.73	cfs

Results		
Depth	1.40	ft
Flow Area	2.4	ft²
Wetted Perimeter	3.97	ft
Top Width	1.83	ft
Critical Depth	1.28	ft
Percent Full	70.1	%
Critical Slope	0.005741	ft/ft
Velocity	5.41	ft/s
Velocity Head	0.45	ft
Specific Energy	1.86	ft
Froude Number	0.84	
Maximum Discharg	16.32	cfs
Discharge Full	15.17	cfs
Slope Full	0.003167	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 13 - B
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.51	cfs
Slope	0.015000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	4.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.95	
Intercepted Flow	0.48	cfs
Bypass Flow	0.03	cfs
Spread	3.21	ft
Depth	0.17	ft
Flow Area	0.2	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.62	ft/s
Equivalent Cross Slope	0.150313	ft/ft
Length Factor	0.80	
Total Interception Length	4.97	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 13
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.66	cfs
Slope	0.034300	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	6.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.97	
Intercepted Flow	0.64	cfs
Bypass Flow	0.02	cfs
Spread	2.79	ft
Depth	0.16	ft
Flow Area	0.2	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.92	ft/s
Equivalent Cross Slope	0.153307	ft/ft
Length Factor	0.86	
Total Interception Length	7.01	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 12 - C
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	1.09	cfs
Slope	0.040800	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	6.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.83	
Intercepted Flow	0.91	cfs
Bypass Flow	0.18	cfs
Spread	3.92	ft
Depth	0.19	ft
Flow Area	0.2	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	4.41	ft/s
Equivalent Cross Slope	0.143601	ft/ft
Length Factor	0.63	
Total Interception Length	9.49	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 13
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.66	cfs
Slope	0.034300	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	6.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.97	
Intercepted Flow	0.64	cfs
Bypass Flow	0.02	cfs
Spread	2.79	ft
Depth	0.16	ft
Flow Area	0.2	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.92	ft/s
Equivalent Cross Slope	0.153307	ft/ft
Length Factor	0.86	
Total Interception Length	7.01	ft

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 13 - C - 1
Type	Curb Inlet in Sag
Solve For	Spread

Input Data		
Discharge	0.32	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	3.87	ft
Throat Incline Angle	90.00	degrees
Depth	0.35	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 13 - B - 1
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.79	cfs
Slope	0.015000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	6.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	1.00	
Intercepted Flow	0.79	cfs
Bypass Flow	2.98e-3	cfs
Spread	4.42	ft
Depth	0.20	ft
Flow Area	0.3	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.72	ft/s
Equivalent Cross Slope	0.138125	ft/ft
Length Factor	0.95	
Total Interception Length	6.28	ft

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 12 - B
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.90	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	6.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	5.69	ft
Throat Incline Angle	90.00	degrees
Depth	0.39	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 12 - A
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.25	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	3.28	ft
Throat Incline Angle	90.00	degrees
Depth	0.34	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 11
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.29	cfs
Slope	0.014600	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	2.50	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.86	
Intercepted Flow	0.25	cfs
Bypass Flow	0.04	cfs
Spread	1.76	ft
Depth	0.14	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.43	ft/s
Equivalent Cross Slope	0.156340	ft/ft
Length Factor	0.66	
Total Interception Length	3.80	ft

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 10
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.54	cfs
Gutter Width	2.00	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	6.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	4.05	ft
Throat Incline Angle	90.00	degrees
Depth	0.38	ft
Gutter Depression	1.5	in
Total Depression	3.5	in

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 10 - A - 1
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.65	cfs
Slope	0.010000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	4.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.93	
Intercepted Flow	0.61	cfs
Bypass Flow	0.04	cfs
Spread	4.44	ft
Depth	0.20	ft
Flow Area	0.3	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.22	ft/s
Equivalent Cross Slope	0.137882	ft/ft
Length Factor	0.78	
Total Interception Length	5.13	ft

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 10 - A - 2
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.20	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	6.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	6.90	ft
Throat Incline Angle	90.00	degrees
Depth	0.41	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 10 - B
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.36	cfs
Slope	0.010000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	2.50	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.86	
Intercepted Flow	0.31	cfs
Bypass Flow	0.05	cfs
Spread	2.82	ft
Depth	0.16	ft
Flow Area	0.2	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.12	ft/s
Equivalent Cross Slope	0.153141	ft/ft
Length Factor	0.67	
Total Interception Length	3.76	ft

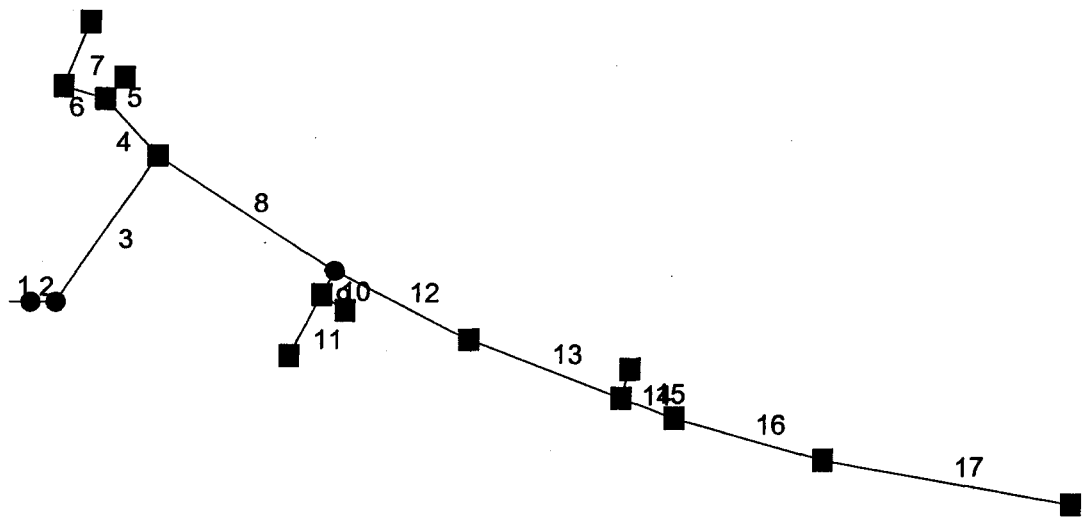
Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 10 - C
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.28	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	8.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	6.35	ft
Throat Incline Angle	90.00	degrees
Depth	0.40	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Hydraflow Plan View



Project file: Stonehouse Glen System 3.stm	IDF file: Norfolk.IDF	No. Lines: 17	10-19-2004

Hydraflow Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	24.0	0.0	MH	11.41	0.00	0.00	0.0	61.00	2.42	61.58	18	Cir	0.013	0.15	71.00	15 to 16
2	1	30.0	0.0	MH	11.41	0.00	0.00	0.0	65.78	2.40	66.50	18	Cir	0.013	0.75	78.00	14 to 15
3	2	199.0	-53.0	Curb	11.41	0.00	0.00	0.0	70.00	5.53	81.00	18	Cir	0.013	1.50	91.43	13 to 14
4	3	87.0	-82.0	Curb	2.53	0.00	0.00	0.0	82.72	0.36	83.03	15	Cir	0.013	1.50	88.84	13 to 13 B
5	4	32.0	90.0	Curb	1.15	0.00	0.00	0.0	84.59	1.00	84.91	15	Cir	0.013	1.00	88.83	13 B to 13 B 1
6	4	51.0	-30.0	Curb	1.08	0.00	0.00	0.0	83.13	0.35	83.31	15	Cir	0.013	1.50	87.94	13 B to 13 C
7	6	74.0	100.0	Curb	0.46	0.00	0.00	0.0	83.41	0.80	84.00	15	Cir	0.013	1.00	87.96	13 C to 13 C 1
8	3	244.0	84.0	MH	8.34	0.00	0.00	0.0	82.72	0.98	85.10	18	Cir	0.013	1.00	98.78	12 to 13
9	8	30.0	90.0	Curb	3.08	0.00	0.00	0.0	91.90	3.97	93.09	15	Cir	0.013	1.50	98.39	12 to 12 A
10	9	32.0	-90.0	Curb	1.27	0.00	0.00	0.0	94.09	1.00	94.41	15	Cir	0.013	1.00	98.33	12 A to 12 B
11	9	75.0	0.0	Curb	1.49	0.00	0.00	0.0	94.47	2.71	96.50	15	Cir	0.013	1.00	100.42	12 C to 12 A
12	8	173.0	-6.0	Curb	5.55	0.00	0.00	0.0	85.35	0.76	86.66	15	Cir	0.013	0.50	97.78	12 to 11
13	12	189.0	-6.0	Curb	5.27	0.00	0.00	0.0	86.76	0.72	88.12	15	Cir	0.013	1.50	95.46	10 to 11
14	13	32.0	-90.0	Curb	1.65	0.00	0.00	0.0	91.22	1.00	91.54	15	Cir	0.013	1.00	95.46	10 A 2 to 10
15	13	66.0	0.0	Curb	2.97	0.00	0.00	0.0	88.22	0.36	88.46	15	Cir	0.013	0.50	96.00	10 A 1 to 10
16	15	180.0	-5.0	Curb	2.21	0.00	0.00	0.0	88.56	0.36	89.21	15	Cir	0.013	0.50	91.72	10 B to 10 A 1
17	16	296.0	-5.0	Curb	1.76	0.00	0.00	0.0	89.31	0.36	90.38	15	Cir	0.013	1.00	94.30	10 C 10 B

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Date: 10-19-2004

Hydraflow Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	Dns line No.
1	15 to 16	11.41	18 c	24.0	61.00	61.58	2.417	62.20	62.87	0.12	End
2	14 to 15	11.41	18 c	30.0	65.78	66.50	2.400	66.72*	68.09*	0.49	1
3	13 to 14	11.41	18 c	199.0	70.00	81.00	5.528	70.73	82.29	1.16	2
4	13 to 13 B	2.53	15 c	87.0	82.72	83.03	0.356	83.47	83.77	0.26	3
5	13 B to 13 B 1	1.15	15 c	32.0	84.59	84.91	1.000	84.96	85.34	0.15	4
6	13 B to 13 C	1.08	15 c	51.0	83.13	83.31	0.353	84.03	84.04	0.05	4
7	13 C to 13 C 1	0.46	15 c	74.0	83.41	84.00	0.797	84.09	84.27	0.09	6
8	12 to 13	8.34	18 c	244.0	82.72	85.10	0.975	83.75	86.20	0.56	3
9	12 to 12 A	3.08	15 c	30.0	91.90	93.09	3.967	92.33	93.79	0.44	8
10	12 A to 12 B	1.27	15 c	32.0	94.09	94.41	1.000	94.47	94.86	0.16	9
11	12 C to 12 A	1.49	15 c	75.0	94.47	96.50	2.707	94.80	96.99	0.17	9
12	12 to 11	5.55	15 c	173.0	85.35	86.66	0.757	86.76*	88.04*	0.16	8
13	10 to 11	5.27	15 c	189.0	86.76	88.12	0.720	88.20	89.34	0.44	12
14	10 A 2 to 10	1.65	15 c	32.0	91.22	91.54	1.000	91.66	92.05	0.19	13
15	10 A 1 to 10	2.97	15 c	66.0	88.22	88.46	0.364	89.78*	89.92*	0.05	13
16	10 B to 10 A 1	2.21	15 c	180.0	88.56	89.21	0.361	89.96	90.16	0.04	15
17	10 C 10 B	1.76	15 c	296.0	89.31	90.38	0.361	90.20	90.93	0.18	16

Project File: Stonehouse Glen System 3I-D-F File: Norfolk.IDF | Total No. Lines: 17 | Run Date: 10-19-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

Hydraflow Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	24.0	0.00	0.00	0.00	0.00	0.00	0.0	7.7	0.0	11.41	16.32	7.29	18	2.42	61.58	61.00	62.87	62.20	71.00	0.00	15 to 16
2	1	30.0	0.00	0.00	0.00	0.00	0.00	0.0	7.5	0.0	11.41	16.27	8.13	18	2.40	66.50	65.78	68.09	66.72	78.00	71.00	14 to 15
3	2	199.0	0.00	0.00	0.00	0.00	0.00	0.0	6.4	0.0	11.41	24.69	10.15	18	5.53	81.00	70.00	82.29	70.73	91.43	78.00	13 to 14
4	3	87.0	0.00	0.00	0.00	0.00	0.00	0.0	0.7	0.0	2.53	3.85	3.32	15	0.36	83.03	82.72	83.77	83.47	88.84	91.43	13 to 13 B
5	4	32.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.15	6.46	3.44	15	1.00	84.91	84.59	85.34	84.96	88.83	88.84	13 B to 13 B
6	4	51.0	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	1.08	3.84	1.29	15	0.35	83.31	83.13	84.04	84.03	87.94	88.84	13 B to 13 C
7	6	74.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.46	5.77	1.51	15	0.80	84.00	83.41	84.27	84.09	87.96	87.94	13 C to 13 C
8	3	244.0	0.00	0.00	0.00	0.00	0.00	0.0	5.0	0.0	8.34	10.37	6.23	18	0.98	85.10	82.72	86.20	83.75	98.78	91.43	12 to 13
9	8	30.0	0.00	0.00	0.00	0.00	0.00	0.0	0.4	0.0	3.08	12.86	6.32	15	3.97	93.09	91.90	93.79	92.33	98.39	98.78	12 to 12 A
10	9	32.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.27	6.46	3.58	15	1.00	94.41	94.09	94.86	94.47	98.33	98.39	12 A to 12 B
11	9	75.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.49	10.62	4.58	15	2.71	96.50	94.47	96.99	94.80	100.42	98.39	12 C to 12 A
12	8	173.0	0.00	0.00	0.00	0.00	0.00	0.0	4.1	0.0	5.55	5.62	4.52	15	0.76	86.66	85.35	88.04	86.76	97.78	98.78	12 to 11
13	12	189.0	0.00	0.00	0.00	0.00	0.00	0.0	3.0	0.0	5.27	5.48	4.31	15	0.72	88.12	86.76	89.34	88.20	95.46	97.78	10 to 11
14	13	32.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.65	6.46	3.85	15	1.00	91.54	91.22	92.05	91.66	95.46	95.46	10 A 2 to 10
15	13	66.0	0.00	0.00	0.00	0.00	0.00	0.0	2.6	0.0	2.97	3.89	2.42	15	0.36	88.46	88.22	89.92	89.78	96.00	95.46	10 A 1 to 10
16	15	180.0	0.00	0.00	0.00	0.00	0.00	0.0	1.6	0.0	2.21	3.88	2.00	15	0.36	89.21	88.56	90.16	89.96	91.72	96.00	10 B to 10 A
17	16	296.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.76	3.88	2.65	15	0.36	90.38	89.31	90.93	90.20	94.30	91.72	10 C 10 B

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Run Date: 10-19-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 62.20 (ft)

Hydraflow Inlet Report

Line No	Line ID	A (ac)	Inlet time (min)	I (in/hr)	C	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet Ht (in)	Curb Inlet L (ft)	Grate Inlet area (sqft)	Grate Inlet L (ft)	Grate Inlet W (ft)	Gutter So (ft/ft)	Gutter W (ft)	Gutter Sw (ft/ft)	Gutter Sx (ft/ft)	Flow depth (ft)	Flow spread (ft)	Byp line No
1	15 to 16	0.00	0.0	0.00	0.00	11.41*	36.85	0.00	48.26	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	Offsite
2	14 to 15	0.00	0.0	0.00	0.00	11.41*	25.44	0.00	36.85	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	1
3	13 to 14	0.00	0.0	0.00	0.00	11.41*	8.34	3.19	16.56	Curb	4.0	6.00	0.00	0.00	0.00	0.034	1.67	0.083	0.020	0.45	17.24	2
4	13 to 13 B	0.00	0.0	0.00	0.00	2.53*	0.00	0.97	1.56	Curb	4.0	4.00	0.00	0.00	0.00	0.015	1.67	0.083	0.020	0.28	8.74	2
5	13 B to 13 B 1	0.00	0.0	0.00	0.00	1.15*	0.00	0.90	0.25	Curb	4.0	6.00	0.00	0.00	0.00	0.015	1.67	0.083	0.020	0.23	6.24	2
6	13 B to 13 C	0.00	0.0	0.00	0.00	1.08*	0.00	1.08	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.33	11.05	2
7	13 C to 13 C 1	0.00	0.0	0.00	0.00	0.46*	0.00	0.46	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.18	3.94	2
8	12 to 13	0.00	0.0	0.00	0.00	8.34*	0.00	0.00	8.34	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	3
9	12 to 12 A	0.00	0.0	0.00	0.00	3.08*	0.00	3.08	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.66	27.65	2
10	12 A to 12 B	0.00	0.0	0.00	0.00	1.27*	0.00	1.27	0.00	Curb	4.0	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.20	4.85	2
11	12 C to 12 A	0.00	0.0	0.00	0.00	1.49*	0.00	0.87	0.62	Curb	4.0	6.00	0.00	0.00	0.00	0.040	1.67	0.083	0.020	0.21	5.24	2
12	12 to 11	0.00	0.0	0.00	0.00	5.55*	0.00	0.93	4.62	Curb	4.0	2.50	0.00	0.00	0.00	0.014	1.67	0.083	0.020	0.36	12.74	2
13	10 to 11	0.00	0.0	0.00	0.00	5.27*	0.00	5.27	0.00	Curb	4.0	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.41	15.10	2
14	10 A 2 to 10	0.00	0.0	0.00	0.00	1.65*	0.00	1.65	0.00	Curb	4.0	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.24	6.79	2
15	10 A 1 to 10	0.00	0.0	0.00	0.00	2.97*	0.00	1.14	1.83	Curb	4.0	4.00	0.00	0.00	0.00	0.010	1.67	0.083	0.020	0.31	10.24	2
16	10 B to 10 A 1	0.00	0.0	0.00	0.00	2.21*	0.00	2.21	0.00	Curb	4.0	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.41	15.25	2
17	10 C 10 B	0.00	0.0	0.00	0.00	1.76*	0.00	1.76	0.00	Curb	4.0	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.25	7.32	2

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Run Date: 10-19-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraflow Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	18	11.41	61.00	62.20	1.20	1.52	7.53	0.88	63.08	1.236	24.0	61.58	62.87	1.29**	1.62	7.04	0.77	63.64	1.090	1.163	N/A	0.15	0.12
2	18	11.41	65.78	66.72	0.94*	1.16	9.81	1.50	68.21	2.305	30.0	66.50	68.09	1.50	1.77	6.46	0.65	68.74	1.181	1.743	0.523	0.75	0.49
3	18	11.41	70.00	70.73	0.73*	0.86	13.26	2.74	73.47	5.073	199	81.00	82.29	1.29**	1.62	7.04	0.77	83.06	1.090	3.082	N/A	1.50	1.16
4	15	2.53	82.72	83.47	0.75*	0.77	3.28	0.17	83.64	0.338	87.0	83.03	83.77	0.74	0.75	3.37	0.18	83.94	0.360	0.349	0.304	1.50	0.26
5	15	1.15	84.59	84.96	0.37*	0.30	3.79	0.22	85.18	0.874	32.0	84.91	85.34	0.43**	0.37	3.08	0.15	85.49	0.493	0.684	N/A	1.00	0.15
6	15	1.08	83.13	84.03	0.90	0.95	1.14	0.02	84.05	0.037	51.0	83.31	84.04	0.73	0.75	1.44	0.03	84.08	0.066	0.052	0.026	1.50	0.05
7	15	0.46	83.41	84.09	0.68	0.68	0.67	0.01	84.10	0.015	74.0	84.00	84.27	0.27**	0.20	2.34	0.09	84.36	0.475	0.245	N/A	1.00	0.09
8	18	8.34	82.72	83.75	1.03*	1.29	6.46	0.65	84.40	0.953	244	85.10	86.20	1.10**	1.39	5.99	0.56	86.76	0.796	0.874	N/A	1.00	0.56
9	15	3.08	91.90	92.33	0.43*	0.37	8.29	1.07	93.40	3.578	30.0	93.09	93.79	0.70**	0.71	4.34	0.29	94.08	0.619	2.099	N/A	1.50	0.44
10	15	1.27	94.09	94.47	0.38*	0.32	3.97	0.24	94.72	0.920	32.0	94.41	94.86	0.45**	0.40	3.18	0.16	95.02	0.499	0.710	N/A	1.00	0.16
11	15	1.49	94.47	94.80	0.33*	0.26	5.81	0.52	95.32	2.353	75.0	96.50	96.99	0.49**	0.44	3.35	0.17	97.16	0.511	1.432	N/A	1.00	0.17
12	15	5.55	85.35	86.76	1.25	1.23	4.52	0.32	87.08	0.739	173	86.66	88.04	1.25	1.23	4.52	0.32	88.36	0.739	0.739	1.278	0.50	0.16
13	15	5.27	86.76	88.20	1.25	1.23	4.30	0.29	88.48	0.666	189	88.12	89.34	1.22	1.22	4.32	0.29	89.63	0.593	0.629	1.190	1.50	0.44
14	15	1.65	91.22	91.66	0.44*	0.39	4.24	0.28	91.94	0.903	32.0	91.54	92.05	0.51**	0.48	3.47	0.19	92.24	0.520	0.711	N/A	1.00	0.19
15	15	2.97	88.22	89.78	1.25	1.23	2.42	0.09	89.87	0.212	66.0	88.46	89.92	1.25	1.23	2.42	0.09	90.01	0.212	0.212	0.140	0.50	0.05
16	15	2.21	88.56	89.96	1.25	1.23	1.80	0.05	90.01	0.117	180	89.21	90.16	0.95	1.00	2.20	0.08	90.24	0.136	0.126	0.228	0.50	0.04
17	15	1.76	89.31	90.20	0.89	0.94	1.88	0.06	90.26	0.101	296	90.38	90.93	0.55	0.52	3.41	0.18	91.11	0.475	0.288	0.852	1.00	0.18

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Run Date: 10-19-2004

NOTES: Initial tailwater elevation = 62.2 (ft) , * Normal depth assumed., ** Critical depth assumed.

Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

~~ROUTE:~~ DATE Sept 1 2004 PROJ: STONEHOUSE GLEN Sect 1
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:
SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT (17)	FLOW TIME MINUTES ACCUMULATED (17)	REMARKS (18)
17-G	17-F	0.23	0.9	—	0.21	10'	5.75	1.21	104.76	103.15	210'	0.006	15"	5.00	3.36	1.32	—	
17-F	17-E	0.28	0.85	0.24	0.45	11.3	5.62	2.53	103.05	102.90	32'	0.0048	15"	4.48	3.76	0.14	1.46	
17-E	17-D	0.13	0.9	0.12	0.57	11.5	5.6	3.19	102.80	102.03	148'	0.0052	15"	4.66	4.09	0.60	2.06	
17-D	17-C	—	—	—	—	12.06	5.54	3.16	101.93	101.34	114'	0.0052	15"	4.66	4.08	0.46	2.52	
17-C	17-B	0.07	0.9	0.06	0.63	12.52	5.50	3.47	101.00	100.85	32'	0.0048	15"	4.48	4.03	0.13	2.65	
17-B	17-A	0.21	0.7	0.15	0.78	12.65	5.49	4.28	100.75	98.85	101'	0.0188	15"	8.86	7.16	0.22	2.87	
17-A	17	—	—	—	—	12.87	5.46	4.28	98.75	95.65	52'	0.0596	15"	15.26	10.26	.08	2.95	
16	17	0.99	0.35	—	0.35	14.0	5.35	1.87	92.16	90.79	286'	0.0048	15"	4.48	3.48	1.36	—	
17	18	0.07	0.35	0.02	1.15	15.36	5.21	5.99	89.70	84.87	140'	0.0345	15"	12.00	9.77	0.24	3.19	
18	19	0.47	0.50	0.24	1.39	15.60	5.19	7.21	84.62	84.41	34'	0.0062	18"	8.27	5.27	0.14	3.33	
19	20	0.11	0.90	0.10	1.49	15.74	5.18	7.72	84.31	82.59	292'	0.0059	18"	8.07	5.20	0.94	4.26	
20	21	0.04	0.90	0.04	2.36	16.67	5.08	11.99	82.09	81.02	205'	0.0052	24"	16.31	5.68	0.60	4.86	
21	22	—	—	—	3.85	17.13	5.04	19.40	80.92	80.70	28'	0.0078	24"	19.98	7.25	0.06	4.86	
22	23	0.18	0.90	0.16	4.01	17.19	5.03	20.17	80.60	79.87	89'	0.0082	24"	20.48	7.43	0.20	5.06	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 - G to 17 - F
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006000	ft/ft
Diameter	15	in
Discharge	1.21	cfs

Results		
Depth	0.42	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.54	ft
Top Width	1.18	ft
Critical Depth	0.43	ft
Percent Full	33.5	%
Critical Slope	0.005240	ft/ft
Velocity	3.36	ft/s
Velocity Head	0.18	ft
Specific Energy	0.59	ft
Froude Number	1.07	
Maximum Discharg	5.38	cfs
Discharge Full	5.00	cfs
Slope Full	0.000351	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 - F to 17 - E
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004800	ft/ft
Diameter	15	in
Discharge	2.53	cfs

Results		
Depth	0.67	ft
Flow Area	0.7	ft²
Wetted Perimeter	2.06	ft
Top Width	1.25	ft
Critical Depth	0.64	ft
Percent Full	53.8	%
Critical Slope	0.005749	ft/ft
Velocity	3.76	ft/s
Velocity Head	0.22	ft
Specific Energy	0.89	ft
Froude Number	0.90	
Maximum Discharg	4.81	cfs
Discharge Full	4.48	cfs
Slope Full	0.001534	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 - E to 17 - D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005200	ft/ft
Diameter	15	in
Discharge	3.19	cfs

Results		
Depth	0.76	ft
Flow Area	0.8	ft²
Wetted Perimeter	2.23	ft
Top Width	1.22	ft
Critical Depth	0.72	ft
Percent Full	60.8	%
Critical Slope	0.006156	ft/ft
Velocity	4.09	ft/s
Velocity Head	0.26	ft
Specific Energy	1.02	ft
Froude Number	0.90	
Maximum Discharg	5.01	cfs
Discharge Full	4.66	cfs
Slope Full	0.002439	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 - D to 17 - C
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005200	ft/ft
Diameter	15	in
Discharge	3.16	cfs

Results		
Depth	0.75	ft
Flow Area	0.8	ft²
Wetted Perimeter	2.22	ft
Top Width	1.22	ft
Critical Depth	0.72	ft
Percent Full	60.4	%
Critical Slope	0.006126	ft/ft
Velocity	4.08	ft/s
Velocity Head	0.26	ft
Specific Energy	1.01	ft
Froude Number	0.90	
Maximum Discharg	5.01	cfs
Discharge Full	4.66	cfs
Slope Full	0.002393	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 - C to 17 - B
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004800	ft/ft
Diameter	15	in
Discharge	3.47	cfs

Results		
Depth	0.83	ft
Flow Area	0.9	ft²
Wetted Perimeter	2.37	ft
Top Width	1.18	ft
Critical Depth	0.75	ft
Percent Full	66.1	%
Critical Slope	0.006350	ft/ft
Velocity	4.03	ft/s
Velocity Head	0.25	ft
Specific Energy	1.08	ft
Froude Number	0.83	
Maximum Discharg	4.81	cfs
Discharge Full	4.48	cfs
Slope Full	0.002886	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 - B to 17 - A
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.018800	ft/ft
Diameter	15	in
Discharge	4.28	cfs

Results		
Depth	0.61	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.94	ft
Top Width	1.25	ft
Critical Depth	0.84	ft
Percent Full	49.0	%
Critical Slope	0.007032	ft/ft
Velocity	7.16	ft/s
Velocity Head	0.80	ft
Specific Energy	1.41	ft
Froude Number	1.82	
Maximum Discharg	9.53	cfs
Discharge Full	8.86	cfs
Slope Full	0.004390	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 - A to 17
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.055800	ft/ft
Diameter	15	in
Discharge	4.28	cfs

Results		
Depth	0.45	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.61	ft
Top Width	1.20	ft
Critical Depth	0.84	ft
Percent Full	36.2	%
Critical Slope	0.007032	ft/ft
Velocity	10.67	ft/s
Velocity Head	1.77	ft
Specific Energy	2.22	ft
Froude Number	3.26	
Maximum Discharg	16.41	cfs
Discharge Full	15.26	cfs
Slope Full	0.004390	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	16 to 17
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004800	ft/ft
Diameter	15	in
Discharge	1.87	cfs

Results		
Depth	0.56	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.84	ft
Top Width	1.24	ft
Critical Depth	0.54	ft
Percent Full	45.1	%
Critical Slope	0.005448	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	0.75	ft
Froude Number	0.93	
Maximum Discharg	4.81	cfs
Discharge Full	4.48	cfs
Slope Full	0.000838	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	17 to 18
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.034500	ft/ft
Diameter	15	in
Discharge	5.99	cfs

Results		
Depth	0.62	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.96	ft
Top Width	1.25	ft
Critical Depth	0.99	ft
Percent Full	50.0	%
Critical Slope	0.009187	ft/ft
Velocity	9.77	ft/s
Velocity Head	1.48	ft
Specific Energy	2.11	ft
Froude Number	2.46	
Maximum Discharg	12.91	cfs
Discharge Full	12.00	cfs
Slope Full	0.008599	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	18 to 19
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006200	ft/ft
Diameter	18	in
Discharge	7.21	cfs

Results		
Depth	1.08	ft
Flow Area	1.4	ft²
Wetted Perimeter	3.05	ft
Top Width	1.34	ft
Critical Depth	1.04	ft
Percent Full	72.3	%
Critical Slope	0.006896	ft/ft
Velocity	5.27	ft/s
Velocity Head	0.43	ft
Specific Energy	1.52	ft
Froude Number	0.92	
Maximum Discharg	8.90	cfs
Discharge Full	8.27	cfs
Slope Full	0.004712	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	19 to 20
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005900	ft/ft
Diameter	18	in
Discharge	7.72	cfs

Results		
Depth	1.18	ft
Flow Area	1.5	ft²
Wetted Perimeter	3.26	ft
Top Width	1.24	ft
Critical Depth	1.08	ft
Percent Full	78.3	%
Critical Slope	0.007229	ft/ft
Velocity	5.20	ft/s
Velocity Head	0.42	ft
Specific Energy	1.59	ft
Froude Number	0.84	
Maximum Discharg	8.68	cfs
Discharge Full	8.07	cfs
Slope Full	0.005402	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	20 to 21
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005200	ft/ft
Diameter	24	in
Discharge	11.99	cfs

Results		
Depth	1.27	ft
Flow Area	2.1	ft²
Wetted Perimeter	3.70	ft
Top Width	1.92	ft
Critical Depth	1.24	ft
Percent Full	63.7	%
Critical Slope	0.005583	ft/ft
Velocity	5.68	ft/s
Velocity Head	0.50	ft
Specific Energy	1.77	ft
Froude Number	0.95	
Maximum Discharg	17.55	cfs
Discharge Full	16.31	cfs
Slope Full	0.002809	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 to 22
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.007800	ft/ft
Diameter	24	in
Discharge	19.40	cfs

Results		
Depth	1.59	ft
Flow Area	2.7	ft²
Wetted Perimeter	4.40	ft
Top Width	1.62	ft
Critical Depth	1.58	ft
Percent Full	79.5	%
Critical Slope	0.007856	ft/ft
Velocity	7.25	ft/s
Velocity Head	0.82	ft
Specific Energy	2.41	ft
Froude Number	0.99	
Maximum Discharg	21.49	cfs
Discharge Full	19.98	cfs
Slope Full	0.007355	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	22 to 23
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.008200	ft/ft
Diameter	24	in
Discharge	20.17	cfs

Results		
Depth	1.61	ft
Flow Area	2.7	ft²
Wetted Perimeter	4.46	ft
Top Width	1.58	ft
Critical Depth	1.61	ft
Percent Full	80.6	%
Critical Slope	0.008197	ft/ft
Velocity	7.43	ft/s
Velocity Head	0.86	ft
Specific Energy	2.47	ft
Froude Number	1.00	
Maximum Discharg	22.04	cfs
Discharge Full	20.48	cfs
Slope Full	0.007950	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 17G
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.83	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	7.30	ft
Throat Incline Angle	90.00	degrees
Depth	0.42	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 17F
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.95	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	7.99	ft
Throat Incline Angle	90.00	degrees
Depth	0.44	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 17E
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.47	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	5.00	ft
Throat Incline Angle	90.00	degrees
Depth	0.38	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 17C
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.25	cfs
Slope	0.048000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	4.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.94	
Intercepted Flow	0.23	cfs
Bypass Flow	0.02	cfs
Spread	1.28	ft
Depth	0.11	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.65	ft/s
Equivalent Cross Slope	0.156349	ft/ft
Length Factor	0.78	
Total Interception Length	5.10	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 17B
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.21	cfs
Slope	0.048000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	6.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	1.00	
Intercepted Flow	0.21	cfs
Bypass Flow	0.00	cfs
Spread	1.20	ft
Depth	0.10	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.50	ft/s
Equivalent Cross Slope	0.156349	ft/ft
Length Factor	1.27	
Total Interception Length	4.74	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 18
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	1.37	cfs
Slope	0.022500	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	8.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.97	
Intercepted Flow	1.32	cfs
Bypass Flow	0.05	cfs
Spread	5.44	ft
Depth	0.22	ft
Flow Area	0.4	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.47	ft/s
Equivalent Cross Slope	0.126510	ft/ft
Length Factor	0.85	
Total Interception Length	9.43	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 19
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.39	cfs
Slope	0.022500	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	4.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.95	
Intercepted Flow	0.37	cfs
Bypass Flow	0.02	cfs
Spread	1.97	ft
Depth	0.15	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	3.06	ft/s
Equivalent Cross Slope	0.156230	ft/ft
Length Factor	0.82	
Total Interception Length	4.90	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 20
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.14	cfs
Slope	0.024000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	2.50	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.93	
Intercepted Flow	0.13	cfs
Bypass Flow	0.01	cfs
Spread	1.17	ft
Depth	0.10	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.44	ft/s
Equivalent Cross Slope	0.156348	ft/ft
Length Factor	0.77	
Total Interception Length	3.25	ft

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 22
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.65	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	6.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	4.58	ft
Throat Incline Angle	90.00	degrees
Depth	0.37	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: Oct 4 2004 PROJ: STONEHOUSE GLEN SECT I
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:
SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT / ACCUMULATED (17)	REMARKS (18)
21-G	21-F	0.47	0.65	–	0.31	13	5.45	1.69	104.97	104.73	40'	0.0060	15"	5.00	3.68	0.18 / –	
21-F	21-E	0.20	0.9	0.18	0.49	13.18	5.45	2.67	100.62	94.25	105'	0.0607	15"	15.91	9.63	0.18 / 0.36	
21-E	21-D	–	–	–	–	13.36	5.45	2.67	90.00	87.70	35'	0.0657	15"	16.56	9.91	0.06 / 0.42	
21-D	21-C	0.93	0.35	0.32	0.82	14.5	5.3	4.34	84.70	82.20	123'	0.0203	15"	9.20	7.39	0.28 / 0.70	
21-C	21-B	0.84	0.35	0.29	1.11	14.73	5.28	5.86	82.10	81.92	20'	0.0088	15"	6.06	5.63	0.06 / 0.76	
21-A	21-B	0.15	0.9	–	0.13	10	5.75	0.74	82.50	81.92	70'	0.0082	15"	5.85	3.26	0.36 / –	
21-B	21	0.10	0.9	0.09	1.33	15	5.25	6.98	81.67	81.51	33'	0.0048	18	7.28	4.69	0.12 / 0.88	
FROM DITCH		0.79	0.35	–	0.28												
20-C	20-B	0.17	0.9	0.15	0.43	13	5.45	2.34	98.12	87.19	113'	0.0967	15"	20.09	10.94	0.17 / –	
20-D	20-B	0.13	0.9	–	0.12	10	5.75	0.69	87.60	87.41	32'	0.006	15"	5.00	2.86	0.18 / –	
20-B	20-A	0.26	0.6	0.16	0.71	13.17	5.45	3.87	87.09	86.80	44'	0.0066	15"	5.25	4.68	0.16 / 0.33	
20-A	20	0.23	0.5	0.12	0.83	13.29	5.45	4.52	85.40	85.23	33'	0.0052	15"	4.66	4.32	0.12 / 0.45	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 - G to 21 - F
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006000	ft/ft
Diameter	15	in
Discharge	1.69	cfs

Results		
Depth	0.50	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.71	ft
Top Width	1.23	ft
Critical Depth	0.52	ft
Percent Full	40.1	%
Critical Slope	0.005374	ft/ft
Velocity	3.68	ft/s
Velocity Head	0.21	ft
Specific Energy	0.71	ft
Froude Number	1.06	
Maximum Discharg	5.38	cfs
Discharge Full	5.00	cfs
Slope Full	0.000685	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 - F to 21 - E
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.060700	ft/ft
Diameter	15	in
Discharge	2.67	cfs

Results		
Depth	0.35	ft
Flow Area	0.3	ft²
Wetted Perimeter	1.39	ft
Top Width	1.12	ft
Critical Depth	0.66	ft
Percent Full	27.7	%
Critical Slope	0.005825	ft/ft
Velocity	9.63	ft/s
Velocity Head	1.44	ft
Specific Energy	1.79	ft
Froude Number	3.41	
Maximum Discharg	17.12	cfs
Discharge Full	15.91	cfs
Slope Full	0.001709	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 - E to 21 - D
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.065700	ft/ft
Diameter	15	in
Discharge	2.67	cfs

Results		
Depth	0.34	ft
Flow Area	0.3	ft²
Wetted Perimeter	1.37	ft
Top Width	1.11	ft
Critical Depth	0.66	ft
Percent Full	27.2	%
Critical Slope	0.005825	ft/ft
Velocity	9.91	ft/s
Velocity Head	1.53	ft
Specific Energy	1.86	ft
Froude Number	3.55	
Maximum Discharg	17.81	cfs
Discharge Full	16.56	cfs
Slope Full	0.001709	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 - D to 21 - C
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.020300	ft/ft
Diameter	15	in
Discharge	4.34	cfs

Results		
Depth	0.60	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.92	ft
Top Width	1.25	ft
Critical Depth	0.84	ft
Percent Full	48.3	%
Critical Slope	0.007090	ft/ft
Velocity	7.39	ft/s
Velocity Head	0.85	ft
Specific Energy	1.45	ft
Froude Number	1.90	
Maximum Discharg	9.90	cfs
Discharge Full	9.20	cfs
Slope Full	0.004514	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 - C to 21 - B
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.008800	ft/ft
Diameter	15	in
Discharge	5.86	cfs

Results		
Depth	0.99	ft
Flow Area	1.0	ft²
Wetted Perimeter	2.74	ft
Top Width	1.02	ft
Critical Depth	0.98	ft
Percent Full	79.1	%
Critical Slope	0.008981	ft/ft
Velocity	5.63	ft/s
Velocity Head	0.49	ft
Specific Energy	1.48	ft
Froude Number	0.98	
Maximum Discharg	6.52	cfs
Discharge Full	6.06	cfs
Slope Full	0.008230	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 - A to 21 - B
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.008200	ft/ft
Diameter	15	in
Discharge	0.74	cfs

Results		
Depth	0.30	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.28	ft
Top Width	1.07	ft
Critical Depth	0.34	ft
Percent Full	24.0	%
Critical Slope	0.005228	ft/ft
Velocity	3.26	ft/s
Velocity Head	0.17	ft
Specific Energy	0.47	ft
Froude Number	1.25	
Maximum Discharg	6.29	cfs
Discharge Full	5.85	cfs
Slope Full	0.000131	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	21 - B to 21
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004800	ft/ft
Diameter	18	in
Discharge	6.98	cfs

Results		
Depth	1.18	ft
Flow Area	1.5	ft²
Wetted Perimeter	3.27	ft
Top Width	1.23	ft
Critical Depth	1.02	ft
Percent Full	78.5	%
Critical Slope	0.006754	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energy	1.52	ft
Froude Number	0.75	
Maximum Discharg	7.83	cfs
Discharge Full	7.28	cfs
Slope Full	0.004416	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	20 - C to 20 - B
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.096700	ft/ft
Diameter	15	in
Discharge	2.34	cfs

Results		
Depth	0.29	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.25	ft
Top Width	1.05	ft
Critical Depth	0.61	ft
Percent Full	23.0	%
Critical Slope	0.005653	ft/ft
Velocity	10.94	ft/s
Velocity Head	1.86	ft
Specific Energy	2.15	ft
Froude Number	4.28	
Maximum Discharg	21.61	cfs
Discharge Full	20.09	cfs
Slope Full	0.001312	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	20 - D to 20 - B
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006000	ft/ft
Diameter	15	in
Discharge	0.69	cfs

Results		
Depth	0.31	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.31	ft
Top Width	1.08	ft
Critical Depth	0.32	ft
Percent Full	25.1	%
Critical Slope	0.005231	ft/ft
Velocity	2.86	ft/s
Velocity Head	0.13	ft
Specific Energy	0.44	ft
Froude Number	1.07	
Maximum Discharg	5.38	cfs
Discharge Full	5.00	cfs
Slope Full	0.000114	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	20 - B to 20 - A
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006600	ft/ft
Diameter	15	in
Discharge	3.87	cfs

Results		
Depth	0.80	ft
Flow Area	0.8	ft²
Wetted Perimeter	2.31	ft
Top Width	1.20	ft
Critical Depth	0.80	ft
Percent Full	63.9	%
Critical Slope	0.006662	ft/ft
Velocity	4.68	ft/s
Velocity Head	0.34	ft
Specific Energy	1.14	ft
Froude Number	0.99	
Maximum Discharg	5.64	cfs
Discharge Full	5.25	cfs
Slope Full	0.003589	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	20 - A to 20
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005200	ft/ft
Diameter	15	in
Discharge	4.52	cfs

Results		
Depth	0.99	ft
Flow Area	1.0	ft²
Wetted Perimeter	2.75	ft
Top Width	1.01	ft
Critical Depth	0.86	ft
Percent Full	79.4	%
Critical Slope	0.007271	ft/ft
Velocity	4.32	ft/s
Velocity Head	0.29	ft
Specific Energy	1.28	ft
Froude Number	0.75	
Maximum Discharg	5.01	cfs
Discharge Full	4.66	cfs
Slope Full	0.004897	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 20
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.14	cfs
Slope	0.024000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	2.50	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.93	
Intercepted Flow	0.13	cfs
Bypass Flow	0.01	cfs
Spread	1.17	ft
Depth	0.10	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.44	ft/s
Equivalent Cross Slope	0.156348	ft/ft
Length Factor	0.77	
Total Interception Length	3.25	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 20 - A
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.46	cfs
Slope	0.000000	ft/ft
Gutter Width	0.00	ft
Gutter Cross Slope	0.000000	ft/ft
Road Cross Slope	0.000000	ft/ft
Mannings Coefficient	0.013	
Curb Opening Length	0.00	ft
Local Depression	0.0	in
Local Depression Width	0.00	ft

Results		
Efficiency	0.00	
Intercepted Flow	0.00	cfs
Bypass Flow	N/A	cfs
Spread	0.00	ft
Depth	0.00	ft
Flow Area	0.0	ft^2
Gutter Depression	0.0	in
Total Depression	0.0	in
Velocity	N/A	ft/s
Equivalent Cross Slope	N/A	ft/ft
Length Factor	N/A	
Total Interception Length	N/A	ft

Error Messages:
Slope must be greater than zero

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 20 - B
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.72	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	6.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	4.91	ft
Throat Incline Angle	90.00	degrees
Depth	0.37	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 20 - C
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.61	cfs
Slope	0.109500	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	6.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.83	
Intercepted Flow	0.51	cfs
Bypass Flow	0.10	cfs
Spread	1.53	ft
Depth	0.13	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	6.23	ft/s
Equivalent Cross Slope	0.156346	ft/ft
Length Factor	0.63	
Total Interception Length	9.50	ft

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 20 - D
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.47	cfs
Slope	0.045000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083330	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	4.00	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.82	
Intercepted Flow	0.39	cfs
Bypass Flow	0.08	cfs
Spread	1.64	ft
Depth	0.14	ft
Flow Area	0.1	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	4.18	ft/s
Equivalent Cross Slope	0.156346	ft/ft
Length Factor	0.61	
Total Interception Length	6.52	ft

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 21 - A
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.42	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	4.64	ft
Throat Incline Angle	90.00	degrees
Depth	0.37	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Worksheet
Worksheet for Curb Inlet On Grade

Project Description	
Worksheet	Curb Inlet - 21 - B
Type	Curb Inlet On Grade
Solve For	Efficiency

Input Data		
Discharge	0.36	cfs
Slope	0.012000	ft/ft
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Mannings Coefficient	0.015	
Curb Opening Length	2.50	ft
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Efficiency	0.84	
Intercepted Flow	0.30	cfs
Bypass Flow	0.06	cfs
Spread	2.58	ft
Depth	0.16	ft
Flow Area	0.2	ft^2
Gutter Depression	1.3	in
Total Depression	3.3	in
Velocity	2.30	ft/s
Equivalent Cross Slope	0.154478	ft/ft
Length Factor	0.63	
Total Interception Length	3.95	ft

Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 21-G
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	1.41	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	10.00	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	6.09	ft
Throat Incline Angle	90.00	degrees
Depth	0.40	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

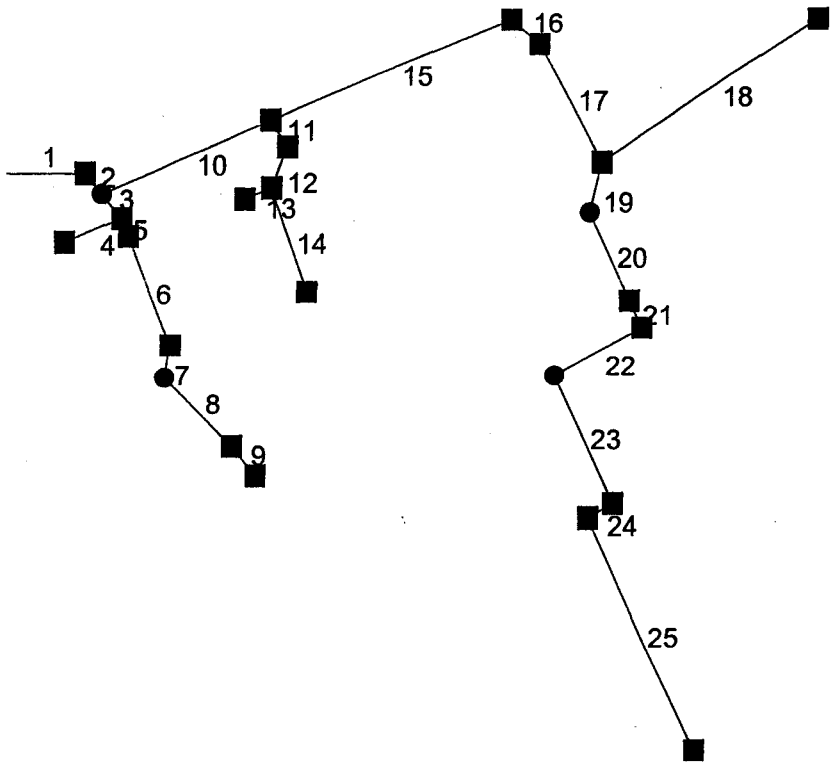
Worksheet
Worksheet for Curb Inlet In Sag

Project Description	
Worksheet	Curb Inlet - 21 - F
Type	Curb Inlet In Sag
Solve For	Spread

Input Data		
Discharge	0.72	cfs
Gutter Width	1.67	ft
Gutter Cross Slope	0.083333	ft/ft
Road Cross Slope	0.020800	ft/ft
Curb Opening Length	2.50	ft
Opening Height	0.39	ft
Curb Throat Type	Horizontal	
Local Depression	2.0	in
Local Depression Width	2.00	ft

Results		
Spread	6.64	ft
Throat Incline Angle	90.00	degrees
Depth	0.41	ft
Gutter Depression	1.3	in
Total Depression	3.3	in

Hydraflow Plan View



Project file: Stonehouse Glen System 2.stm	IDF file: Norfolk.IDF	No. Lines: 25	10-18-2004

Hydraflow Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	89.0	0.0	Curb	17.11	0.00	0.00	0.0	79.87	0.82	80.60	24	Cir	0.013	1.10	85.71	23 to 22
2	1	28.0	46.0	MH	19.40	0.00	0.00	0.0	80.70	0.79	80.92	24	Cir	0.013	0.85	85.81	21 to 22
3	2	33.0	0.0	Curb	6.98	0.00	0.00	0.0	81.51	0.48	81.67	18	Cir	0.013	1.50	86.18	21 to 21B
4	3	70.0	113.0	Curb	0.74	0.00	0.00	0.0	81.92	0.83	82.50	15	Cir	0.013	1.00	85.75	21A to 21B
5	3	20.0	21.0	Gneric	5.28	0.00	0.00	0.0	81.92	0.90	82.10	15	Cir	0.013	0.50	85.95	21B to 21C
6	5	123.0	0.0	Gneric	4.34	0.00	0.00	0.0	82.20	2.03	84.70	15	Cir	0.013	0.70	92.70	21D to 21C
7	6	35.0	33.0	MH	2.67	0.00	0.00	0.0	87.70	6.57	90.00	15	Cir	0.013	0.85	98.25	21D to 21E
8	7	105.0	-57.0	Curb	2.67	0.00	0.00	0.0	94.25	6.07	100.62	15	Cir	0.013	0.50	108.95	21F to 21E
9	8	40.0	5.0	Curb	1.69	0.00	0.00	0.0	104.73	0.60	104.97	15	Cir	0.013	1.00	108.89	21G to 21F
10	2	205.0	-67.0	Curb	11.99	0.00	0.00	0.0	81.02	0.52	82.09	24	Cir	0.013	1.25	92.20	21 to 20
11	10	33.0	75.0	Curb	4.52	0.00	0.00	0.0	86.53	0.52	86.70	15	Cir	0.013	1.25	92.27	20 to 20 - A
12	11	44.0	60.0	Curb	3.87	0.00	0.00	0.0	86.80	0.66	87.09	15	Cir	0.013	1.10	91.33	20 - A to 20 - B
13	12	32.0	45.0	Curb	0.69	0.00	0.00	0.0	87.41	0.59	87.60	15	Cir	0.013	1.00	91.20	20 - D to 20 - B
14	12	113.0	-45.0	Curb	2.34	0.00	0.00	0.0	87.19	9.67	98.12	15	Cir	0.013	1.00	100.13	20 - C to 20 - B
15	10	292.0	0.0	Curb	7.72	0.00	0.00	0.0	82.59	0.59	84.31	18	Cir	0.013	1.25	89.14	19 to 20
16	15	41.0	60.0	Curb	7.21	0.00	0.00	0.0	84.41	0.51	84.62	18	Cir	0.013	0.70	88.86	18 to19
17	16	140.0	20.0	Gneric	5.99	0.00	0.00	0.0	84.87	3.45	89.70	15	Cir	0.013	1.50	103.40	17 to 18
18	17	286.0	-90.0	Gneric	5.35	0.00	0.00	0.0	90.79	0.48	92.16	15	Cir	0.013	1.00	96.83	16 to 17
19	17	52.0	46.0	MH	4.28	0.00	0.00	0.0	95.65	5.96	98.75	15	Cir	0.013	0.75	111.67	17 - A to 17
20	19	101.0	-42.0	Curb	4.28	0.00	0.00	0.0	98.85	2.13	101.00	15	Cir	0.013	0.50	107.49	17 - B to 17 - A
21	20	32.0	0.0	Curb	3.47	0.00	0.00	0.0	101.10	0.47	101.25	15	Cir	0.013	1.50	107.49	17 - C to 17 - B

Project File: Stonehouse Glen System 2.stm	I-D-F File: Norfolk.IDF	Total number of lines: 25	Date: 10-18-2004

Hydraflow Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
22	21	112.0	90.0	MH	3.16	0.00	0.00	0.0	101.35	0.52	101.93	15	Cir	0.013	1.00	112.26	17 - D to 17 - C
23	22	148.0	-90.0	Curb	3.19	0.00	0.00	0.0	102.03	0.52	102.80	15	Cir	0.013	1.50	110.95	17 - E to 17 - D
24	23	32.0	90.0	Curb	2.53	0.00	0.00	0.0	102.90	0.47	103.05	15	Cir	0.013	1.50	110.95	17 - F to 17 - E
25	24	268.0	-90.0	Curb	1.21	0.00	0.00	0.0	103.15	0.60	104.76	15	Cir	0.013	1.00	108.68	17 - G to 17 - F

Project File: Stonehouse Glen System 2.stm	I-D-F File: Norfolk.IDF	Total number of lines: 25	Date: 10-18-2004

Hydraflow Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	Dns line No.
1	23 to 22	17.11	24 c	89.0	79.87	80.60	0.820	81.62	82.07	0.82	End
2	21 to 22	19.40	24 c	28.0	80.70	80.92	0.786	82.89*	83.09*	0.50	1
3	21 to 21B	6.98	18 c	33.0	81.51	81.67	0.485	83.60*	83.74*	0.36	2
4	21A to 21B	0.74	15 c	70.0	81.92	82.50	0.829	84.11*	84.12*	0.01	3
5	21B to 21C	5.28	15 c	20.0	81.92	82.10	0.900	84.11*	84.24*	0.14	3
6	21D to 21C	4.34	15 c	123.0	82.20	84.70	2.033	84.39	85.53	0.27	5
7	21D to 21E	2.67	15 c	35.0	87.70	90.00	6.571	88.04	90.65	0.22	6
8	21F to 21E	2.67	15 c	105.0	94.25	100.62	6.067	94.61	101.27	0.13	7
9	21G to 21F	1.69	15 c	40.0	104.73	104.97	0.600	105.23	105.49	0.19	8
10	21 to 20	11.99	24 c	205.0	81.02	82.09	0.522	83.60*	84.17*	0.28	2
11	20 to 20 - A	4.52	15 c	33.0	86.53	86.70	0.515	87.54	87.70	0.36	10
12	20 - A to 20 - B	3.87	15 c	44.0	86.80	87.09	0.659	88.06	88.18	0.20	11
13	20 - D to 20 - B	0.69	15 c	32.0	87.41	87.60	0.594	88.38	88.38	0.01	12
14	20 - C to 20 - B	2.34	15 c	113.0	87.19	98.12	9.673	88.38	98.73	0.24	12
15	19 to 20	7.72	18 c	292.0	82.59	84.31	0.589	84.46*	86.04*	0.37	10
16	18 to19	7.21	18 c	41.0	84.41	84.62	0.512	86.41*	86.60*	0.18	15
17	17 to 18	5.99	15 c	140.0	84.87	89.70	3.450	86.78	90.68	0.79	16
18	16 to 17	5.35	15 c	286.0	90.79	92.16	0.479	92.04*	94.00*	0.30	17
19	17 - A to 17	4.28	15 c	52.0	95.65	98.75	5.962	96.11	99.58	0.29	17
20	17 - B to 17 - A	4.28	15 c	101.0	98.85	101.00	2.129	99.86	101.83	0.19	19
21	17 - C to 17 - B	3.47	15 c	32.0	101.10	101.25	0.469	102.02	102.12	0.34	20
22	17 - D to 17 - C	3.16	15 c	112.0	101.35	101.93	0.518	102.46	102.72	0.23	21
23	17 - E to 17 - D	3.19	15 c	148.0	102.03	102.80	0.520	102.95	103.52	0.45	22
24	17 - F to 17 - E	2.53	15 c	32.0	102.90	103.05	0.469	103.96	104.00	0.15	23
25	17 - G to 17 - F	1.21	15 c	268.0	103.15	104.76	0.601	104.15	105.20	0.15	24

Project File: Stonehouse Glen System 2I-D-F File: Norfolk.IDF | Total No. Lines: 25 | Run Date: 10-18-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

Hydraflow Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	89.0	0.00	0.00	0.00	0.00	0.00	0.0	8.1	0.0	17.11	20.48	6.40	24	0.82	80.60	79.87	82.07	81.62	85.71	0.00	23 to 22
2	1	28.0	0.00	0.00	0.00	0.00	0.00	0.0	7.9	0.0	19.40	20.05	6.18	24	0.79	80.92	80.70	83.09	82.89	85.81	85.71	21 to 22
3	2	33.0	0.00	0.00	0.00	0.00	0.00	0.0	1.8	0.0	6.98	7.31	3.95	18	0.48	81.67	81.51	83.74	83.60	86.18	85.81	21 to 21B
4	3	70.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.74	5.88	0.60	15	0.83	82.50	81.92	84.12	84.11	85.75	86.18	21A to 21B
5	3	20.0	0.00	0.00	0.00	0.00	0.00	0.0	1.7	0.0	5.28	6.13	4.30	15	0.90	82.10	81.92	84.24	84.11	85.95	86.18	21B to 21C
6	5	123.0	0.00	0.00	0.00	0.00	0.00	0.0	1.0	0.0	4.34	9.21	4.26	15	2.03	84.70	82.20	85.53	84.39	92.70	85.95	21D to 21C
7	6	35.0	0.00	0.00	0.00	0.00	0.00	0.0	0.8	0.0	2.67	16.55	6.97	15	6.57	90.00	87.70	90.65	88.04	98.25	92.70	21D to 21E
8	7	105.0	0.00	0.00	0.00	0.00	0.00	0.0	0.2	0.0	2.67	15.91	6.70	15	6.07	100.62	94.25	101.27	94.61	108.95	98.25	21F to 21E
9	8	40.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.69	5.00	3.56	15	0.60	104.97	104.73	105.49	105.23	108.89	108.95	21G to 21F
10	2	205.0	0.00	0.00	0.00	0.00	0.00	0.0	6.8	0.0	11.99	16.34	3.82	24	0.52	82.09	81.02	84.17	83.60	92.20	85.81	21 to 20
11	10	33.0	0.00	0.00	0.00	0.00	0.00	0.0	0.9	0.0	4.52	4.63	4.28	15	0.52	86.70	86.53	87.70	87.54	92.27	92.20	20 to 20 - A
12	11	44.0	0.00	0.00	0.00	0.00	0.00	0.0	0.6	0.0	3.87	5.24	3.28	15	0.66	87.09	86.80	88.18	88.06	91.33	92.27	20 - A to 20
13	12	32.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.69	4.98	0.76	15	0.59	87.60	87.41	88.38	88.38	91.20	91.33	20 - D to 20
14	12	113.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.34	20.08	2.93	15	9.67	98.12	87.19	98.73	88.38	100.13	91.33	20 - C to 20
15	10	292.0	0.00	0.00	0.00	0.00	0.00	0.0	5.1	0.0	7.72	8.06	4.37	18	0.59	84.31	82.59	86.04	84.46	89.14	92.20	19 to 20
16	15	41.0	0.00	0.00	0.00	0.00	0.00	0.0	4.9	0.0	7.21	7.52	4.08	18	0.51	84.62	84.41	86.60	86.41	88.86	89.14	18 to19
17	16	140.0	0.00	0.00	0.00	0.00	0.00	0.0	4.1	0.0	5.99	11.99	5.34	15	3.45	89.70	84.87	90.68	86.78	103.40	88.86	17 to 18
18	17	286.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.35	4.47	4.36	15	0.48	92.16	90.79	94.00	92.04	96.83	103.40	16 to 17
19	17	52.0	0.00	0.00	0.00	0.00	0.00	0.0	3.8	0.0	4.28	15.77	7.74	15	5.96	98.75	95.65	99.58	96.11	111.67	103.40	17 - A to 17
20	19	101.0	0.00	0.00	0.00	0.00	0.00	0.0	3.3	0.0	4.28	9.42	4.49	15	2.13	101.00	98.85	101.83	99.86	107.49	111.67	17 - B to 17
21	20	32.0	0.00	0.00	0.00	0.00	0.00	0.0	3.1	0.0	3.47	4.42	3.70	15	0.47	101.25	101.10	102.12	102.02	107.49	107.49	17 - C to 17

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 81.62 (ft)

Hydraflow Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
22	21	112.0	0.00	0.00	0.00	0.00	0.00	0.0	2.5	0.0	3.16	4.65	3.31	15	0.52	101.93	101.35	102.72	102.46	112.26	107.49	17 - D to 17
23	22	148.0	0.00	0.00	0.00	0.00	0.00	0.0	1.7	0.0	3.19	4.66	3.83	15	0.52	102.80	102.03	103.52	102.95	110.95	112.26	17 - E to 17
24	23	32.0	0.00	0.00	0.00	0.00	0.00	0.0	1.5	0.0	2.53	4.42	2.41	15	0.47	103.05	102.90	104.00	103.96	110.95	110.95	17 - F to 17
25	24	268.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.21	5.01	2.14	15	0.60	104.76	103.15	105.20	104.15	108.68	110.95	17 - G to 17

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 81.62 (ft)

Hydraflow Inlet Report

Line No	Line ID	A (ac)	Inlet time (min)	I (in/hr)	C	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet Ht (in)	Curb Inlet L (ft)	Grate Inlet area (sqft)	Grate Inlet L (ft)	Grate Inlet W (ft)	Gutter So (ft/ft)	Gutter W (ft)	Gutter Sw (ft/ft)	Gutter Sx (ft/ft)	Flow depth (ft)	Flow spread (ft)	Byp line No
1	23 to 22	0.00	0.0	0.00	0.00	17.11*	69.58	86.69	0.00	Curb	0.4	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	3.43	166.01	Offsite
2	21 to 22	0.00	0.0	0.00	0.00	19.40*	50.18	0.00	69.58	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	1
3	21 to 21B	0.00	0.0	0.00	0.00	6.98*	9.41	1.60	14.79	Curb	0.4	2.50	0.00	0.00	0.00	0.012	1.67	0.083	0.020	0.50	19.74	2
4	21A to 21B	0.00	0.0	0.00	0.00	0.74*	0.00	0.74	0.00	Curb	0.4	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.25	7.40	2
5	21B to 21C	0.00	0.0	0.00	0.00	5.28*	0.00	4.50	0.78	Genr	0.0	0.00	0.00	0.00	0.00	Sag	3.00	0.001	0.001	0.30	300.00	3
6	21D to 21C	0.00	0.0	0.00	0.00	4.34*	2.67	4.00	3.01	Genr	0.0	0.00	0.00	0.00	0.00	Sag	3.00	0.001	0.001	0.30	300.00	3
7	21D to 21E	0.00	0.0	0.00	0.00	2.67*	0.00	0.00	2.67	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	6
8	21F to 21E	0.00	0.0	0.00	0.00	2.67*	0.00	2.67	0.00	Curb	0.4	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.60	24.65	2
9	21G to 21F	0.00	0.0	0.00	0.00	1.69*	0.00	1.69	0.00	Curb	0.4	10.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.17	3.44	2
10	21 to 20	0.00	0.0	0.00	0.00	11.99*	0.00	1.38	10.61	Curb	0.4	2.50	0.00	0.00	0.00	0.012	1.67	0.083	0.020	0.46	17.74	2
11	20 to 20 - A	0.00	0.0	0.00	0.00	4.52*	0.00	0.78	3.74	Curb	0.4	2.50	0.00	0.00	0.00	0.020	1.67	0.083	0.020	0.32	10.74	2
12	20 - A to 20 - B	0.00	0.0	0.00	0.00	3.87*	0.00	3.87	0.00	Curb	0.4	6.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.43	16.07	2
13	20 - D to 20 - B	0.00	0.0	0.00	0.00	0.69*	0.00	0.19	0.50	Curb	0.4	4.00	0.00	0.00	0.00	1.000	1.67	0.083	0.020	0.10	1.20	2
14	20 - C to 20 - B	0.00	0.0	0.00	0.00	2.34*	0.00	0.63	1.71	Curb	0.4	4.00	0.00	0.00	0.00	0.109	1.67	0.083	0.020	0.21	5.24	2
15	19 to 20	0.00	0.0	0.00	0.00	7.72*	0.00	1.54	6.18	Curb	0.4	4.00	0.00	0.00	0.00	0.022	1.67	0.083	0.020	0.37	13.24	2
16	18 to19	0.00	0.0	0.00	0.00	7.21*	0.00	2.82	4.39	Curb	0.4	8.00	0.00	0.00	0.00	0.022	1.67	0.083	0.020	0.36	12.74	2
17	17 to 18	0.00	0.0	0.00	0.00	5.99*	4.28	5.00	5.27	Genr	0.0	0.00	0.00	0.00	0.00	Sag	3.00	0.001	0.001	0.30	300.00	3
18	16 to 17	0.00	0.0	0.00	0.00	5.35*	0.00	5.00	0.35	Genr	0.0	0.00	0.00	0.00	0.00	Sag	3.00	0.001	0.001	0.30	300.00	3
19	17 - A to 17	0.00	0.0	0.00	0.00	4.28*	0.00	0.00	4.28	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	17
20	17 - B to 17 - A	0.00	0.0	0.00	0.00	4.28*	0.00	1.45	2.83	Curb	0.4	6.00	0.00	0.00	0.00	0.048	1.67	0.083	0.020	0.28	8.74	2
21	17 - C to 17 - B	0.00	0.0	0.00	0.00	3.47*	3.16	1.20	5.43	Curb	0.4	4.00	0.00	0.00	0.00	0.048	1.67	0.083	0.020	0.31	10.24	2
22	17 - D to 17 - C	0.00	0.0	0.00	0.00	3.16*	0.00	0.00	3.16	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	21

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraflow Inlet Report

Line No	Line ID	A (ac)	Inlet time (min)	I (in/hr)	C	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet Ht (in)	Curb Inlet L (ft)	Grate Inlet area (sqft)	Grate Inlet L (ft)	Grate Inlet W (ft)	Gutter So (ft/ft)	Gutter W (ft)	Gutter Sw (ft/ft)	Gutter Sx (ft/ft)	Flow depth (ft)	Flow spread (ft)	Byp line No
23	17 - E to 17 - D	0.00	0.0	0.00	0.00	3.19*	0.00	3.19	0.00	Curb	0.4	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.67	28.43	2
24	17 - F to 17 - E	0.00	0.0	0.00	0.00	2.53*	0.00	2.53	0.00	Curb	0.4	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.58	23.59	2
25	17 - G to 17 - F	0.00	0.0	0.00	0.00	1.21*	0.00	1.21	0.00	Curb	0.4	2.50	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.35	12.34	2

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraflow Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	24	17.11	79.87	81.62	1.75	2.91	5.87	0.54	82.16	0.518	89.0	80.60	82.07	1.47**	2.47	6.94	0.75	82.81	0.728	0.623	N/A	1.10	0.82
2	24	19.40	80.70	82.89	2.00	3.14	6.18	0.59	83.48	0.736	28.0	80.92	83.09	2.00	3.14	6.18	0.59	83.69	0.736	0.736	0.206	0.85	0.50
3	18	6.98	81.51	83.60	1.50	1.77	3.95	0.24	83.84	0.442	33.0	81.67	83.74	1.50	1.77	3.95	0.24	83.99	0.442	0.442	0.146	1.50	0.36
4	15	0.74	81.92	84.11	1.25	1.23	0.60	0.01	84.11	0.013	70.0	82.50	84.12	1.25	1.23	0.60	0.01	84.12	0.013	0.013	0.009	1.00	0.01
5	15	5.28	81.92	84.11	1.25	1.23	4.30	0.29	84.40	0.669	20.0	82.10	84.24	1.25	1.23	4.30	0.29	84.53	0.669	0.669	0.134	0.50	0.14
6	15	4.34	82.20	84.39	1.25	1.23	3.54	0.19	84.58	0.452	123	84.70	85.53	0.83**	0.87	4.99	0.39	85.92	0.734	0.593	N/A	0.70	0.27
7	15	2.67	87.70	88.04	0.34*	0.27	9.82	1.50	89.54	6.423	35.0	90.00	90.65	0.65**	0.65	4.11	0.26	90.92	0.587	3.505	N/A	0.85	0.22
8	15	2.67	94.25	94.61	0.36*	0.29	9.29	1.34	95.95	5.487	105	100.62	101.27	0.65**	0.65	4.11	0.26	101.54	0.587	3.037	N/A	0.50	0.13
9	15	1.69	104.73	105.23	0.50*	0.46	3.65	0.21	105.44	0.588	40.0	104.97	105.49	0.52	0.49	3.47	0.19	105.68	0.511	0.550	0.220	1.00	0.19
10	24	11.99	81.02	83.60	2.00	3.14	3.82	0.23	83.82	0.281	205	82.09	84.17	2.00	3.14	3.82	0.23	84.40	0.281	0.281	0.576	1.25	0.28
11	15	4.52	86.53	87.54	1.01*	1.06	4.27	0.28	87.82	0.507	33.0	86.70	87.70	1.00	1.05	4.29	0.29	87.99	0.512	0.510	0.168	1.25	0.36
12	15	3.87	86.80	88.06	1.25	1.23	3.15	0.15	88.21	0.359	44.0	87.09	88.18	1.09	1.14	3.40	0.18	88.36	0.325	0.342	0.151	1.10	0.20
13	15	0.69	87.41	88.38	0.97	1.02	0.67	0.01	88.39	0.013	32.0	87.60	88.38	0.78	0.81	0.86	0.01	88.39	0.022	0.018	0.006	1.00	0.01
14	15	2.34	87.19	88.38	1.19	1.21	1.94	0.06	88.44	0.114	113	98.12	98.73	0.61**	0.60	3.92	0.24	98.97	0.564	0.339	N/A	1.00	0.24
15	18	7.72	82.59	84.46	1.50	1.77	4.37	0.30	84.75	0.541	292	84.31	86.04	1.50	1.77	4.37	0.30	86.33	0.540	0.541	1.579	1.25	0.37
16	18	7.21	84.41	86.41	1.50	1.77	4.08	0.26	86.67	0.472	41.0	84.62	86.60	1.50	1.77	4.08	0.26	86.86	0.471	0.472	0.193	0.70	0.18
17	15	5.99	84.87	86.78	1.25	1.23	4.88	0.37	87.15	0.861	140	89.70	90.68	0.98**	1.03	5.81	0.52	91.20	0.939	0.900	N/A	1.50	0.79
18	15	5.35	90.79	92.04	1.25*	1.23	4.36	0.30	92.34	0.687	286	92.16	94.00	1.25	1.23	4.36	0.30	94.30	0.686	0.687	1.964	1.00	0.30
19	15	4.28	95.65	96.11	0.46*	0.41	10.51	1.72	97.83	5.360	52.0	98.75	99.58	0.83**	0.86	4.96	0.38	99.96	0.728	3.044	N/A	0.75	0.29
20	15	4.28	98.85	99.86	1.01	1.07	4.01	0.25	100.11	0.447	101	101.00	101.83	0.83**	0.86	4.96	0.38	102.21	0.728	0.587	N/A	0.50	0.19
21	15	3.47	101.10	102.02	0.92	0.97	3.59	0.20	102.22	0.364	32.0	101.25	102.12	0.87	0.91	3.82	0.23	102.34	0.421	0.392	0.126	1.50	0.34

Project File: Stonehouse Glen System 2.stm	I-D-F File: Norfolk.IDF	Total number of lines: 25	Run Date: 10-18-2004

NOTES: Initial tailwater elevation = 81.62 (ft), * Normal depth assumed., ** Critical depth assumed.

Hydraflow Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
22	15	3.16	101.35	102.46	1.11	1.15	2.75	0.12	102.57	0.214	112	101.93	102.72	0.79	0.81	3.88	0.23	102.95	0.457	0.336	0.376	1.00	0.23
23	15	3.19	102.03	102.95	0.92	0.97	3.29	0.17	103.12	0.305	148	102.80	103.52	0.72	0.73	4.37	0.30	103.82	0.619	0.462	0.684	1.50	0.45
24	15	2.53	102.90	103.96	1.06	1.11	2.27	0.08	104.04	0.144	32.0	103.05	104.00	0.95	1.00	2.54	0.10	104.10	0.181	0.163	0.052	1.50	0.15
25	15	1.21	103.15	104.15	1.00	1.05	1.15	0.02	104.17	0.037	268	104.76	105.20	0.44**	0.39	3.13	0.15	105.35	0.496	0.267	N/A	1.00	0.15

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Initial tailwater elevation = 81.62 (ft) , * Normal depth assumed., ** Critical depth assumed.

Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: _____ PROJ: STONEHOUSE GLEN SECTION I
COUNTY: _____ DISTRICT: CURB & GUTTER
DESCRIPTION: _____
SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPA-CITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT / ACCUMULATED (17)	REMARKS (18)
~~13~~	~~14~~	~~0.27~~	~~0.6~~	~~0.16~~	~~2.25~~	~~16.81~~	~~5.07~~	~~11.41~~	~~81.00~~	~~70.62~~	~~173'~~	~~0.060~~	~~18"~~	~~25.73~~	~~14.12~~	~~0.84~~	
~~14A~~	~~14~~	~~0.73~~	~~0.35~~	~~0.26~~	~~—~~	~~18~~	~~5.54~~	~~1.44~~	~~76.17~~	~~72.88~~	~~28'~~	~~0.113~~	~~15"~~	~~21.71~~	~~10.03~~		
~~14~~	~~15~~	~~—~~	~~—~~	~~—~~	~~3.51~~	~~15.81~~	~~5.07~~	~~12.73~~	~~65.38~~	~~62.00~~	~~34'~~	~~0.080~~	~~18"~~	~~29.71~~	~~16.16~~		
~~15~~	~~16~~	~~—~~	~~—~~	~~—~~	~~—~~			~~12.73~~	~~56.39~~	~~56.25~~	~~31'~~	~~0.0045~~	~~24"~~	~~15.17~~	~~5.41~~		
27	28	1.33	0.45	0.60	1.07	14.7	5.29	5.66	66.67	65.08	199'	0.0080	15"	5.78	5.34		
28	29	—	—	—	—	—	—	5.66	64.00	60.40	45'	0.08	15"	18.27	13.13		
29	29A	—	—	—	—	—	—	5.66	56.40	56.25	30'	0.005	18"	7.43	4.63		

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	27 to 28
Flow Element	Circular Channel
Method	Manning's Formul:
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.008000	ft/ft
Diameter	15	in
Discharge	5.29	cfs

Results		
Depth	0.94	ft
Flow Area	1.0	ft²
Wetted Perimeter	2.63	ft
Top Width	1.08	ft
Critical Depth	0.93	ft
Percent Full	75.3	%
Critical Slope	0.008167	ft/ft
Velocity	5.34	ft/s
Velocity Head	0.44	ft
Specific Energy	1.38	ft
Froude Number	0.98	
Maximum Discharg	6.21	cfs
Discharge Full	5.78	cfs
Slope Full	0.006707	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	28 to 29
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.080000	ft/ft
Diameter	15	in
Discharge	5.66	cfs

Results		
Depth	0.48	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.67	ft
Top Width	1.21	ft
Critical Depth	0.96	ft
Percent Full	38.2	%
Critical Slope	0.008679	ft/ft
Velocity	13.13	ft/s
Velocity Head	2.68	ft
Specific Energy	3.16	ft
Froude Number	3.89	
Maximum Discharg	19.65	cfs
Discharge Full	18.27	cfs
Slope Full	0.007678	ft/ft
Flow Type	Supercritical	

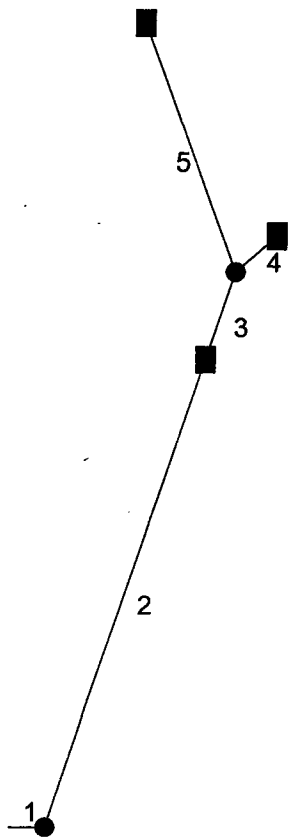
Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	29 to 29 - A
Flow Element	Circular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005000	ft/ft
Diameter	18	in
Discharge	5.66	cfs

Results		
Depth	0.98	ft
Flow Area	1.2	ft²
Wetted Perimeter	2.82	ft
Top Width	1.43	ft
Critical Depth	0.92	ft
Percent Full	65.3	%
Critical Slope	0.006061	ft/ft
Velocity	4.63	ft/s
Velocity Head	0.33	ft
Specific Energy	1.31	ft
Froude Number	0.88	
Maximum Discharg	7.99	cfs
Discharge Full	7.43	cfs
Slope Full	0.002904	ft/ft
Flow Type	Subcritical	

Hydraflow Plan View



Project file: Stonehouse Glen System 4.stm	IDF file: Norfolk.IDF	No. Lines: 5	10-20-2004

Hydraflow Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	23.0	0.0	MH	5.66	0.00	0.00	0.0	61.00	3.78	61.87	15	Cir	0.013	0.85	73.17	29 to 28
2	1	240.0	-65.0	Curb	5.66	0.00	0.00	0.0	66.18	0.79	68.08	15	Cir	0.013	0.50	73.25	27 to 28
3	2	45.0	0.0	MH	2.49	0.00	0.00	0.0	68.18	0.49	68.40	15	Cir	0.013	0.75	74.83	26 to 27
4	3	31.0	33.0	Curb	0.82	0.00	0.00	0.0	71.08	1.00	71.39	15	Cir	0.013	1.00	75.31	26 A to 26
5	3	128.0	-52.0	Curb	1.70	0.00	0.00	0.0	68.50	8.01	78.75	15	Cir	0.013	1.00	82.67	25 to 26

Project File: Stonehouse Glen System 4.stm | I-D-F File: Norfolk.IDF | Total number of lines: 5 | Date: 10-20-2004

Hydraflow Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	Dns line No.
1	29 to 28	5.66	15 c	23.0	61.00	61.87	3.783	62.00	62.82	0.42	End
2	27 to 28	5.66	15 c	240.0	66.18	68.08	0.792	67.20	69.08	0.22	1
3	26 to 27	2.49	15 c	45.0	68.18	68.40	0.489	69.31	69.35	0.07	2
4	26 A to 26	0.82	15 c	31.0	71.08	71.39	1.000	71.39	71.75	0.12	3
5	25 to 26	1.70	15 c	128.0	68.50	78.75	8.008	69.42	79.27	0.19	3

Project File: Stonehouse Glen System 4I-D-F File: Norfolk.IDF | Total No. Lines: 5 | Run Date: 10-20-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

Hydraflow Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	23.0	0.00	0.00	0.00	0.00	0.00	0.0	2.3	0.0	5.66	12.56	5.51	15	3.78	61.87	61.00	62.82	62.00	73.17	0.00	29 to 28
2	1	240.0	0.00	0.00	0.00	0.00	0.00	0.0	1.0	0.0	5.66	5.75	5.33	15	0.79	68.08	66.18	69.08	67.20	73.25	73.17	27 to 28
3	2	45.0	0.00	0.00	0.00	0.00	0.00	0.0	0.7	0.0	2.49	4.52	2.31	15	0.49	68.40	68.18	69.35	69.31	74.83	73.25	26 to 27
4	3	31.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.82	6.46	3.09	15	1.00	71.39	71.08	71.75	71.39	75.31	74.83	26 A to 26
5	3	128.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.70	18.27	2.63	15	8.01	78.75	68.50	79.27	69.42	82.67	74.83	25 to 26

Project File: Stonehouse Glen System 4.stm | I-D-F File: Norfolk.IDF | Total number of lines: 5 | Run Date: 10-20-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 62.00 (ft)

Hydraflow Inlet Report

Line No	Line ID	A (ac)	Inlet time (min)	I (in/hr)	C	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet Ht (in)	Curb Inlet L (ft)	Grate Inlet area (sqft)	Grate Inlet L (ft)	Grate Inlet W (ft)	Gutter So (ft/ft)	Gutter W (ft)	Gutter Sw (ft/ft)	Gutter Sx (ft/ft)	Flow depth (ft)	Flow spread (ft)	Byp line No
1	29 to 28	0.00	0.0	0.00	0.00	5.66*	0.79	0.00	6.45	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	Offsite
2	27 to 28	0.00	0.0	0.00	0.00	5.66*	2.49	8.15	0.00	Curb	4.0	8.00	0.00	0.00	0.00	Sag	1.67	0.083	0.020	0.58	23.71	1
3	26 to 27	0.00	0.0	0.00	0.00	2.49*	0.00	0.00	2.49	MH	0.0	0.00	0.00	0.00	0.00	0.000	0.00	0.000	0.000	0.00	0.00	2
4	26 A to 26	0.00	0.0	0.00	0.00	0.82*	0.00	0.62	0.20	Curb	4.0	6.00	0.00	0.00	0.00	0.040	1.67	0.083	0.020	0.18	3.74	1
5	25 to 26	0.00	0.0	0.00	0.00	1.70*	0.00	1.11	0.59	Curb	4.0	8.00	0.00	0.00	0.00	0.055	1.67	0.083	0.020	0.21	5.24	1

Project File: Stonehouse Glen System 4.stm | I-D-F File: Norfo!k.IDF | Total number of lines: 5 | Run Date: 10-20-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraflow Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	15	5.66	61.00	62.00	1.00	1.05	5.38	0.45	62.45	0.804	23.0	61.87	62.82	0.95**	1.00	5.64	0.50	63.32	0.892	0.848	N/A	0.85	0.42
2	15	5.66	66.18	67.20	1.02*	1.07	5.29	0.44	67.63	0.778	240	68.08	69.08	1.00	1.05	5.37	0.45	69.53	0.802	0.790	1.896	0.50	0.22
3	15	2.49	68.18	69.31	1.13	1.16	2.14	0.07	69.38	0.131	45.0	68.40	69.35	0.95	1.00	2.49	0.10	69.45	0.174	0.152	0.069	0.75	0.07
4	15	0.82	71.08	71.39	0.31*	0.24	3.39	0.18	71.57	0.843	31.0	71.39	71.75	0.36**	0.30	2.78	0.12	71.87	0.480	0.662	N/A	1.00	0.12
5	15	1.70	68.50	69.42	0.92	0.97	1.75	0.05	69.47	0.087	128	78.75	79.27	0.52**	0.49	3.50	0.19	79.46	0.523	0.305	N/A	1.00	0.19

Project File: Stonehouse Glen System 4.stm	I-D-F File: Norfolk.IDF	Total number of lines: 5	Run Date: 10-20-2004

NOTES: Initial tailwater elevation = 62 (ft), * Normal depth assumed., ** Critical depth assumed.

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Appendix IV

Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

County	JAMES CITY COUNTY	Date:	10/28/03
Subdivision	STONEHOUSE GLEN		
Street Name	HOMESTEAD DRIVE		
Developer	STONEHOUSE AT WILLIAMSBURG, K. McDermott	Phone:	908-234-2620 x2

ADT	Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements.
CBR_D	Design CBR = Average of CBR_T x 2/3 and modified only as discussed in the Pavement Design Guide.
CBR_T	CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide
DME	VDOT District Materials Engineer
EPT	Equivalent projected traffic
HCV	Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires).
%HCV	Percentage of the total traffic volume composed of Heavy Commercial Vehicles.
RF	Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading.
SSV	Soil support value of subgrade (SSV = CBR_D x RF)
D_P	Thickness index of proposed pavement design computed by the Conventional Pavement Design Method
D_R	Thickness index required, based on Design ADT and SSV, determined by Appendix II.

Step 1: Determine Design ADT

ADT	1600
%HCV = 100 x HCV x ADT) or ~~20 x HCV~~ Note: For %HCV ≤ 5%, use ADT	Note: For %HCV>5%, EPT>ADT
Design ADT Use greater of ADT or EPT	1600

Step 2: Determine Design Values CBR, RF, and SSV

Sample	DBR_T	Resiliency Factor	(RF)
# 1		Source	Value
# 2		Table 1	
# 3		Appendix I	3
#		~~DME approved RF~~	
#		For preliminary designs, use the lowest RF value in the equation	
#			

CBR_D	x	RF	=	SSV
(6)	x	(3)	=	18

Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide. (See Appendix III for material notations and thickness equivalency values (a)).

D_R = 14.5 from Appendix II

Description of Proposed Pavement Section

	Material Notation	Thickness, h	a	(a x h)
Surface	SM 9.5A	2	2.25	4.5
Base	BM-25 37.5	3	2.15	6.45
Subbase	TYPE I SIZE 21B	8	0.5	4.0

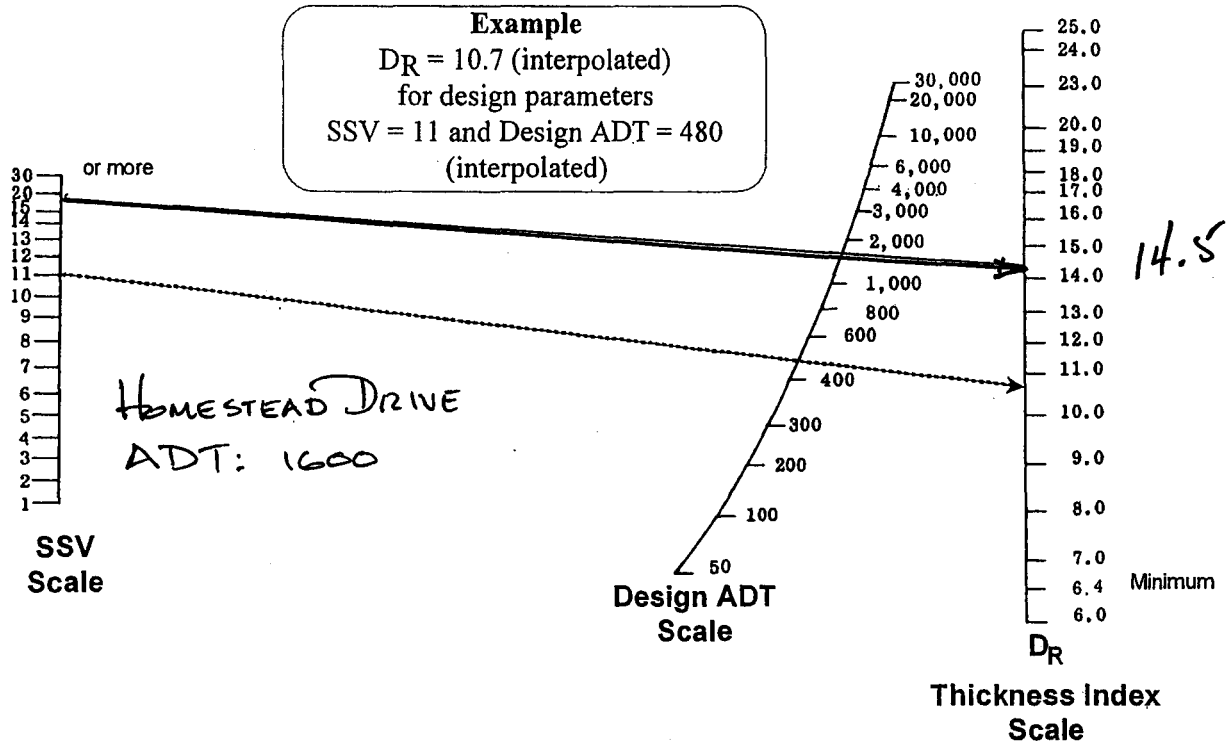
D_P must equal or exceed the value of D_R. $D_P = \Sigma(a \times h)$ = 14.95

Appendix II
Nomograph for Determining Required Pavement Thickness Index D_R

(Note: An enlarged version of this nomograph is provided on the last page of this reference.)

Final pavement design must be based on the results of appropriate soil tests.

Preliminary designs may be based on values established in Appendix I.



To determine D_R, project a line from the value for SSV through the value for the Design ADT.

The nomograph depicted correlates the soil support value of the subgrade (SSV = Design CBR x RF), the traffic volume (Design ADT), and the minimum required pavement design thickness index (D_R) for subdivision streets and secondary road pavement, based on AASHO design equations. This nomograph assumes the following:

1. Use of Design ADT for two way traffic, equally distributed, thereby deriving the thickness index (D_R) required for any portion of the pavement to support one-half of the design ADT.
2. For D_R greater than 20, staged construction providing an initial stage D_R value of 20 may be permitted.
3. The District Materials Engineer may consider reducing the minimum D_R value of 6.4 for secondary system facilities having a Design ADT <50.

APPENDIX III

Paving Materials & Allowable Values

Location & Notation	Material	Material Notation	Thickness Equivalency Value	Lift Thickness Min. inches	Lift Thickness Max. inches
Surface a_1	Asphalt Concrete (SM-9.0A, D)[1]	A.C.	1.67 *	1	1.5
	Asphalt Concrete (SM-9.5A, D)[1]			2 [2]	3
	Prime & Double Seal or Class "C" or D" Blotted Seal Coat Surface Treatments [3]	D.S.	0.84	—	—
Intermediate a_1	Asphalt Concrete (IM-19.0) [1]	A.C.	1.67 *	2	3
Base a_2	Asphalt Concrete (BM-2537.5) [1]	A.C.	1.67 *	3	—
	Full Depth Asphalt Concrete (BM-25.0 or BM 37.5) over Subgrade[1]	A.C.	1.60 **	6	—
	Untreated Aggregate [4]	Agg.	1.00	6	8 [4]
	Cement Treated Aggregate [4]	CTA	1.67		
	Cement Treated Select Material, Type II, min. CBR = 20	Sel. Mat. C	1.50		
	Select Material Type I & II, non-plastic, min. CBR = 30	Sel. Mat.	0.84		
	Select Material, Type II, non-plastic, min. CBR = 20	Sel. Mat.	0.60		
	Soil Cement	S.C.	1.00		
	Cement Treated Select Material, Type II	Sel. Mat. C	1.17		
	Cement Treated Select Borrow	Sel. Bor. C	1.00		
	Open Graded Drainage Layer	OGDL	0.60	3	3
Subase a_3	Untreated Aggregate [4]	Agg.	0.60	4	8 [4]
	Cement Treated Aggregate [4]	CTA	1.33		
	Select Material Type I, non-plastic, min. CBR = 30	Sel. Mat.	0.50		
	Select Material Type II, non-plastic, min. CBR = 20	Sel. Mat.	0.40		
	Soil Cement	S.C.	1.00	6	8
	Soil Lime	S.L.	0.92		
	Cement Treated Select Material, Type II	Sel. Mat. C	1.17		
	Cement Treated Select Borrow	Sel. Bor. C	1.00		

Footnotes for Appendix III

[1] When 4½ inches or more of any combination of Asphalt Concrete (surface + intermediate + base) is called for, the following thickness equivalency values should be used * = 2.25 and ** = 2.15

[2] 1½ inches is acceptable when placed on an asphalt concrete base material.

[3] Prime and Double Seal Surface Treatment, in lieu of blotted seal coat surface treatment, may only be used as outlined in Appendix IV (for new subdivision streets) and the current Location and Design Division I&I Memorandum (for secondary road projects).

[4] For aggregate materials, the maximum combined thickness of base and subbase layers considered for the purpose of calculating the thickness index value shall be 12 inches.

[5] An intermediate mix is required between the surface and base mix when BM-37.5 is used.

Appendix IV

Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

County	JAMES CITY COUNTY	Date:	10/28/03
Subdivision	Stonehouse Glen		
Street Name	BUCKINGHAM		
Developer	STONEHOUSE AT WILLIAMSBURG	Phone:	908-234-2620 x 27

ADT	Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements.
CBR_D	Design CBR = Average of CBR_T x 2/3 and modified only as discussed in the Pavement Design Guide.
CBR_T	CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide
DME	VDOT District Materials Engineer
EPT	Equivalent projected traffic
HCV	Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires).
%HCV	Percentage of the total traffic volume composed of Heavy Commercial Vehicles.
RF	Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading.
SSV	Soil support value of subgrade (SSV = CBR_D x RF)
D_P	Thickness index of proposed pavement design computed by the Conventional Pavement Design Method
D_R	Thickness index required, based on Design ADT and SSV, determined by Appendix II.

Step 1: Determine Design ADT

ADT	760
%HCV = 100 x HCV x ADT) or 20 x HCV (Note: For %HCV ≤ 5%, use ADT)	Note: For %HCV>5%, EPT>ADT
Design ADT Use greater of ADT or EPT	760

Step 2: Determine Design Values CBR, RF, and SSV

Sample	DBR_T
# 1	
# 2	
# 3	
#	
#	
#	

Resiliency Factor	(RF)
Source	Value
Table 1	
Appendix I	3
DME approved RF	

For preliminary designs, use the lowest RF value in the equation

CBR_D x RF = SSV

(6) x (3) = 18

Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide. (See Appendix III for material notations and thickness equivalency values (a)).

D_R = 12 from Appendix II

Description of Proposed Pavement Section

	Material Notation	Thickness, h	a	(a x h)
Surface	SM 9.5 A	1.5	2.25	3.375
Base	BM-25 37.5	3.	2.15	6.45
Subbase	TYPE I SIZE 21B	6	0.5	3.0

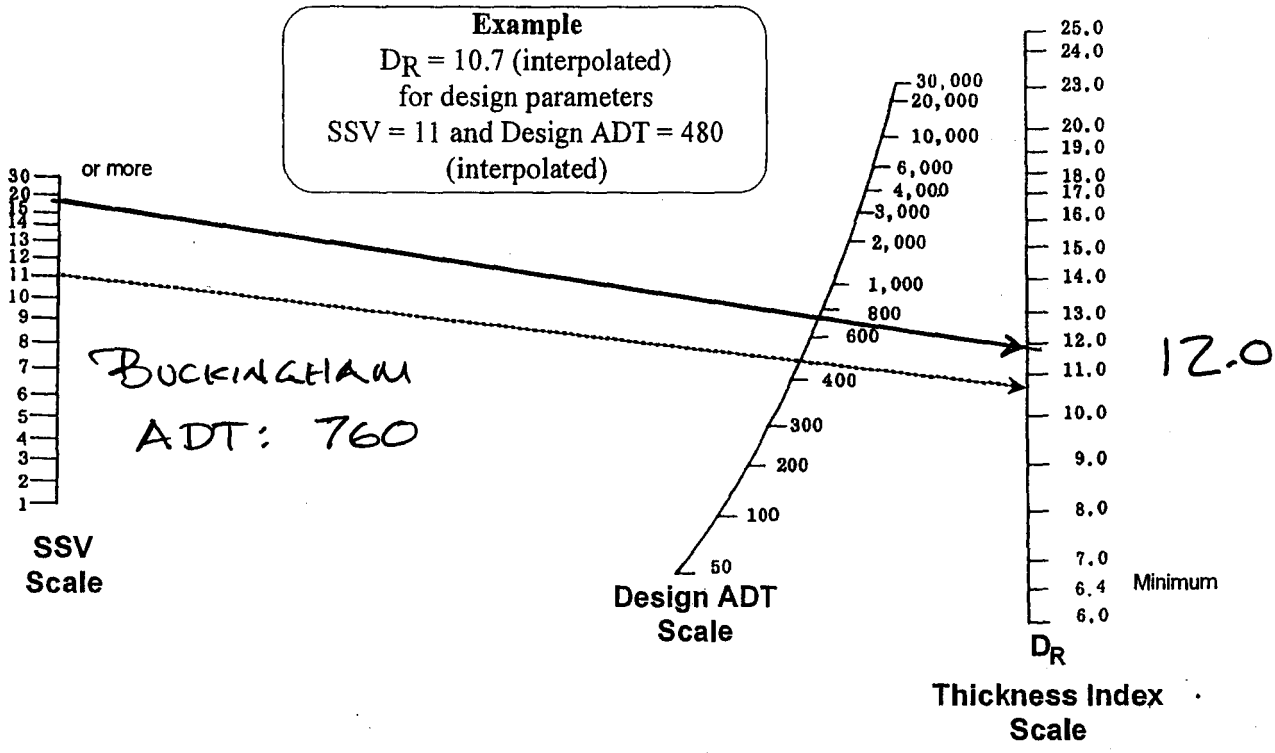
D_P must equal or exceed the value of D_R. $D_P = \Sigma(a \times h)$ = 13.2

Appendix II
Nomograph for Determining Required Pavement Thickness Index D_R

(Note: An enlarged version of this nomograph is provided on the last page of this reference.)

Final pavement design must be based on the results of appropriate soil tests.

Preliminary designs may be based on values established in Appendix I.



To determine D_R, project a line from the value for SSV through the value for the Design ADT.

The nomograph depicted correlates the soil support value of the subgrade (SSV = Design CBR x RF), the traffic volume (Design ADT), and the minimum required pavement design thickness index (D_R) for subdivision streets and secondary road pavement, based on AASHO design equations. This nomograph assumes the following:

1. Use of Design ADT for two way traffic, equally distributed, thereby deriving the thickness index (D_R) required for any portion of the pavement to support one-half of the design ADT.
2. For D_R greater than 20, staged construction providing an initial stage D_R value of 20 may be permitted.
3. The District Materials Engineer may consider reducing the minimum D_R value of 6.4 for secondary system facilities having a Design ADT <50.

APPENDIX III

Paving Materials & Allowable Values

Location & Notation	Material	Material Notation	Thickness Equivalency Value	Lift Thickness Min. inches	Lift Thickness Max. inches
Surface a_1	Asphalt Concrete (SM-9.0A, D)[1]	A.C.	1.67 *	1	1.5
	Asphalt Concrete (SM-9.5A, D)[1]			2 [2]	3
	Prime & Double Seal or Class "C" or D" Blotted Seal Coat Surface Treatments [3]	D.S.	0.84	—	—
Intermediate a_1	Asphalt Concrete (IM-19.0) [1]	A.C.	1.67 *	2	3
Base a_2	Asphalt Concrete (BM-2537.5) [1]	A.C.	1.67 *	3	—
	Full Depth Asphalt Concrete (BM-25.0 or BM 37.5) over Subgrade[1]	A.C.	1.60 **	6	—
	Untreated Aggregate [4]	Agg.	1.00	6	8 [4]
	Cement Treated Aggregate [4]	CTA	1.67		
	Cement Treated Select Material, Type II, min. CBR = 20	Sel. Mat. C	1.50		
	Select Material Type I & II, non-plastic, min. CBR = 30	Sel. Mat.	0.84		
	Select Material, Type II, non-plastic, min. CBR = 20	Sel. Mat.	0.60		
	Soil Cement	S.C.	1.00		
	Cement Treated Select Material, Type II	Sel. Mat. C	1.17		
	Cement Treated Select Borrow	Sel. Bor. C	1.00		
	Open Graded Drainage Layer	OGDL	0.60	3	3
Subase a_3	Untreated Aggregate [4]	Agg.	0.60	4	8 [4]
	Cement Treated Aggregate [4]	CTA	1.33		
	Select Material Type I, non-plastic, min. CBR = 30	Sel. Mat.	0.50		
	Select Material Type II, non-plastic, min. CBR = 20	Sel. Mat.	0.40		
	Soil Cement	S.C.	1.00	6	8
	Soil Lime	S.L.	0.92		
	Cement Treated Select Material, Type II	Sel. Mat. C	1.17		
	Cement Treated Select Borrow	Sel. Bor. C	1.00		

Footnotes for Appendix III

[1] When 4½ inches or more of any combination of Asphalt Concrete (surface + intermediate + base) is called for, the following thickness equivalency values should be used * = 2.25 and ** = 2.15

[2] 1½ inches is acceptable when placed on an asphalt concrete base material.

[3] Prime and Double Seal Surface Treatment, in lieu of blotted seal coat surface treatment, may only be used as outlined in Appendix IV (for new subdivision streets) and the current Location and Design Division I&I Memorandum (for secondary road projects).

[4] For aggregate materials, the maximum combined thickness of base and subbase layers considered for the purpose of calculating the thickness index value shall be 12 inches.

[5] An intermediate mix is required between the surface and base mix when BM-37.5 is used.

Appendix IV

Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

County	JAMES CITY COUNTY	Date:	10/23/03
Subdivision	STONEHOUSE GLEN		
Street Name	OTDOWAY COURT, MARRIN COURT, STAFFORD LANE & ASHLOCK COURT		
Developer	STONEHOUSE AT WILLIAMSBURG, K. McDERMOTT	Phone:	908-234-2620 x27

ADT	Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements.
CBR_D	Design CBR = Average of CBR_T x 2/3 and modified only as discussed in the Pavement Design Guide.
CBR_T	CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide
DME	VDOT District Materials Engineer
EPT	Equivalent projected traffic
HCV	Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires).
%HCV	Percentage of the total traffic volume composed of Heavy Commercial Vehicles.
RF	Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading.
SSV	Soil support value of subgrade (SSV = CBR_D x RF)
D_P	Thickness index of proposed pavement design computed by the Conventional Pavement Design Method
D_R	Thickness index required, based on Design ADT and SSV, determined by Appendix II.

Step 1: Determine Design ADT

ADT	≤ 280
%HCV = 100 x HCV x ADT) or 20 x HCV Note: For %HCV ≤ 5%, use ADT	~~≤280~~ Note: For %HCV>5%, EPT>ADT
Design ADT Use greater of ADT or EPT	280

Step 2: Determine Design Values CBR, RF, and SSV

Sample	DBR_T
# 1	
# 2	
# 3	
#	
#	
#	

Resiliency Factor	(RF)
Source	Value
Table 1	
Appendix I	3
DME approved RF	3

For preliminary designs, use the lowest RF value in the equation

CBR_D	x	RF	=	SSV
(6)	x	(3)	=	18

Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide.
(See Appendix III for material notations and thickness equivalency values (a)).

D_R = 7.8 from Appendix II

Description of Proposed Pavement Section

	Material Notation	Thickness, h	a	(a x h)
Surface	SM 9.5 A	1.5	2.25	3.375
Base	BM-25 375	3	2.15	6.45
Subbase	TYPE I - SIZE 21B	4	0.5	2.00

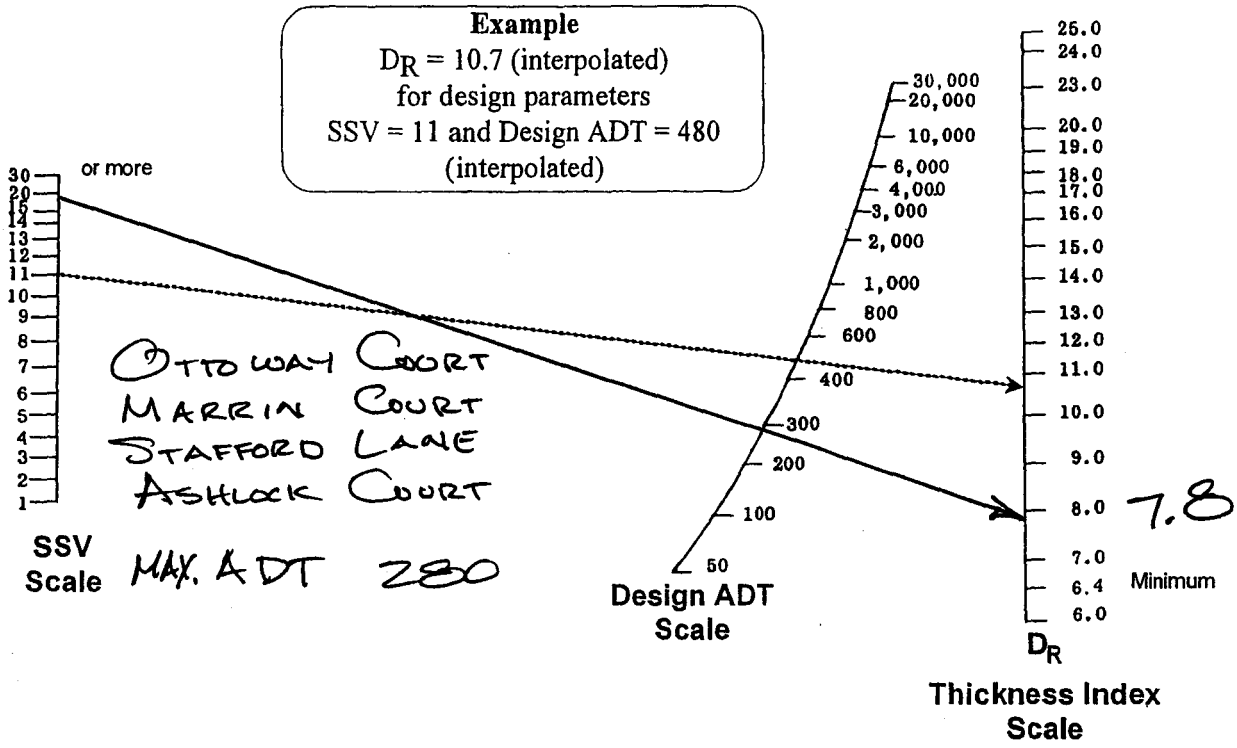
D_P must equal or exceed the value of D_R. $D_P = \Sigma(a \times h) =$ 11.825

Appendix II
Nomograph for Determining Required Pavement Thickness Index D_R

(Note: An enlarged version of this nomograph is provided on the last page of this reference.)

Final pavement design must be based on the results of appropriate soil tests.

Preliminary designs may be based on values established in Appendix I.



To determine D_R, project a line from the value for SSV through the value for the Design ADT.

The nomograph depicted correlates the soil support value of the subgrade (SSV = Design CBR x RF), the traffic volume (Design ADT), and the minimum required pavement design thickness index (D_R) for subdivision streets and secondary road pavement, based on AASHO design equations. This nomograph assumes the following:

1. Use of Design ADT for two way traffic, equally distributed, thereby deriving the thickness index (D_R) required for any portion of the pavement to support one-half of the design ADT.
2. For D_R greater than 20, staged construction providing an initial stage D_R value of 20 may be permitted.
3. The District Materials Engineer may consider reducing the minimum D_R value of 6.4 for secondary system facilities having a Design ADT <50.

APPENDIX III

Paving Materials & Allowable Values

Location & Notation	Material	Material Notation	Thickness Equivalency Value	Lift Thickness Min. inches	Lift Thickness Max. inches
Surface a_1	Asphalt Concrete (SM-9.0A, D)[1]	A.C.	1.67 *	1	1.5
	Asphalt Concrete (SM-9.5A, D)[1]			2 [2]	3
	Prime & Double Seal or Class "C" or D" Blotted Seal Coat Surface Treatments [3]	D.S.	0.84	—	—
Intermediate a_1	Asphalt Concrete (IM-19.0) [1]	A.C.	1.67 *	2	3
Base a_2	Asphalt Concrete (BM-2537.5) [1]	A.C.	1.67 *	3	—
	Full Depth Asphalt Concrete (BM-25.0 or BM 37.5) over Subgrade[1]	A.C.	1.60 **	6	—
	Untreated Aggregate [4]	Agg.	1.00	6	8 [4]
	Cement Treated Aggregate [4]	CTA	1.67		
	Cement Treated Select Material, Type II, min. CBR = 20	Sel. Mat. C	1.50		
	Select Material Type I & II, non-plastic, min. CBR = 30	Sel. Mat.	0.84		
	Select Material, Type II, non-plastic, min. CBR = 20	Sel. Mat.	0.60		
	Soil Cement	S.C.	1.00		
	Cement Treated Select Material, Type II	Sel. Mat. C	1.17		
	Cement Treated Select Borrow	Sel. Bor. C	1.00		
	Open Graded Drainage Layer	OGDL	0.60	3	3
Subase a_3	Untreated Aggregate [4]	Agg.	0.60	4	8 [4]
	Cement Treated Aggregate [4]	CTA	1.33		
	Select Material Type I, non-plastic, min. CBR = 30	Sel. Mat.	0.50		
	Select Material Type II, non-plastic, min. CBR = 20	Sel. Mat.	0.40		
	Soil Cement	S.C.	1.00	6	8
	Soil Lime	S.L.	0.92		
	Cement Treated Select Material, Type II	Sel. Mat. C	1.17		
	Cement Treated Select Borrow	Sel. Bor. C	1.00		

Footnotes for Appendix III

[1] When 4½ inches or more of any combination of Asphalt Concrete (surface + intermediate + base) is called for, the following thickness equivalency values should be used * = 2.25 and ** = 2.15

[2] 1½ inches is acceptable when placed on an asphalt concrete base material.

[3] Prime and Double Seal Surface Treatment, in lieu of blotted seal coat surface treatment, may only be used as outlined in Appendix IV (for new subdivision streets) and the current Location and Design Division I&I Memorandum (for secondary road projects).

[4] For aggregate materials, the maximum combined thickness of base and subbase layers considered for the purpose of calculating the thickness index value shall be 12 inches.

[5] An intermediate mix is required between the surface and base mix when BM-37.5 is used.

Supporting Engineering Documents
For
Stonehouse Glen Subdivision
Section II

James City County, Virginia

December 30, 2003
Revised December 28, 2004
Revised March 16, 2005
Revised May 12, 2005
Revised July 15, 2005

S-116-03

COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024785
7-15-05
PROFESSIONAL ENGINEER

JUL 2005
RECEIVED
PLANNING DEPARTMENT

5th submission
FINAL COMPS.

LMDG Project No.
2002261-504.04

LANDMARK
DESIGN GROUP

Engineers ♦ Planners ♦ Surveyors ♦ Landscape Architects ♦ Environmental Scientists
4029 Ironbound Road, Suite 100, Williamsburg, VA 23188 (757) 253-2975 FAX: (757) 229-0049
lmdg@landmarkdg.com

Supporting Engineering Documents

Table of Contents

- Project Description / Existing Site Conditions / Adjacent Area Description
- Stormwater Management Narrative
- Erosion & Sediment Control and Stormwater Management Design Plan Checklist
- Sediment Basin Calculations
- Channel Adequacy Calculations
- Pre and Post Developed Calculations
- Drainage Calculations
- Road Pavement Calculations
- Sewer and Water Data Sheets
- Drainage Area Maps

PROJECT DESCRIPTION/EXISTING SITE CONDITIONS/ADJACENT AREA DESCRIPTION

Stonehouse Glen Subdivision

Revised December 28, 2004, December 30, 2003

PROJECT DESCRIPTION:

Section 2 of the Stonehouse Glen subdivision proposes the construction of 62 single-family detached residential homesites and 2 stormwater management facility designed for channel adequacy protection only. To effect this plan, disturbance to approximately 9.3 acres of land will be required for construction of proposed public streets, on-site public utilities, the stormwater management facilities and other erosion and sediment control devices.

EXISTING SITE CONDITIONS:

Existing topography is characterized by relatively narrow ridgetops with intervening ravine systems. Elevations range from approximately 50 feet above MSL to approximately 115 feet above MSL. The existing land use is vacant. The existing cover is forested with a combination of mixed deciduous and evergreen species; the majority of the site has been repeatedly timbered over the past 50+ years. Surface drainage flows generally from the south to the north through a series of ravines which coalesce at Bird Swamp, and thereafter, flows enter the Ware Creek and ultimately the York River.

ADJACENT AREA DESCRIPTION:

Adjacent on-site areas (Land Bays 19, 20 and 22) are characterized by the same topographic features and drainage patterns, with surface drainage flowing along the same path as described above. All land east, west, north and south of the subject site is undeveloped, wooded and characterized by ridgetops dissected by ravines. The floodplain of Bird Swamp is broad with a braided channel; all other ravine systems are restricted in width and depth and with fairly direct flow lines. Substantial undisturbed land separates the proposed land disturbance activities associated with the subject project with the majority of post-development flow being directed to the many ravine systems, well below erosive velocities. Potential impacts to receiving waters are expected to be negligible given structural E&S practices and the sequence of construction proposed.

STORMWATER MANAGEMENT NARRATIVE

STONEHOUSE GLEN - SECTION 2
STORMWATER MANAGEMENT NARRATIVE

The Stonehouse Glen area lies within the watershed of Richardson Mill Pond. Consequently, it is provided with water quality requirements by Richardson Mill Pond, as are all other developments in that watershed.

The area of the development drains to several different ravine systems. The stormwater management plan was developed to provide minimal increases in flow depth and velocity in the major ravine system draining 18 of the subdivision lots, and most of the roadways. The remaining lots all drain directly to natural drainage systems.

The post development drainage flows to three points of discharge from this project. The two largest drainage areas flow to BMP 4 and BMP5. These two Basins will serve as temporary sediment basins during construction, and will be converted to permanent BMPs upon final stabilization. These Basins have been designed to provide for Channel adequacy by controlling the one- year storm event. The remaining outfall will drain into an existing reach (13); which will be improved to handle the increased velocities and provide for Channel adequacy. Virtually all of the soils within the drainage area lie within Soil Horizon Group C.

EROSION & SEDIMENT CONTROL AND STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST

James City County, Virginia
Environmental Division

Erosion and Sediment Control and Stormwater Management Design Plan Checklists

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GENERAL INFORMATION

Project Name: STONEHOUSE GLEN \ PHASE II
Owner / Applicant: LANDMARK DESIGN GROUP
Plan Preparer: LANDMARK DESIGN GROUP Email: _____
Project Location: STONE HOUSE DISTRICT WARE CREEK WATERSHED
Tax Map / Parcel: _____
County Plan No. (if known): _____
County BMP Type: _____ (-)
Other information submitted in addition to this checklist (Check all that apply):

- ■ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ■ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ■ Erosion & Sediment Control Plan Design Report.
- ■ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ■ Stormwater Management Design Report.
- ☐ Other, List: _____

Issue Date
March 1, 2001

JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

EROSION AND SEDIMENT CONTROL PLAN CHECKLIST

I. *GENERAL:*

Yes	No	N/A	
■	☐	☐	*FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH).
■	☐	☐	*LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project.
■	☐	☐	*VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site.

II. *SITE PLAN:*

Yes	No	N/A	
■	☐	☐	*VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site.
■	☐	☐	*INDICATE NORTH* direction in relation to the site.
■	☐	☐	*LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities.
■	☐	☐	*DISTURBED AREA ESTIMATES* in acres or square feet for the project.
■	☐	☐	*EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval.
■	☐	☐	*FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required).
■	☐	☐	*EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat.
■	☐	☐	*EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas.

Yes	No	N/A	
■	☐	☐	*EXISTING SITE FEATURES* including roads, buildings, homes, utilities, streams, fences, structures and other important surface features of the site.
■	☐	☐	*SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia.
■	☐	☐	*ENVIRONMENTAL INVENTORY* in accordance with Section 23-10(2) of the Chesapeake Bay Preservation Ordinance of James City County. Inventory generally includes: tidal shores and wetlands, non-tidal wetlands, resource protection area, hydric soils and slopes steeper than 25 percent. For wetlands, provide a copy of issued permits or satisfactory evidence that appropriate permits are being pursued for the entire project.
☐	☐	■	*100-YEAR FLOODPLAIN LIMITS* or any special flood hazard areas or flood zones based on appropriate Federal Management Agency Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs) of James City County, Virginia.
■	☐	☐	*DRAINAGE AREAS* for offsite and onsite areas, existing or proposed as applicable. Include drainage divides and directional labels for all subareas at points of interest and size (in acres), weighted runoff coefficient or curve number and times of concentration for each subarea.
■	☐	☐	*CRITICAL EROSION AREAS* which require special consideration or unique erosion and sediment control measures. Refer to the VESCH, Chapter 6 for criteria.
■	☐	☐	*DEVELOPMENT PLAN* for the site showing all improvements such as buildings, structures, parking areas, access roadways, above and below ground utilities, stormwater management and drainage facilities, trails or sidewalks, proposed vegetation and landscaping, amenities, etc.
■	☐	☐	*LOCATION OF PRACTICES* proposed for erosion and sediment control, tree protection and temporary stormwater management due to land disturbance activities at the site. Use standard abbreviations, labels and symbols consistent for plan views based on minimum standards and specifications in Chapter 3 of the VESCH.
■	☐	☐	*TEMPORARY STOCKPILE AREAS* or staging and equipment storage areas as required for onsite or offsite construction activities or indicate that none are anticipated for this project.
☐	☐	■	*OFFSITE LAND DISTURBING AREAS* including borrow sites, waste areas, utility extensions, etc. and required erosion and sediment controls. If none are anticipated for the project, then indicate on the plans by general or erosion and sediment control notes.
■	☐	☐	*DETAILS* or alternately, appropriate reference to current minimum standards and specifications of the VESCH for each measure proposed for the project. Non-modified, standard duplicated details (silt fence, diversion dikes, etc.) may be referenced to the current version of the VESCH. Specific dimensional or modified standards (basins, traps, outlet protections, check dams, etc.) require presentation on detail sheets. Schedules or tables may be used for multiple site measures such as sediment traps, basins, channels, slope drains, etc. Any modification to standard details should be clearly defined, explained and illustrated.

Yes No N/A

■ ☐ ☐ *MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project.

■ ☐ ☐ *TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project.

■ ☐ ☐ *CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor.

■ ☐ ☐ *PHASING PLAN* if required for larger project sites that are to be developed in stages or phases.

■ ☐ ☐ *STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes dated May 5, 1999.

☐ ■ ☐ *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications.

III. *NARRATIVE:*

Yes No N/A

■ ☐ ☐ *PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed.

■ ☐ ☐ *EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site.

■ ☐ ☐ *ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity.

☐ ■ ☐ *OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented.

■ ☐ ☐ *SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable.

■ ☐ ☐ *CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.)

Yes No N/A

■ ☐ ☐ *PROPOSED EROSION & SEDIMENT CONTROL MEASURES* inclusive to the specific erosion and sediment control plan as proposed for the land disturbing activity. Measures should be consistent with those proposed on the site drawings. Address general use, installation, limitations, sequencing and maintenance requirements for each control measure.

■ ☐ ☐ *STABILIZATION MEASURES* required for the site, either temporary or permanent, and during and following construction including temporary and permanent seeding and mulching, paving, stone, soil stabilization blankets and matting, sodding, landscaping or special stabilization techniques to be utilized at the site.

■ ☐ ☐ *STORMWATER MANAGEMENT CONSIDERATIONS* for the site, either of temporary or permanent nature, and strategies, sequences and measures required for control. May reference the stormwater management plan for the site, if prepared, for permanent stormwater management facilities and control of drainage once the site is stabilized.

IV. *CALCULATIONS:*

Yes No N/A

■ ☐ ☐ *CALCULATIONS AND COMPUTATIONS* associated with hydrology, hydraulics and design of proposed temporary and permanent erosion and sediment control measures including: sediment traps and basins, diversions, stormwater conveyance channels, culverts, slope drains, outlet protections, etc. Computations are not required on the construction plan and may be attached in a supplemental erosion and sediment control plan design report, if presented in a clear and organized format.

■ ☐ ☐ *TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET* submitted for each basin along with schematic or sketch cross-section showing applicable design and construction data, storage volumes (wet-dry), dimensions and elevations. Peak design runoff to be based on the 2- or 25-year design storm event based on maximum disturbed site conditions (existing, interim or proposed conditions) in accordance with Minimum Standard 3.14 of the VESCH.

JAMES CITY COUNTY, VIRGINIA
ENVIRONMENTAL DIVISION

STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST

I. *GENERAL:*

Yes	No	N/A	
■	☐	☐	*FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH).
☐	■	☐	*WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only.
☐	■	☐	*VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site.
☐	■	☐	*PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications.
☐	☐	■	*WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only).
☐	☐	■	*PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet.
☐	■	☐	*INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project.
☐	☐	■	*FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable.
■	☐	☐	*DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map.

Yes No N/A

■ ☐ ☐ *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins.

■ ☐ ☐ *STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations.

■ ☐ ☐ *TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided.

■ ☐ ☐ *MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities.

■ ☐ ☐ *STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information.

☐ ☐ ☐ *PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.)

- ■ ☐ ☐ North arrow and plan legend.
- ■ ☐ ☐ Property lines.
- ■ ☐ ☐ Adjacent property information.
- ■ ☐ ☐ Existing site features and existing impervious cover areas.
- ■ ☐ ☐ Impervious cover tabulations.
- ■ ☐ ☐ Existing drainage facilities (natural or manmade).
- ■ ☐ ☐ Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.).
- ■ ☐ ☐ Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography.
- ■ ☐ ☐ Existing and proposed easement locations.

Yes	No	N/A	
■	☐	☐	Proposed site improvements and proposed impervious cover areas.
■	☐	☐	Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information.
☐	☐	■	Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.).
■	☐	☐	Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.).
■	☐	☐	Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations.
☐	☐	■	Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties.
☐	☐	■	Test boring locations with reference surface elevations (if known).
■	☐	☐	Risers, barrels, underdrains, overflows and outlet protections.
☐	☐	■	Emergency spillway level section and outlet channel.
■	☐	☐	Existing and proposed site utilities and protection measures.
■	☐	☐	Erosion and sediment control measures (for site or BMP).
■	☐	☐	Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities.

II. *STORMWATER CONVEYANCE SYSTEMS:*

Yes	No	N/A	
■	☐	☐	*PLAN VIEWS*
			■ ☐ ☐ Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule.
			■ ☐ ☐ Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled.
			■ ☐ ☐ All structure numbers labeled.
			■ ☐ ☐ Adequate horizontal clearance from other site utilities or structures.
■	☐	☐	*PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas.
■	☐	☐	*DETAILS*
			■ ☐ ☐ Typical storm drain bedding details or reference note.
			■ ☐ ☐ Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.).
			■ ☐ ☐ Inlet shaping detail or applicable reference note.
			■ ☐ ☐ Step detail or applicable reference note (if depth 4 ft. or more).
			☐ ☐ ■ Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included.
			■ ☐ ☐ Outlet protections at all pipe outfalls.

Yes No N/A

■ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

- ■ ☐ ☐ Storm Sewer Design computations based on 10-year design event.
- ■ ☐ ☐ Hydraulic Grade Line computations based on 10-year design event.
- ■ ☐ ☐ Inlet computations based on current VDOT procedure for spread, ponding depth and grate size required.
- ☐ ☐ ■ Culvert Headwater computations. Design based on 10-year design storm event and check only for 100-year storm event.
- ■ ☐ ☐ Open Channel computations based on 2-year design event for velocity and 10-year design event for capacity.
- ■ ☐ ☐ Standard outlet protection or special energy dissipators.
- ☐ ☐ ■ Pipe thickness design computations, as required, for selected pipe type (live load, minimum cover, maximum height of cover, etc.).
- ■ ☐ ☐ Adequate channel computations for receiving channels (based on field measured channel section data).

III. *STORMWATER MANAGEMENT / BMP FACILITIES:*

Yes No N/A

■ ☐ ☐ *HYDROLOGY* - An SCS based methodology is required for the design of stormwater management/BMP facilities with watersheds exceeding 20 acres. Under 20 acres, other generally accepted methodologies such as the modified rational, critical storm are allowable. Refer to Chapter 5 of the VESCH or Chapter 5 of the VSMH.

- ■ ☐ ☐ Runoff Curve Number or Coefficient determinations: predeveloped and ultimate development land use scenarios.
- ■ ☐ ☐ Time of concentration: predeveloped and ultimate development indicating overland, shallow concentrated, and channel flow components (200 ft. maximum length for overland flow).
- ■ ☐ ☐ Hydrograph generation (tabular or graphical): pre- and postdevelopment conditions for the 1-, 2-, 10-, and 100-year design storm events.

■ ☐ ☐ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

- ☐ ■ ☐ Screening and layout consistent with Section 24-98(d) of the Chapter 24 Zoning ordinance (landscaping, screening, visibility, etc.).
- ■ ☐ ☐ Basic considerations for safety and unauthorized entry.
- ■ ☐ ☐ Proper length to width ratio (Typically 2H:1V).
- ☐ ☐ ■ Facilities with deep pools (4 feet or more in depth) provided with two benches. Fifteen (15) ft. safety bench outward from normal pool at maximum 6 percent slope and aquatic bench inward from normal shoreline below normal pool. Narrower widths may be considered on a case-by-case basis.
- ■ ☐ ☐ Pond buffer minimum 25 feet outward from maximum design WSEL. Additional setbacks may be required to permanent structures.
- ■ ☐ ☐ No trees, shrubs or woody plants within 15 feet of embankment toe or 25 feet from principal spillway structure.

Yes	No	N/A	
☐	☐	■	Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation.

Yes	No	N/A	
■	☐	☐	*HYDRAULIC COMPUTATIONS*
■	☐	☐	Elevation- or Stage- Storage curve and/or tabular data.
■	☐	☐	Weir / Orifice Control - Extended Detention.
■	☐	☐	Weir / Orifice Control - riser 1-year control for channel protection.
■	☐	☐	Weir / Orifice Control - riser 2-year control for quantity (if required).
■	☐	☐	Weir / Orifice Control - riser 10-year control for quantity (if required).
■	☐	☐	Inlet / Outlet (barrel) control - (All Storms).
■	☐	☐	Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions.
☐	☐	■	Emergency spillway capacity and depth of flow.
■	☐	☐	Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions.
■	☐	☐	Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria.
■	☐	☐	*POND or RESERVOIR ROUTING*
■	☐	☐	Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation.
☐	☐	■	Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass).
■	☐	☐	*MISCELLANEOUS COMPUTATIONS*
☐	☐	■	Water quality volume for permanent pool based on selected BMP treatment volume (WQv).
☐	☐	■	Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations.
■	☐	☐	Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria.
■	☐	☐	Pond drain computations (within 24 hours).
■	☐	☐	Anti-seep collar design (concrete preferred) or match material type.
☐	☐	■	Filter diaphragm design (or alternative method of controlling seepage).

Yes	No	N/A	
☐	■	☐	Riser / base structure flotation analyses. FS = 1.25 minimum.
☐	■	■	Downstream danger reach study and/or emergency action plan (if conditions warrant).
☐	☐	■	Upstream backwater analyses onto offsite adjacent property (if conditions warrant).
☐	☐	■	100 year floodplain impacts (if conditions warrant).

Yes	No	N/A	
■	☐	☐	*GEOTECHNICAL REQUIREMENTS*
☐	■	■	Geotechnical Report with recommendations specific to BMP facility type selected. Report prepared by a registered professional engineer. Requires submission, review and approval prior to issuance of Land Disturbance Permit.
☐	■	☐	Initial Feasibility Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).
☐	■	☐	Concept Design Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).
☐	■	☐	Minimum Boring locations: borrow area, pool area, principal control structure, top of facility near one abutment and emergency spillway if provided.
☐	■	☐	Boring logs with Unified Soil Classification (ASTM D2487), soils descriptions and depths to bedrock and the seasonal water table indicated.
■	☐	☐	Standard County Record Drawing/Construction Certification note provided on plan. *Note: It is understood that preparation of record drawings and construction certifications as required for project facilities may not necessarily be performed by the plan preparer. These components may be performed by others.*
■	☐	☐	*PRINCIPAL SPILLWAY PROFILE AND ASSOCIATED DETAILS*
■	☐	☐	*EXISTING GROUND AND PROPOSED GRADE*
■	☐	☐	Embankment or excavation side slopes labeled (3H:1V maximum).
■	☐	☐	Minimum top width labeled (per VESCH or VSMH requirements).
■	☐	☐	Removal of unsuitable material under proposed facility (per Geotechnical Report requirements).

Yes No N/A

■ ☐ ☐ *CORE TRENCH*

- ■ ☐ ☐ Material (per plan or Geotechnical Report).
- ■ ☐ ☐ Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
- ■ ☐ ☐ Side slopes (1:1 maximum steepness)
- ■ ☐ ☐ Depth (4' minimum or greater as dictated by Geotechnical Report).

■ ☐ ☐ *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*

- ■ ☐ ☐ Durable, watertight, resistant material (concrete preferred).
- ■ ☐ ☐ Riser diameter is at least 1.25 times larger than barrel diameter.
- ■ ☐ ☐ All pertinent dimensions and elevations shown.
- ■ ☐ ☐ Control orifice or weir dimensions and elevations shown.
- ■ ☐ ☐ Trash rack - removable - for each release.
- ■ ☐ ☐ Anti-vortex device, baffle or plate.
- ■ ☐ ☐ Riser base structure with dimensions and embedment specifications (concrete preferred).
- ■ ☐ ☐ Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
- ■ ☐ ☐ Low flow orifice with trash rack device.

■ ☐ ☐ *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*

- ■ ☐ ☐ Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
- ■ ☐ ☐ Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
- ■ ☐ ☐ Pipe inverts, length, size, class and slope shown.
- ■ ☐ ☐ Flared end section or endwall provided on barrel outlet.

■ ☐ ☐ *SEEPAGE CONTROL*

- ☐ ■ ☐ Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water).

- ■ ☐ ☐ *ANTI-SEEP COLLARS*
  - ■ ☐ ☐ Anti-seep collar, concrete preferred.
  - ■ ☐ ☐ Size - 15 percent increase in length of saturation using outside pipe diameter.
  - ■ ☐ ☐ Spacing and location on barrel (located at least 2 feet from a pipe joint).

☐ ☐ ■ *FILTER DIAPHRAGMS*

☐ ☐ ☐ Design based on latest NRCS design methods and certified by a professional engineer.

Yes No N/A

■ ☐ ☐ *ELEVATION AND DIMENSIONAL DESIGN DATA*

■ ☐ ☐ Top of facility - construction height and settled height (10 percent settlement).

■ ☐ ☐ Crest of principal control structure spillway at least one (1) foot below crest of emergency spillway, if provided.

☐ ☐ ■ Minimum freeboard of one (1) foot above the 100-year design high water elevation for facilities <u>with</u> an emergency spillway.

■ ☐ ☐ Minimum freeboard of two (2) feet above the 100-year design high water elevation for facilities <u>without</u> an emergency spillway or in accordance with the SCS National Engineering Handbook (prior approval required).

■ ☐ ☐ Basin Sediment Clean-Out elevation (permanent mode). Typically 10 to 25 percent of water quality volume.

■ ☐ ☐ *CROSS SECTION THROUGH FACILITY*

■ ☐ ☐ Existing Ground.

■ ☐ ☐ Proposed grade.

■ ☐ ☐ Top of facility - constructed and settled.

☐ ☐ ■ Location of emergency spillway with side slopes labeled (emergency spillway in cut).

■ ☐ ☐ Bottom of core trench (4' minimum).

☐ ☐ ■ Location of each soil boring.

■ ☐ ☐ Barrel location.

☐ ☐ ■ Existing and proposed utility location/protection.

☐ ☐ ■ *EMERGENCY SPILLWAY PROFILE*

☐ ☐ ☐ Existing ground.

☐ ☐ ☐ Inlet, level (control) and outlet sections per SCS.

☐ ☐ ☐ Spillway and crest elevations.

■ ☐ ☐ *PRETREATMENT DEVICES* of adequate depth and properly designed using required pretreatment volumes for the selected County BMP facility type. Including, but not limited to: sediment forebays, sediment basins, sumps, grass channels, gravel diaphragms, plunge pools, chamber separators, manufactured systems or other acceptable methods.

Yes	No	N/A	
■	☐	☐	*CONSTRUCTION SPECIFICATIONS and NOTES*
■	☐	☐	Anticipated sequence of construction for BMP (consistent with erosion and sediment control plan).
■	☐	☐	Provisions to control base stream or storm flow conditions encountered during construction.
■	☐	☐	Site and subgrade preparation requirements.
■	☐	☐	Embankment, fill and backfill material soil and placement (lift) thickness requirements.
■	☐	☐	Compaction and soil moisture content requirements.
■	☐	☐	Geosynthetics for drainage, filtration, moisture barrier, separation, and reinforcement purposes.
☐	☐	■	Clay or synthetic (PVC or HDPE) pond liners.
■	☐	☐	Storm drain, underdrain and pipe conduit requirements.
☐	☐	■	Minimum depth of pipe cover for temporary (construction) and final cover conditions.
☐	☐	■	Permanent shutoff valve and pond drain.
■	☐	☐	Concrete requirements for structural components.
■	☐	☐	Riprap and slope protection.
■	☐	☐	Access or maintenance road surface, base, subbase.
■	☐	☐	Temporary and permanent stabilization measures.
■	☐	☐	Temporary or permanent safety fencing.
☐	☐	■	BMP Landscaping (deep, shallow, fringe, perimeter,etc.)
☐	☐	■	Dust and traffic control (if warranted).
■	☐	☐	Construction monitoring and certification by professional.
☐	☐	☐	Other: _____
☐	☐	☐	Other: _____.
■	☐	☐	*MAINTENANCE PROVISIONS*
■	☐	☐	Entity responsible for maintenance identified..
■	☐	☐	Maintenance Plan which outlines the long-term schedule for inspection/maintenance of the facility and forebays
■	☐	☐	Maintenance access from public right-of-way or publicly traveled road.
■	☐	☐	Maintenance easement provided encompassing high water pool and buffer, principal and emergency spillways, outlet structures, forebays, embankment area and possible sediment-removal stockpile areas.
☐	☐	■	Minimum 6 foot wide public safety shelf (landing) or alternative fencing.

IV. *OUTLET PROTECTIONS:*

Yes	No	N/A	
■	☐	☐	Sized for maximum design release (generally 10-year storm).
■	☐	☐	Flared end section or endwall.
■	☐	☐	Dimensions.
■	☐	☐	Rock or riprap size, quantity and placement thickness.
■	☐	☐	Slope at 0 percent (Level Grade).
☐	☐	■	Geotextiles (nonwoven).
☐	☐	■	Special energy dissipators are required for design discharge velocities that exceed eighteen (18) feet per second; or if use of standard outlet protection would result in velocities exceeding permissible channel velocities; or if space restricts or limits their use.

V. *ADDITIONAL COMMENTS OR INFORMATION SPECIFIC TO THE PLAN:*

Plan Preparer: A. RAMSAY

Date: 11/27/04.

SWMProg/BMP/Checklist/ChkList

SEDIMENT BASIN CALCULATIONS

Pond 3: sed trap 3

[43] Hint: Has no inflow (Outflow=Zero)

Routing by Stor-Ind method
Peak Elev= 0.00' @ 0.00 hrs Surf.Area= 0 sf Storage= 0 cf
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

#	Invert	Avail.Storage	Storage Description
1	81.00'	3,170 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
81.00	210	0	0
82.00	342	276	276
83.00	507	425	701
84.00	701	604	1,305
85.00	925	813	2,118
86.00	1,180	1,053	3,170

Stage-Area-Storage for Pond 3: sed trap 3

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
81.00	210	0	81.52	279	144
81.01	211	3	81.53	280	146
81.02	213	6	81.54	281	149
81.03	214	8	81.55	283	152
81.04	215	11	81.56	284	155
81.05	217	14	81.57	285	157
81.06	218	17	81.58	287	160
81.07	219	19	81.59	288	163
81.08	221	22	81.60	289	166
81.09	222	25	81.61	291	168
81.10	223	28	81.62	292	171
81.11	225	30	81.63	293	174
81.12	226	33	81.64	294	177
81.13	227	36	81.65	296	179
81.14	228	39	81.66	297	182
81.15	230	41	81.67	298	185
81.16	231	44	81.68	300	188
81.17	232	47	81.69	301	190
81.18	234	50	81.70	302	193
81.19	235	52	81.71	304	196
81.20	236	55	81.72	305	199
81.21	238	58	81.73	306	201
81.22	239	61	81.74	308	204
81.23	240	63	81.75	309	207
81.24	242	66	81.76	310	210
81.25	243	69	81.77	312	213
81.26	244	72	81.78	313	215
81.27	246	75	81.79	314	218
81.28	247	77	81.80	316	221
81.29	248	80	81.81	317	224
81.30	250	83	81.82	318	226
81.31	251	86	81.83	320	229
81.32	252	88	81.84	321	232
81.33	254	91	81.85	322	235
81.34	255	94	81.86	324	237
81.35	256	97	81.87	325	240
81.36	258	99	81.88	326	243
81.37	259	102	81.89	327	246
81.38	260	105	81.90	329	248
81.39	261	108	81.91	330	251
81.40	263	110	81.92	331	254
81.41	264	113	81.93	333	257
81.42	265	116	81.94	334	259
81.43	267	119	81.95	335	262
81.44	268	121	81.96	337	265
81.45	269	124	81.97	338	268
81.46	271	127	81.98	339	270
81.47	272	130	81.99	341	273
81.48	273	132	82.00	342	276
81.49	275	135	82.01	344	280
81.50	276	138	82.02	345	284
81.51	277	141	82.03	347	289

Stage-Area-Storage for Pond 3: sed trap 3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
82.04	349	293	82.56	434	514
82.05	350	297	82.57	436	518
82.06	352	301	82.58	438	522
82.07	354	306	82.59	439	526
82.08	355	310	82.60	441	531
82.09	357	314	82.61	443	535
82.10	358	318	82.62	444	539
82.11	360	323	82.63	446	543
82.12	362	327	82.64	448	548
82.13	363	331	82.65	449	552
82.14	365	335	82.66	451	556
82.15	367	340	82.67	453	560
82.16	368	344	82.68	454	565
82.17	370	348	82.69	456	569
82.18	372	352	82.70	458	573
82.19	373	357	82.71	459	577
82.20	375	361	82.72	461	582
82.21	377	365	82.73	462	586
82.22	378	369	82.74	464	590
82.23	380	374	82.75	466	594
82.24	382	378	82.76	467	599
82.25	383	382	82.77	469	603
82.26	385	386	82.78	471	607
82.27	387	391	82.79	472	611
82.28	388	395	82.80	474	616
82.29	390	399	82.81	476	620
82.30	391	403	82.82	477	624
82.31	393	408	82.83	479	628
82.32	395	412	82.84	481	633
82.33	396	416	82.85	482	637
82.34	398	420	82.86	484	641
82.35	400	425	82.87	486	645
82.36	401	429	82.88	487	650
82.37	403	433	82.89	489	654
82.38	405	437	82.90	491	658
82.39	406	442	82.91	492	662
82.40	408	446	82.92	494	667
82.41	410	450	82.93	495	671
82.42	411	454	82.94	497	675
82.43	413	459	82.95	499	679
82.44	415	463	82.96	500	684
82.45	416	467	82.97	502	688
82.46	418	471	82.98	504	692
82.47	420	476	82.99	505	696
82.48	421	480	83.00	507	701
82.49	423	484	83.01	509	707
82.50	425	488	83.02	511	713
82.51	426	492	83.03	513	719
82.52	428	497	83.04	515	725
82.53	429	501	83.05	517	731
82.54	431	505	83.06	519	737
82.55	433	509	83.07	521	743

Stage-Area-Storage for Pond 3: sed trap 3 (continued)

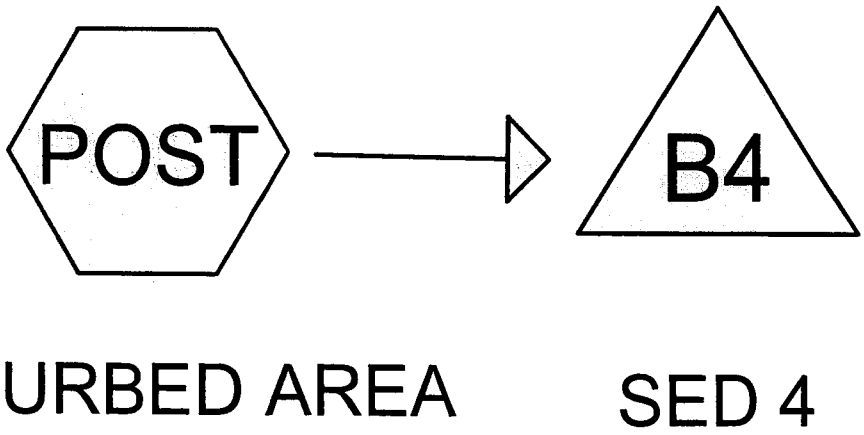
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
83.08	523	749	83.60	623	1,063
83.09	524	755	83.61	625	1,069
83.10	526	761	83.62	627	1,075
83.11	528	767	83.63	629	1,081
83.12	530	773	83.64	631	1,087
83.13	532	779	83.65	633	1,093
83.14	534	785	83.66	635	1,099
83.15	536	791	83.67	637	1,105
83.16	538	797	83.68	639	1,111
83.17	540	803	83.69	641	1,117
83.18	542	809	83.70	643	1,123
83.19	544	815	83.71	645	1,129
83.20	546	821	83.72	647	1,135
83.21	548	827	83.73	649	1,141
83.22	550	833	83.74	651	1,147
83.23	552	839	83.75	653	1,154
83.24	554	845	83.76	654	1,160
83.25	556	852	83.77	656	1,166
83.26	557	858	83.78	658	1,172
83.27	559	864	83.79	660	1,178
83.28	561	870	83.80	662	1,184
83.29	563	876	83.81	664	1,190
83.30	565	882	83.82	666	1,196
83.31	567	888	83.83	668	1,202
83.32	569	894	83.84	670	1,208
83.33	571	900	83.85	672	1,214
83.34	573	906	83.86	674	1,220
83.35	575	912	83.87	676	1,226
83.36	577	918	83.88	678	1,232
83.37	579	924	83.89	680	1,238
83.38	581	930	83.90	682	1,244
83.39	583	936	83.91	684	1,250
83.40	585	942	83.92	685	1,256
83.41	587	948	83.93	687	1,262
83.42	588	954	83.94	689	1,268
83.43	590	960	83.95	691	1,274
83.44	592	966	83.96	693	1,280
83.45	594	972	83.97	695	1,286
83.46	596	978	83.98	697	1,292
83.47	598	984	83.99	699	1,298
83.48	600	990	84.00	701	1,305
83.49	602	996	84.01	703	1,313
83.50	604	1,003	84.02	705	1,321
83.51	606	1,009	84.03	708	1,329
83.52	608	1,015	84.04	710	1,337
83.53	610	1,021	84.05	712	1,345
83.54	612	1,027	84.06	714	1,353
83.55	614	1,033	84.07	717	1,361
83.56	616	1,039	84.08	719	1,370
83.57	618	1,045	84.09	721	1,378
83.58	620	1,051	84.10	723	1,386
83.59	621	1,057	84.11	726	1,394

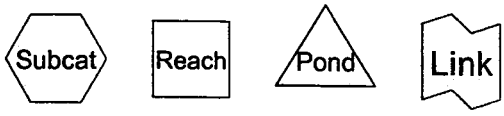
Stage-Area-Storage for Pond 3: sed trap 3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
84.12	728	1,402	84.64	844	1,825
84.13	730	1,410	84.65	847	1,833
84.14	732	1,418	84.66	849	1,841
84.15	735	1,426	84.67	851	1,849
84.16	737	1,435	84.68	853	1,857
84.17	739	1,443	84.69	856	1,865
84.18	741	1,451	84.70	858	1,874
84.19	744	1,459	84.71	860	1,882
84.20	746	1,467	84.72	862	1,890
84.21	748	1,475	84.73	865	1,898
84.22	750	1,483	84.74	867	1,906
84.23	753	1,491	84.75	869	1,914
84.24	755	1,500	84.76	871	1,922
84.25	757	1,508	84.77	873	1,931
84.26	759	1,516	84.78	876	1,939
84.27	761	1,524	84.79	878	1,947
84.28	764	1,532	84.80	880	1,955
84.29	766	1,540	84.81	882	1,963
84.30	768	1,548	84.82	885	1,971
84.31	770	1,557	84.83	887	1,979
84.32	773	1,565	84.84	889	1,987
84.33	775	1,573	84.85	891	1,996
84.34	777	1,581	84.86	894	2,004
84.35	779	1,589	84.87	896	2,012
84.36	782	1,597	84.88	898	2,020
84.37	784	1,605	84.89	900	2,028
84.38	786	1,613	84.90	903	2,036
84.39	788	1,622	84.91	905	2,044
84.40	791	1,630	84.92	907	2,052
84.41	793	1,638	84.93	909	2,061
84.42	795	1,646	84.94	912	2,069
84.43	797	1,654	84.95	914	2,077
84.44	800	1,662	84.96	916	2,085
84.45	802	1,670	84.97	918	2,093
84.46	804	1,678	84.98	921	2,101
84.47	806	1,687	84.99	923	2,109
84.48	809	1,695	85.00	925	2,118
84.49	811	1,703	85.01	928	2,128
84.50	813	1,711	85.02	930	2,139
84.51	815	1,719	85.03	933	2,149
84.52	817	1,727	85.04	935	2,160
84.53	820	1,735	85.05	938	2,170
84.54	822	1,744	85.06	940	2,181
84.55	824	1,752	85.07	943	2,191
84.56	826	1,760	85.08	945	2,202
84.57	829	1,768	85.09	948	2,212
84.58	831	1,776	85.10	950	2,223
84.59	833	1,784	85.11	953	2,233
84.60	835	1,792	85.12	956	2,244
84.61	838	1,800	85.13	958	2,254
84.62	840	1,809	85.14	961	2,265
84.63	842	1,817	85.15	963	2,275

Stage-Area-Storage for Pond 3: sed trap 3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
85.16	966	2,286
85.17	968	2,296
85.18	971	2,307
85.19	973	2,317
85.20	976	2,328
85.21	979	2,339
85.22	981	2,349
85.23	984	2,360
85.24	986	2,370
85.25	989	2,381
85.26	991	2,391
85.27	994	2,402
85.28	996	2,412
85.29	999	2,423
85.30	1,001	2,433
85.31	1,004	2,444
85.32	1,007	2,454
85.33	1,009	2,465
85.34	1,012	2,475
85.35	1,014	2,486
85.36	1,017	2,496
85.37	1,019	2,507
85.38	1,022	2,517
85.39	1,024	2,528
85.40	1,027	2,539
85.41	1,030	2,549
85.42	1,032	2,560
85.43	1,035	2,570
85.44	1,037	2,581
85.45	1,040	2,591
85.46	1,042	2,602
85.47	1,045	2,612
85.48	1,047	2,623
85.49	1,050	2,633
85.50	1,053	2,644
85.51	1,055	2,654
85.52	1,058	2,665
85.53	1,060	2,675
85.54	1,063	2,686
85.55	1,065	2,696
85.56	1,068	2,707
85.57	1,070	2,717
85.58	1,073	2,728
85.59	1,075	2,738
85.60	1,078	2,749
85.61	1,081	2,760
85.62	1,083	2,770
85.63	1,086	2,781
85.64	1,088	2,791
85.65	1,091	2,802
85.66	1,093	2,812
85.67	1,096	2,823
85.68	1,098	2,833
85.69	1,101	2,844
85.70	1,104	2,854
85.71	1,106	2,865
85.72	1,109	2,875
85.73	1,111	2,886
85.74	1,114	2,896
85.75	1,116	2,907
85.76	1,119	2,917
85.77	1,121	2,928
85.78	1,124	2,938
85.79	1,126	2,949
85.80	1,129	2,959
85.81	1,132	2,970
85.82	1,134	2,981
85.83	1,137	2,991
85.84	1,139	3,002
85.85	1,142	3,012
85.86	1,144	3,023
85.87	1,147	3,033
85.88	1,149	3,044
85.89	1,152	3,054
85.90	1,155	3,065
85.91	1,157	3,075
85.92	1,160	3,086
85.93	1,162	3,096
85.94	1,165	3,107
85.95	1,167	3,117
85.96	1,170	3,128
85.97	1,172	3,138
85.98	1,175	3,149
85.99	1,177	3,159
86.00	**1,180**	**3,170**





Drainage Diagram for SED 4
Prepared by Landmark Design Group 05/09/2005
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TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONEHOUSE GLEN SECTION II

Basin # 5 Location _____

Total area draining to basin: 4.9 acres.

Basin Volume Design

Wet Storage:

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

2. Available basin volume = 329 cu. yds. at elevation 70.80. (From storage - elevation curve)

3. Excavate N/A cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 4.9 acres = 161.7 cu. yds.

5. Elevation corresponding to cleanout level = 69.30.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 1.5 ft. (Min. = 1.0 ft.)

Dry Storage:

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

8. Total available basin volume at crest of riser* = 690 cu. yds. at elevation 73.25. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 3 in.

10. Diameter of flexible tubing = 5 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 73.25

Top of Dam = 77

Design High Water = 73.90 (25YR)

Upstream Toe of Dam = 67.00

Basin Shape

12. Length of Flow / Effective Width — L / We = 60/20

If > 2, baffles are not required ✓

If < 2, baffles are required _____

Runoff

13. Q_2 = 8.8 cfs (From Chapter 5)

14. Q_{25} = 22.1 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 22.1 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using Q_2)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 0.65 ft. (Using Q_{25})

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter (D_r) = 48 in. Actual head (h) = 0.65 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 64 ft.

Head (H) on barrel through embankment = 8.66 ft.

(From Plate 3.14-7).

19. Barrel diameter = 24 in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 72 inches.

Height = 21 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = _____cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 6.25 ft.

Slope of upstream face of embankment (Z) = 3 :1.

Slope of principal spillway barrel (S_b) = 1.26 %

Length of barrel in saturated zone (L_s) = 46.69 ft.

24. Number of collars required = 3 dimensions = 3'-6" x 3'-6"

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = 77^{00}

Design High Water = $73.^{90}$

Emergency Spillway Crest = N/A

Principal Spillway Crest = 73^{25}

Dewatering Orifice Invert = $70.^{80}$

Cleanout Elevation = 69^{30}

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = 67^{00}

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

BMP #5

LENGTH OF PIPE IN SATURATED ZONE

$$L_S = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 6.25'$

$Z = 3:1$

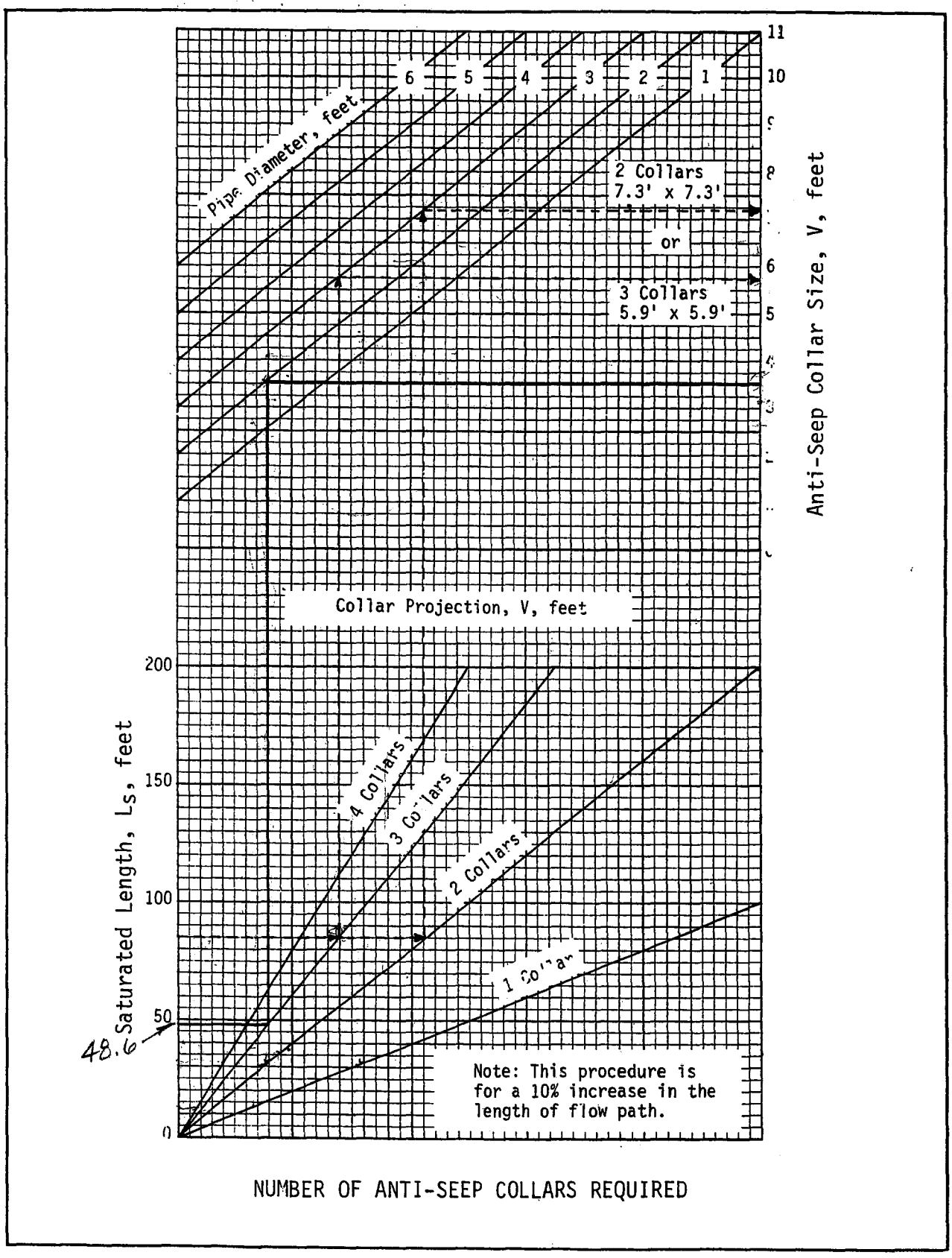
$S = 1.26\%$ $.0126\%$

$$L_S = 6.25(3+4)\left(1+\frac{0.0126}{0.25-0.0126}\right)$$

$L_S = 6.25 \times 7 \times 1.053$

$L_S = 46.07$

USE 3 ANTI-SEEP COLLARS 3'-6" X 3'-6"



Source: USDA-SCS

Plate 3.14-12

Subcatchment POST: DISTURBED AREA

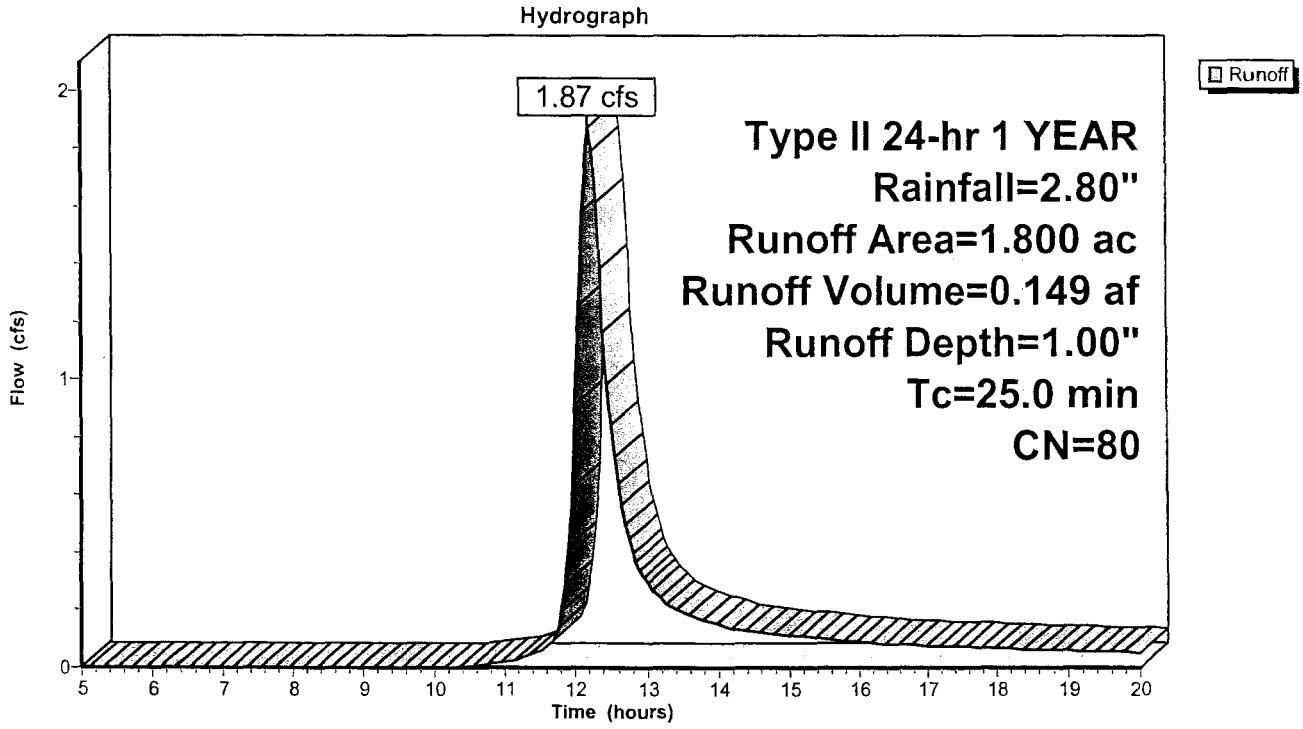
Runoff = 1.87 cfs @ 12.20 hrs, Volume= 0.149 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
1.800	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment POST: DISTURBED AREA



Pond B4: SED 4

Inflow Area = 1.800 ac, Inflow Depth = 1.00" for 1 YEAR event
Inflow = 1.87 cfs @ 12.20 hrs, Volume= 0.149 af
Outflow = 0.31 cfs @ 12.96 hrs, Volume= 0.139 af, Atten= 84%, Lag= 46.1 min
Primary = 0.31 cfs @ 12.96 hrs, Volume= 0.139 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 49.50' Surf.Area= 1,197 sf Storage= 3,285 cf
Peak Elev= 51.32' @ 12.96 hrs Surf.Area= 1,847 sf Storage= 6,280 cf (2,995 cf above start)
Plug-Flow detention time= 307.8 min calculated for 0.064 af (43% of inflow)
Center-of-Mass det. time= 102.3 min (916.7 - 814.4)

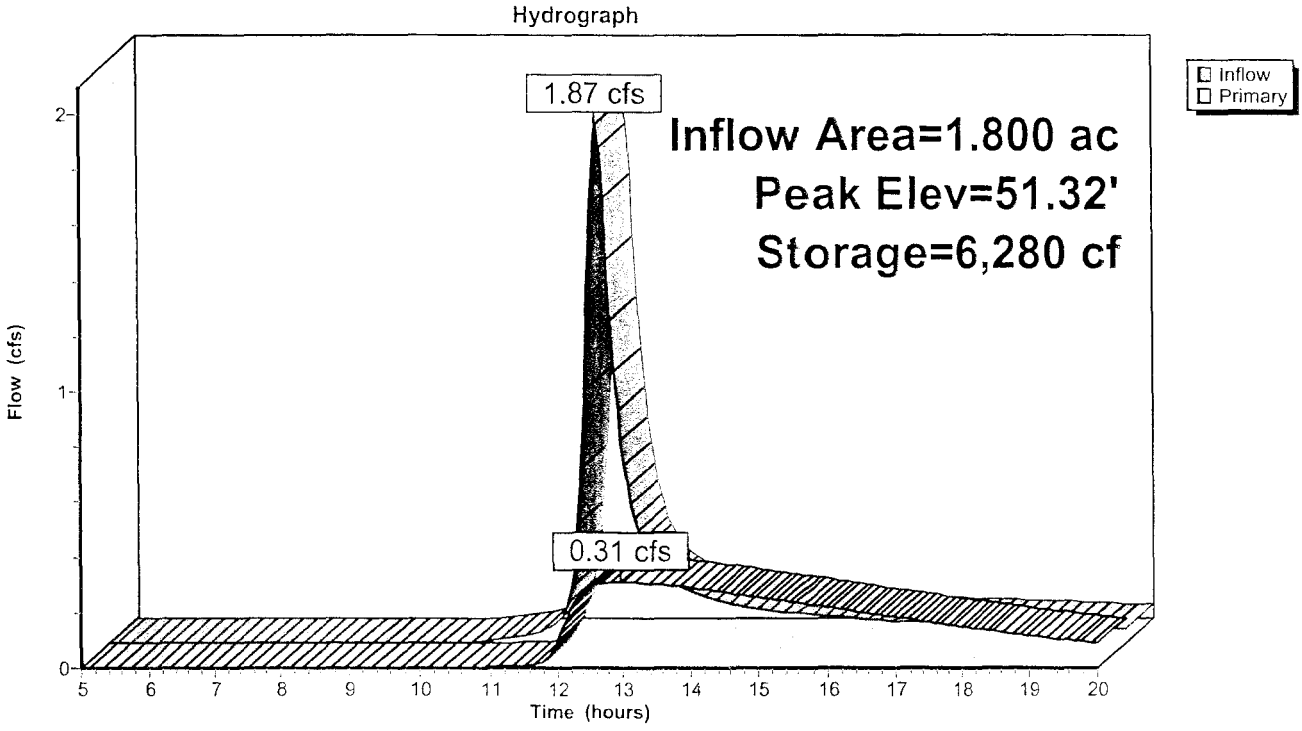
#	Invert	Avail.Storage	Storage Description
1	47.50'	23,684 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.50	485	0	0
54.00	2,800	10,676	10,676
57.50	4,633	13,008	23,684

#	Routing	Invert	Outlet Devices
1	Primary	45.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900
2	Device 1	49.50'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	54.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.31 cfs @ 12.96 hrs HW=51.32' (Free Discharge)
└**1=Culvert** (Passes 0.31 cfs of 34.90 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.31 cfs @ 6.3 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond B4: SED 4


Hydrograph
1.87 cfs
0.31 cfs
Inflow Area=1.800 ac
Peak Elev=51.32'
Storage=6,280 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Stage-Discharge for Pond B4: SED 4

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
47.50	0.00	52.80	0.42
47.60	0.00	52.90	0.43
47.70	0.00	53.00	0.43
47.80	0.00	53.10	0.44
47.90	0.00	53.20	0.45
48.00	0.00	53.30	0.45
48.10	0.00	53.40	0.46
48.20	0.00	53.50	0.47
48.30	0.00	53.60	0.47
48.40	0.00	53.70	0.48
48.50	0.00	53.80	0.48
48.60	0.00	53.90	0.49
48.70	0.00	54.00	0.49
48.80	0.00	54.10	1.80
48.90	0.00	54.20	4.18
49.00	0.00	54.30	7.26
49.10	0.00	54.40	10.91
49.20	0.00	54.50	15.05
49.30	0.00	54.60	19.63
49.40	0.00	54.70	24.60
49.50	0.00	54.80	29.94
49.60	0.02	54.90	35.63
49.70	0.06	55.00	41.64
49.80	0.10	55.10	45.63
49.90	0.12	55.20	45.88
50.00	0.14	55.30	46.13
50.10	0.16	55.40	46.38
50.20	0.18	55.50	46.62
50.30	0.19	55.60	46.87
50.40	0.21	55.70	47.11
50.50	0.22	55.80	47.35
50.60	0.23	55.90	47.60
50.70	0.25	56.00	47.83
50.80	0.26	56.10	48.07
50.90	0.27	56.20	48.31
51.00	0.28	56.30	48.55
51.10	0.29	56.40	48.78
51.20	0.30	56.50	49.02
51.30	0.31	56.60	49.25
51.40	0.31	56.70	49.48
51.50	0.32	56.80	49.71
51.60	0.33	56.90	49.94
51.70	0.34	57.00	50.17
51.80	0.35	57.10	50.40
51.90	0.36	57.20	50.62
52.00	0.36	57.30	50.85
52.10	0.37	57.40	51.07
52.20	0.38	57.50	**51.30**
52.30	0.39		
52.40	0.39		
52.50	0.40		
52.60	0.41		
52.70	0.41		

Subcatchment POST: DISTURBED AREA

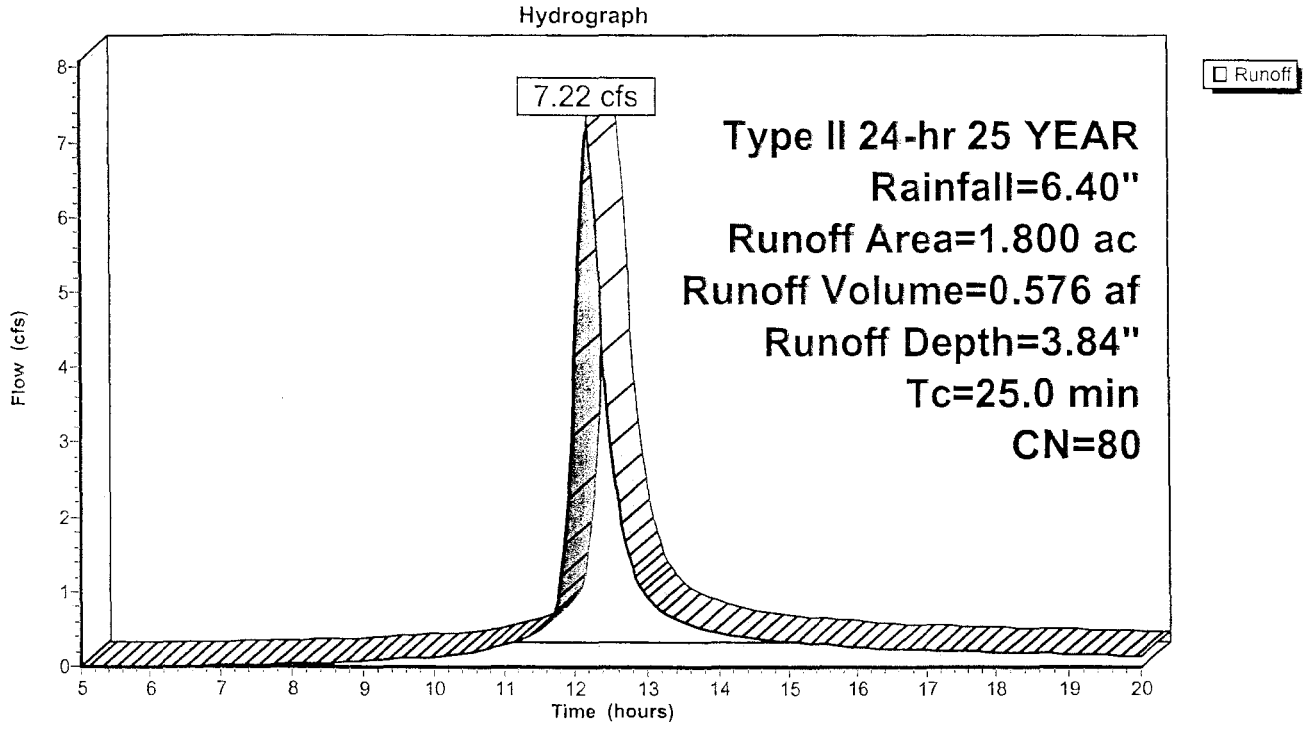
Runoff = 7.22 cfs @ 12.18 hrs, Volume= 0.576 af, Depth= 3.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 YEAR Rainfall=6.40"

Area (ac)	CN	Description
1.800	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment POST: DISTURBED AREA



Pond B4: SED 4

Inflow Area =	1.800 ac,	Inflow Depth =	3.84"	for	25 YEAR event
Inflow =	7.22 cfs @	12.18 hrs,	Volume=	0.576 af	
Outflow =	6.14 cfs @	12.31 hrs,	Volume=	0.495 af,	Atten= 15%, Lag= 7.9 min
Primary =	6.14 cfs @	12.31 hrs,	Volume=	0.495 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 49.50' Surf.Area= 1,197 sf Storage= 3,285 cf
Peak Elev= 54.26' @ 12.31 hrs Surf.Area= 2,938 sf Storage= 11,656 cf (8,371 cf above start)
Plug-Flow detention time= 164.7 min calculated for 0.419 af (73% of inflow)
Center-of-Mass det. time= 74.3 min (860.2 - 785.8)

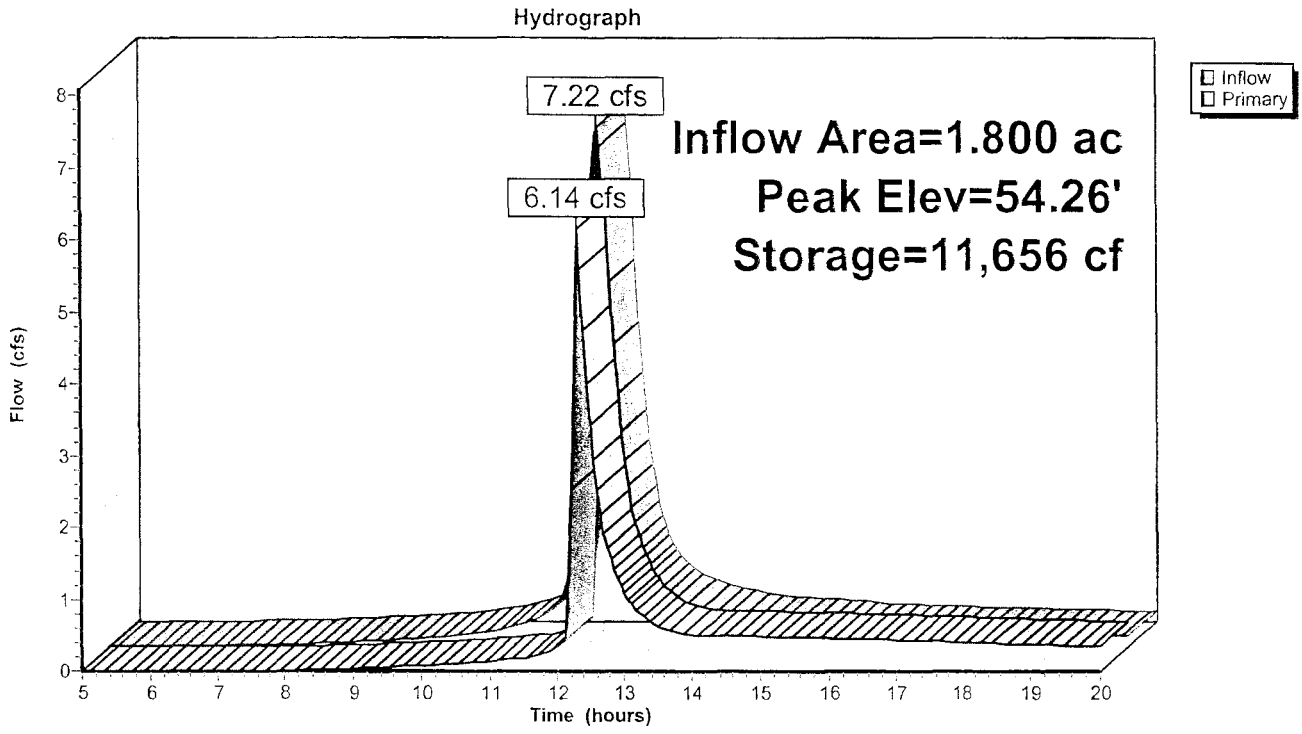
#	Invert	Avail.Storage	Storage Description
1	47.50'	23,684 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.50	485	0	0
54.00	2,800	10,676	10,676
57.50	4,633	13,008	23,684

#	Routing	Invert	Outlet Devices
1	Primary	45.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900
2	Device 1	49.50'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	54.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

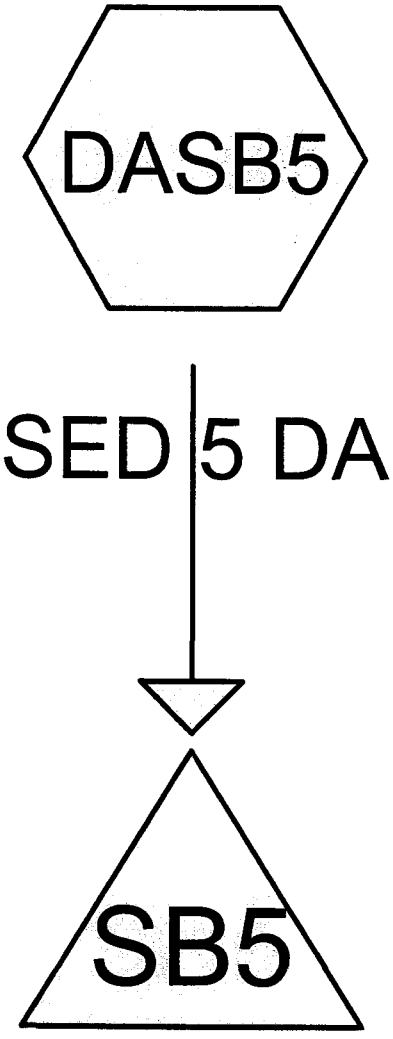
Primary OutFlow Max=5.88 cfs @ 12.31 hrs HW=54.26' (Free Discharge)
└**1=Culvert** (Passes 5.88 cfs of 43.47 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.51 cfs @ 10.4 fps)
  └**3=Orifice/Grate** (Weir Controls 5.37 cfs @ 1.7 fps)

Pond B4: SED 4

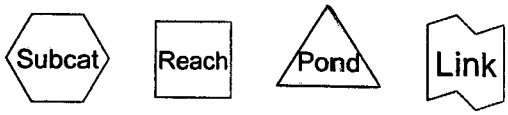

Hydrograph
7.22 cfs
6.14 cfs
Inflow Area=1.800 ac
Peak Elev=54.26'
Storage=11,656 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Stage-Discharge for Pond B4: SED 4

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
47.50	0.00	52.80	0.42
47.60	0.00	52.90	0.43
47.70	0.00	53.00	0.43
47.80	0.00	53.10	0.44
47.90	0.00	53.20	0.45
48.00	0.00	53.30	0.45
48.10	0.00	53.40	0.46
48.20	0.00	53.50	0.47
48.30	0.00	53.60	0.47
48.40	0.00	53.70	0.48
48.50	0.00	53.80	0.48
48.60	0.00	53.90	0.49
48.70	0.00	54.00	0.49
48.80	0.00	54.10	1.80
48.90	0.00	54.20	4.18
49.00	0.00	54.30	7.26
49.10	0.00	54.40	10.91
49.20	0.00	54.50	15.05
49.30	0.00	54.60	19.63
49.40	0.00	54.70	24.60
49.50	0.00	54.80	29.94
49.60	0.02	54.90	35.63
49.70	0.06	55.00	41.64
49.80	0.10	55.10	45.63
49.90	0.12	55.20	45.88
50.00	0.14	55.30	46.13
50.10	0.16	55.40	46.38
50.20	0.18	55.50	46.62
50.30	0.19	55.60	46.87
50.40	0.21	55.70	47.11
50.50	0.22	55.80	47.35
50.60	0.23	55.90	47.60
50.70	0.25	56.00	47.83
50.80	0.26	56.10	48.07
50.90	0.27	56.20	48.31
51.00	0.28	56.30	48.55
51.10	0.29	56.40	48.78
51.20	0.30	56.50	49.02
51.30	0.31	56.60	49.25
51.40	0.31	56.70	49.48
51.50	0.32	56.80	49.71
51.60	0.33	56.90	49.94
51.70	0.34	57.00	50.17
51.80	0.35	57.10	50.40
51.90	0.36	57.20	50.62
52.00	0.36	57.30	50.85
52.10	0.37	57.40	51.07
52.20	0.38	57.50	**51.30**
52.30	0.39		
52.40	0.39		
52.50	0.40		
52.60	0.41		
52.70	0.41		



SED BASIN 5



Drainage Diagram for bmp5
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONEHOUSE GLEN SECTION II

Basin # 5 Location _____

Total area draining to basin: 4.9 acres.

Basin Volume Design

Wet Storage:

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

2. Available basin volume = 329 cu. yds. at elevation 70.80. (From storage - elevation curve)

3. Excavate N/A cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 4.9 acres = 161.7 cu. yds.

5. Elevation corresponding to cleanout level = 69.30.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 1.5 ft. (Min. = 1.0 ft.)

Dry Storage:

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

8. Total available basin volume at crest of riser* = 690 cu. yds. at elevation 73.25. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 3 in.

10. Diameter of flexible tubing = 5 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 73.25

Top of Dam = 77

Design High Water = 78.70 (25YR)

Upstream Toe of Dam = 67.00

Basin Shape

12. Length of Flow / Effective Width — L / We = 60/20

If > 2, baffles are not required ✓

If < 2, baffles are required _____

Runoff

13. Q_2 = 8.8 cfs (From Chapter 5)

14. Q_{25} = 22.1 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 22.1 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using Q_2)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 0.65 ft. (Using Q_{25})

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter (D_r) = 48 in. Actual head (h) = 0.65 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 64 ft.

Head (H) on barrel through embankment = 8.66 ft.

(From Plate 3.14-7).

19. Barrel diameter = 24 in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 72 inches.

Height = 21 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = _____cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 6.25 ft.

Slope of upstream face of embankment (Z) = 3 :1.

Slope of principal spillway barrel (S_b) = 1.26 %

Length of barrel in saturated zone (L_s) = 46.69 ft.

24. Number of collars required = 3 dimensions = 3'-6" x 3'-6"

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = 77^{00}

Design High Water = $73.^{90}$

Emergency Spillway Crest = N/A

Principal Spillway Crest = 73^{25}

Dewatering Orifice Invert = $70.^{80}$

Cleanout Elevation = 69^{80}

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = 67^{00}

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

BMP #5

LENGTH OF PIPE IN SATURATED ZONE

$$L_s = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 6.25'$

$Z = 3:1$

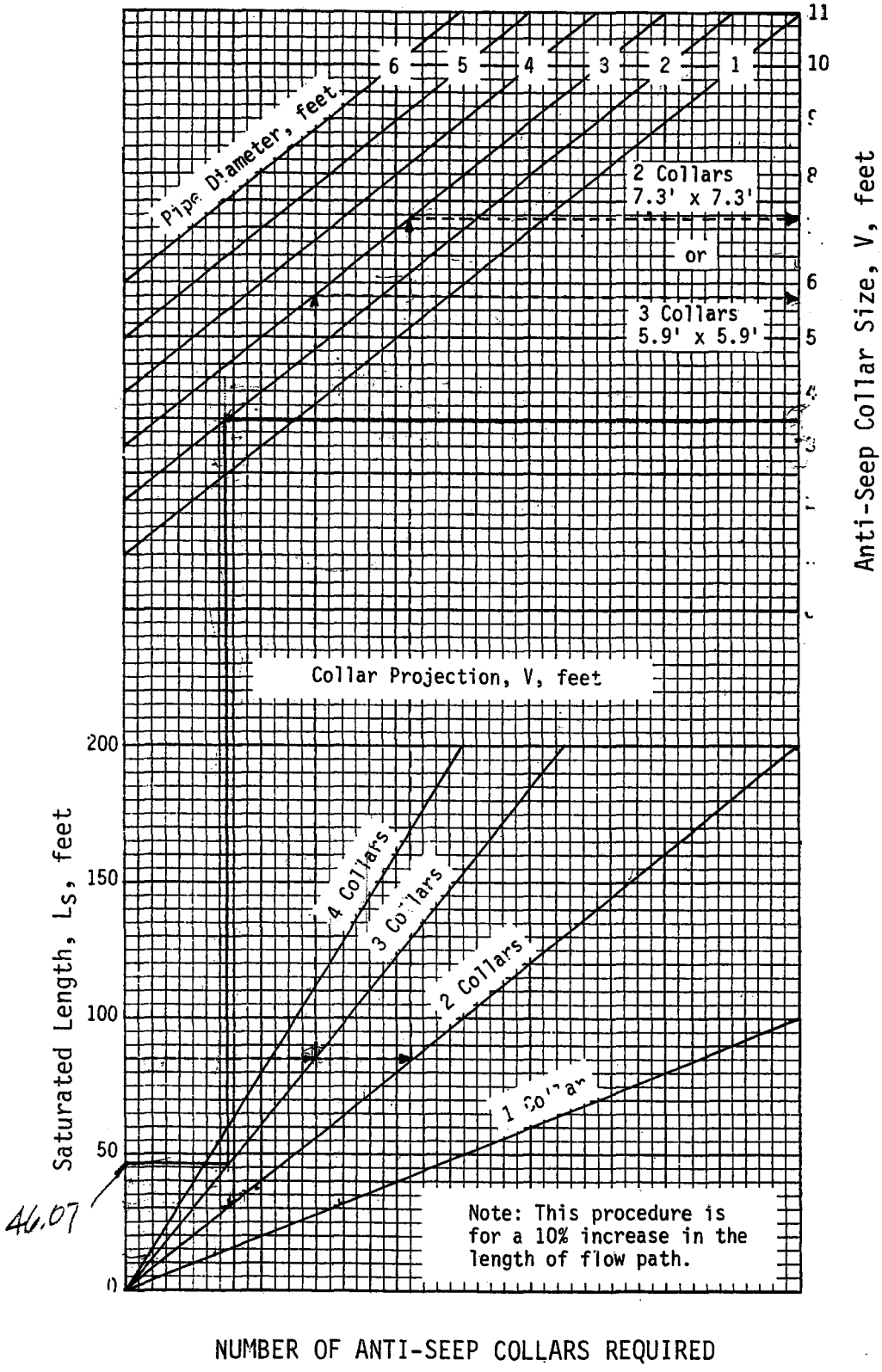
$S = 1.26\%$ $.0126\%$

$$L_s = 6.25(3+4)\left(1+\frac{0.0126}{0.25-0.0126}\right)$$

$L_s = 6.25 \times 7 \times 1.053$

$L_s = 46.07$

USE 3 ANTI-SEEP COLLARS 3'-6" X 3'-6"



Source: USDA-SCS

Plate 3.14-12

Subcatchment DASB5: SED 5 DA

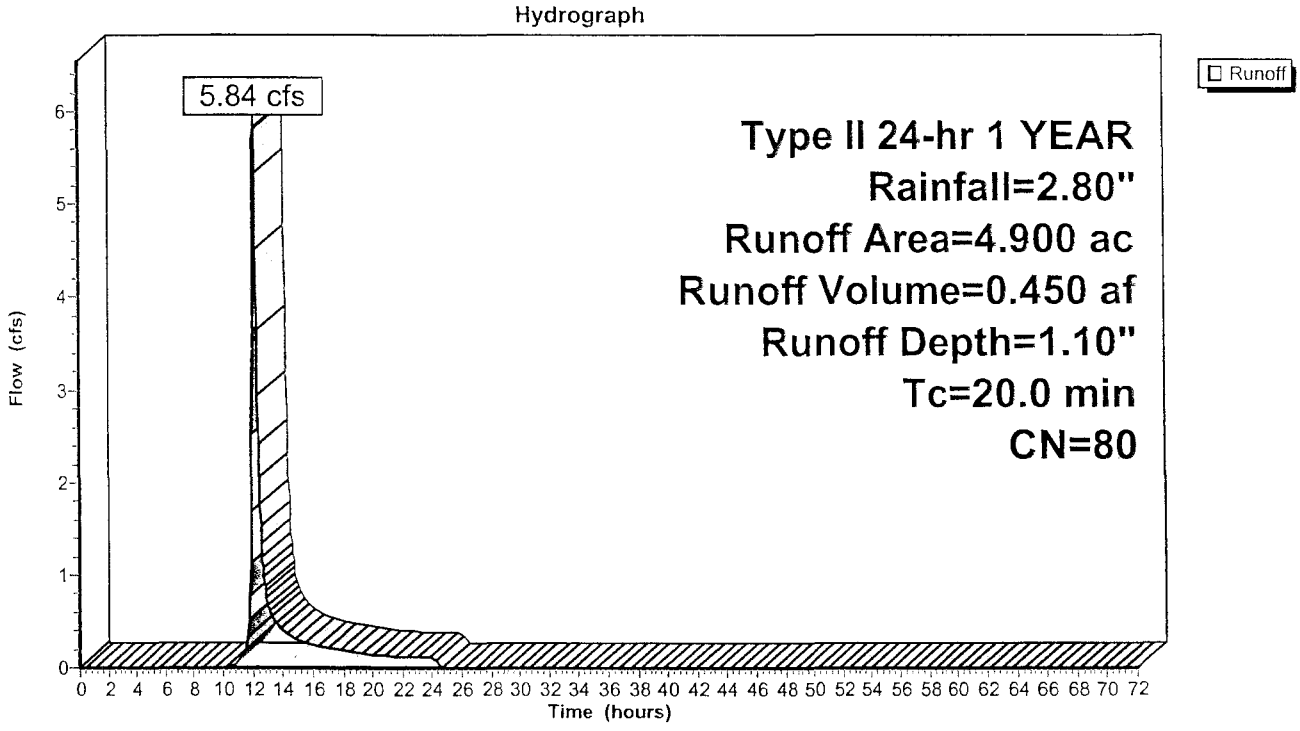
Runoff = 5.84 cfs @ 12.14 hrs, Volume= 0.450 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
4.900	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment DASB5: SED 5 DA



Pond SB5: SED BASIN 5

Inflow Area =	4.900 ac,	Inflow Depth =	1.10"	for	1 YEAR event
Inflow =	5.84 cfs @	12.14 hrs,	Volume=	0.450 af	
Outflow =	0.68 cfs @	13.03 hrs,	Volume=	0.450 af,	Atten= 88%, Lag= 53.4 min
Primary =	0.68 cfs @	13.03 hrs,	Volume=	0.450 af	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 70.84' Surf.Area= 2,997 sf Storage= 9,043 cf
Peak Elev= 73.28' @ 13.03 hrs Surf.Area= 4,445 sf Storage= 18,773 cf (9,730 cf above start)
Plug-Flow detention time= 747.8 min calculated for 0.242 af (54% of inflow)
Center-of-Mass det. time= 353.8 min (1,213.3 - 859.5)

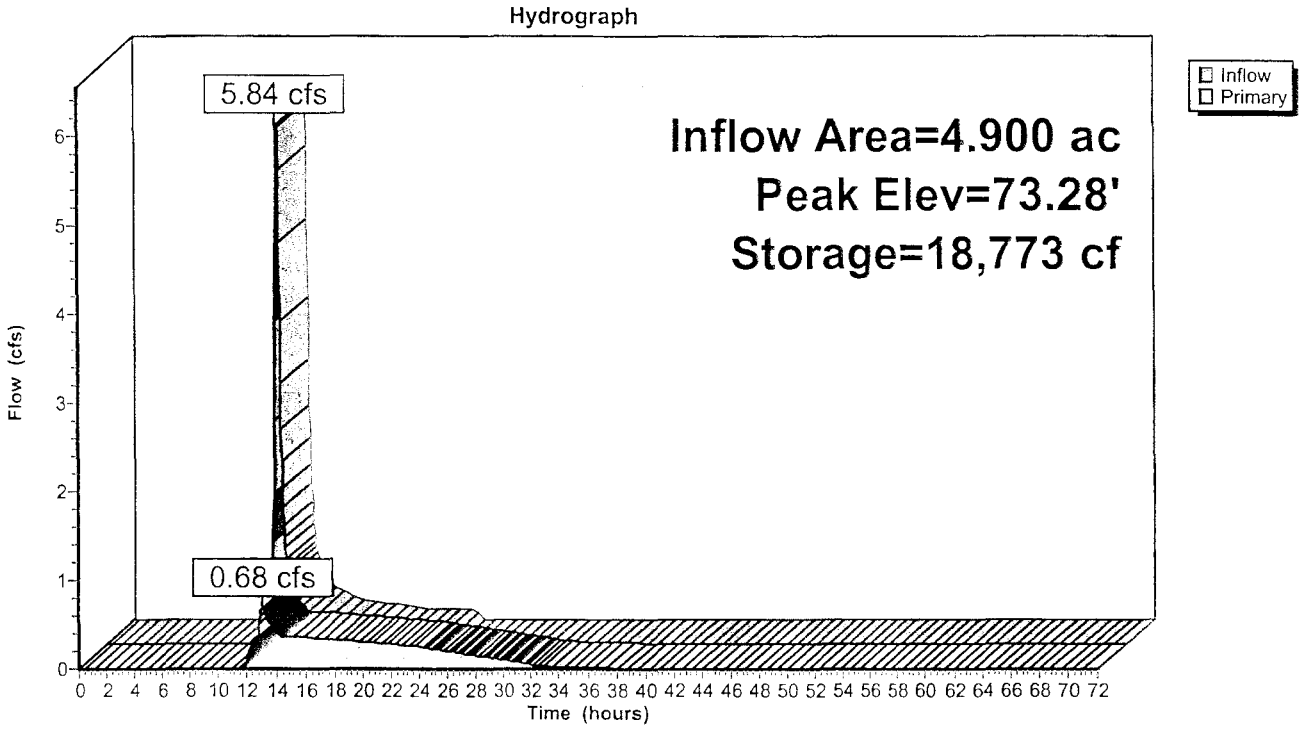
#	Invert	Avail.Storage	Storage Description
1	67.00'	31,425 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
67.00	1,300	0	0
70.00	2,500	5,700	5,700
75.00	5,460	19,900	25,600
76.00	6,190	5,825	31,425

#	Routing	Invert	Outlet Devices
1	Primary	66.00'	**24.0" x 64.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 65.22' S= 0.0122 '/' n= 0.012 Cc= 0.900
2	Device 1	70.84'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.62 cfs @ 13.03 hrs HW=73.28' (Free Discharge)
└**1=Culvert** (Passes 0.62 cfs of 37.92 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 7.3 fps)
  └**3=Orifice/Grate** (Weir Controls 0.26 cfs @ 0.6 fps)

Pond SB5: SED BASIN 5



Stage-Discharge for Pond SB5: SED BASIN 5

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
67.00	0.00	72.30	0.27
67.10	0.00	72.40	0.28
67.20	0.00	72.50	0.29
67.30	0.00	72.60	0.30
67.40	0.00	72.70	0.31
67.50	0.00	72.80	0.32
67.60	0.00	72.90	0.33
67.70	0.00	73.00	0.34
67.80	0.00	73.10	0.35
67.90	0.00	73.20	0.35
68.00	0.00	73.30	0.82
68.10	0.00	73.40	2.76
68.20	0.00	73.50	5.51
68.30	0.00	73.60	8.89
68.40	0.00	73.70	12.80
68.50	0.00	73.80	17.16
68.60	0.00	73.90	21.94
68.70	0.00	74.00	27.10
68.80	0.00	74.10	32.62
68.90	0.00	74.20	38.47
69.00	0.00	74.30	40.87
69.10	0.00	74.40	41.15
69.20	0.00	74.50	41.43
69.30	0.00	74.60	41.70
69.40	0.00	74.70	41.97
69.50	0.00	74.80	42.25
69.60	0.00	74.90	42.52
69.70	0.00	75.00	42.78
69.80	0.00	75.10	43.05
69.90	0.00	75.20	43.32
70.00	0.00	75.30	43.58
70.10	0.00	75.40	43.84
70.20	0.00	75.50	44.10
70.30	0.00	75.60	44.36
70.40	0.00	75.70	44.62
70.50	0.00	75.80	44.87
70.60	0.00	75.90	45.13
70.70	0.00	76.00	**45.38**
70.80	0.00		
70.90	0.01		
71.00	0.05		
71.10	0.09		
71.20	0.11		
71.30	0.14		
71.40	0.16		
71.50	0.17		
71.60	0.19		
71.70	0.20		
71.80	0.22		
71.90	0.23		
72.00	0.24		
72.10	0.25		
72.20	0.26		

Subcatchment DASB5: SED 5 DA

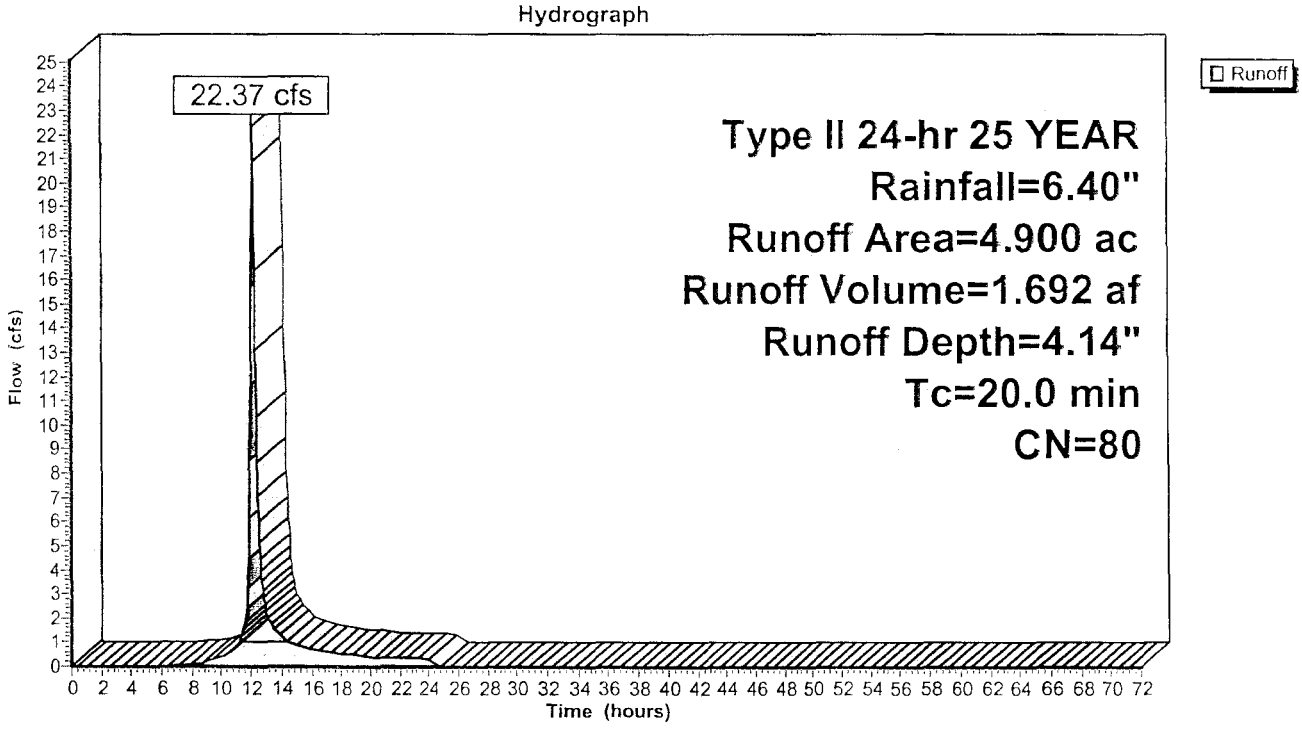
Runoff = 22.37 cfs @ 12.12 hrs, Volume= 1.692 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 YEAR Rainfall=6.40"

Area (ac)	CN	Description
4.900	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment DASB5: SED 5 DA



Pond SB5: SED BASIN 5

Inflow Area =	4.900 ac,	Inflow Depth = 4.14"	for 25 YEAR event		
Inflow =	22.37 cfs @	12.12 hrs, Volume=	1.692 af		
Outflow =	22.11 cfs @	12.15 hrs, Volume=	1.691 af,	Atten= 1%,	Lag= 1.5 min
Primary =	22.11 cfs @	12.15 hrs, Volume=	1.691 af		

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 70.84' Surf.Area= 2,997 sf Storage= 9,043 cf
Peak Elev= 73.90' @ 12.15 hrs Surf.Area= 4,810 sf Storage= 21,233 cf (12,190 cf above start)
Plug-Flow detention time= 241.7 min calculated for 1.483 af (88% of inflow)
Center-of-Mass det. time= 146.7 min (968.1 - 821.4)

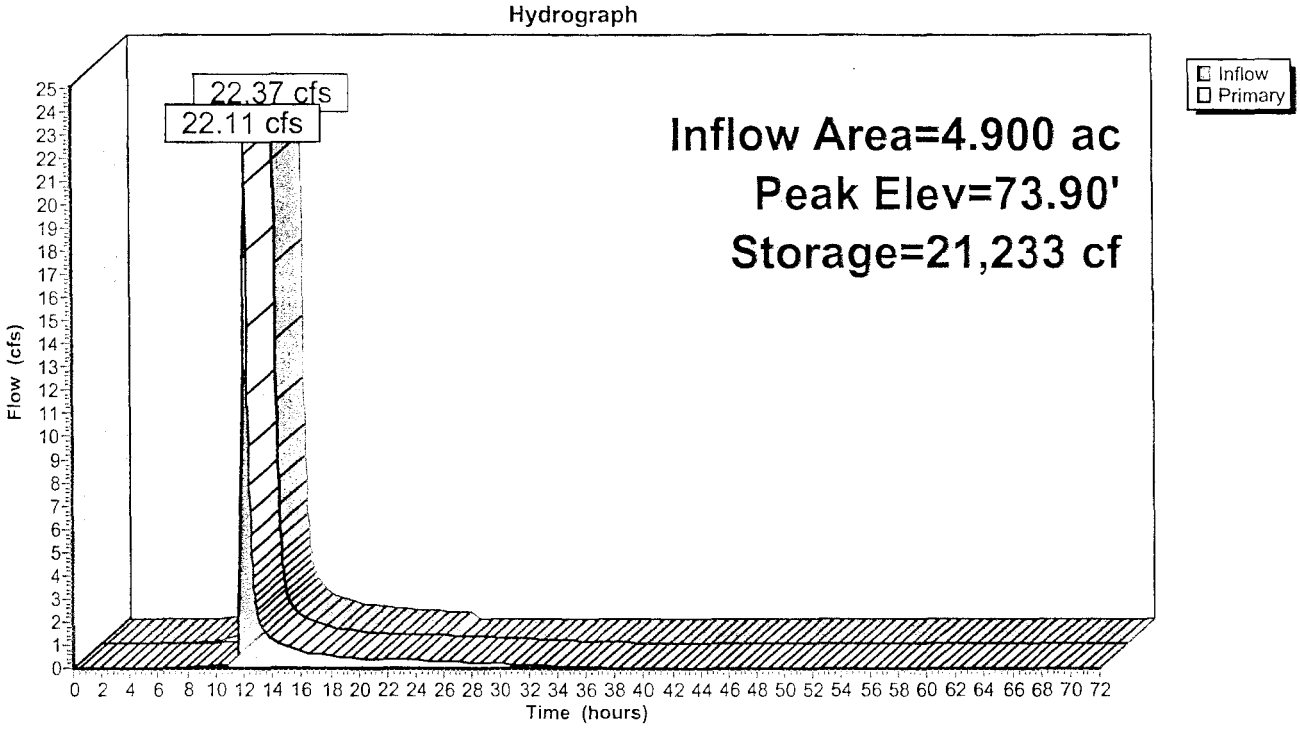
#	Invert	Avail.Storage	Storage Description
1	67.00'	31,425 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
67.00	1,300	0	0
70.00	2,500	5,700	5,700
75.00	5,460	19,900	25,600
76.00	6,190	5,825	31,425

#	Routing	Invert	Outlet Devices
1	Primary	66.00'	**24.0" x 64.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 65.22' S= 0.0122 '/' n= 0.012 Cc= 0.900
2	Device 1	70.84'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=22.03 cfs @ 12.15 hrs HW=73.90' (Free Discharge)
└**1=Culvert** (Passes 22.03 cfs of 39.74 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.41 cfs @ 8.3 fps)
└**3=Orifice/Grate** (Weir Controls 21.62 cfs @ 2.6 fps)

Pond SB5: SED BASIN 5



Stage-Discharge for Pond SB5: SED BASIN 5

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
67.00	0.00	72.30	0.27
67.10	0.00	72.40	0.28
67.20	0.00	72.50	0.29
67.30	0.00	72.60	0.30
67.40	0.00	72.70	0.31
67.50	0.00	72.80	0.32
67.60	0.00	72.90	0.33
67.70	0.00	73.00	0.34
67.80	0.00	73.10	0.35
67.90	0.00	73.20	0.35
68.00	0.00	73.30	0.82
68.10	0.00	73.40	2.76
68.20	0.00	73.50	5.51
68.30	0.00	73.60	8.89
68.40	0.00	73.70	12.80
68.50	0.00	73.80	17.16
68.60	0.00	73.90	21.94
68.70	0.00	74.00	27.10
68.80	0.00	74.10	32.62
68.90	0.00	74.20	38.47
69.00	0.00	74.30	40.87
69.10	0.00	74.40	41.15
69.20	0.00	74.50	41.43
69.30	0.00	74.60	41.70
69.40	0.00	74.70	41.97
69.50	0.00	74.80	42.25
69.60	0.00	74.90	42.52
69.70	0.00	75.00	42.78
69.80	0.00	75.10	43.05
69.90	0.00	75.20	43.32
70.00	0.00	75.30	43.58
70.10	0.00	75.40	43.84
70.20	0.00	75.50	44.10
70.30	0.00	75.60	44.36
70.40	0.00	75.70	44.62
70.50	0.00	75.80	44.87
70.60	0.00	75.90	45.13
70.70	0.00	76.00	**45.38**
70.80	0.00		
70.90	0.01		
71.00	0.05		
71.10	0.09		
71.20	0.11		
71.30	0.14		
71.40	0.16		
71.50	0.17		
71.60	0.19		
71.70	0.20		
71.80	0.22		
71.90	0.23		
72.00	0.24		
72.10	0.25		
72.20	0.26		

CHANNEL ADEQUACY CALCULATIONS

SUMMARY

This section details channel adequacy for channels/reaches within this subdivision. An exhibit has been prepared showing the locations where sections were taken and is located at the back of this section. Upon field observation all channels were found to be similar in characteristic and a n-value determination form has been provided following this summary. In all cases the post-developed velocities did not exceed the allowable 2.5 fps.

N value Determination

Project: Stonehouse Glen Phase 2 **Project No.** 2002261-500.04

Date: 3/16/2005 **Prepared By:** AJR

Date Of Field Survey 3/4/2005
Crew: wp/bw

Conditions Noted:

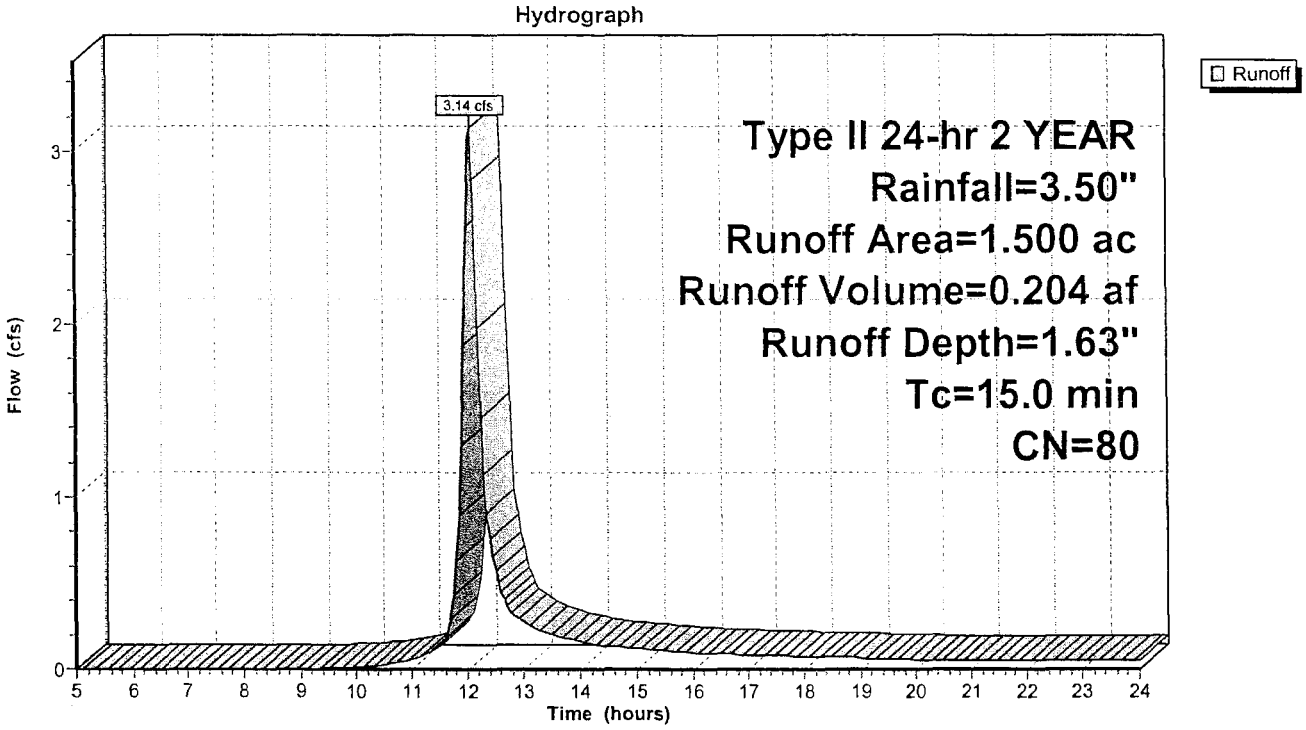
Channel 1
section a

	Reference	n	Description
Basic n Value	Table 5-16	0.02	Channel cut into earth
Surface irregularity	Table 5-17	0.01	Moderate
Shape variations	Table 5-18	0	Occasional
Obstructions	Table 5-19	0.01	minor
Vegetation	Table 5-20	0.015	Dense Growth of Grasses and tree seedlings along outside edge of flow pattern.
Sinuosity	Table 5-21	0	Ratio 156/150 = 1.04 Minor
	Total	0.055	

Permissible Velociy Based upon Field Observation 2.5'/sec sandy loam

CHANNEL 1
REACH 13

Subcatchment 0+00: DA AT 0+00



LandMark Design Group Inc.
4029 Ironbound Road Suite 100
Williamsburg, Va. 23188
757-253-2975
Mon Dec 27 11:07:57 2004

PROJECT: 4.04 Stonehouse Glen Sec.II with curb\dwg\SURFACE\SHGLENPH2SURFACE.pro

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Record: 121491 Name:
Layer: EX-DA Color: 11 View: Profile Linetype: SOLID

CP#	Sta	Elev	Attributes
1	-25.0000	74.6445	
2	-11.5631	70.5606	
3	1.9231	66.7192	
4	10.3059	66.0435	
5	15.8717	65.7247	
6	25.0000	68.6190	

0+00
Worksheet for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2
Worksheet	OUTFALL AT 13
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.118000	ft/ft

Elevation range: 65.72 ft to 74.60 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
-25.00	74.60	-25.00	25.00	0.055
-11.00	70.56			
1.92	66.72			
10.31	66.04			
15.87	65.72			
25.00	68.62			

Discharge	3.14	cfs

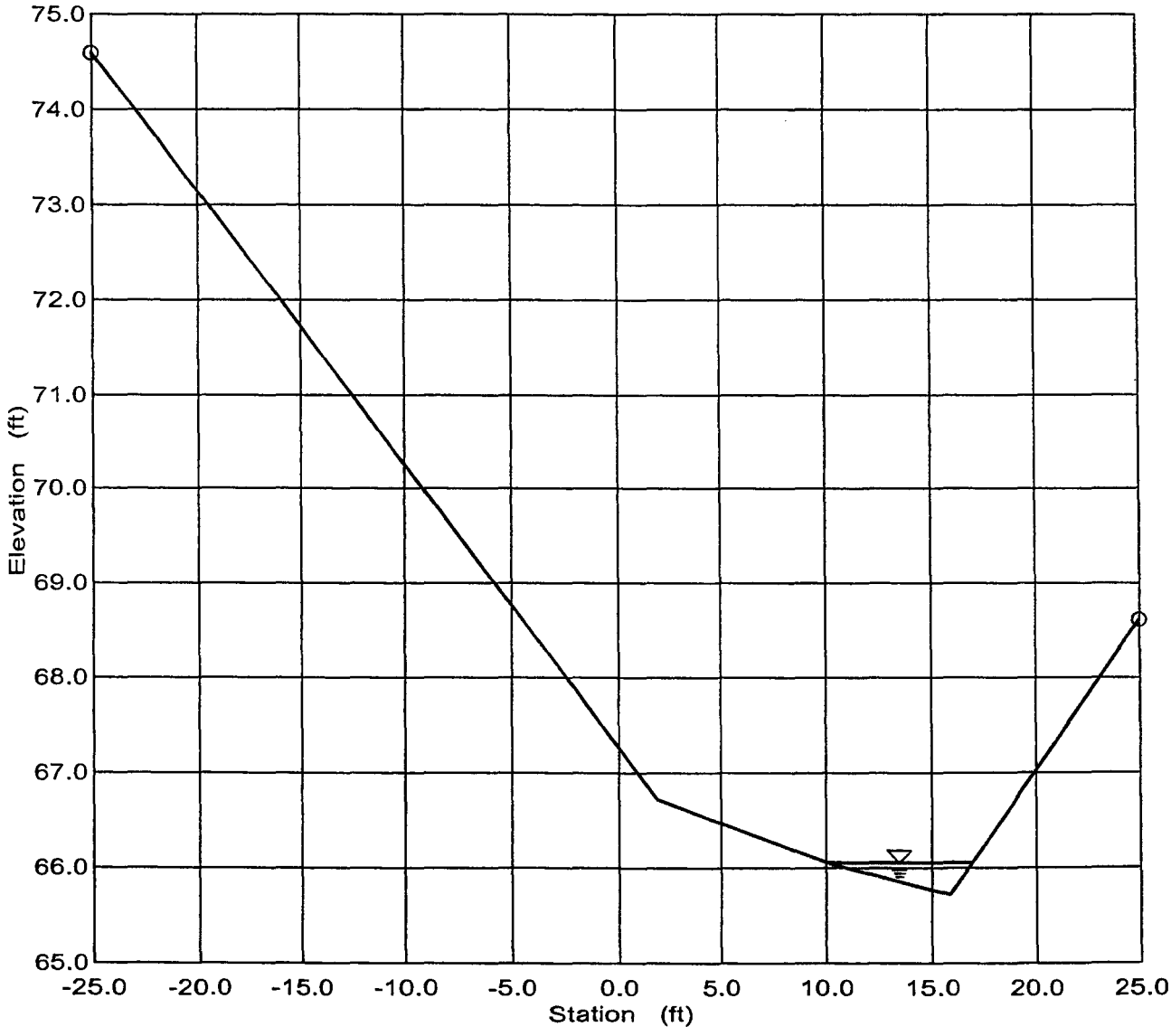
Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	66.05	ft
Flow Area	1.12	ft²
Wetted Perimeter	6.80	ft
Top Width	6.74	ft
Height	0.33	ft
Critical Depth	66.08	ft
Critical Slope	0.078743	ft/ft
Velocity	2.79	ft/s
Velocity Head	0.12	ft
Specific Energy	66.17	ft
Froude Number	1.21	

Flow is supercritical.

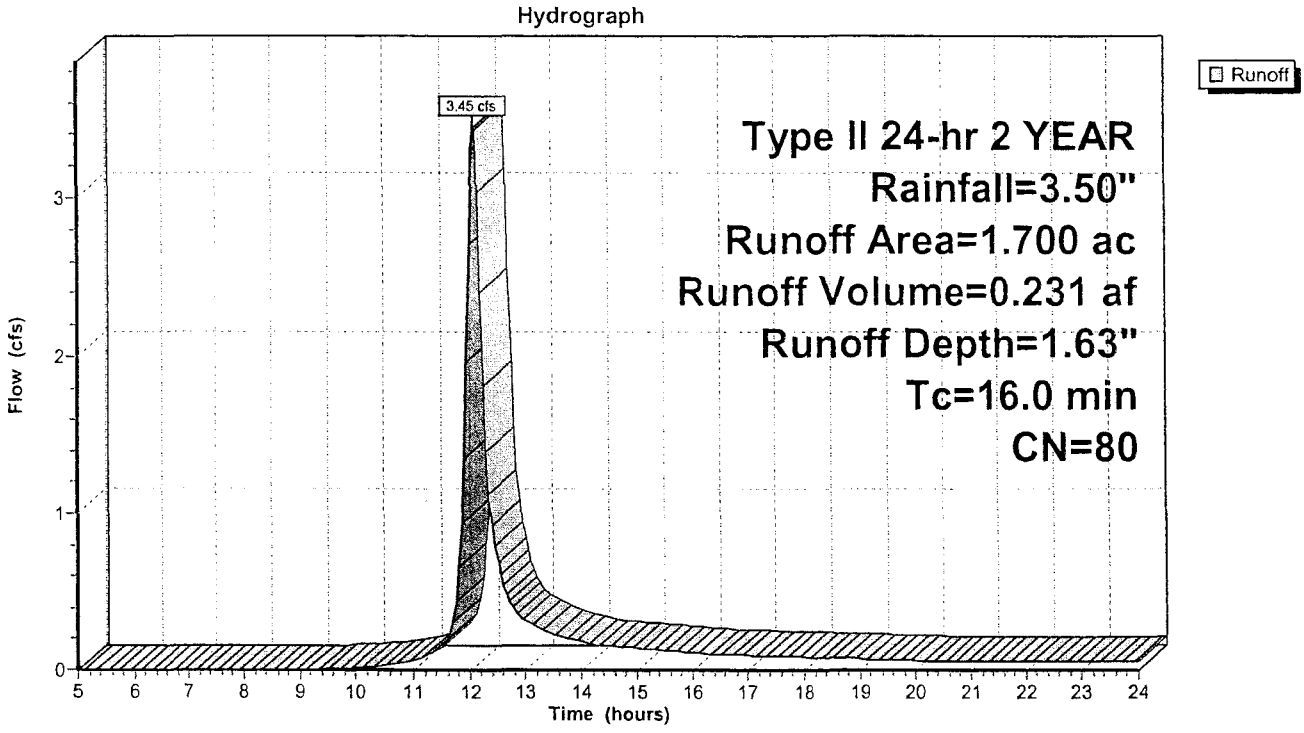
0+00
Cross Section for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2
Worksheet	OUTFALL AT 13
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.118000	ft/ft
Water Surface Elevation	66.05	ft
Discharge	3.14	cfs



Subcatchment 0+50: DA AT 0+50



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PROJECT: 4.04 Stonehouse Glen Sec.II with curb\dwg\SURFACE\SHGLENPH2SURFACE.pro

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Record: 121497 Name:
Layer: EX-DA Color: 11 View: Profile Linetype: SOLID

CP#	Sta	Elev	Attributes
1	0.0000	66.9198	
2	15.8836	61.4877	
3	18.0643	60.7226	
4	18.8960	60.6480	
5	31.9817	59.1293	
6	46.2017	64.8085	
7	50.0000	66.4198	

0+50
Worksheet for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2
Worksheet	1+00
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.140000	ft/ft

Elevation range: 59.10 ft to 66.90 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	66.90	0.00	50.00	0.055
15.90	61.50			
18.10	60.70			
18.90	60.60			
32.00	59.10			
46.20	64.80			
50.00	66.40			

Discharge	3.45	cfs

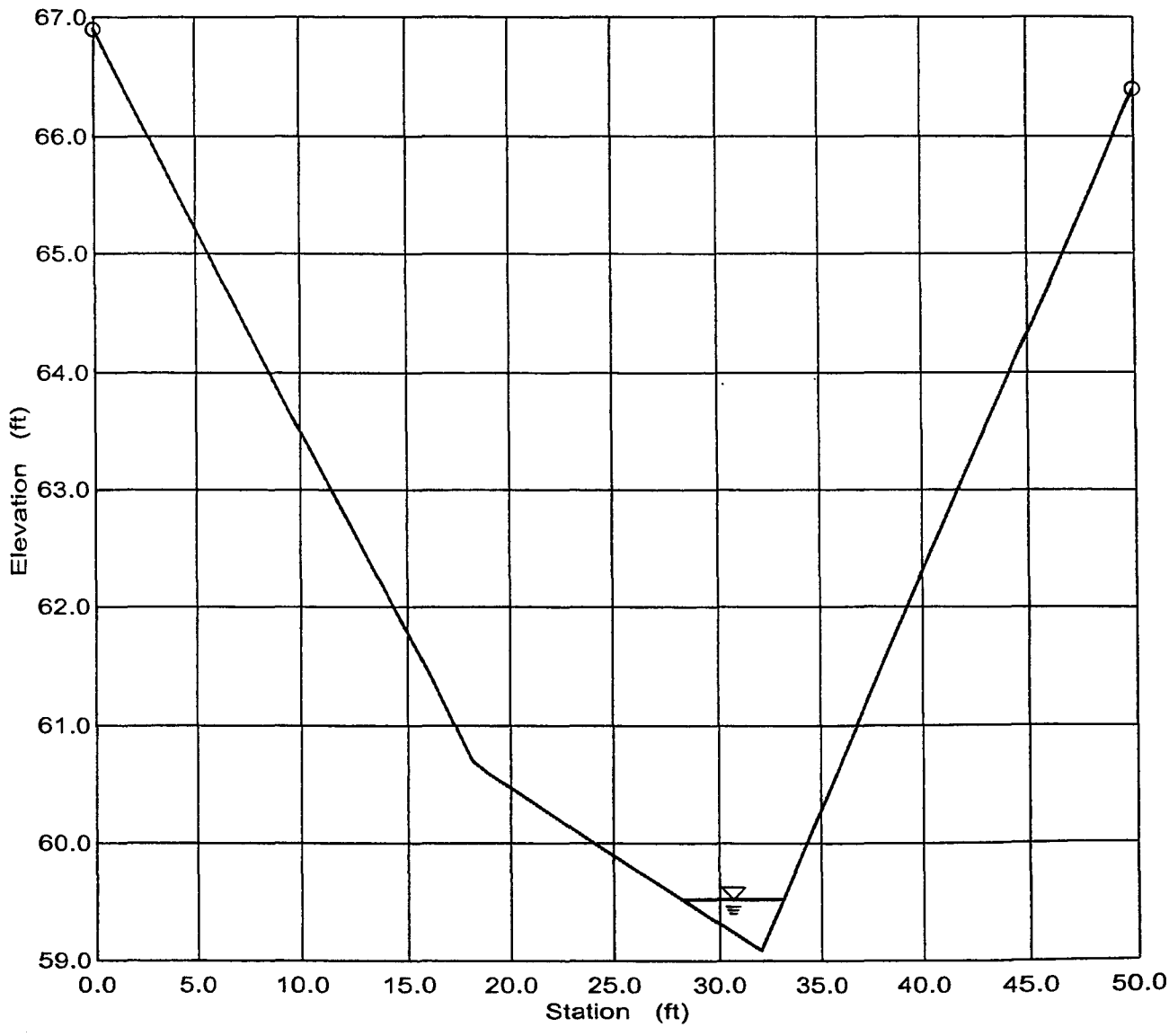
Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	59.52	ft
Flow Area	0.98	ft^2
Wetted Perimeter	4.80	ft
Top Width	4.70	ft
Height	0.42	ft
Critical Depth	59.57	ft
Critical Slope	0.073445	ft/ft
Velocity	3.51	ft/s
Velocity Head	0.19	ft
Specific Energy	59.71	ft
Froude Number	1.35	
Flow is supercritical.		

0+50

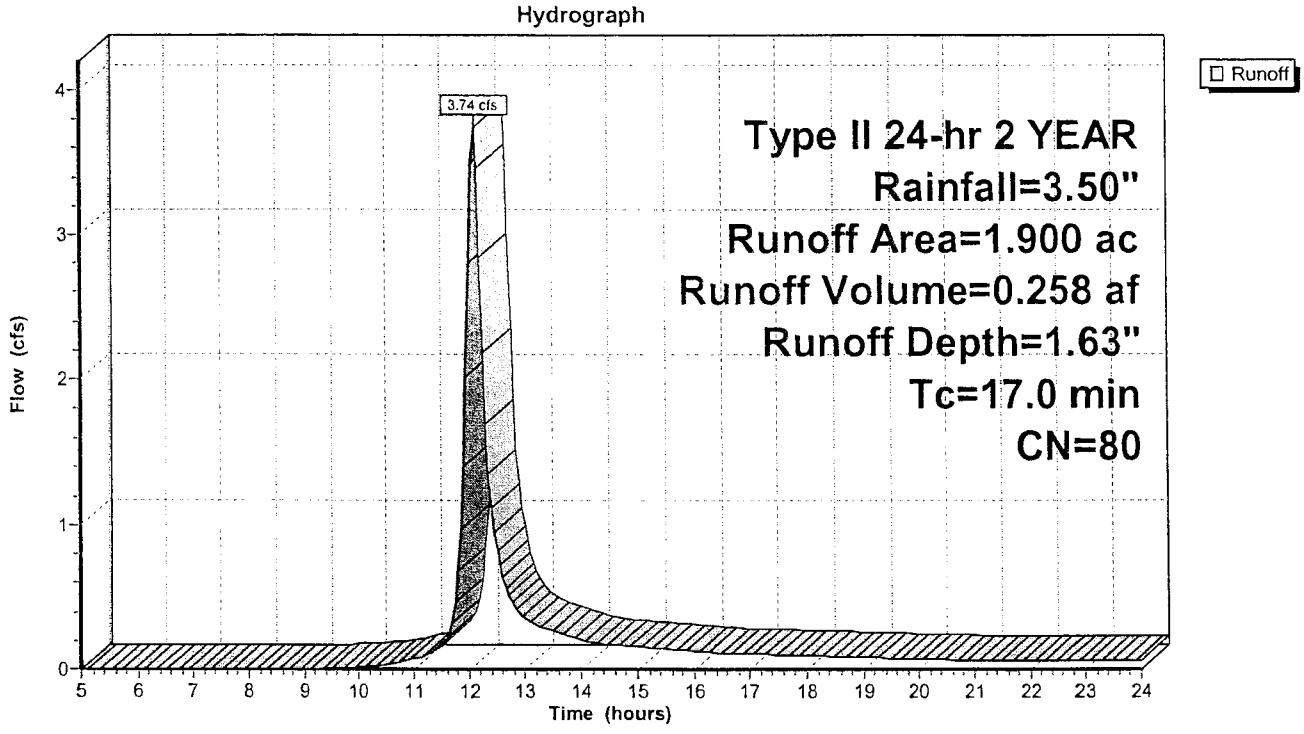
Cross Section for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2
Worksheet	1+00
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.140000	ft/ft
Water Surface Elevation	59.52	ft
Discharge	3.45	cfs



Subcatchment 1+00: (new Subcat)



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Mon Dec 27 11:22:45 2004

PROJECT: 4.04 Stonehouse Glen Sec.II with curb\dwg\SURFACE\SHGLENPH2SURFACE.pro

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Record: 121494 Name:
Layer: EX-DA Color: 11 View: Profile Linetype: SOLID

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1	0.0000	56.5259	
2	23.3979	50.0559	
3	25.9754	49.3533	
4	31.3180	52.0327	
5	50.0000	61.0393	

1+00
Worksheet for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2
Worksheet	OUTFALL @ 1+00
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.250000	ft/ft

Elevation range: 49.35 ft to 61.04 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	56.52	0.00	50.00	0.055
23.40	50.06			
25.97	49.35			
31.32	52.03			
50.00	61.04			

Discharge	3.74	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	49.86	ft
Flow Area	0.72	ft²
Wetted Perimeter	3.04	ft
Top Width	2.85	ft
Height	0.51	ft
Critical Depth	49.99	ft
Critical Slope	0.070078	ft/ft
Velocity	5.18	ft/s
Velocity Head	0.42	ft
Specific Energy	50.27	ft
Froude Number	1.82	

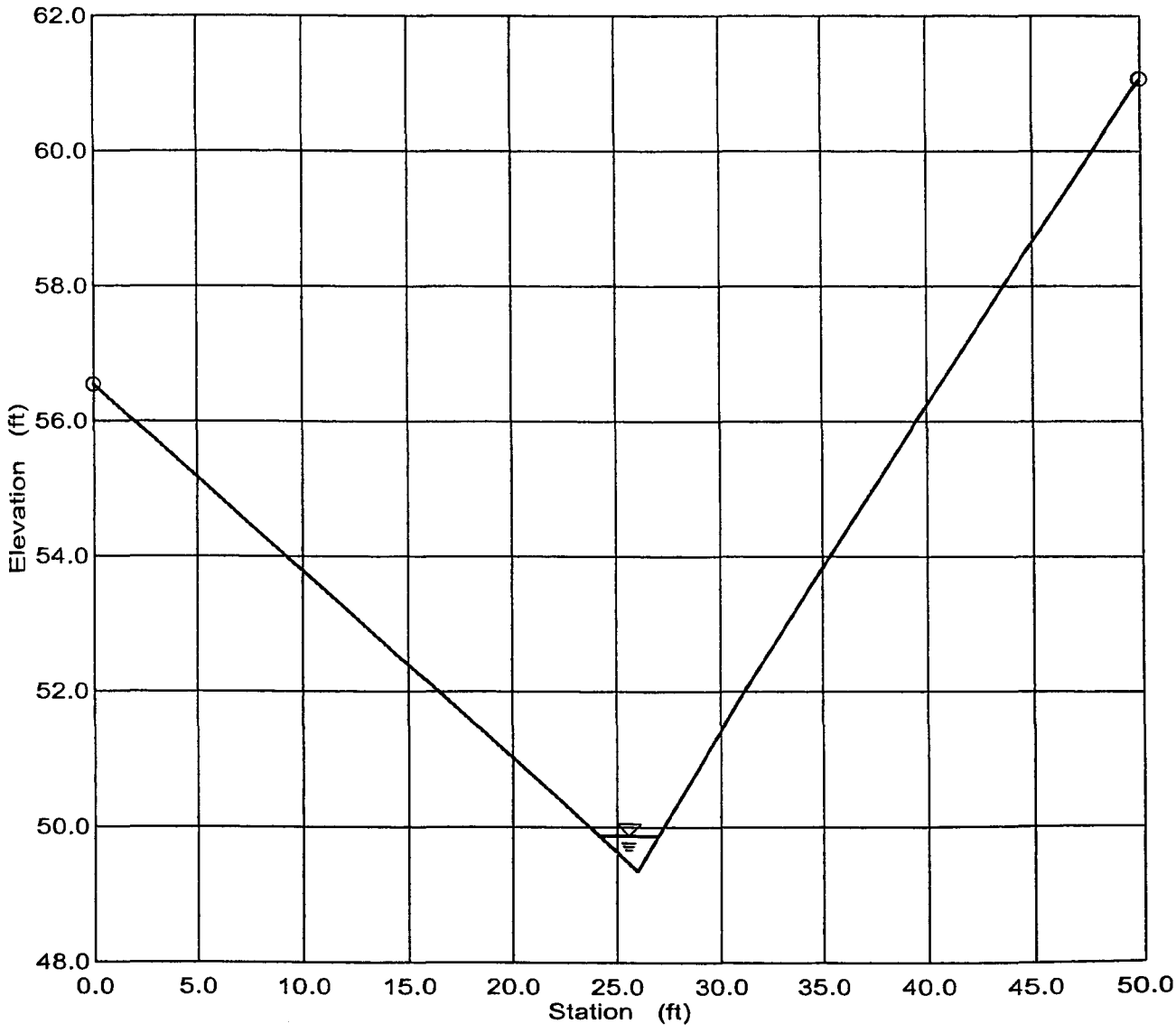
Flow is supercritical.

1+00

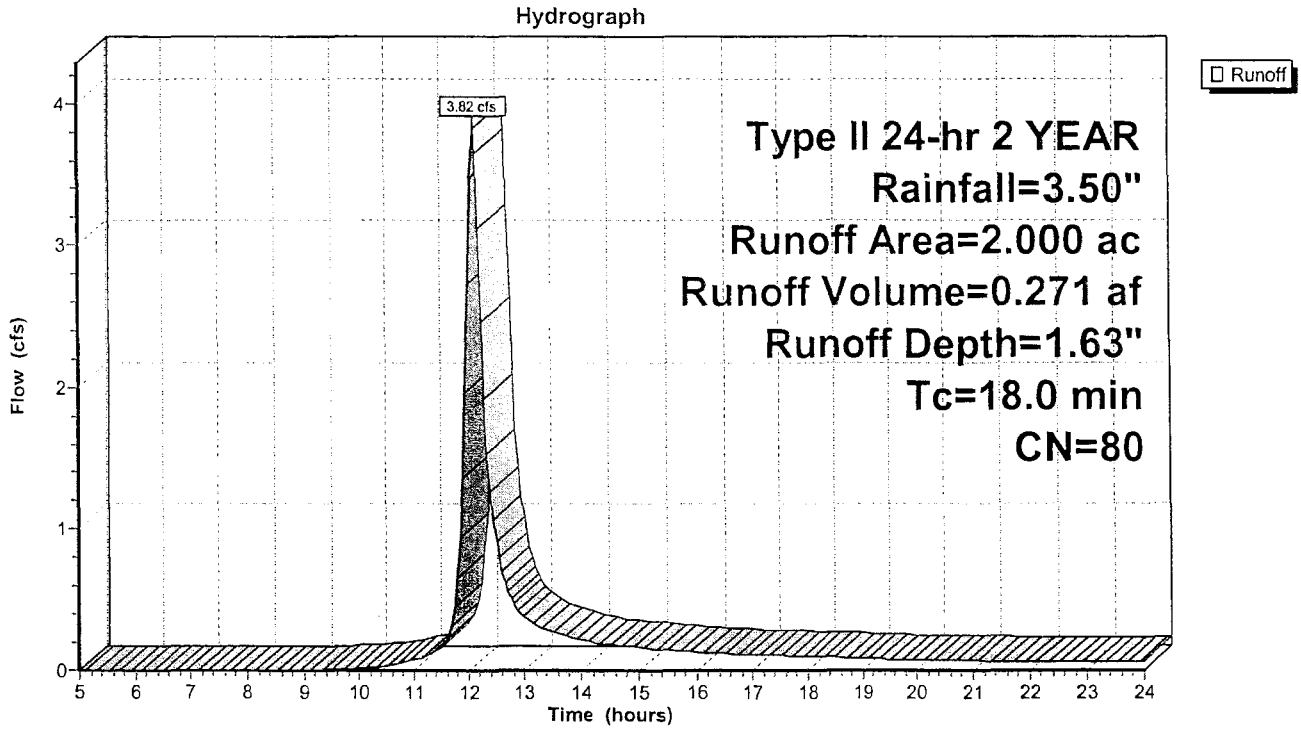
Cross Section for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2
Worksheet	OUTFALL @ 1+00
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.250000	ft/ft
Water Surface Elevation	49.86	ft
Discharge	3.74	cfs



Subcatchment 1+25: DA AT 1+25



1+25
Worksheet for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2
Worksheet	1+25
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.060000	ft/ft

Elevation range: 47.25 ft to 48.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
-8.00	48.00	-8.00	7.50	0.055
0.00	47.25			
7.50	48.00			

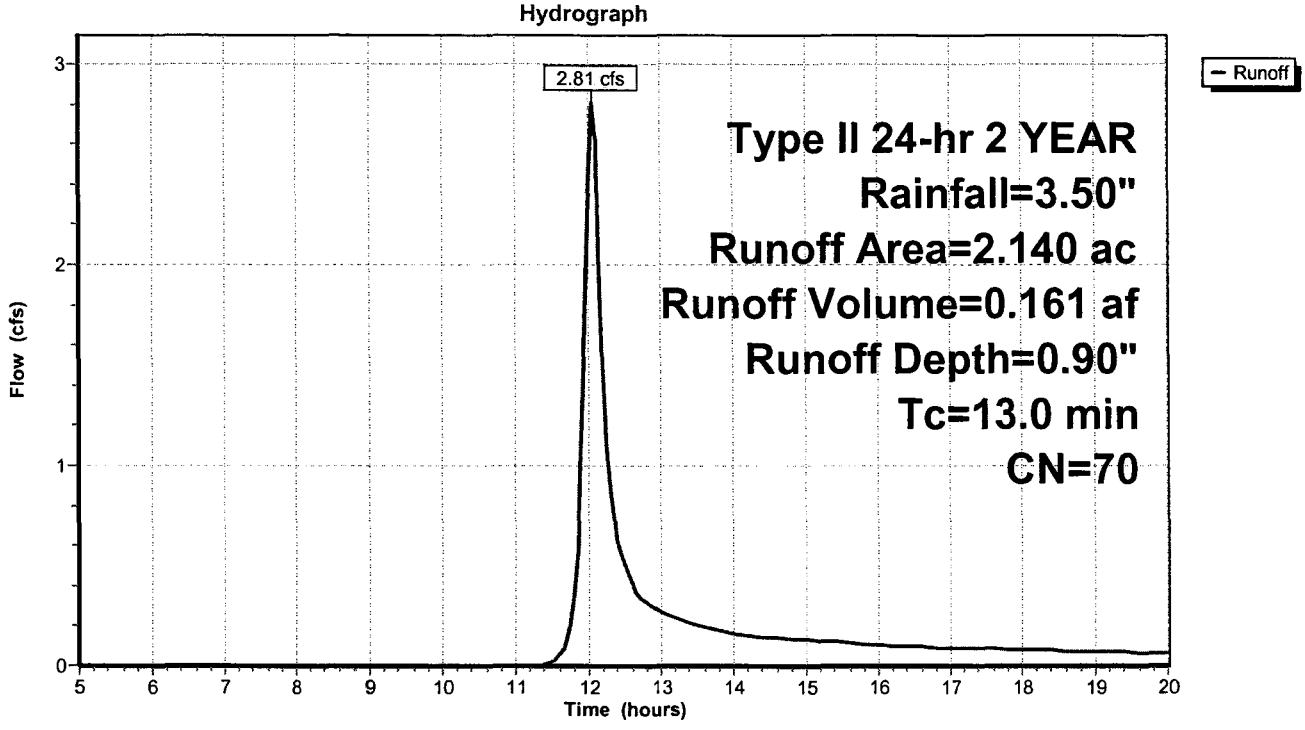
Discharge	3.82	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	47.65	ft
Flow Area	1.68	ft²
Wetted Perimeter	8.38	ft
Top Width	8.34	ft
Height	0.40	ft
Critical Depth	47.64	ft
Critical Slope	0.076797	ft/ft
Velocity	2.27	ft/s
Velocity Head	0.08	ft
Specific Energy	47.73	ft
Froude Number	0.89	

Flow is subcritical.

CHANNEL 2
REACH BCD

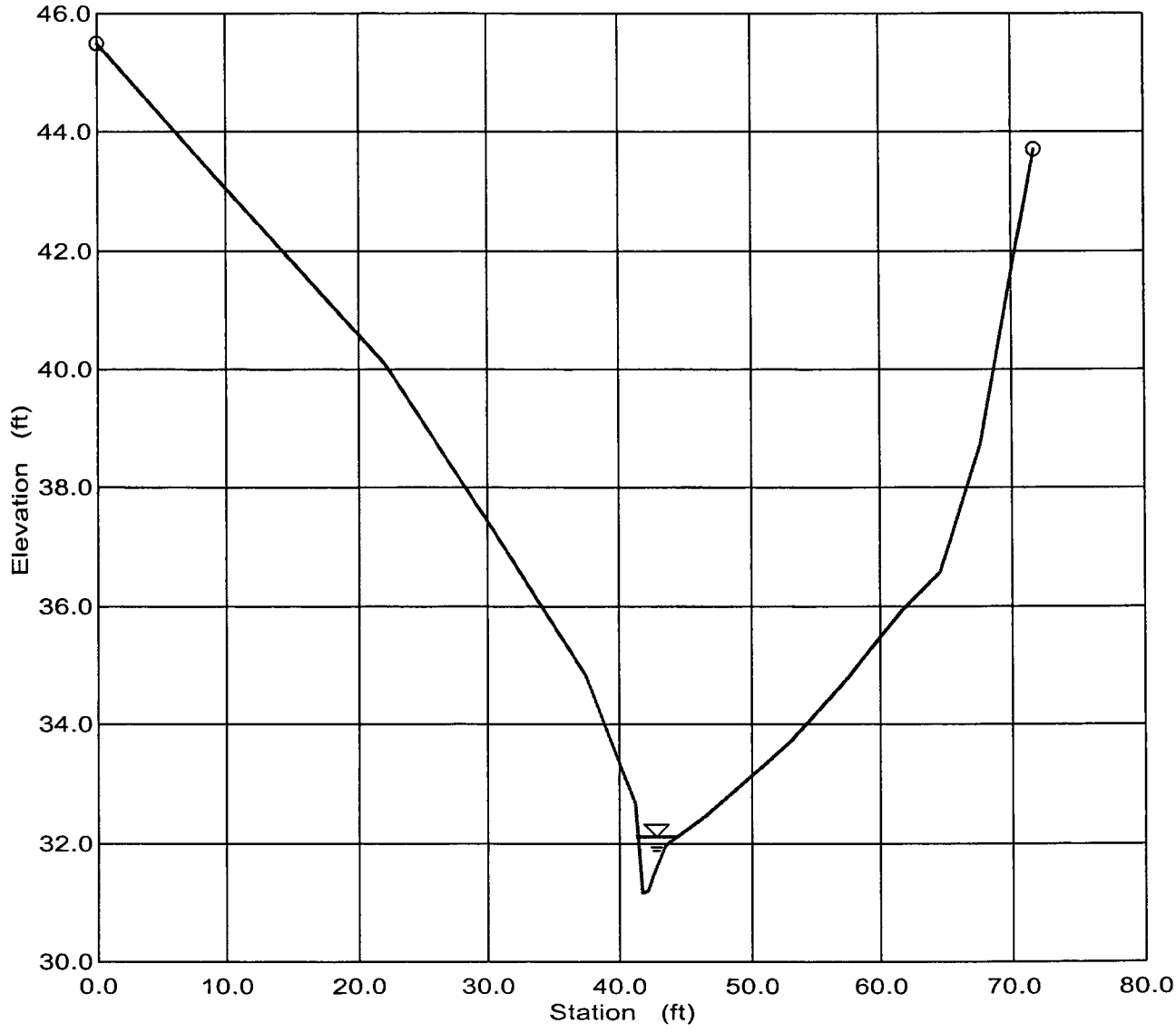
Subcatchment 2S: DA TO SECTION B



Section B PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.025700	ft/ft
Water Surface Elevation	32.10	ft
Discharge	2.81	cfs



CHANNEL 2 STA 0+60 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.025700	ft/ft

Elevation range: 31.15 ft to 45.48 ft.

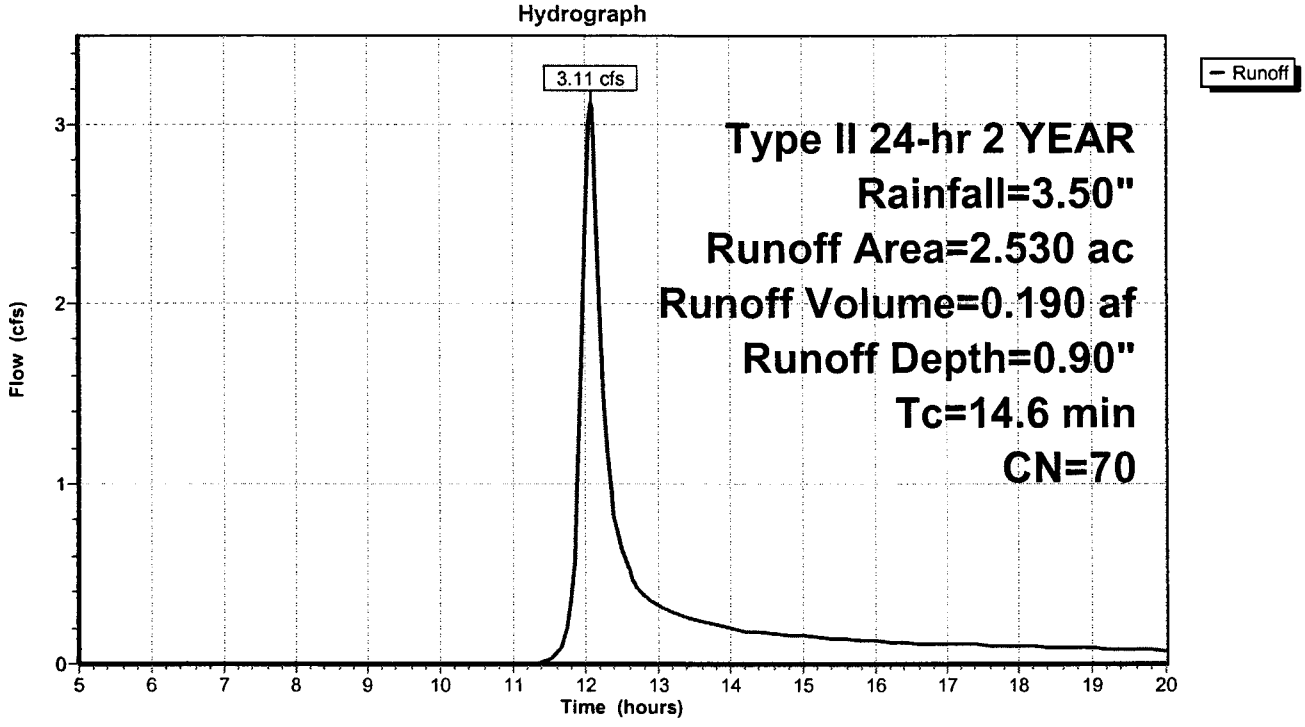
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	45.48	0.00	71.74	0.055
11.33	42.74			
22.06	40.10			
30.21	37.35			
37.46	34.83			
41.14	32.68			
41.69	31.15			
42.16	31.17			
42.53	31.44			
43.49	31.97			
46.58	32.46			
53.01	33.72			
57.56	34.80			
61.61	35.89			
64.49	36.56			
67.56	38.74			
71.74	43.70			

Discharge	2.81	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	32.10	ft
Flow Area	1.32	ft²
Wetted Perimeter	3.84	ft
Top Width	2.94	ft
Height	0.95	ft
Critical Depth	31.85	ft
Critical Slope	0.090084	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	32.17	ft
Froude Number	0.56	

Flow is subcritical.

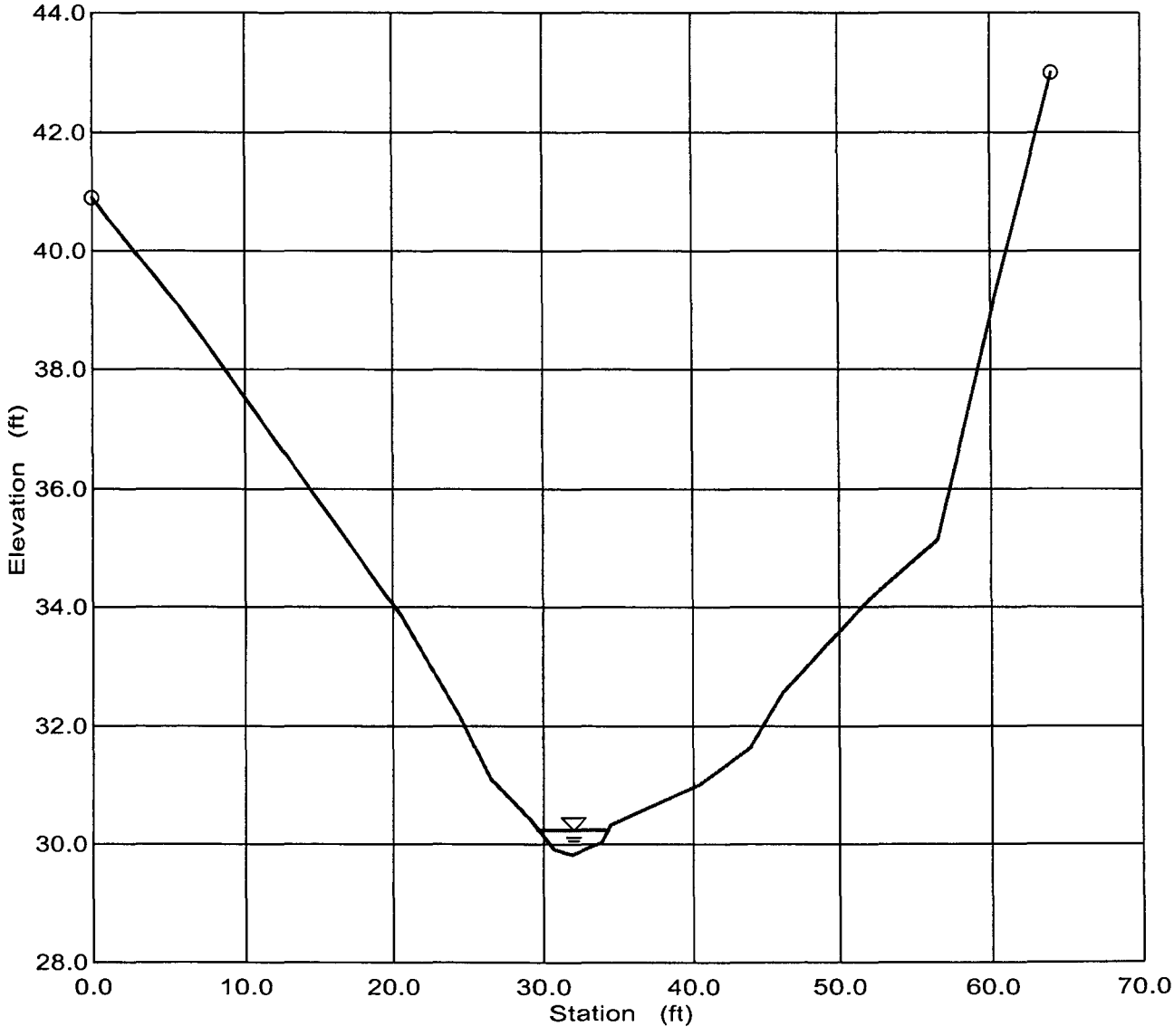
Subcatchment 3S: DA TO SECTION C



Section C PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.043400	ft/ft
Water Surface Elevation	30.25	ft
Discharge	3.11	cfs



CHANNEL 2 STA 1+13 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

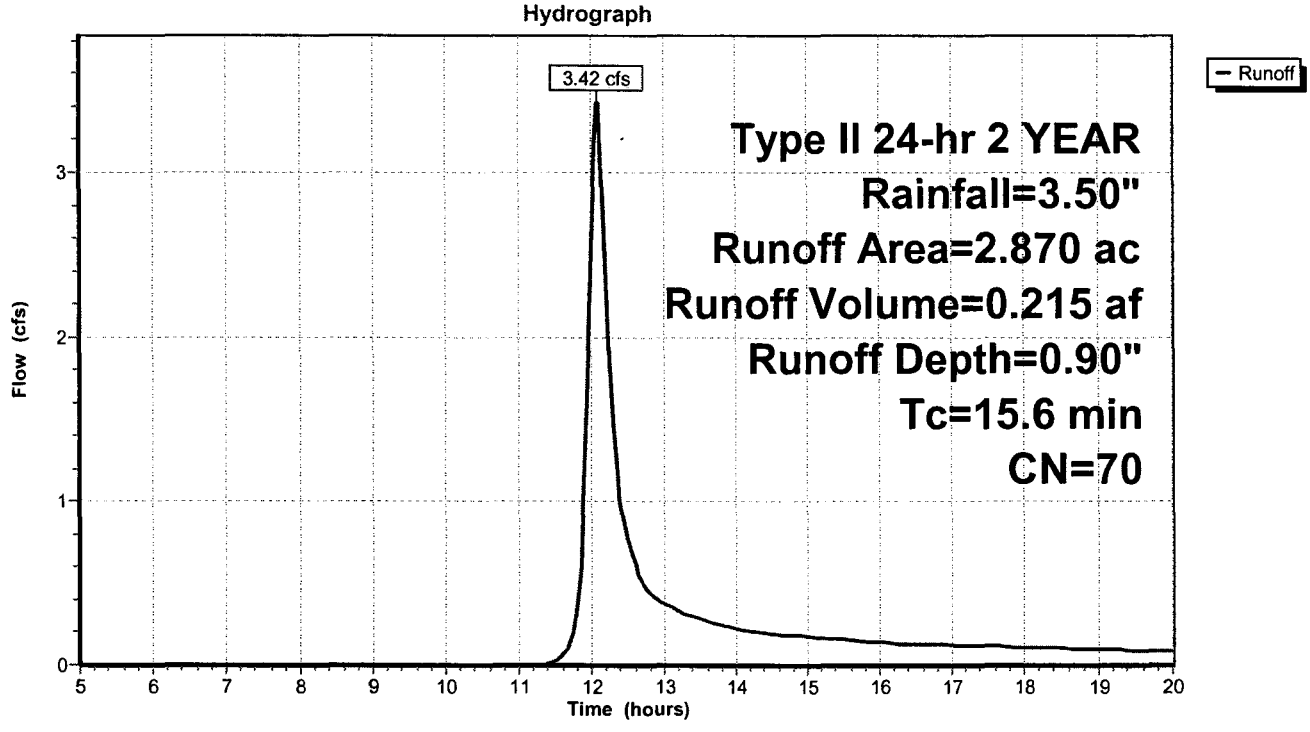
Input Data		
Channel Slope	0.043400	ft/ft

Elevation range: 29.81 ft to 43.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	40.89	0.00	64.06	0.055
5.55	39.15			
13.57	36.28			
20.56	33.85			
24.60	32.14			
26.50	31.10			
29.12	30.42			
30.63	29.92			
31.82	29.81			
33.82	30.04			
34.43	30.31			
40.56	31.00			
44.03	31.63			
46.30	32.55			
51.94	34.10			
56.46	35.14			
60.13	39.05			
64.06	43.00			
Discharge	3.11	cfs		

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	30.25	ft
Flow Area	1.31	ft^2
Wetted Perimeter	4.76	ft
Top Width	4.64	ft
Height	0.44	ft
Critical Depth	30.20	ft
Critical Slope	0.072089	ft/ft
Velocity	2.38	ft/s
Velocity Head	0.09	ft
Specific Energy	30.33	ft
Froude Number	0.79	
Flow is subcritical.		

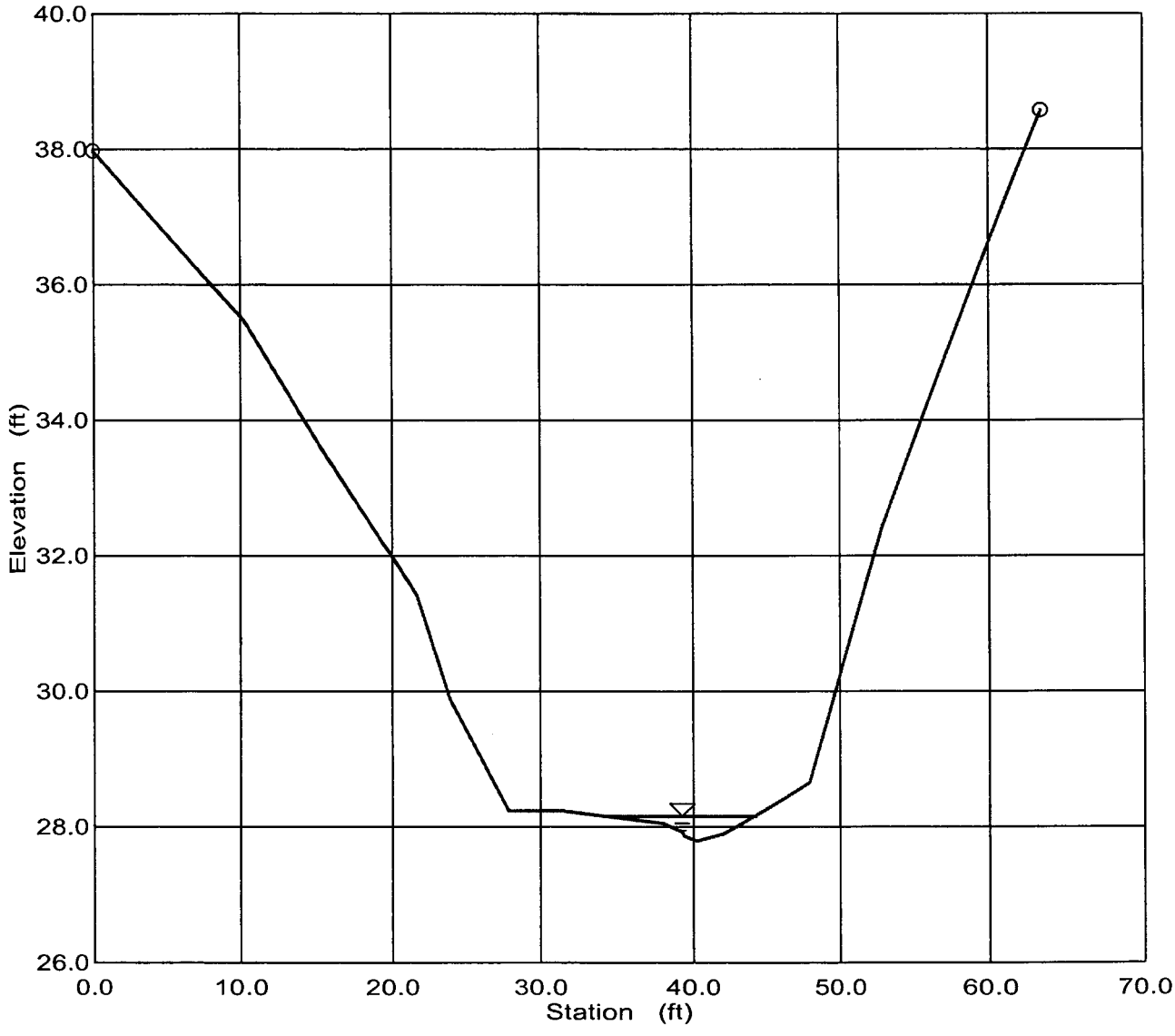
Subcatchment 4S: DA TO SECTION D



Cross Section D PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.040	
Channel Slope	0.040000	ft/ft
Water Surface Elevation	28.15	ft
Discharge	3.42	cfs



CHANNEL 2 STA 1+50 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.040000	ft/ft

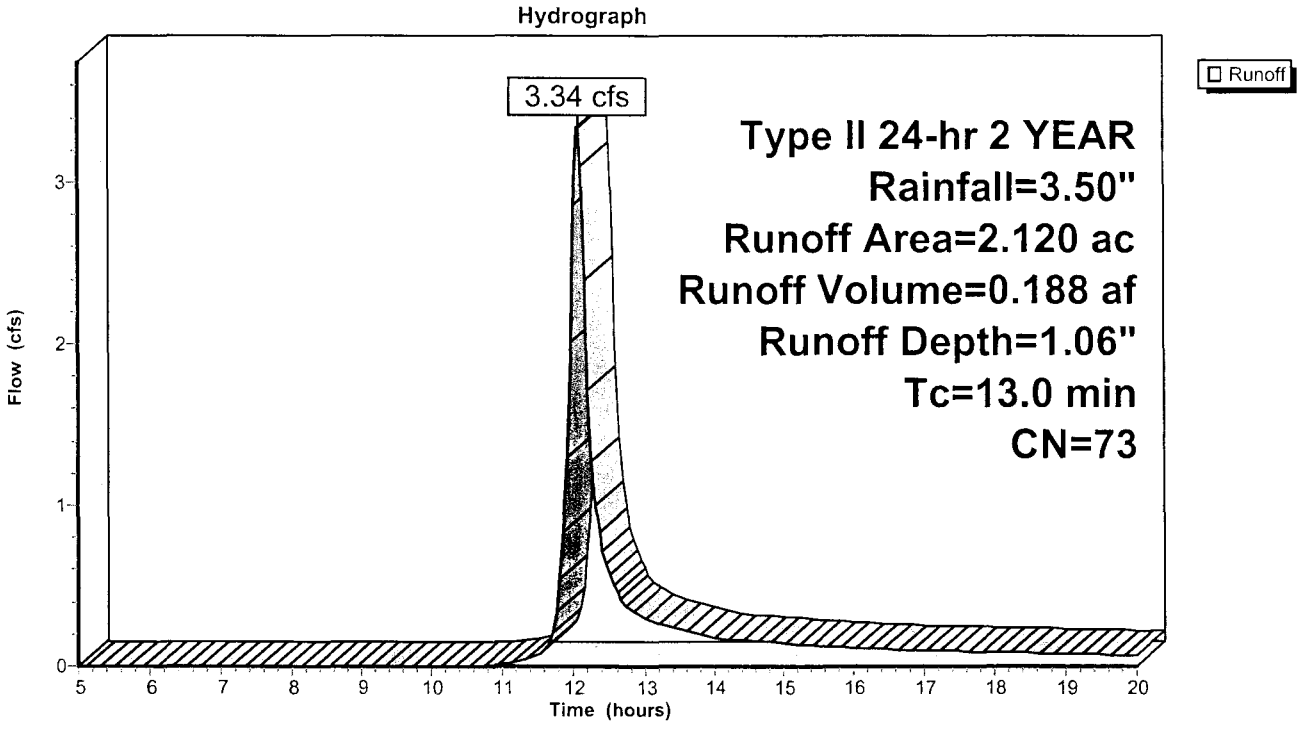
Elevation range: 27.77 ft to 38.57 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	37.95	0.00	63.40	0.040
10.21	35.47			
15.66	33.47			
21.58	31.41			
23.87	29.89			
27.88	28.23			
31.54	28.23			
38.10	28.04			
39.30	27.92			
39.49	27.87			
40.25	27.77			
42.00	27.88			
42.71	27.95			
46.37	28.42			
47.91	28.64			
52.99	32.43			
61.66	37.58			
63.40	38.57			

Discharge	3.42	cfs

Results		
Wtd. Mannings Coefficient	0.040	
Water Surface Elevation	28.15	ft
Flow Area	1.57	ft²
Wetted Perimeter	9.85	ft
Top Width	9.81	ft
Height	0.38	ft
Critical Depth	28.14	ft
Critical Slope	0.043350	ft/ft
Velocity	2.18	ft/s
Velocity Head	0.07	ft
Specific Energy	28.22	ft
Froude Number	0.96	
Flow is subcritical.		

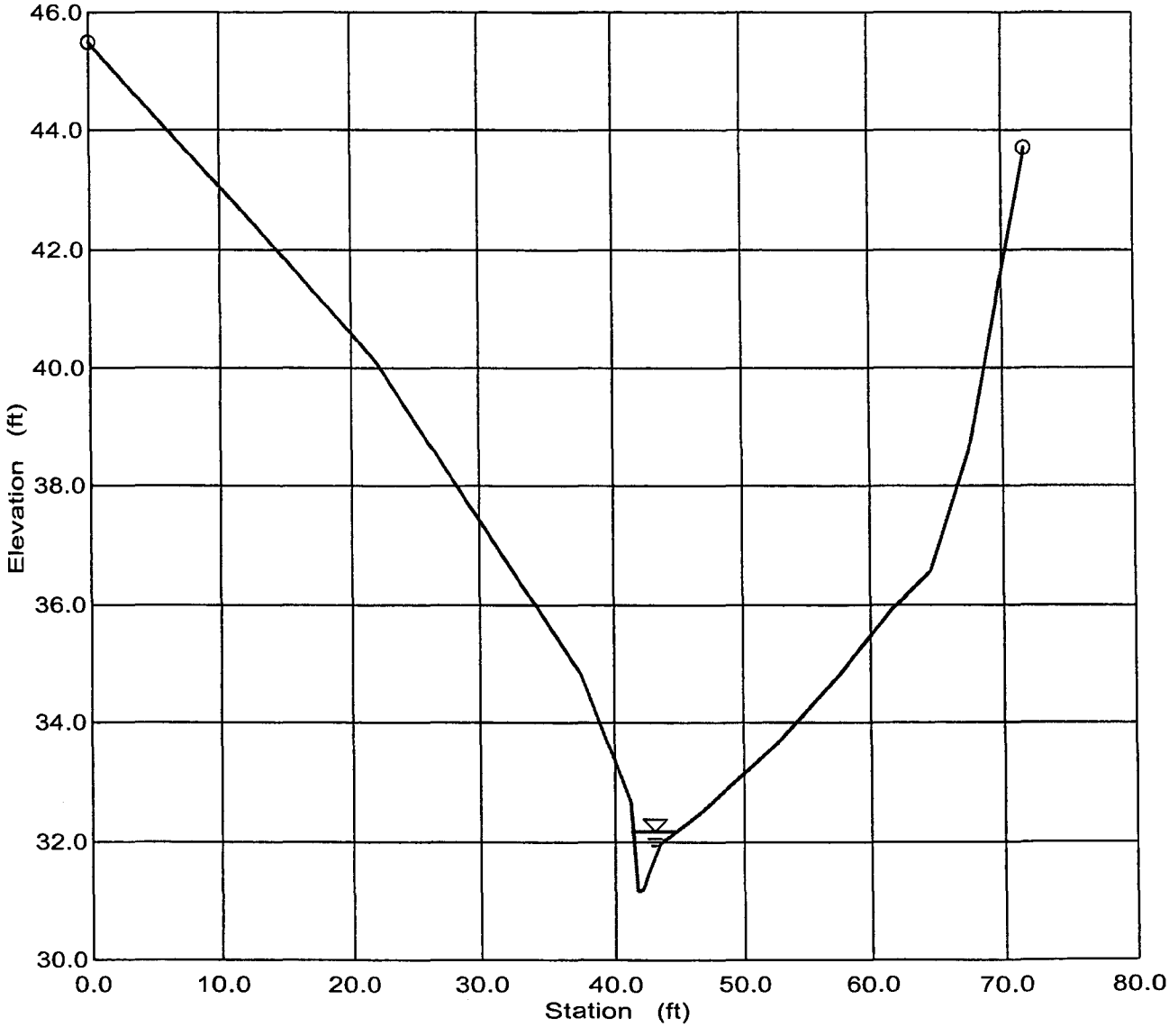
Subcatchment 12S: DA TO SECTION B



Section B POST
Cross Section for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2
Worksheet	SECTION B POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.025700	ft/ft
Water Surface Elevation	32.17	ft
Discharge	3.34	cfs



CHANNEL 2 STA 0+60 POST
Worksheet for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2
Worksheet	SECTION B POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

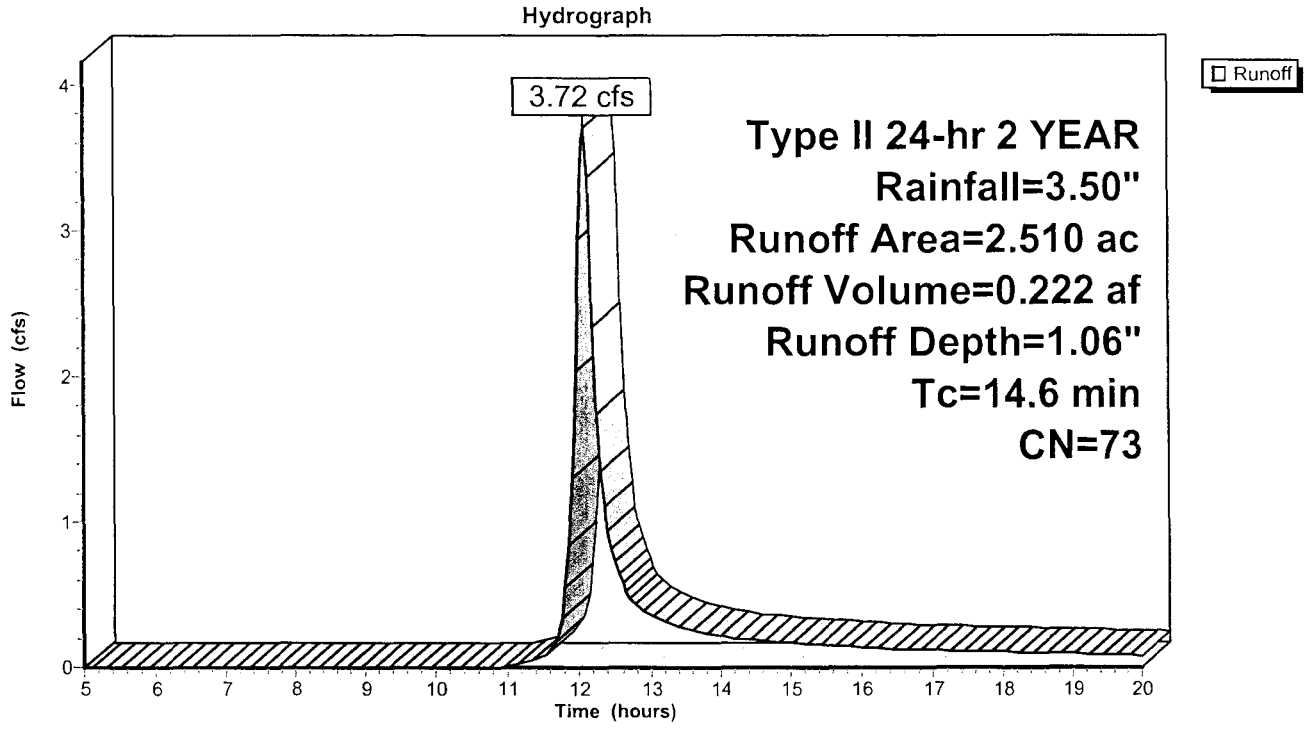
Input Data		
Channel Slope	0.025700	ft/ft

Elevation range: 31.15 ft to 45.48 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	45.48	0.00	71.74	0.055
11.33	42.74			
22.06	40.10			
30.21	37.35			
37.46	34.83			
41.14	32.68			
41.69	31.15			
42.16	31.17			
42.53	31.44			
43.49	31.97			
46.58	32.46			
53.01	33.72			
57.56	34.80			
61.61	35.89			
64.49	36.56			
67.56	38.74			
71.74	43.70			
Discharge	3.34	cfs		

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	32.17	ft
Flow Area	1.54	ft²
Wetted Perimeter	4.36	ft
Top Width	3.40	ft
Height	1.02	ft
Critical Depth	31.91	ft
Critical Slope	0.088399	ft/ft
Velocity	2.17	ft/s
Velocity Head	0.07	ft
Specific Energy	32.24	ft
Froude Number	0.57	
Flow is subcritical.		

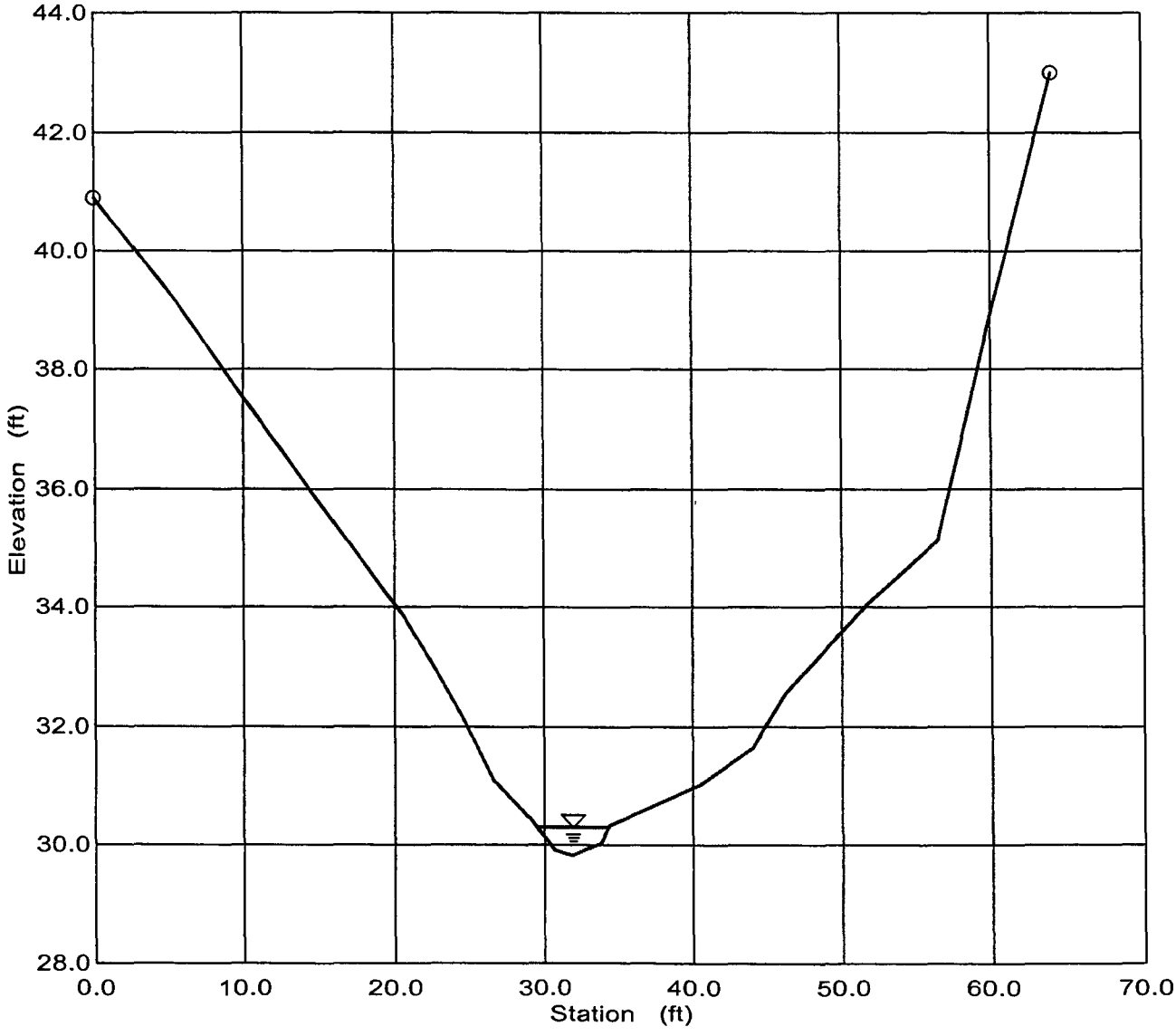
Subcatchment 13S: DA TO SECTION C



Section C POST
Cross Section for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2
Worksheet	SECTION C POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.043400	ft/ft
Water Surface Elevation	30.28	ft
Discharge	3.72	cfs



CHANNEL 2 STA 1+13 POST
Worksheet for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2
Worksheet	SECTION C POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

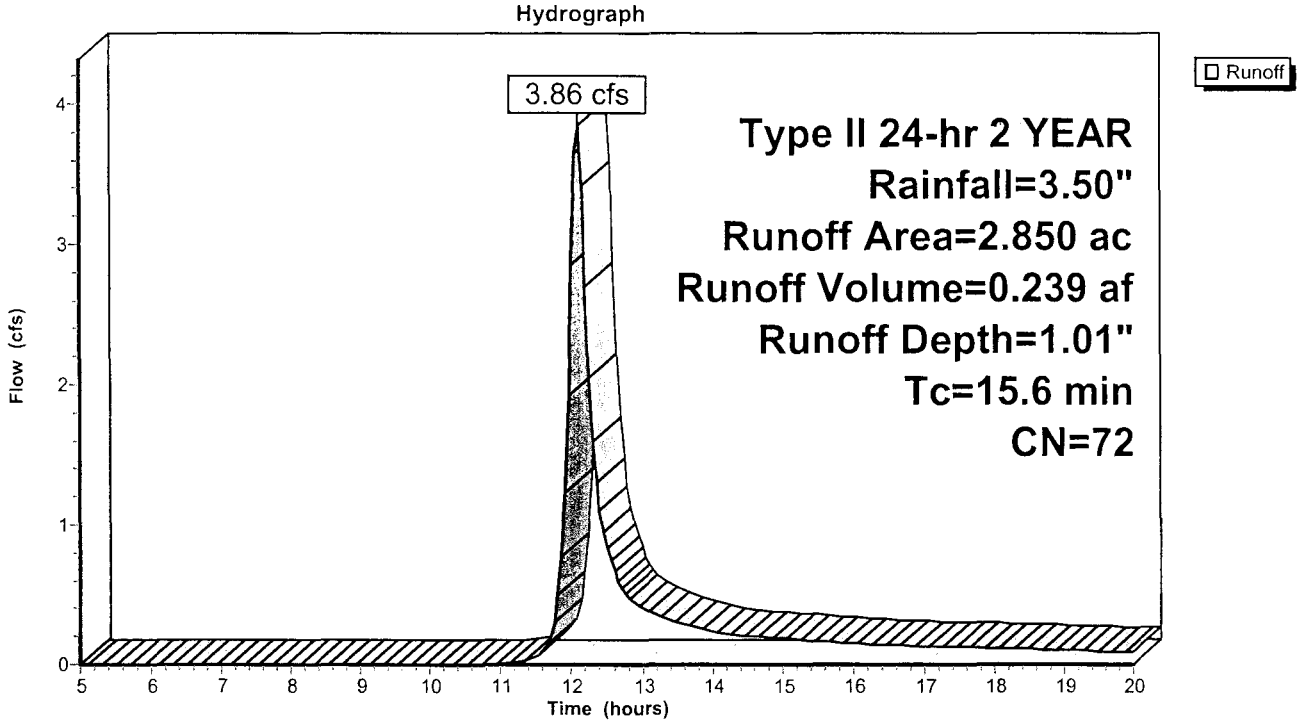
Input Data		
Channel Slope	0.043400	ft/ft

Elevation range: 29.81 ft to 43.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	40.89	0.00	64.06	0.055
5.55	39.15			
13.57	36.28			
20.56	33.85			
24.60	32.14			
26.50	31.10			
29.12	30.42			
30.63	29.92			
31.82	29.81			
33.82	30.04			
34.43	30.31			
40.56	31.00			
44.03	31.63			
46.30	32.55			
51.94	34.10			
56.46	35.14			
60.13	39.05			
64.06	43.00			
Discharge	3.72	cfs		

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	30.28	ft
Flow Area	1.48	ft^2
Wetted Perimeter	4.97	ft
Top Width	4.84	ft
Height	0.47	ft
Critical Depth	30.24	ft
Critical Slope	0.070085	ft/ft
Velocity	2.51	ft/s
Velocity Head	0.10	ft
Specific Energy	30.38	ft
Froude Number	0.80	
Flow is subcritical.		

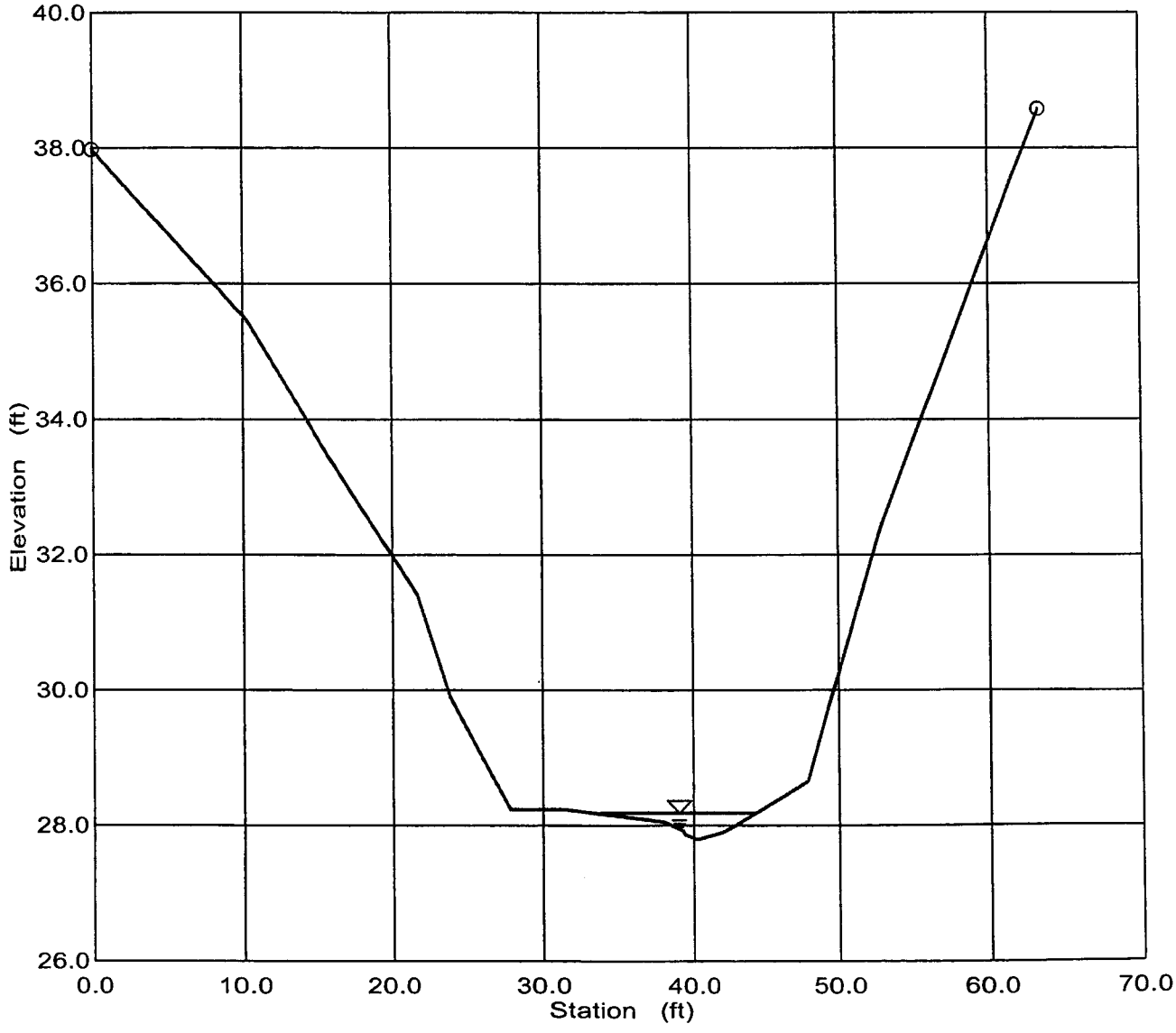
Subcatchment 14S: DA TO SECTION D



Section D POST
Cross Section for Irregular Channel

Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2
Worksheet	SECTION D POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.040	
Channel Slope	0.040000	ft/ft
Water Surface Elevation	28.16	ft
Discharge	3.86	cfs



CHANNEL 2 STA 1+50 POST
Worksheet for Irregular Channel

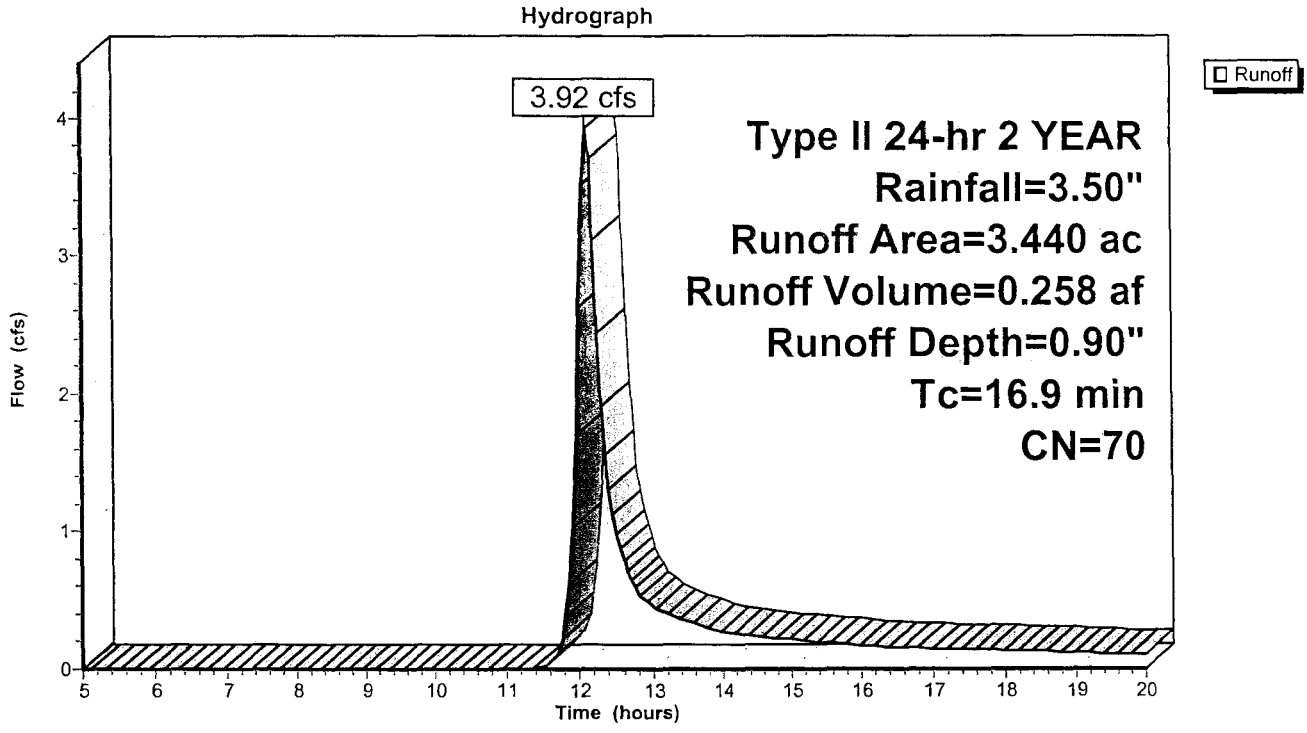
Project Description	
Project File	k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2
Worksheet	SECTION D POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.040000 ft/ft			
Elevation range: 27.77 ft to 38.57 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	37.95	0.00	63.40	0.040
10.21	35.47			
15.66	33.47			
21.58	31.41			
23.87	29.89			
27.88	28.23			
31.54	28.23			
38.10	28.04			
39.30	27.92			
39.49	27.87			
40.25	27.77			
42.00	27.88			
42.71	27.95			
46.37	28.42			
47.91	28.64			
52.99	32.43			
61.66	37.58			
63.40	38.57			
Discharge	3.86	cfs		

Results		
Wtd. Mannings Coefficient	0.040	
Water Surface Elevation	28.16	ft
Flow Area	1.73	ft²
Wetted Perimeter	10.54	ft
Top Width	10.50	ft
Height	0.39	ft
Critical Depth	28.16	ft
Critical Slope	0.042867	ft/ft
Velocity	2.23	ft/s
Velocity Head	0.08	ft
Specific Energy	28.24	ft
Froude Number	0.97	
Flow is subcritical.		

CHANNEL 3
REACH KLN

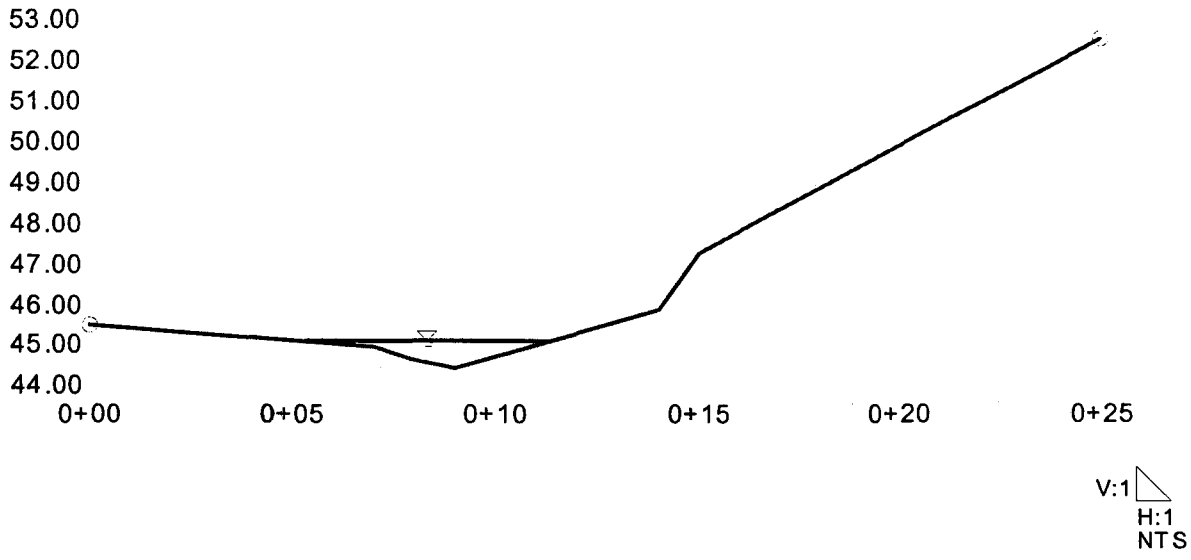
Subcatchment 3S: DA to DSECTION 'N'



Cross Section
Cross Section for Irregular Channel

Project Description	
Worksheet	Section N Pre
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.055	
Slope	0.036300	ft/ft
Water Surface Elevation	45.09	ft
Elevation Range	44.42 to 52.53	
Discharge	3.92	cfs



Worksheet
Worksheet for Irregular Channel

Project Description	
Worksheet	Section N Pre
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.036300	ft/ft
Discharge	3.92	cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Meth	Pavlovskii's Method

Results		
Mannings Coefficient	0.055	
Water Surface Elevation	45.09	ft
Elevation Range	44.42 to 52.53	
Flow Area	1.752	ft²
Wetted Perimeter	6.11	ft
Top Width	5.93	ft
Actual Depth	0.67	ft
Critical Elevation	45.00	ft
Critical Slope	0.069715	ft/ft
Velocity	2.24	ft/s
Velocity Head	0.08	ft
Specific Energy	45.17	ft
Froude Number	0.73	
Flow Type	Subcritical	

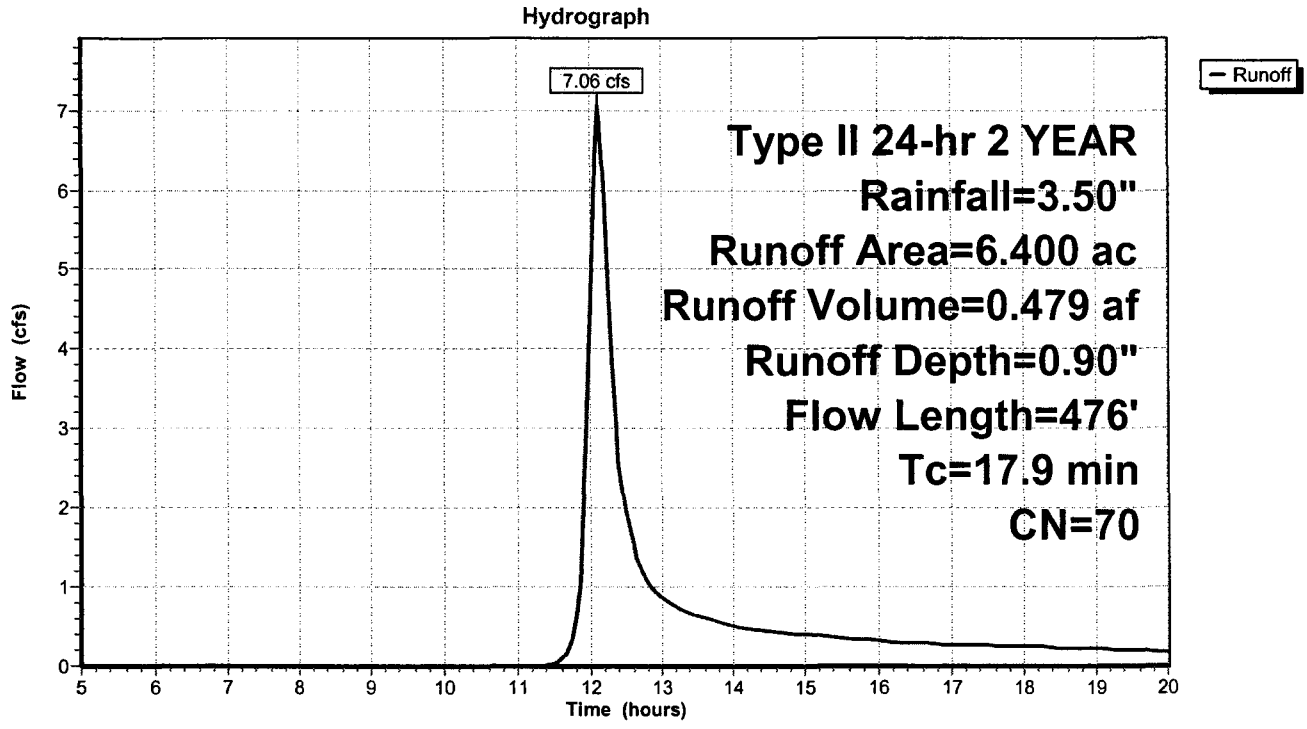
Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+25	0.055

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	45.48
0+07	44.97
0+08	44.60
0+09	44.42
0+10	44.71
0+12	45.30
0+14	45.86
0+15	47.23
0+25	52.53

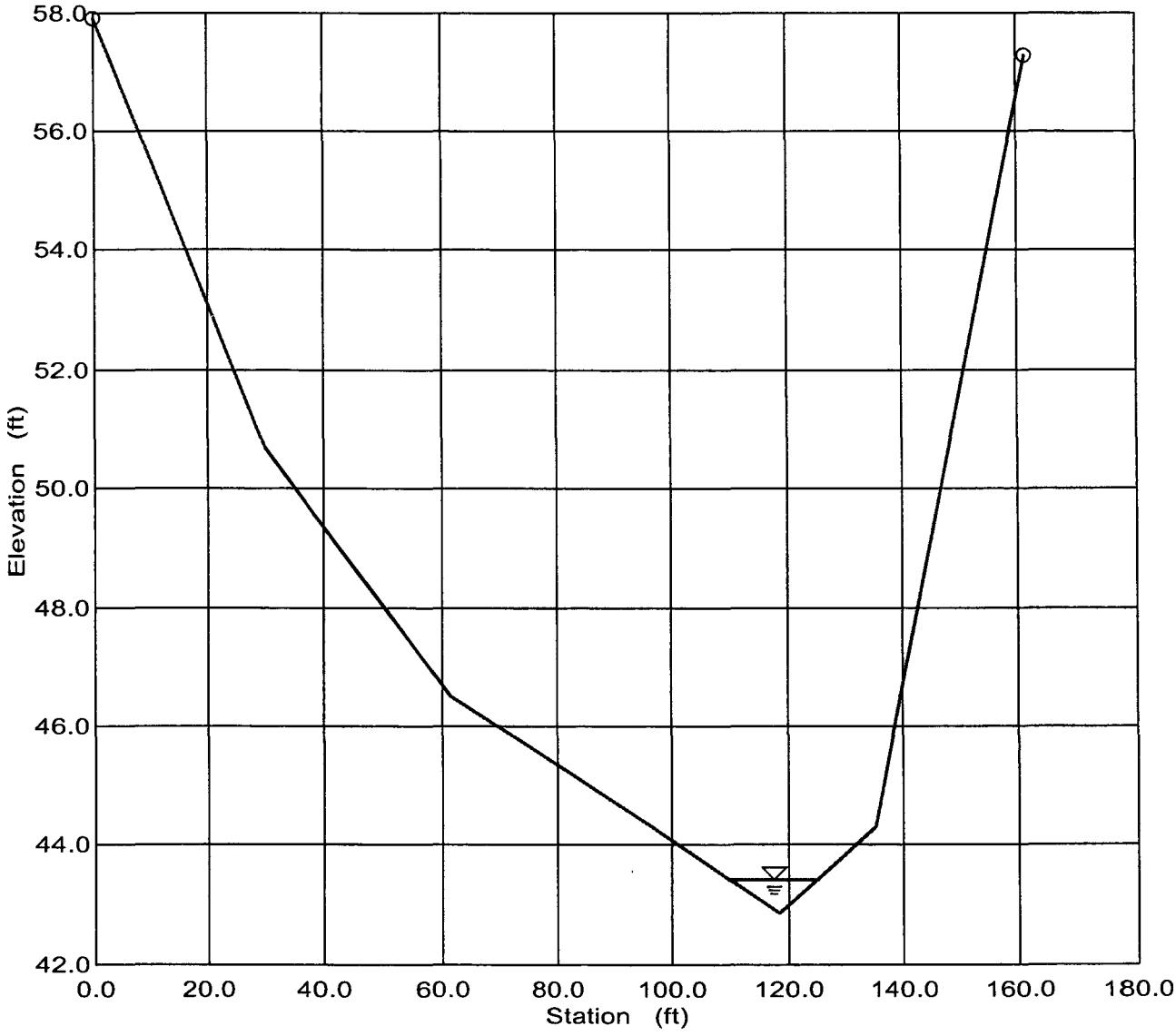
Subcatchment 1S: DA TO SECTION L



Section L PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION L
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.021700	ft/ft
Water Surface Elevation	43.42	ft
Discharge	7.28	cfs



CHANNEL 3 STA 0+00 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION L
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

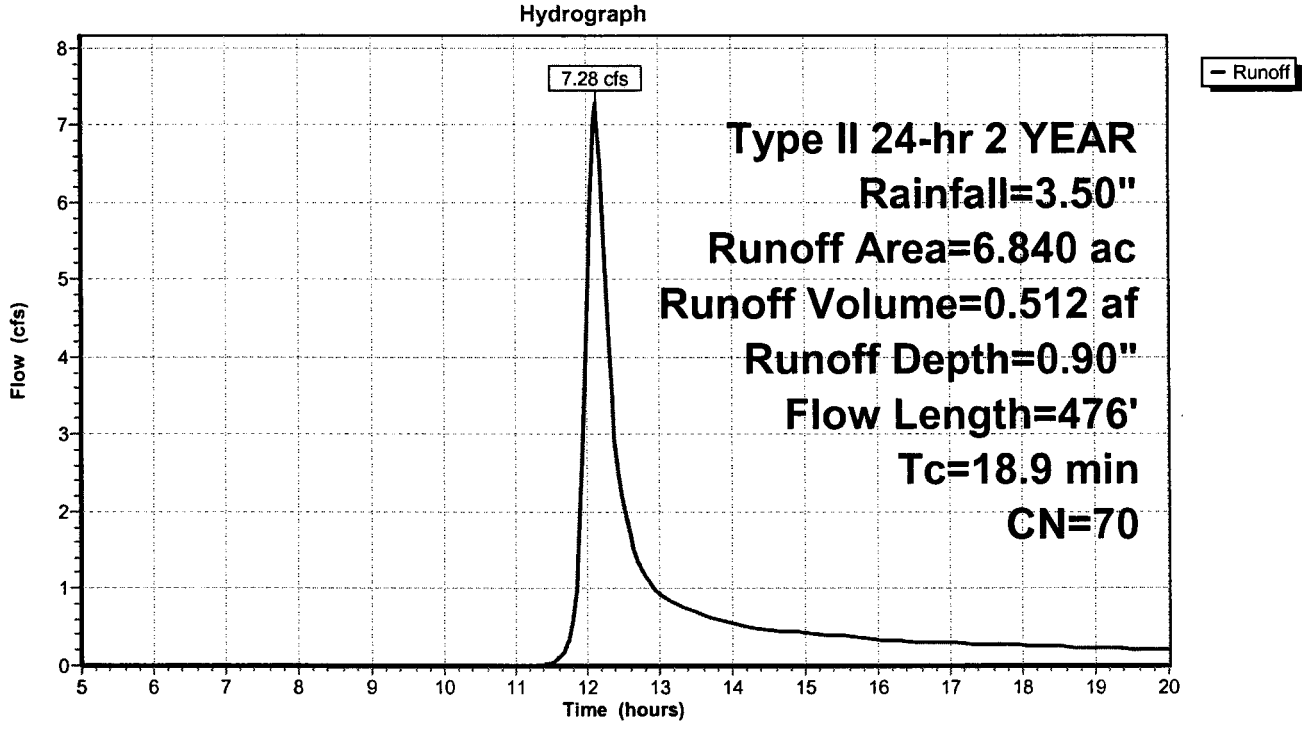
Input Data		
Channel Slope	0.021700 ft/ft	
Elevation range: 42.86 ft to 57.89 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	57.89	0.00	161.70	0.055
29.83	50.68			
61.34	46.50			
96.55	44.29			
118.55	42.86			
135.23	44.30			
161.70	57.29			

Discharge	7.28	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	43.42	ft
Flow Area	4.27	ft²
Wetted Perimeter	15.22	ft
Top Width	15.17	ft
Height	0.56	ft
Critical Depth	43.31	ft
Critical Slope	0.072829	ft/ft
Velocity	1.71	ft/s
Velocity Head	0.05	ft
Specific Energy	43.47	ft
Froude Number	0.57	
Flow is subcritical.		

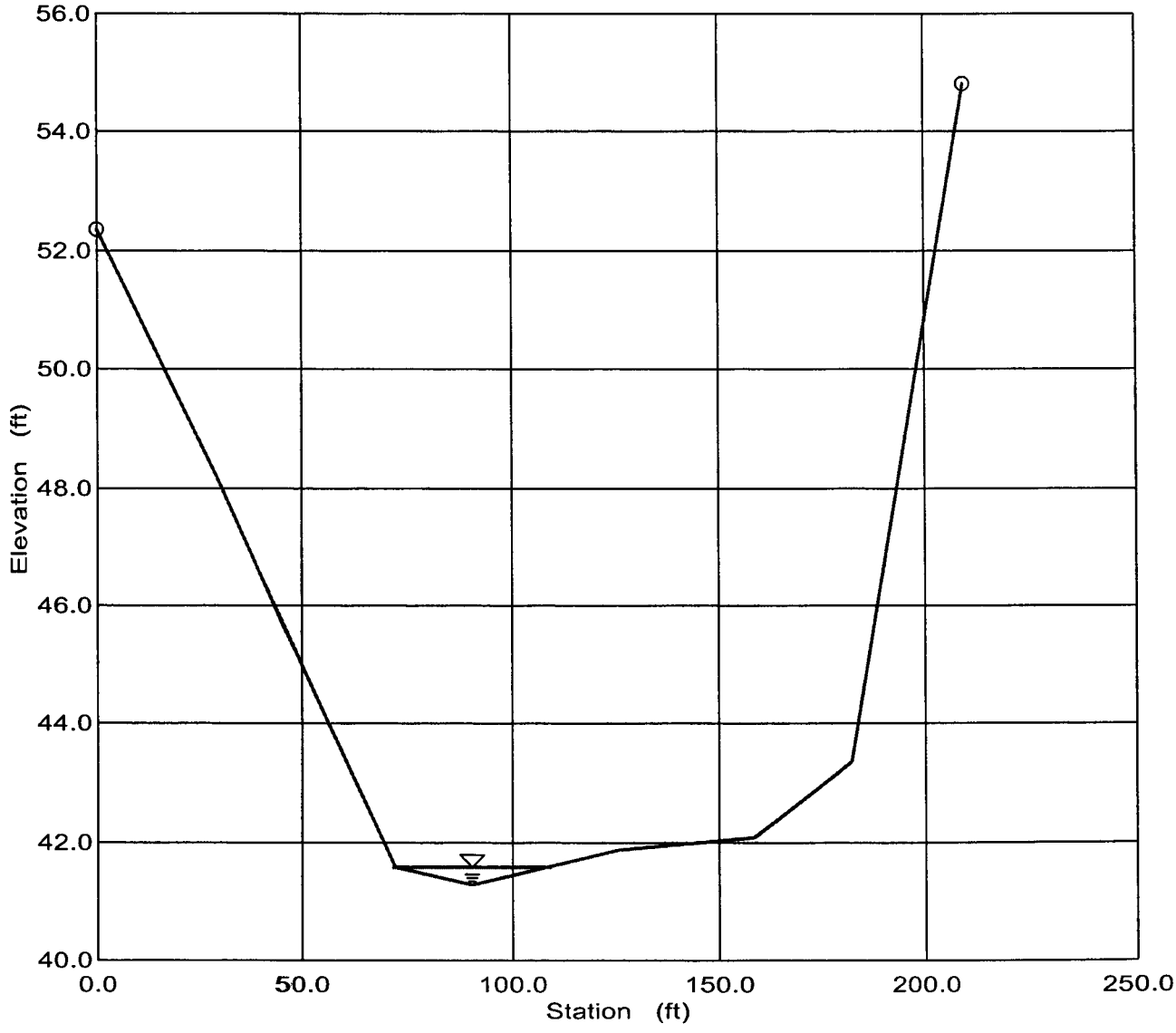
Subcatchment 2S: DA TO SECTION K



Section K PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION K
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.021700	ft/ft
Water Surface Elevation	41.58	ft
Discharge	7.06	cfs



CHANNEL 3 STA 0+46 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION K
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.021700	ft/ft

Elevation range: 41.27 ft to 54.82 ft.

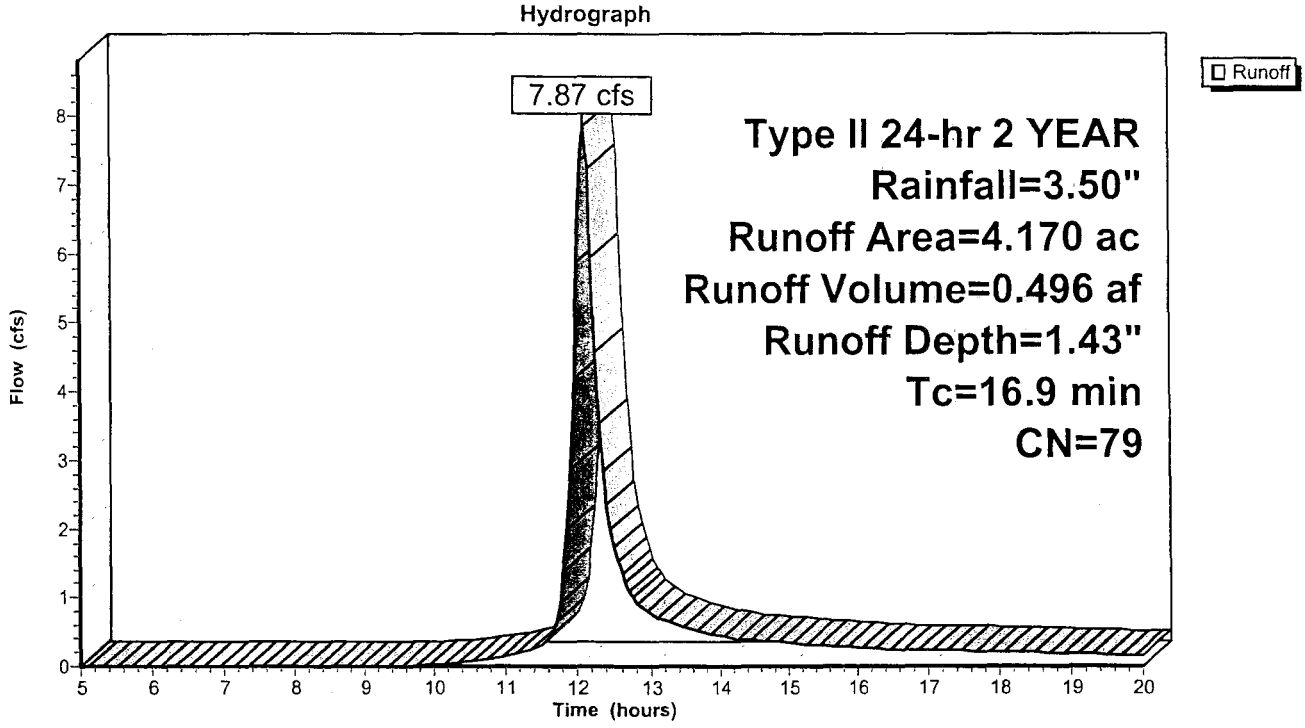
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	52.34	0.00	209.83	0.055
29.56	48.16			
71.70	41.56			
90.28	41.27			
126.20	41.86			
158.29	42.07			
182.06	43.35			
209.83	54.82			

Discharge	7.06	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	41.58	ft
Flow Area	6.02	ft²
Wetted Perimeter	37.64	ft
Top Width	37.63	ft
Height	0.31	ft
Critical Depth	41.51	ft
Critical Slope	0.089391	ft/ft
Velocity	1.17	ft/s
Velocity Head	0.02	ft
Specific Energy	41.60	ft
Froude Number	0.52	

Flow is subcritical.

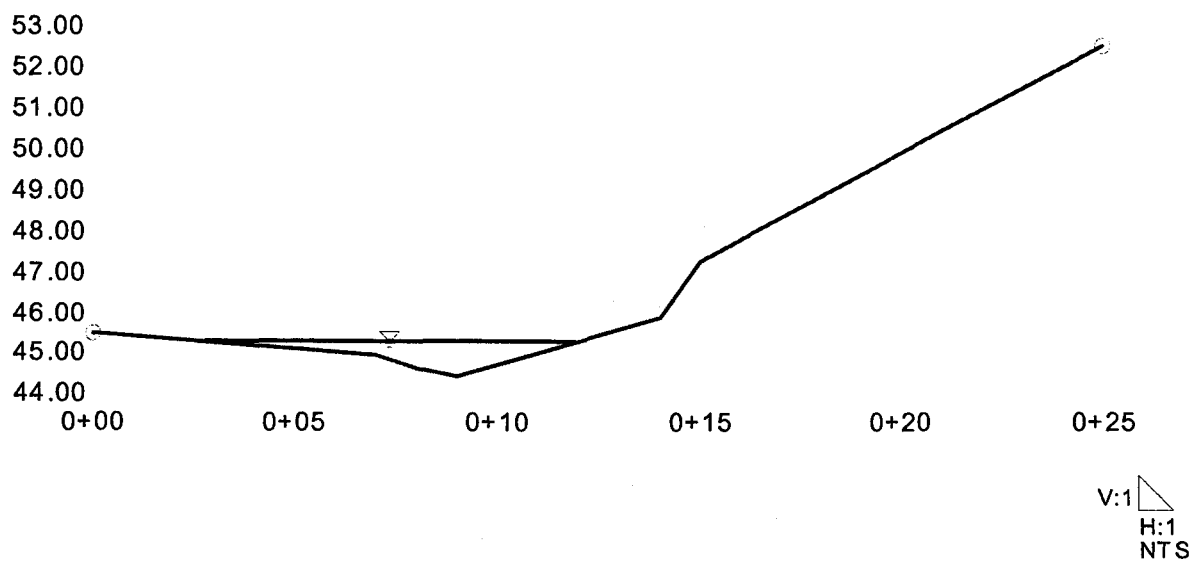
Subcatchment 13S: DA TO SECTION 'N'



Cross Section
Cross Section for Irregular Channel

Project Description	
Worksheet	Section N Post
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.055	
Slope	0.036300	ft/ft
Water Surface Elevation	45.28	ft
Elevation Range	44.42 to 52.53	
Discharge	7.87	cfs



Worksheet
Worksheet for Irregular Channel

Project Description	
Worksheet	Section N Post
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.036300	ft/ft
Discharge	7.87	cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Meth	Horton's Method

Results		
Mannings Coefficient	0.055	
Water Surface Elevation	45.28	ft
Elevation Range	44.42 to 52.53	
Flow Area	3.152	ft²
Wetted Perimeter	9.33	ft
Top Width	9.12	ft
Actual Depth	0.86	ft
Critical Elevation	45.19	ft
Critical Slope	0.066770	ft/ft
Velocity	2.50	ft/s
Velocity Head	0.10	ft
Specific Energy	45.37	ft
Froude Number	0.75	
Flow Type	Subcritical	

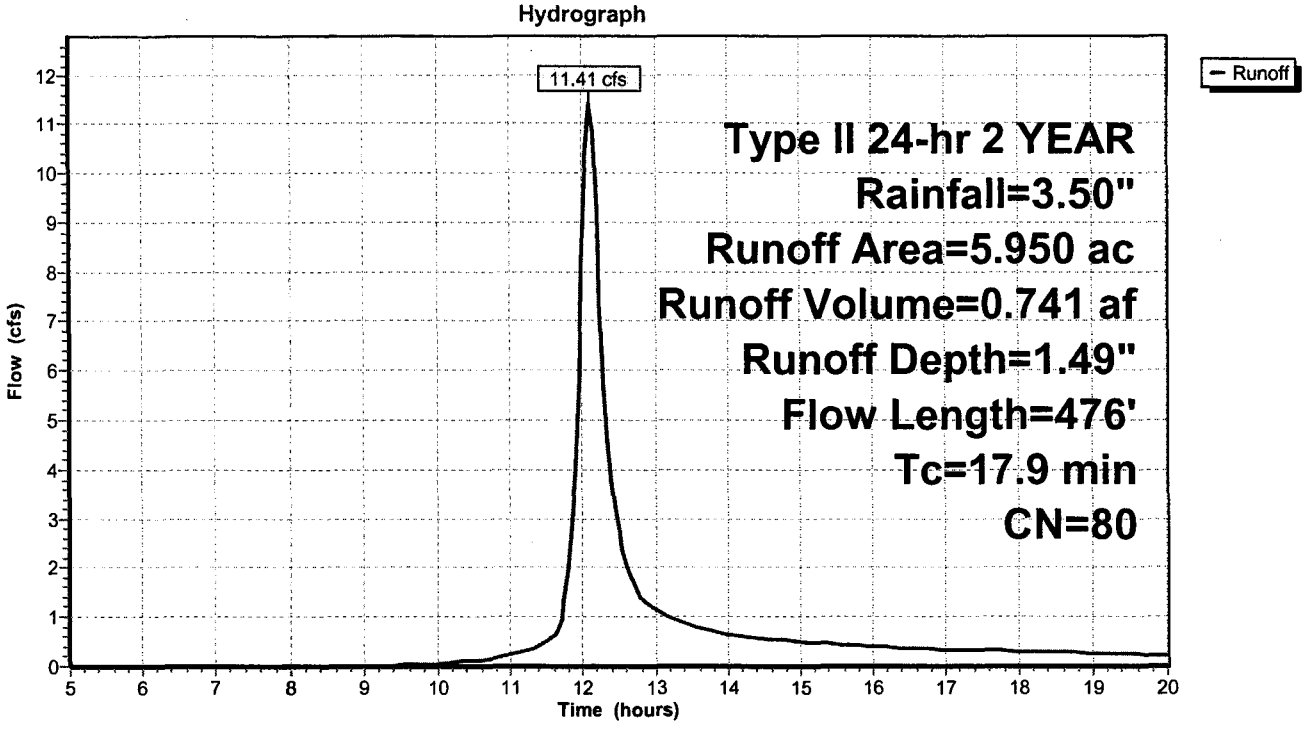
Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+25	0.055

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	45.48
0+07	44.97
0+08	44.60
0+09	44.42
0+10	44.71
0+12	45.30
0+14	45.86
0+15	47.23
0+25	52.53

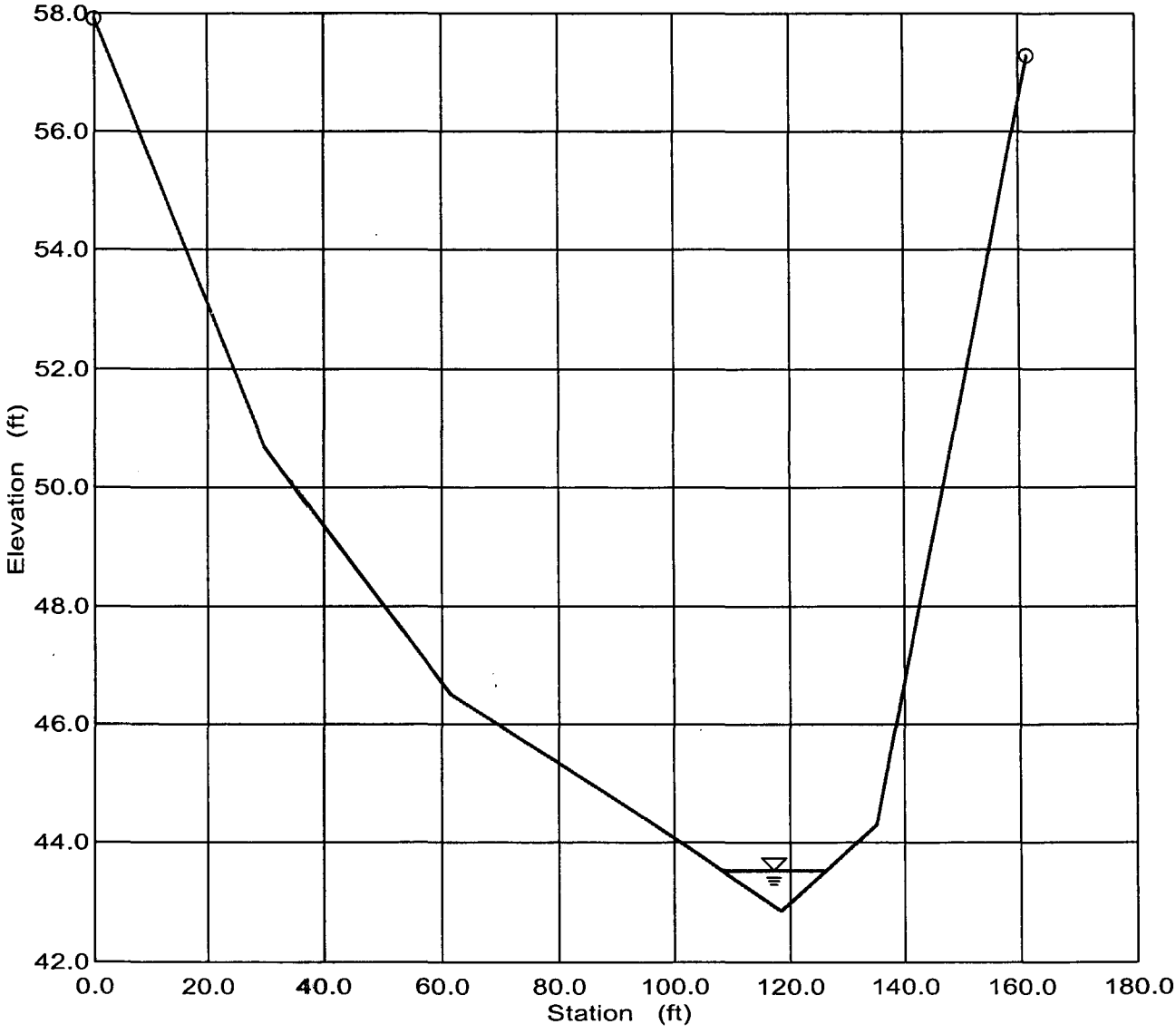
Subcatchment 11S: DA TO SECTION L



Section L POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION L POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.021700	ft/ft
Water Surface Elevation	43.53	ft
Discharge	11.41	cfs



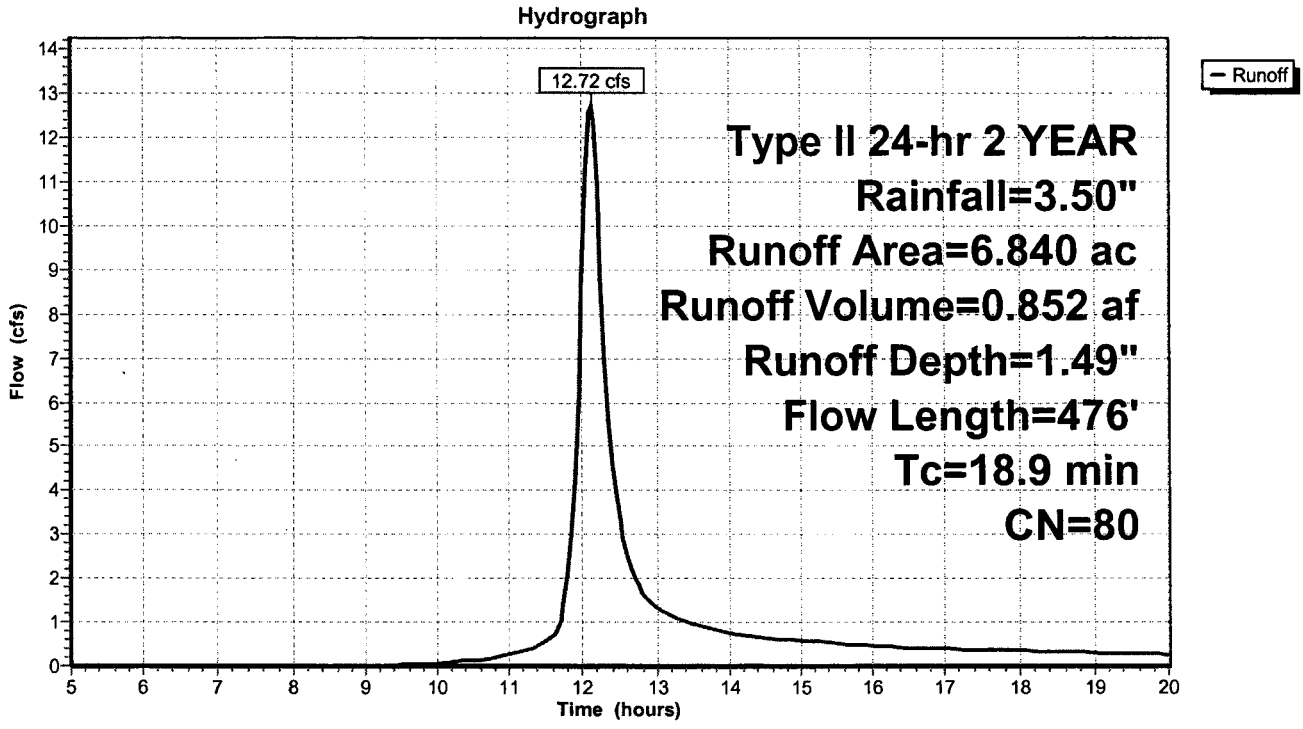
CHANNEL 3 STA 0+00 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION L POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data					
Channel Slope	0.021700 ft/ft				
Elevation range: 42.86 ft to 57.89 ft.					
Station (ft)	Elevation (ft)		Start Station	End Station	Roughness
0.00	57.89		0.00	161.70	0.055
29.83	50.68				
61.34	46.50				
96.55	44.29				
118.55	42.86				
135.23	44.30				
161.70	57.29				
Discharge	11.41	cfs			

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	43.53	ft
Flow Area	5.98	ft^2
Wetted Perimeter	18.01	ft
Top Width	17.96	ft
Height	0.67	ft
Critical Depth	43.40	ft
Critical Slope	0.068592	ft/ft
Velocity	1.91	ft/s
Velocity Head	0.06	ft
Specific Energy	43.58	ft
Froude Number	0.58	
Flow is subcritical.		

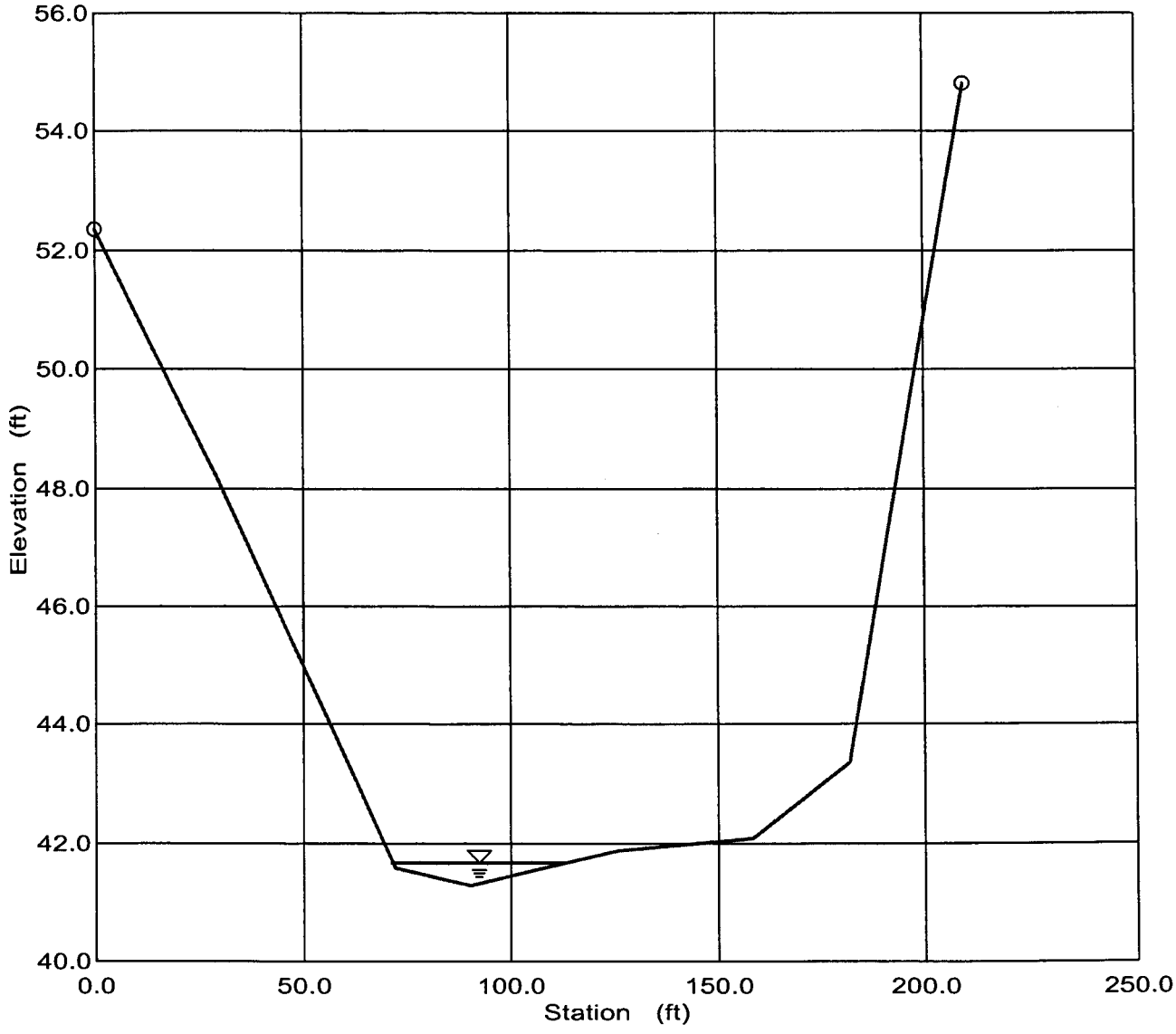
Subcatchment 12S: DA TO SECTION K



Section K POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION K POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.021700	ft/ft
Water Surface Elevation	41.66	ft
Discharge	12.72	cfs



CHANNEL 3 STA 0+46 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION K POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

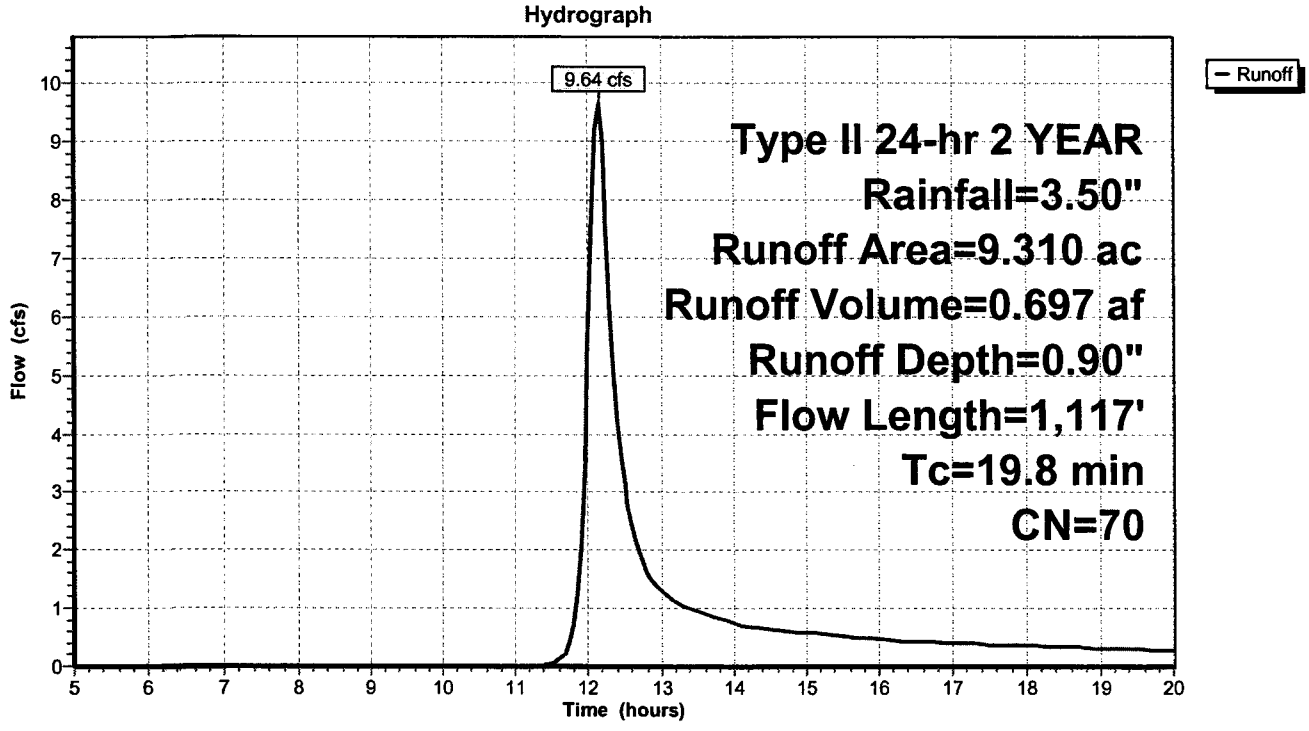
Input Data		
Channel Slope	0.021700 ft/ft	
Elevation range: 41.27 ft to 54.82 ft.		
Station (ft)	Elevation (ft)	
0.00	52.34	
29.56	48.16	
71.70	41.56	
90.28	41.27	
126.20	41.86	
158.29	42.07	
182.06	43.35	
209.83	54.82	
Discharge	12.72	cfs

Start Station	End Station	Roughness
0.00	209.83	0.055

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	41.66	ft
Flow Area	9.01	ft²
Wetted Perimeter	42.66	ft
Top Width	42.64	ft
Height	0.39	ft
Critical Depth	41.57	ft
Critical Slope	0.082247	ft/ft
Velocity	1.41	ft/s
Velocity Head	0.03	ft
Specific Energy	41.69	ft
Froude Number	0.54	
Flow is subcritical.		

CHANNEL 4
REACH EFG

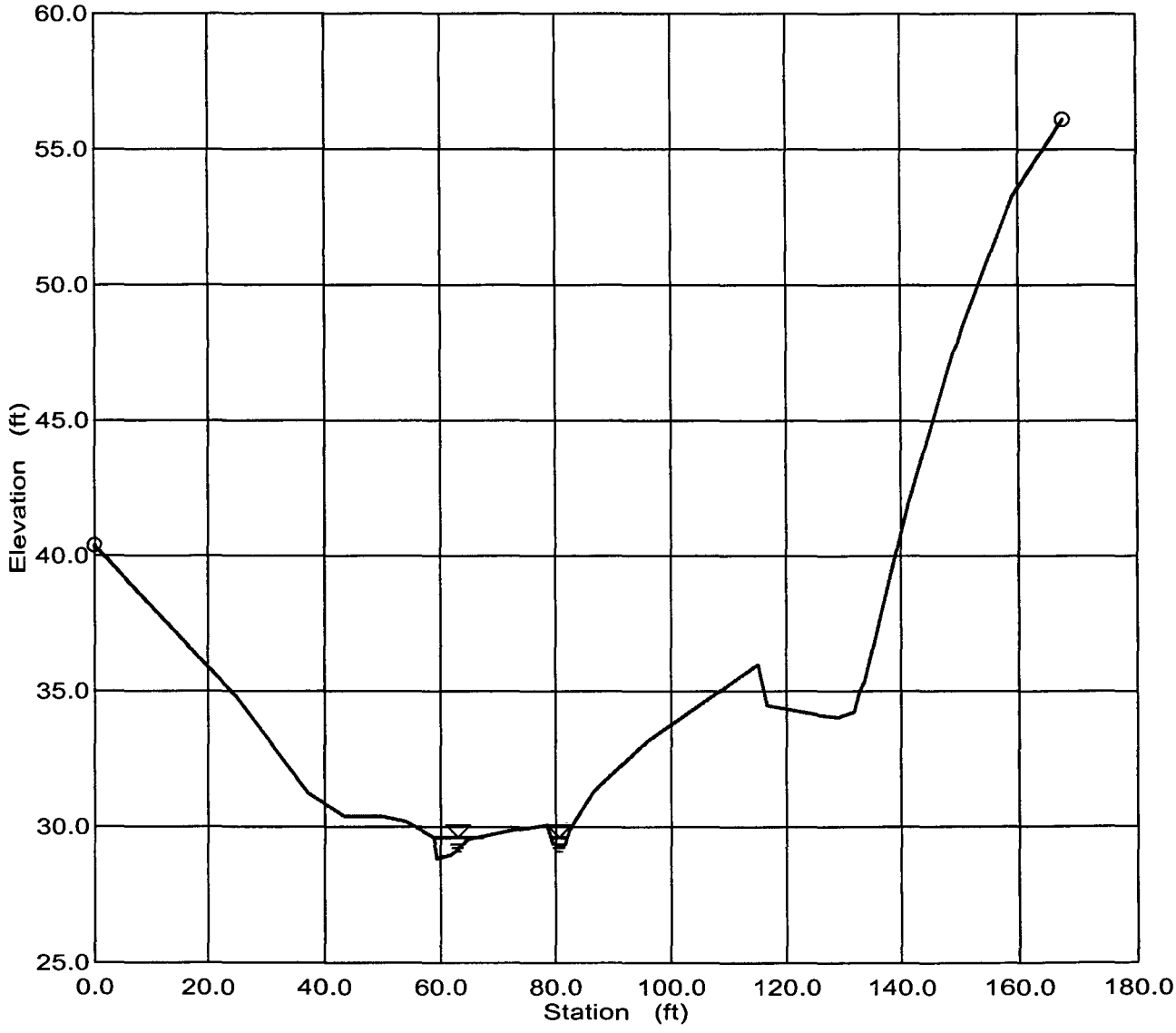
Subcatchment 1S: DA TO SECTION G



Section G PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION G
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.034800	ft/ft
Water Surface Elevation	29.60	ft
Discharge	9.64	cfs



CHANNEL 4 STA 0+00 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION G
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.034800 ft/ft			
Elevation range: 28.81 ft to 56.05 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	40.35	0.00	167.65	0.055
24.63	34.76			
37.14	31.18			
43.26	30.37			
49.70	30.38			
53.78	30.19			
58.85	29.57			
59.23	28.81			
61.79	28.96			
62.56	29.08			
64.82	29.49			
71.98	29.82			
78.33	30.04			
79.45	29.39			
80.47	29.28			
81.38	29.25			
82.33	29.86			
86.77	31.27			
96.11	33.14			
115.14	35.95			
116.60	34.47			
118.15	34.38			
126.53	34.07			
129.30	34.01			
131.93	34.16			
132.88	34.92			
133.67	35.32			
141.38	41.82			
149.27	47.49			
149.74	47.77			
150.67	48.43			
159.33	53.24			
167.65	56.05			
Discharge	9.64	cfs		

Results

CHANNEL 4 STA 0+00 PRE

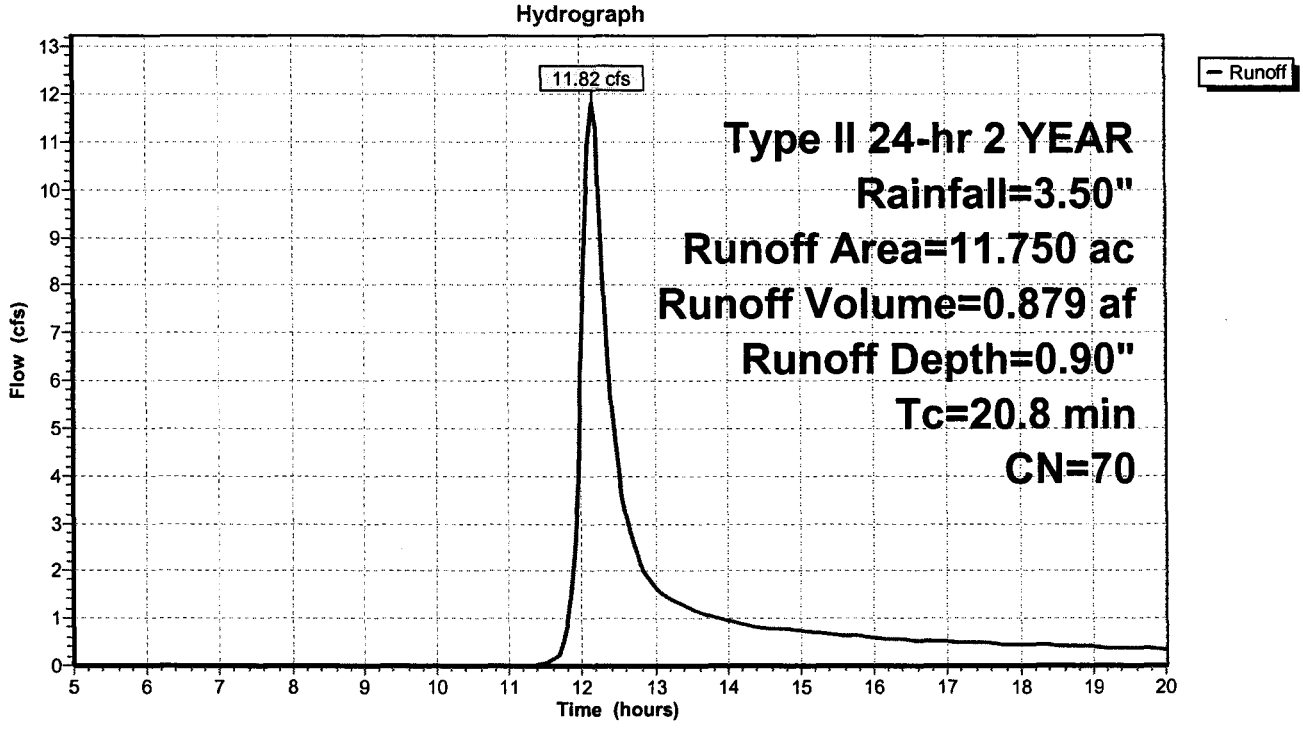
Worksheet for Irregular Channel

Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	29.60	ft
Flow Area	4.01	ft^2
Wetted Perimeter	12.21	ft
Top Width	11.51	ft
Height	0.79	ft
Critical Depth	29.49	ft
Critical Slope	0.068644	ft/ft
Velocity	2.40	ft/s
Velocity Head	0.09	ft
Specific Energy	29.69	ft
Froude Number	0.72	

Flow is subcritical.

Flow is divided.

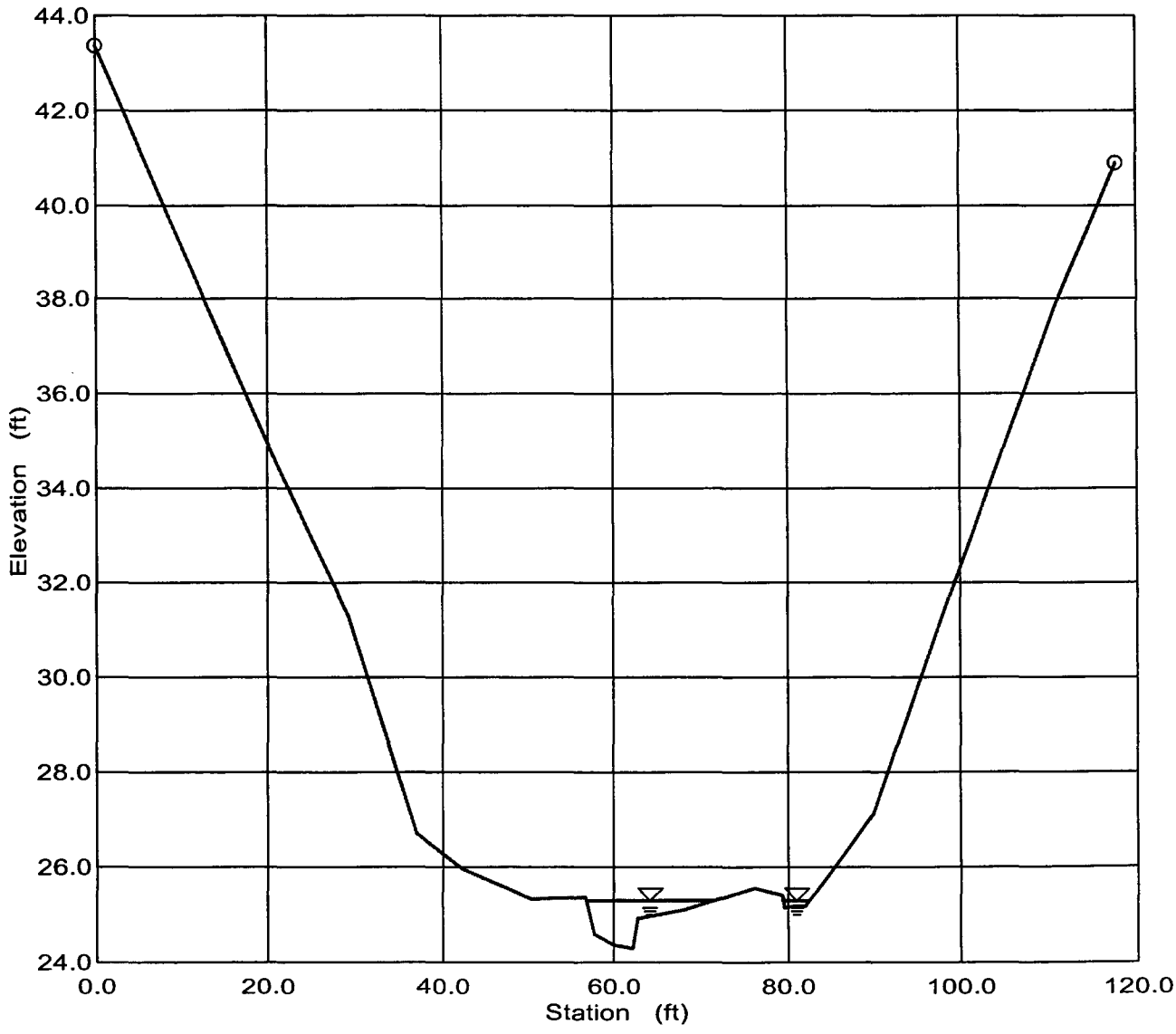
Subcatchment 2S: AREA TO SECTION F



Section F PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.014400	ft/ft
Water Surface Elevation	25.30	ft
Discharge	11.82	cfs



CHANNEL 4 STA 1+10 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.014400	ft/ft

Elevation range: 24.27 ft to 43.37 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	43.37	0.00	117.90	0.055
19.81	35.03			
29.21	31.29			
36.96	26.69			
42.14	25.94			
50.37	25.31			
56.79	25.36			
57.87	24.57			
59.92	24.35			
62.32	24.27			
62.75	24.91			
68.24	25.11			
76.15	25.54			
79.33	25.41			
79.68	25.15			
80.87	25.17			
82.02	25.19			
87.10	26.41			
90.02	27.12			
98.81	31.69			
111.48	38.05			
117.90	40.89			

Discharge	11.82	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	25.30	ft
Flow Area	6.97	ft^2
Wetted Perimeter	18.43	ft
Top Width	17.77	ft
Height	1.03	ft
Critical Depth	25.02	ft
Critical Slope	0.064988	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.04	ft
Specific Energy	25.34	ft

CHANNEL 4 STA 1+10 PRE

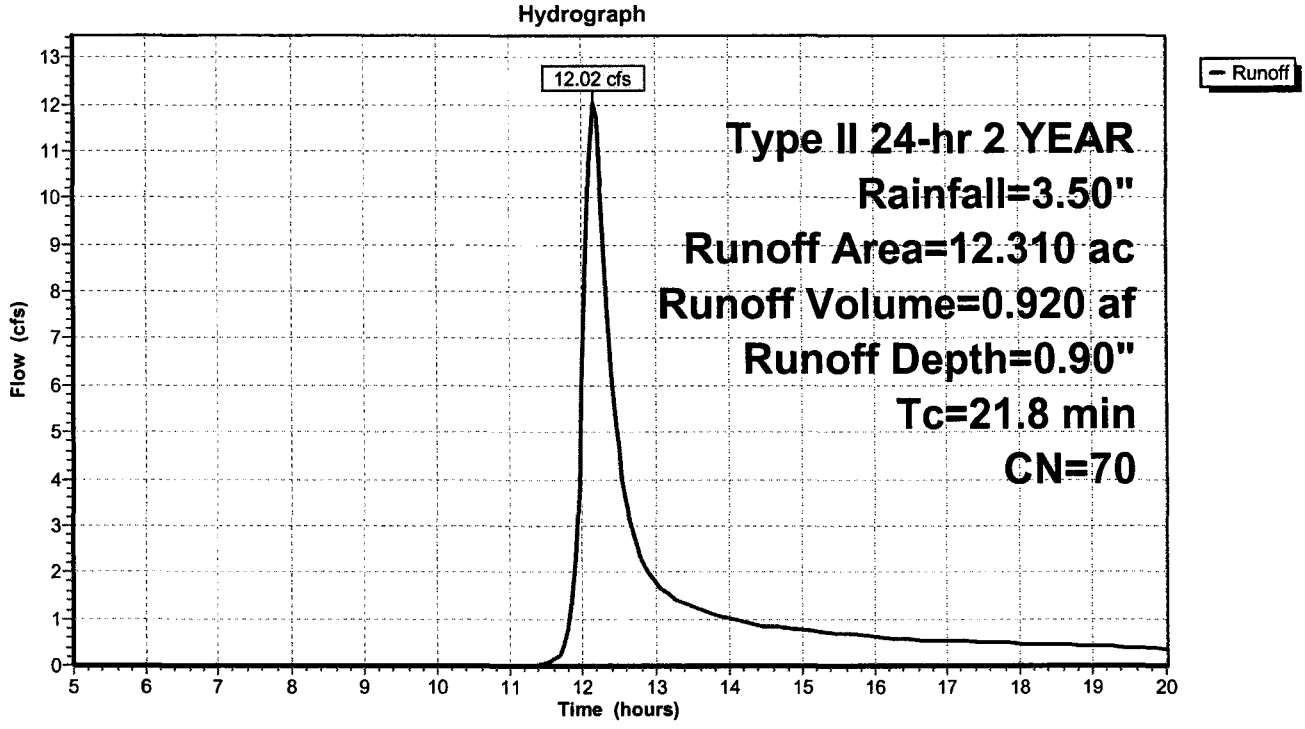
Worksheet for Irregular Channel

Froude Number	0.48

Flow is subcritical.

Flow is divided.

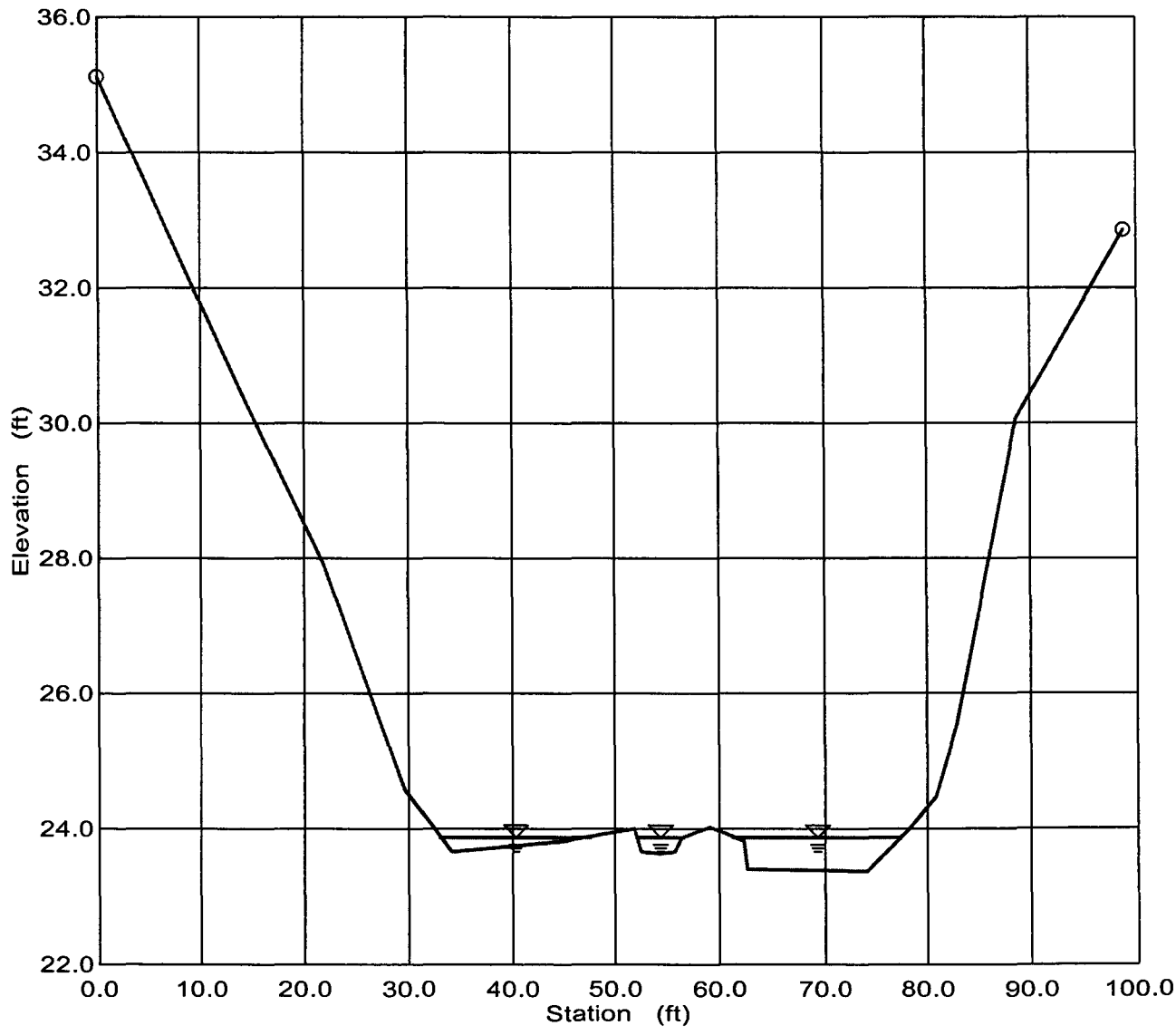
Subcatchment 3S: AREA TO SECTION E



Section E PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION E
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.014400	ft/ft
Water Surface Elevation	23.87	ft
Discharge	12.02	cfs



CHANNEL 4 STA 1+60 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION E
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.014400	ft/ft

Elevation range: 23.37 ft to 35.10 ft.

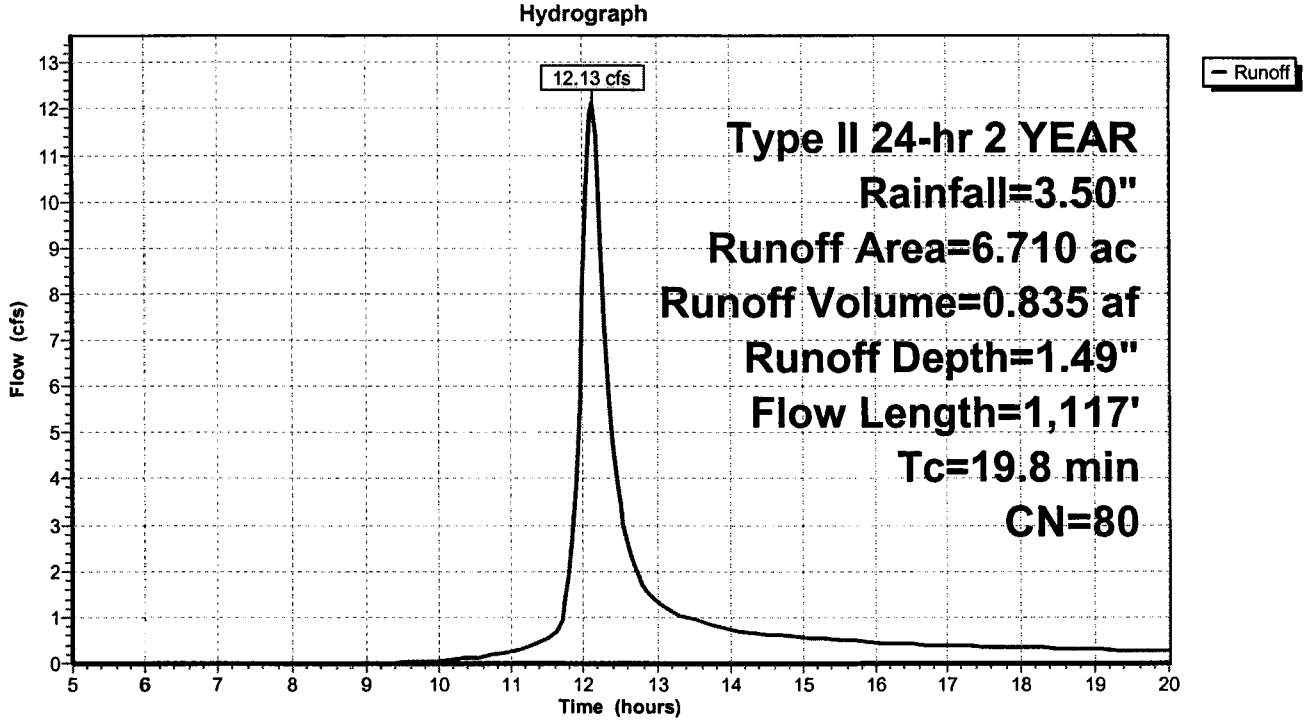
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	35.10	0.00	98.85	0.055
13.85	30.48			
21.76	27.90			
29.59	24.55			
34.07	23.66			
44.99	23.80			
51.91	23.98			
52.59	23.65			
54.42	23.63			
55.66	23.66			
56.34	23.85			
59.16	24.02			
62.24	23.80			
62.60	23.39			
74.32	23.37			
78.34	23.99			
80.92	24.45			
82.81	25.51			
88.64	30.05			
98.85	32.84			

Discharge	12.02	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	23.87	ft
Flow Area	9.17	ft²
Wetted Perimeter	35.63	ft
Top Width	35.31	ft
Height	0.50	ft
Critical Depth	23.71	ft
Critical Slope	0.074815	ft/ft
Velocity	1.31	ft/s
Velocity Head	0.03	ft
Specific Energy	23.89	ft
Froude Number	0.45	

Flow is subcritical.

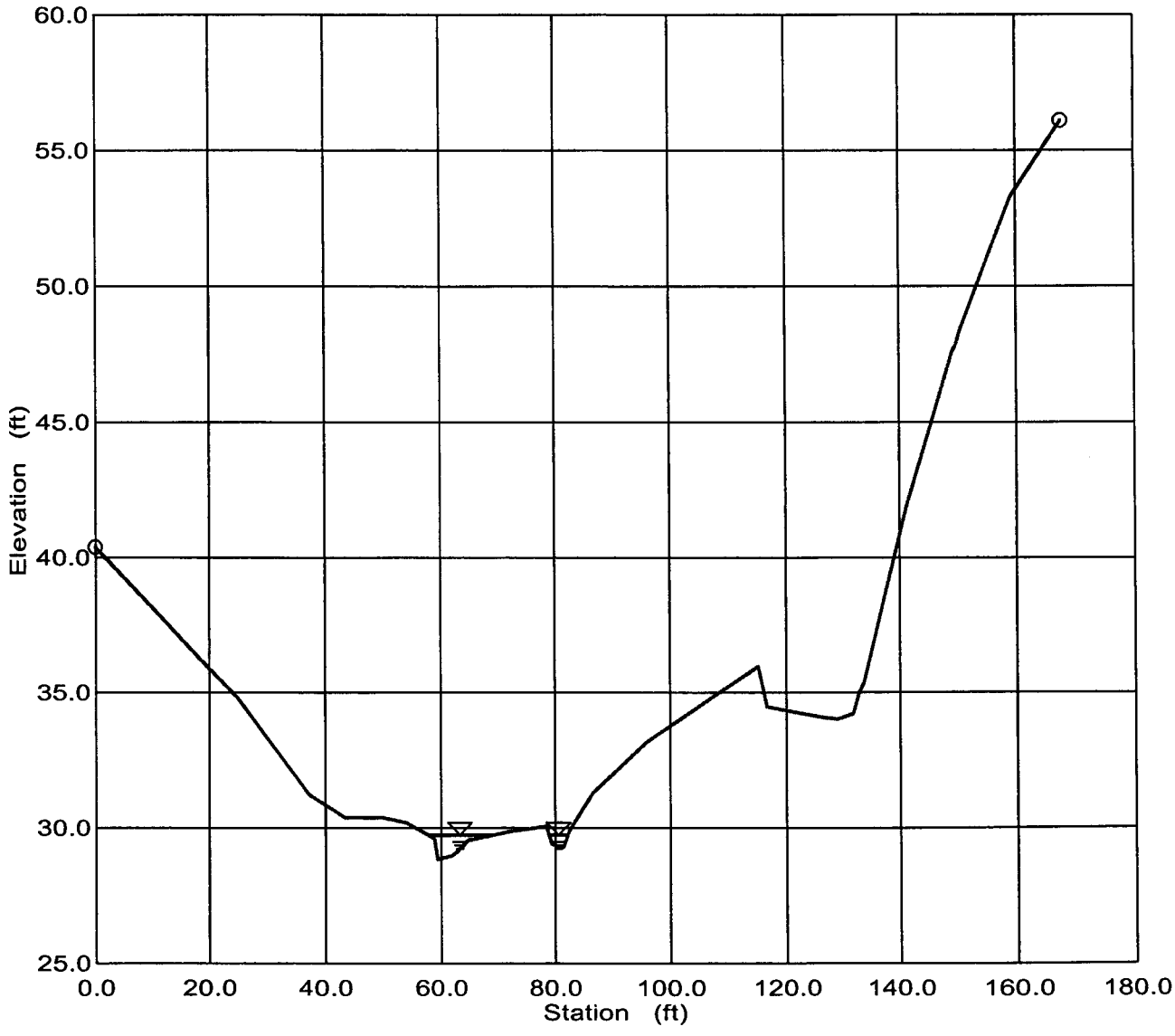
Subcatchment 11S: DA TO SECTION G



Section G POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION G POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.034800	ft/ft
Water Surface Elevation	29.68	ft
Discharge	12.13	cfs



CHANNEL 4 STA 0+00 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION G POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.034800 ft/ft			
Elevation range: 28.81 ft to 56.05 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	40.35	0.00	167.65	0.055
24.63	34.76			
37.14	31.18			
43.26	30.37			
49.70	30.38			
53.78	30.19			
58.85	29.57			
59.23	28.81			
61.79	28.96			
62.56	29.08			
64.82	29.49			
71.98	29.82			
78.33	30.04			
79.45	29.39			
80.47	29.28			
81.38	29.25			
82.33	29.86			
86.77	31.27			
96.11	33.14			
115.14	35.95			
116.60	34.47			
118.15	34.38			
126.53	34.07			
129.30	34.01			
131.93	34.16			
132.88	34.92			
133.67	35.32			
141.38	41.82			
149.27	47.49			
149.74	47.77			
150.67	48.43			
159.33	53.24			
167.65	56.05			
Discharge	12.13	cfs		

Results

CHANNEL 4 STA 0+00 POST

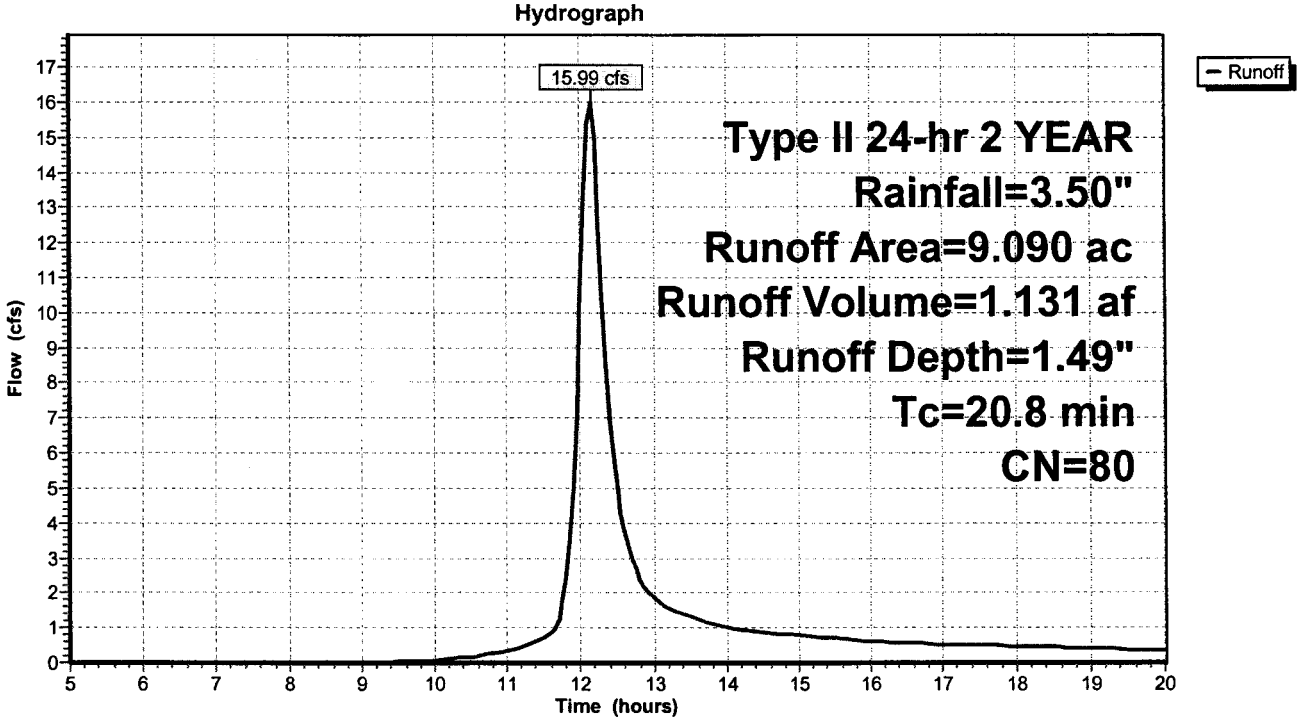
Worksheet for Irregular Channel

Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	29.68	ft
Flow Area	4.97	ft^2
Wetted Perimeter	14.73	ft
Top Width	13.99	ft
Height	0.87	ft
Critical Depth	29.57	ft
Critical Slope	0.067987	ft/ft
Velocity	2.44	ft/s
Velocity Head	0.09	ft
Specific Energy	29.77	ft
Froude Number	0.72	

Flow is subcritical.

Flow is divided.

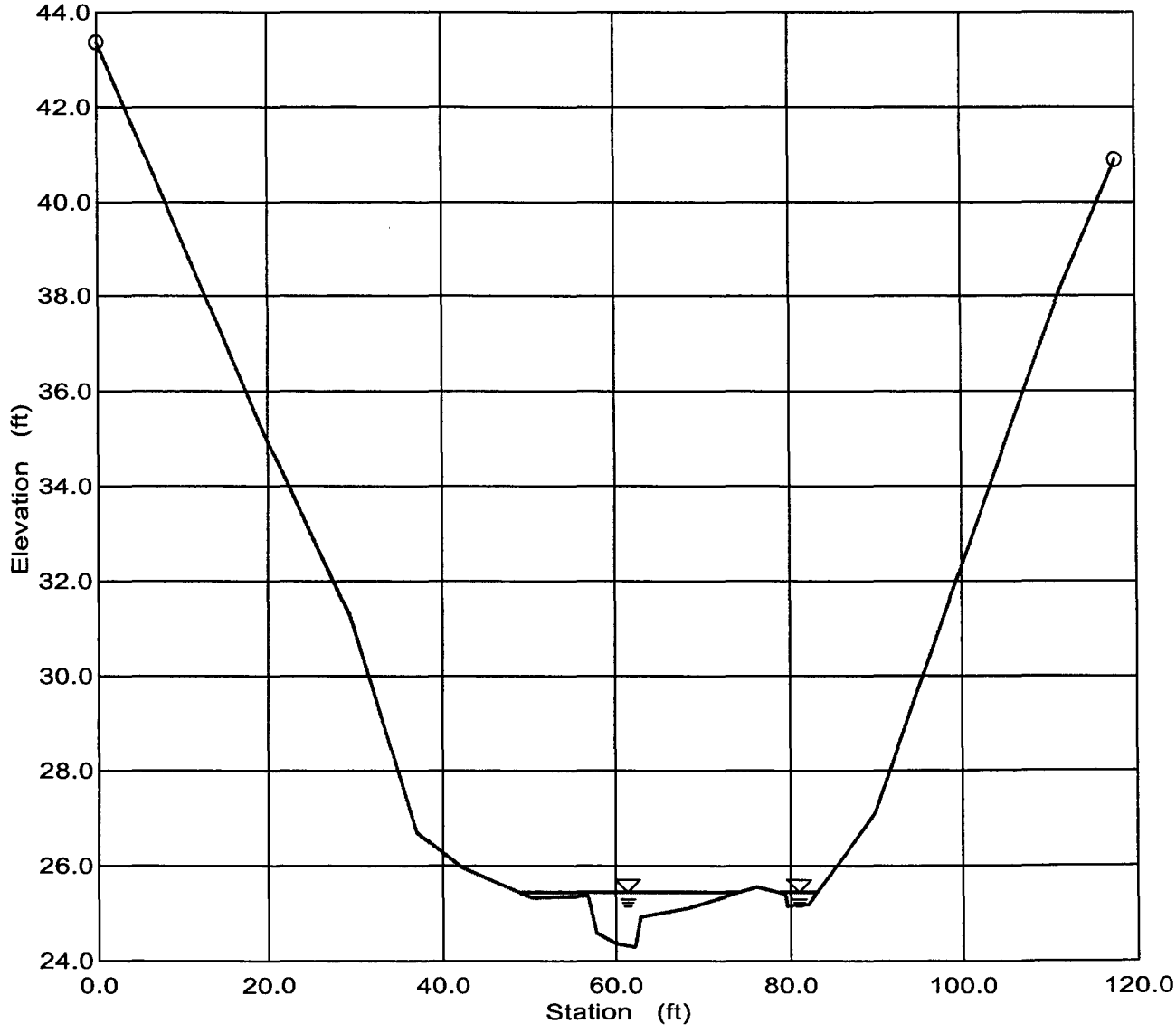
Subcatchment 12S: AREA TO SECTION F



Section F POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION F POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.014400	ft/ft
Water Surface Elevation	25.43	ft
Discharge	15.99	cfs



CHANNEL 4 STA 1+10 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION F POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.014400	ft/ft

Elevation range: 24.27 ft to 43.37 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	43.37	0.00	117.90	0.055
19.81	35.03			
29.21	31.29			
36.96	26.69			
42.14	25.94			
50.37	25.31			
56.79	25.36			
57.87	24.57			
59.92	24.35			
62.32	24.27			
62.75	24.91			
68.24	25.11			
76.15	25.54			
79.33	25.41			
79.68	25.15			
80.87	25.17			
82.02	25.19			
87.10	26.41			
90.02	27.12			
98.81	31.69			
111.48	38.05			
117.90	40.89			
Discharge	15.99	cfs		

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	25.43	ft
Flow Area	10.15	ft^2
Wetted Perimeter	29.99	ft
Top Width	29.25	ft
Height	1.16	ft
Critical Depth	25.14	ft
Critical Slope	0.064180	ft/ft
Velocity	1.57	ft/s
Velocity Head	0.04	ft
Specific Energy	25.46	ft

CHANNEL 4 STA 1+10 POST

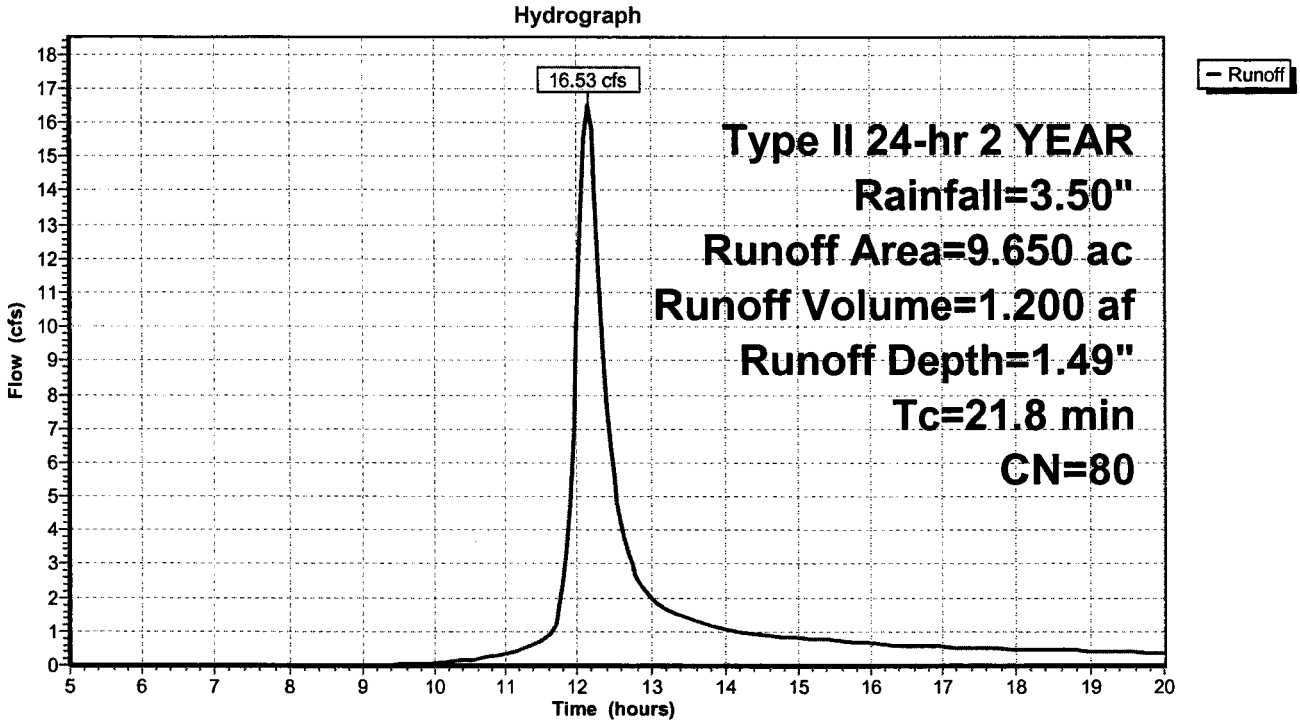
Worksheet for Irregular Channel

Froude Number	0.47

Flow is subcritical.

Flow is divided.

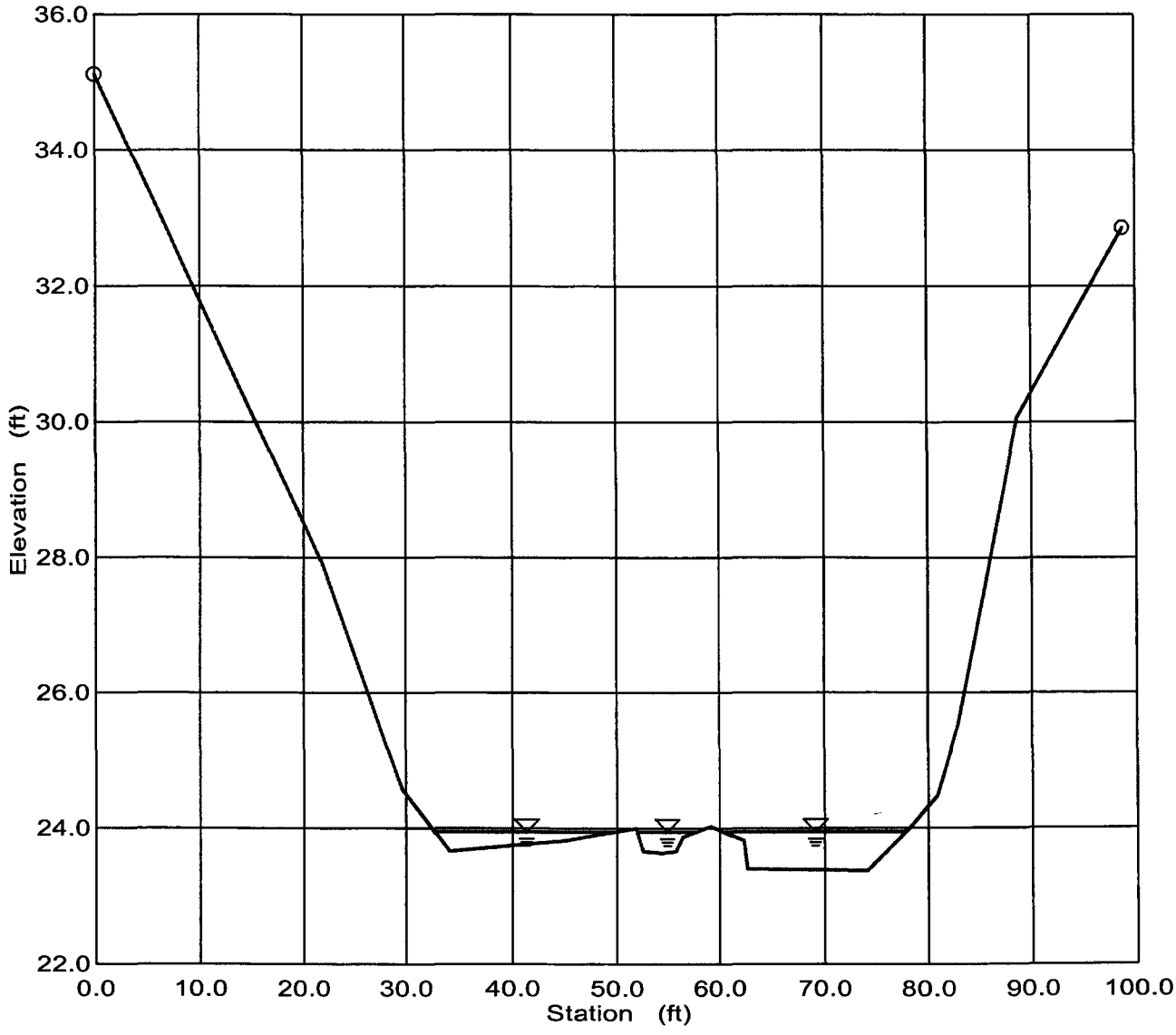
Subcatchment 13S: AREA TO SECTION E



Section E POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION E POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.014400	ft/ft
Water Surface Elevation	23.94	ft
Discharge	16.53	cfs



CHANNEL 4 STA 1+60 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION E POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.014400 ft/ft

Elevation range: 23.37 ft to 35.10 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	35.10	0.00	98.85	0.055
13.85	30.48			
21.76	27.90			
29.59	24.55			
34.07	23.66			
44.99	23.80			
51.91	23.98			
52.59	23.65			
54.42	23.63			
55.66	23.66			
56.34	23.85			
59.16	24.02			
62.24	23.80			
62.60	23.39			
74.32	23.37			
78.34	23.99			
80.92	24.45			
82.81	25.51			
88.64	30.05			
98.85	32.84			

Discharge 16.53 cfs

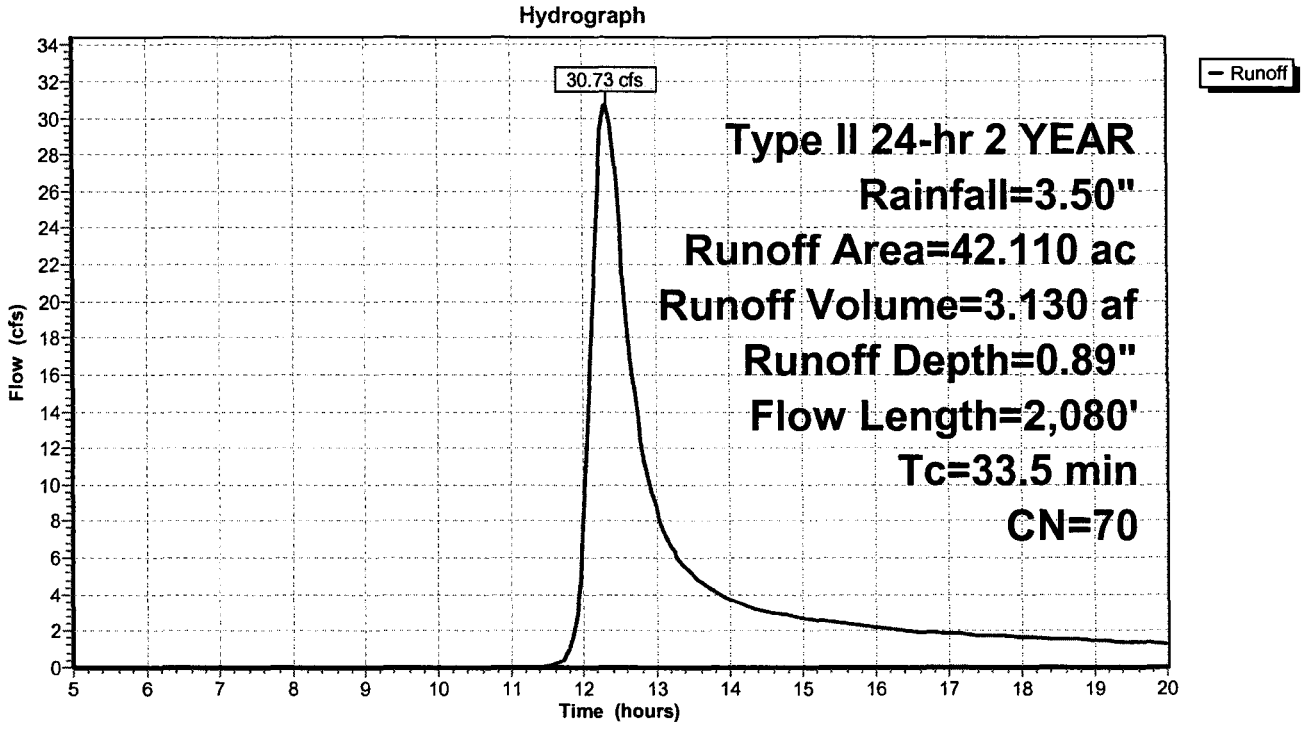
Results

Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	23.94	ft
Flow Area	11.77	ft^2
Wetted Perimeter	41.31	ft
Top Width	40.95	ft
Height	0.57	ft
Critical Depth	23.77	ft
Critical Slope	0.073690	ft/ft
Velocity	1.40	ft/s
Velocity Head	0.03	ft
Specific Energy	23.97	ft
Froude Number	0.46	

Flow is subcritical.

CHANNEL 5
REACH HIJ

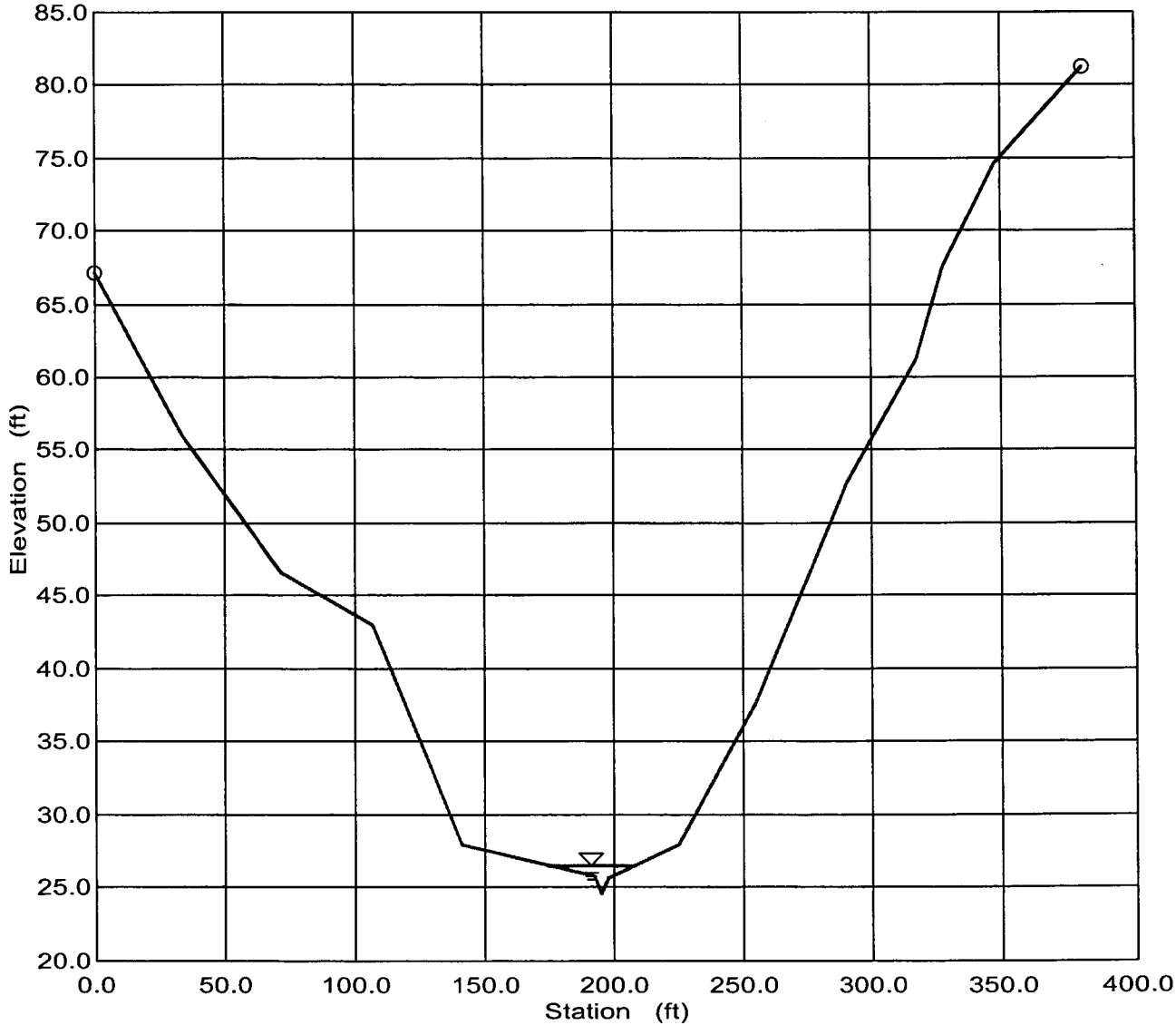
Subcatchment 1S: DA TO SECTION J



Section J PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION J
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.007739	ft/ft
Water Surface Elevation	26.53	ft
Discharge	30.73	cfs



CHANNEL 5 STA 0+00 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION J
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

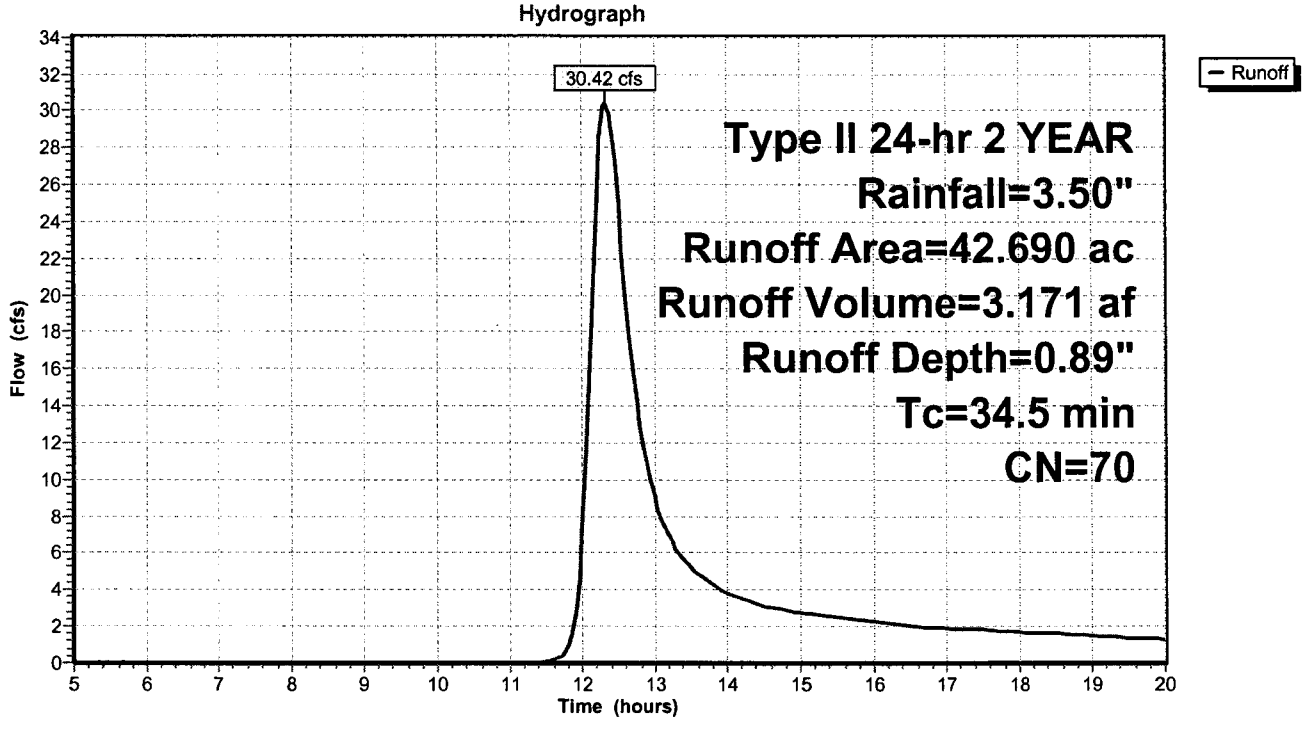
Input Data		
Channel Slope	0.007739	ft/ft

Elevation range: 24.53 ft to 81.26 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	67.07	0.00	380.57	0.055
34.02	55.96			
71.76	46.55			
106.69	42.96			
141.53	27.92			
192.30	25.77			
195.00	24.53			
197.99	25.67			
224.67	27.97			
254.79	37.53			
290.17	52.81			
317.48	61.22			
327.63	67.48			
347.81	74.53			
380.57	81.26			
Discharge	30.73	cfs		

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	26.53	ft
Flow Area	19.05	ft^2
Wetted Perimeter	34.09	ft
Top Width	33.55	ft
Height	2.00	ft
Critical Depth	26.12	ft
Critical Slope	0.060396	ft/ft
Velocity	1.61	ft/s
Velocity Head	0.04	ft
Specific Energy	26.57	ft
Froude Number	0.38	
Flow is subcritical.		

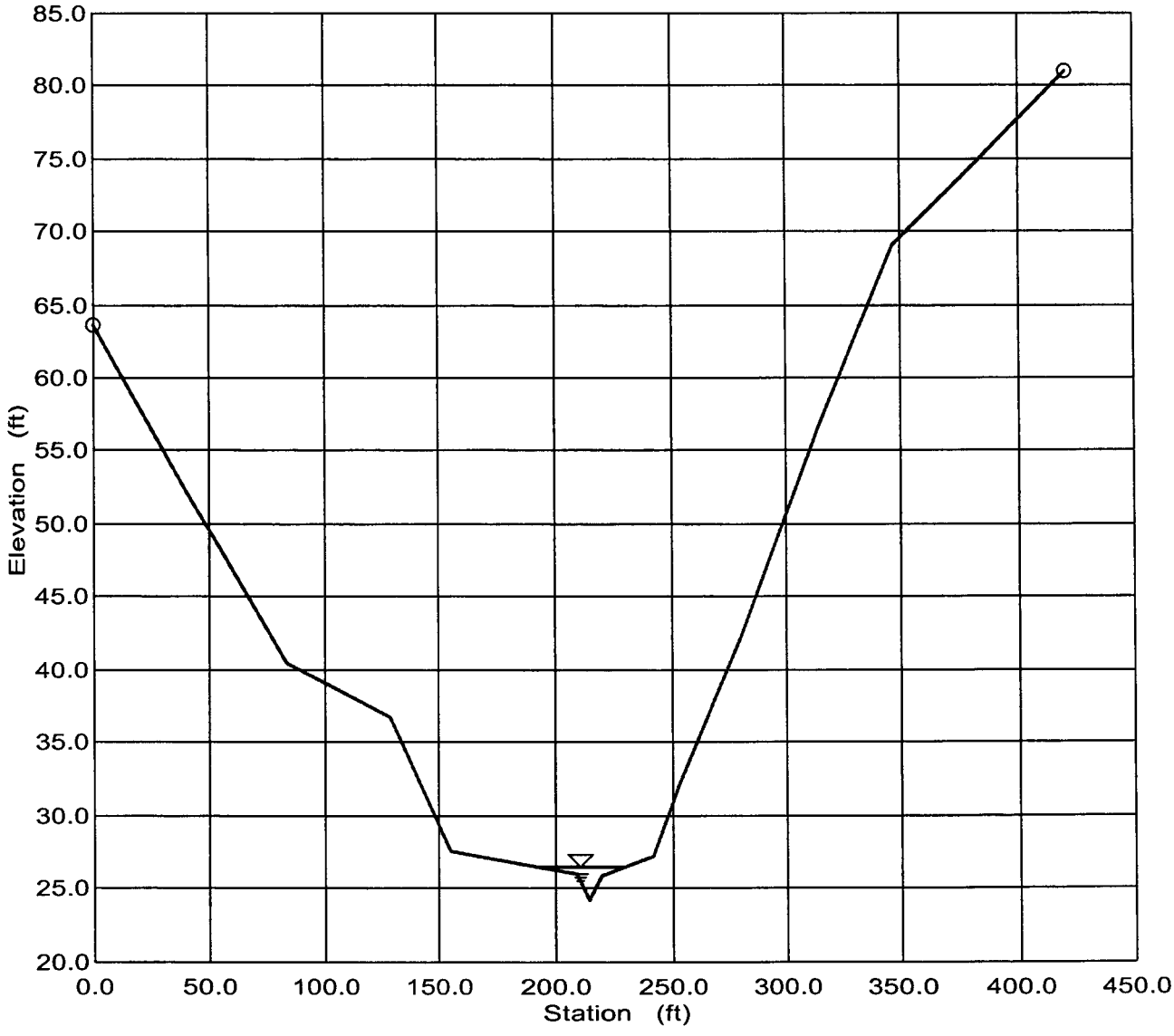
Subcatchment 2S: DA TO SECTION I



Section I PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION I
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.005519	ft/ft
Water Surface Elevation	26.43	ft
Discharge	30.42	cfs



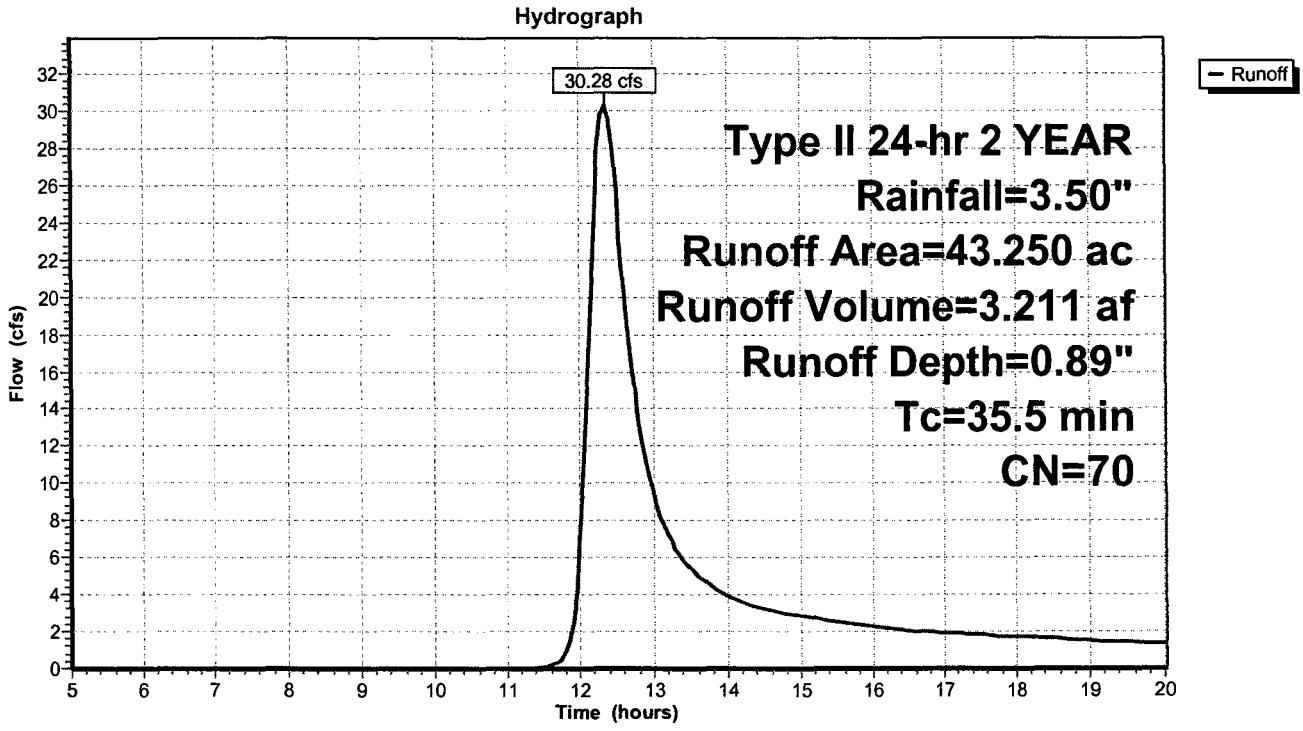
CHANNEL 5 STA 0+49 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION I
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.005519 ft/ft			
Elevation range: 24.15 ft to 80.96 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	63.63	0.00	420.85	0.055
38.85	52.56			
83.31	40.41			
128.99	36.78			
154.92	27.50			
209.19	25.95			
214.68	24.15			
219.66	25.81			
241.99	27.25			
252.21	31.89			
279.97	41.98			
313.46	56.38			
347.45	69.08			
420.85	80.96			
Discharge	30.42 cfs			

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	26.43	ft
Flow Area	21.75	ft²
Wetted Perimeter	37.39	ft
Top Width	36.81	ft
Height	2.28	ft
Critical Depth	25.59	ft
Critical Slope	0.052650	ft/ft
Velocity	1.40	ft/s
Velocity Head	0.03	ft
Specific Energy	26.46	ft
Froude Number	0.32	
Flow is subcritical.		

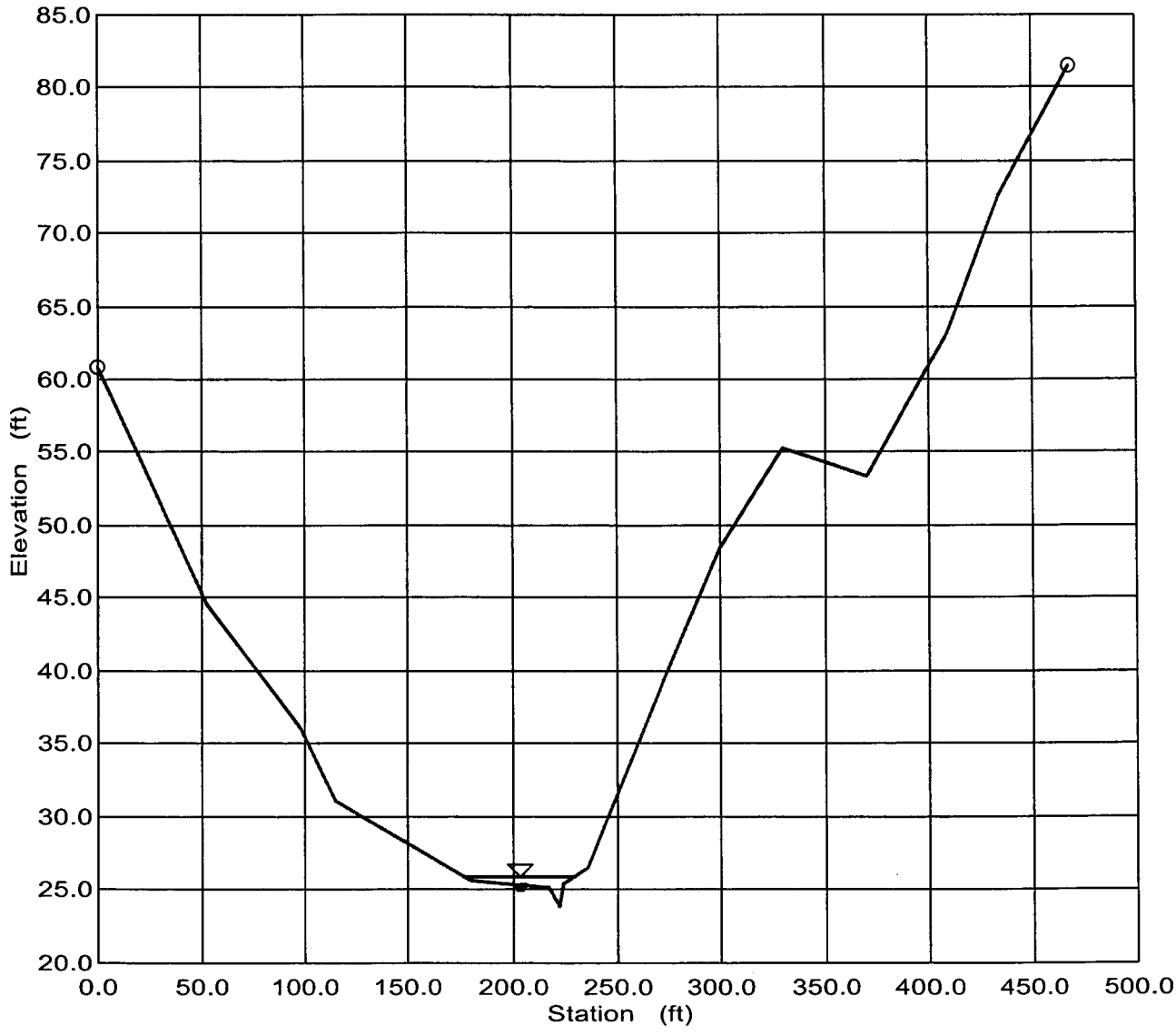
Subcatchment 3S: DA TO SECTION H



Section H PRE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION H
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.005500	ft/ft
Water Surface Elevation	25.89	ft
Discharge	38.90	cfs



CHANNEL 5 STA 1+03 PRE
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION H
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

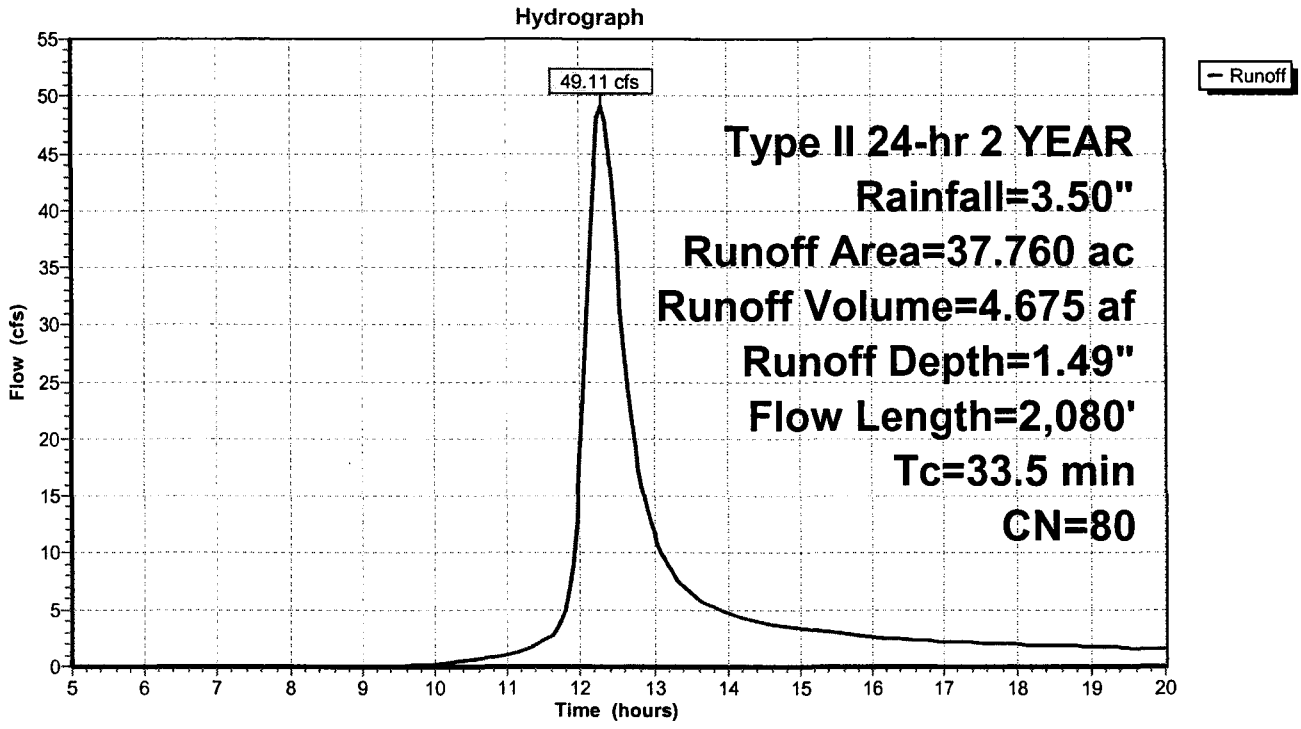
Input Data		
Channel Slope	0.005500	ft/ft

Elevation range: 23.85 ft to 81.44 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	60.82	0.00	468.29	0.055
52.66	44.51			
98.00	36.03			
115.30	31.08			
179.90	25.64			
217.41	25.17			
222.01	23.85			
224.20	25.40			
235.54	26.42			
271.89	39.25			
300.08	48.45			
330.02	55.25			
370.26	53.40			
408.60	62.99			
433.86	72.48			
468.29	81.44			
Discharge	38.90	cfs		

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	25.89	ft
Flow Area	29.12	ft²
Wetted Perimeter	53.47	ft
Top Width	52.76	ft
Height	2.04	ft
Critical Depth	25.53	ft
Critical Slope	0.065789	ft/ft
Velocity	1.34	ft/s
Velocity Head	0.03	ft
Specific Energy	25.92	ft
Froude Number	0.32	
Flow is subcritical.		

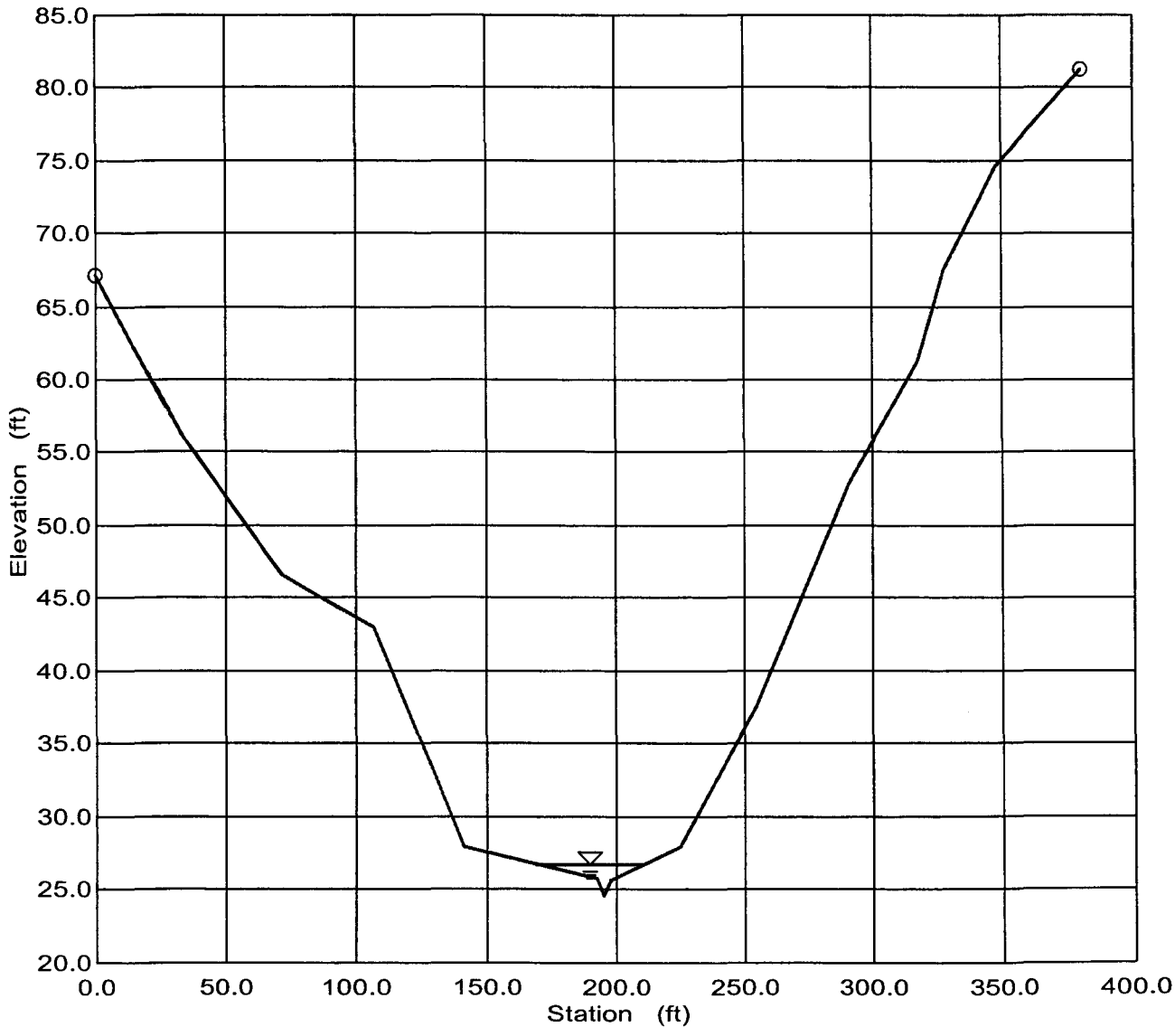
Subcatchment 11S: DA TO SECTION J



Section J POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION J POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.007739	ft/ft
Water Surface Elevation	26.75	ft
Discharge	49.11	cfs



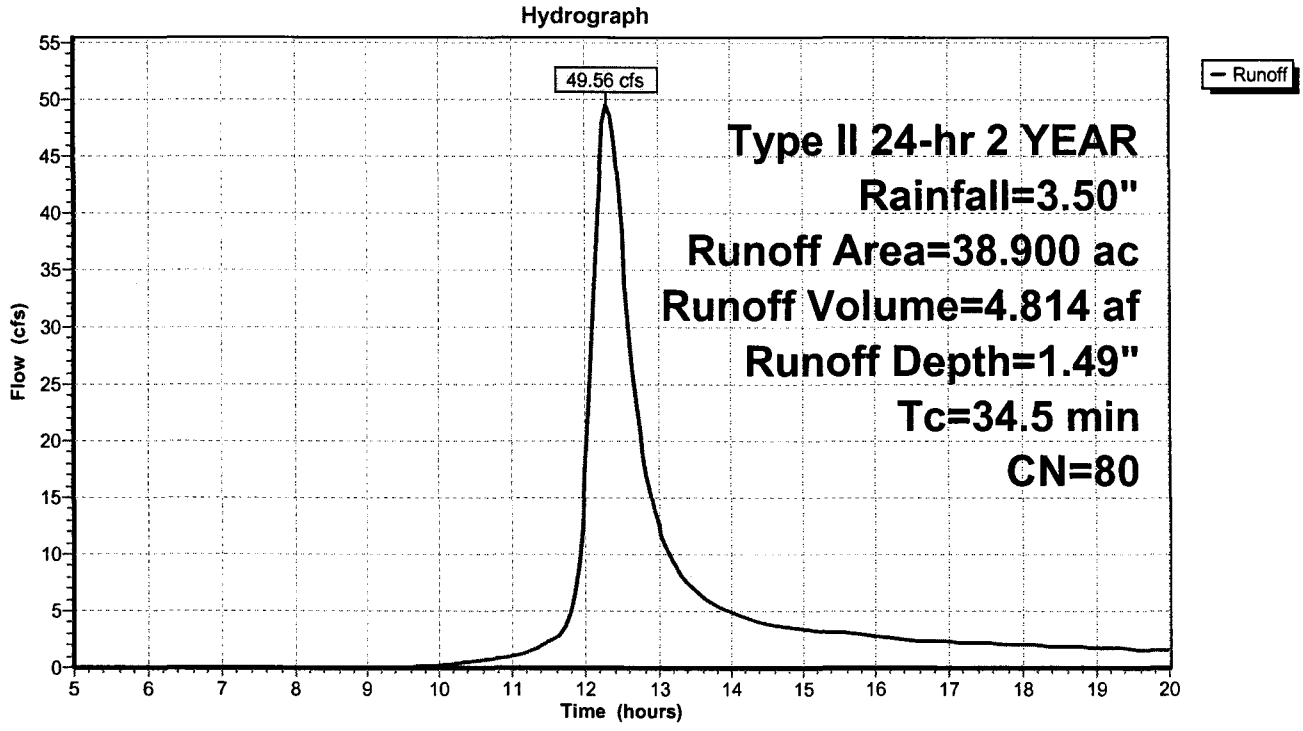
CHANNEL 5 STA 0+00 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION J POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.007739 ft/ft			
Elevation range: 24.53 ft to 81.26 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	67.07	0.00	380.57	0.055
34.02	55.96			
71.76	46.55			
106.69	42.96			
141.53	27.92			
192.30	25.77			
195.00	24.53			
197.99	25.67			
224.67	27.97			
254.79	37.53			
290.17	52.81			
317.48	61.22			
327.63	67.48			
347.81	74.53			
380.57	81.26			
Discharge	49.11 cfs			

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	26.75	ft
Flow Area	27.43	ft²
Wetted Perimeter	41.97	ft
Top Width	41.42	ft
Height	2.22	ft
Critical Depth	26.31	ft
Critical Slope	0.057651	ft/ft
Velocity	1.79	ft/s
Velocity Head	0.05	ft
Specific Energy	26.80	ft
Froude Number	0.39	
Flow is subcritical.		

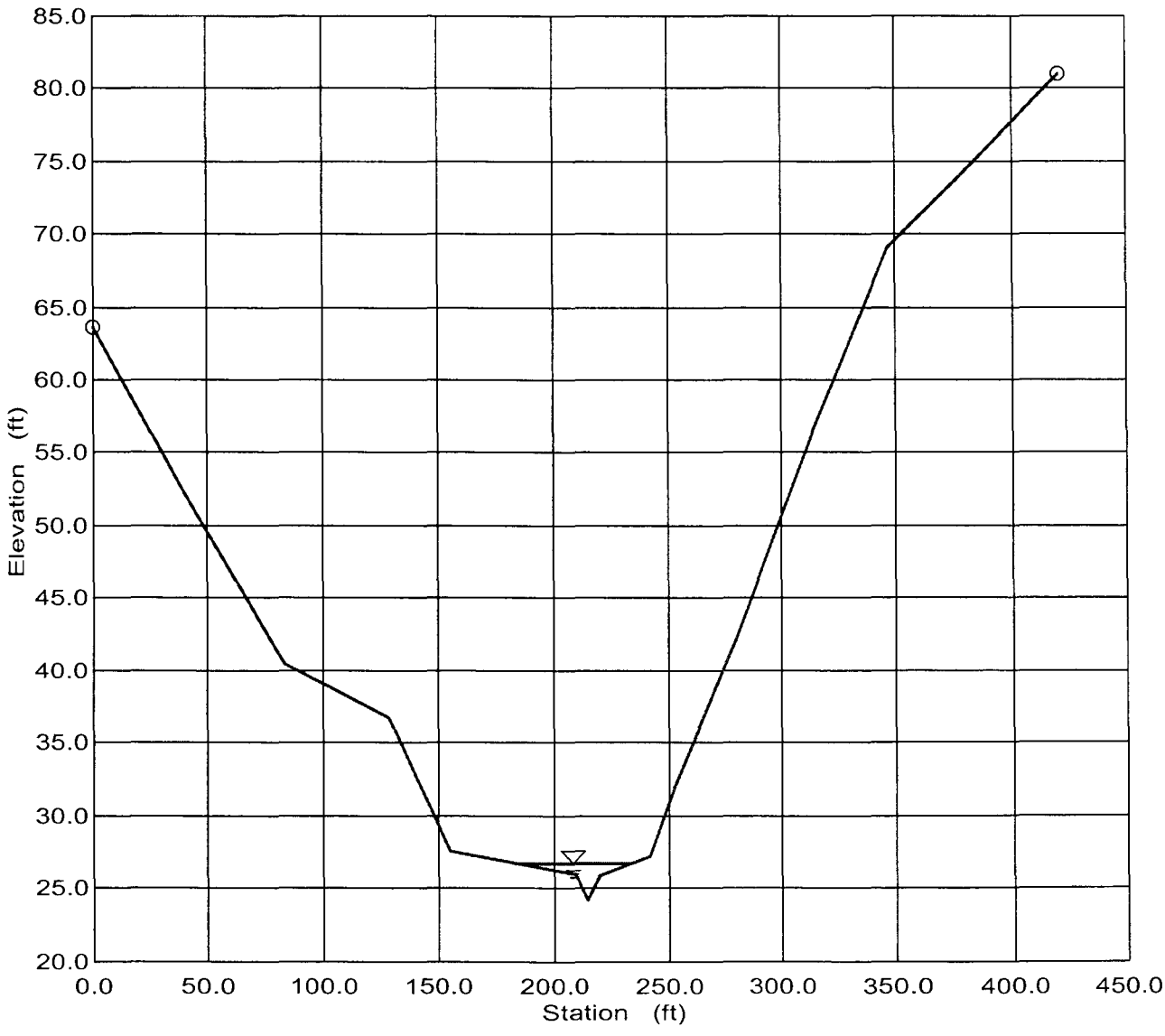
Subcatchment 12S: DA TO SECTION I



Section I POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION I POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.005519	ft/ft
Water Surface Elevation	26.68	ft
Discharge	49.56	cfs



CHANNEL 5 STA 0+49 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION I POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.005519	ft/ft

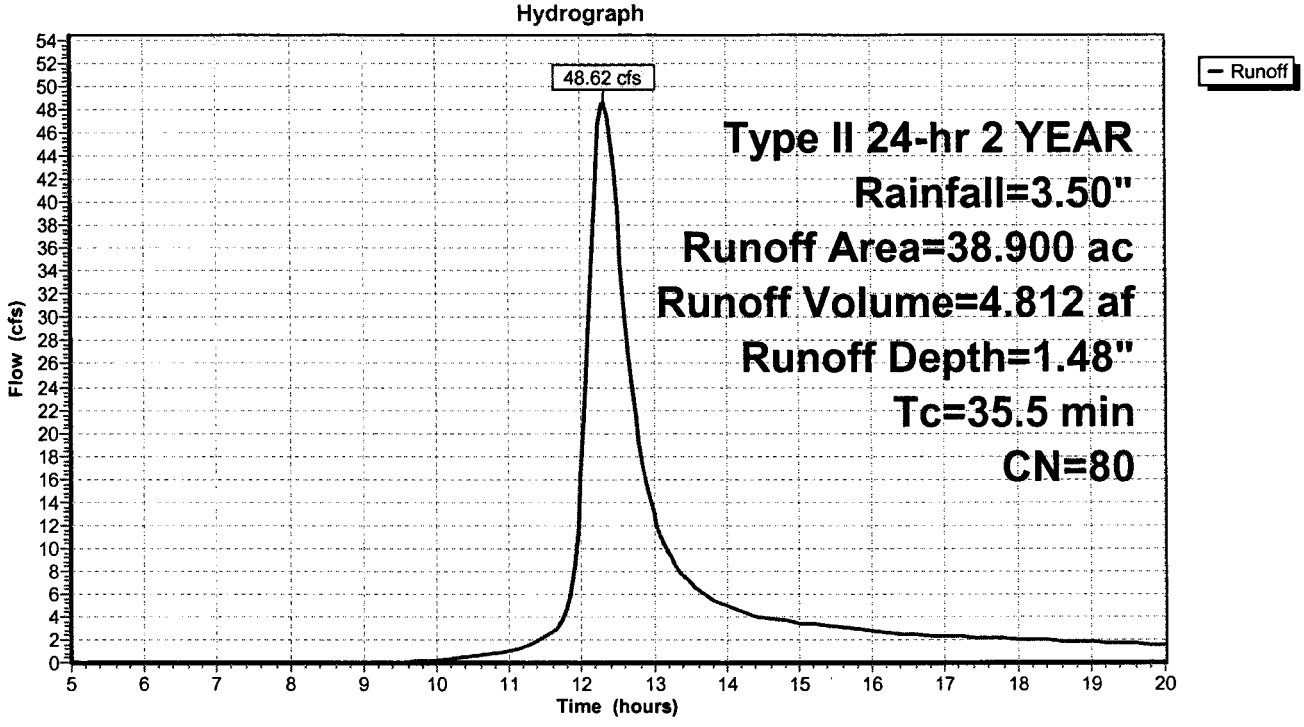
Elevation range: 24.15 ft to 80.96 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	63.63	0.00	420.85	0.055
38.85	52.56			
83.31	40.41			
128.99	36.78			
154.92	27.50			
209.19	25.95			
214.68	24.15			
219.66	25.81			
241.99	27.25			
252.21	31.89			
279.97	41.98			
313.46	56.38			
347.45	69.08			
420.85	80.96			

Discharge	49.56	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	26.68	ft
Flow Area	32.83	ft^2
Wetted Perimeter	50.34	ft
Top Width	49.75	ft
Height	2.53	ft
Critical Depth	25.94	ft
Critical Slope	0.050633	ft/ft
Velocity	1.51	ft/s
Velocity Head	0.04	ft
Specific Energy	26.72	ft
Froude Number	0.33	
Flow is subcritical.		

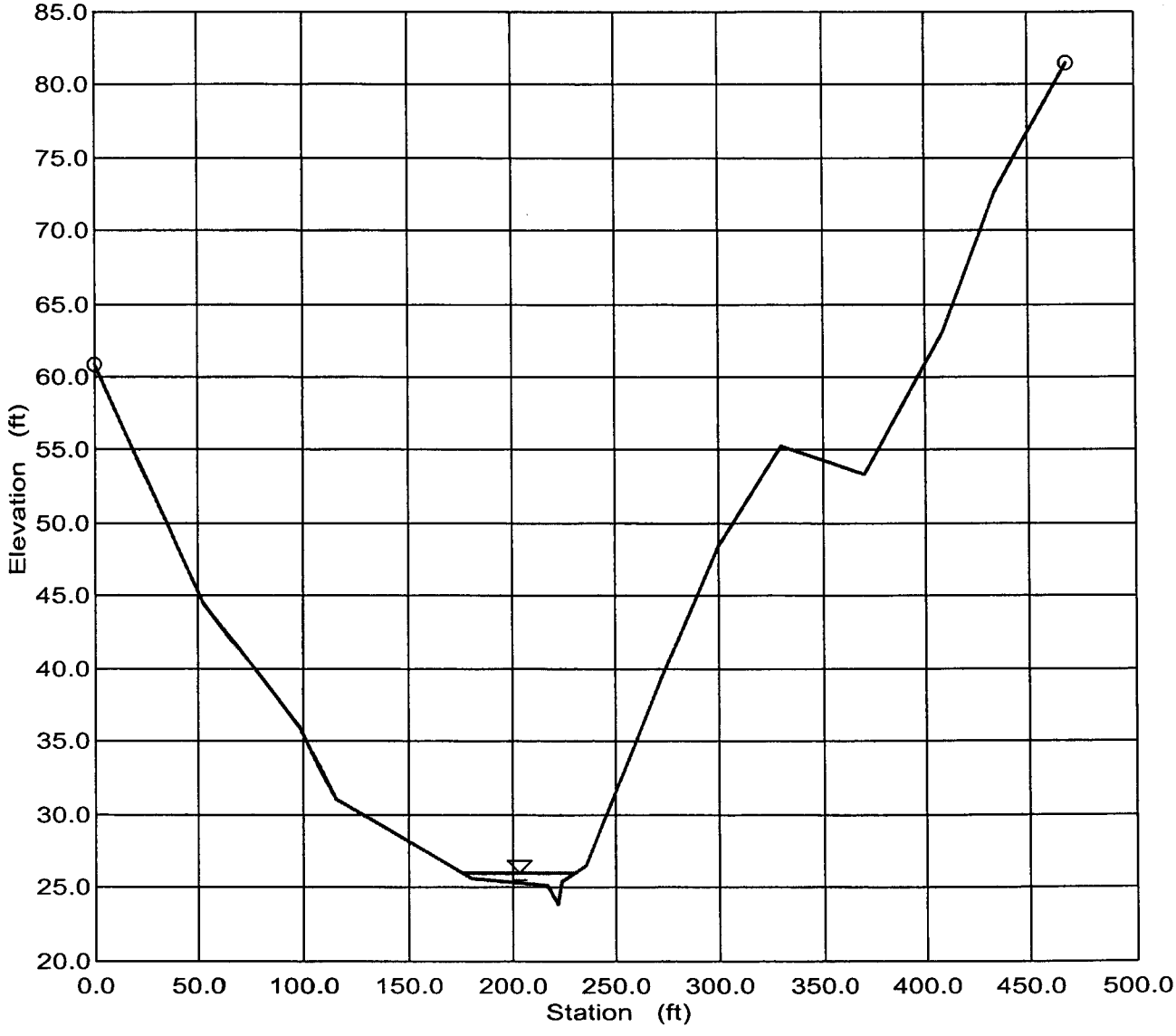
Subcatchment 13S: DA TO SECTION H



Section H POST
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION H POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.055	
Channel Slope	0.005500	ft/ft
Water Surface Elevation	25.98	ft
Discharge	48.62	cfs



CHANNEL 5 STA 1+03 POST
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\shg2.fm2
Worksheet	SECTION H POST
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.005500	ft/ft

Elevation range: 23.85 ft to 81.44 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	60.82	0.00	468.29	0.055
52.66	44.51			
98.00	36.03			
115.30	31.08			
179.90	25.64			
217.41	25.17			
222.01	23.85			
224.20	25.40			
235.54	26.42			
271.89	39.25			
300.08	48.45			
330.02	55.25			
370.26	53.40			
408.60	62.99			
433.86	72.48			
468.29	81.44			

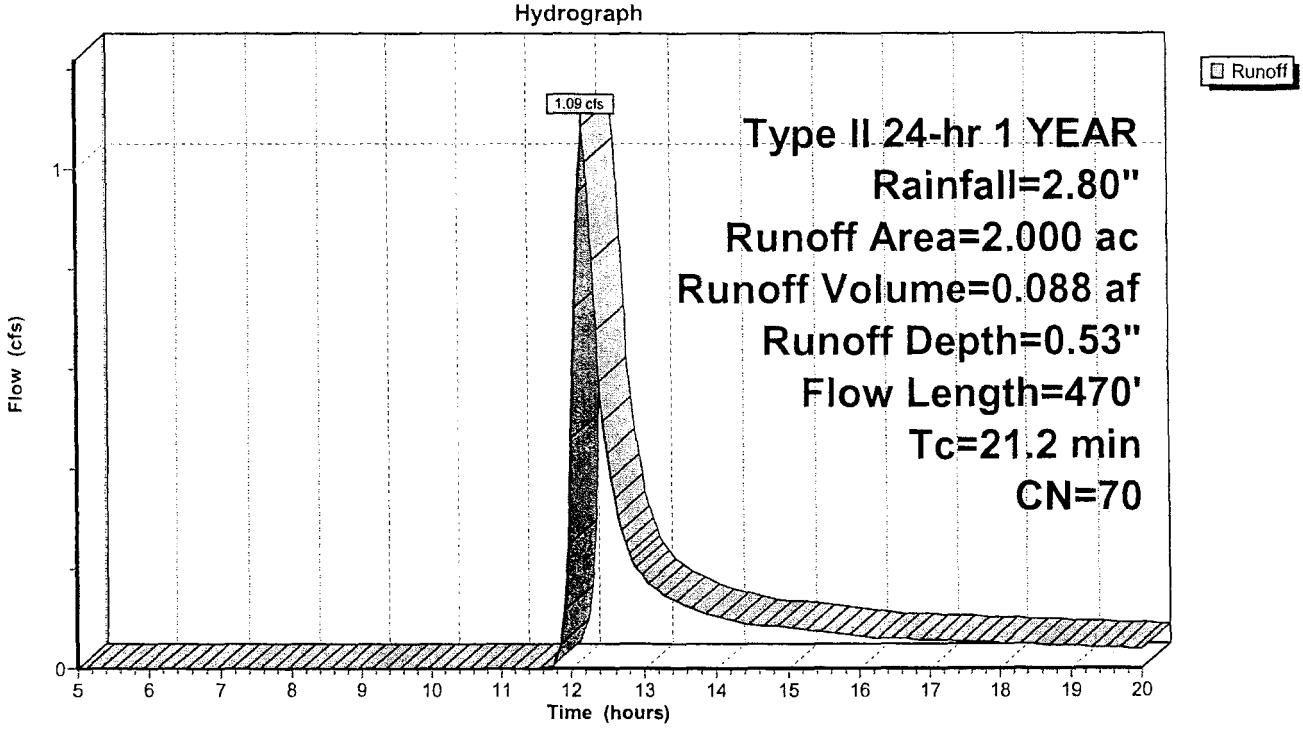
Discharge	48.62	cfs

Results		
Wtd. Mannings Coefficient	0.055	
Water Surface Elevation	25.98	ft
Flow Area	33.78	ft²
Wetted Perimeter	55.48	ft
Top Width	54.75	ft
Height	2.13	ft
Critical Depth	25.60	ft
Critical Slope	0.064502	ft/ft
Velocity	1.44	ft/s
Velocity Head	0.03	ft
Specific Energy	26.01	ft
Froude Number	0.32	

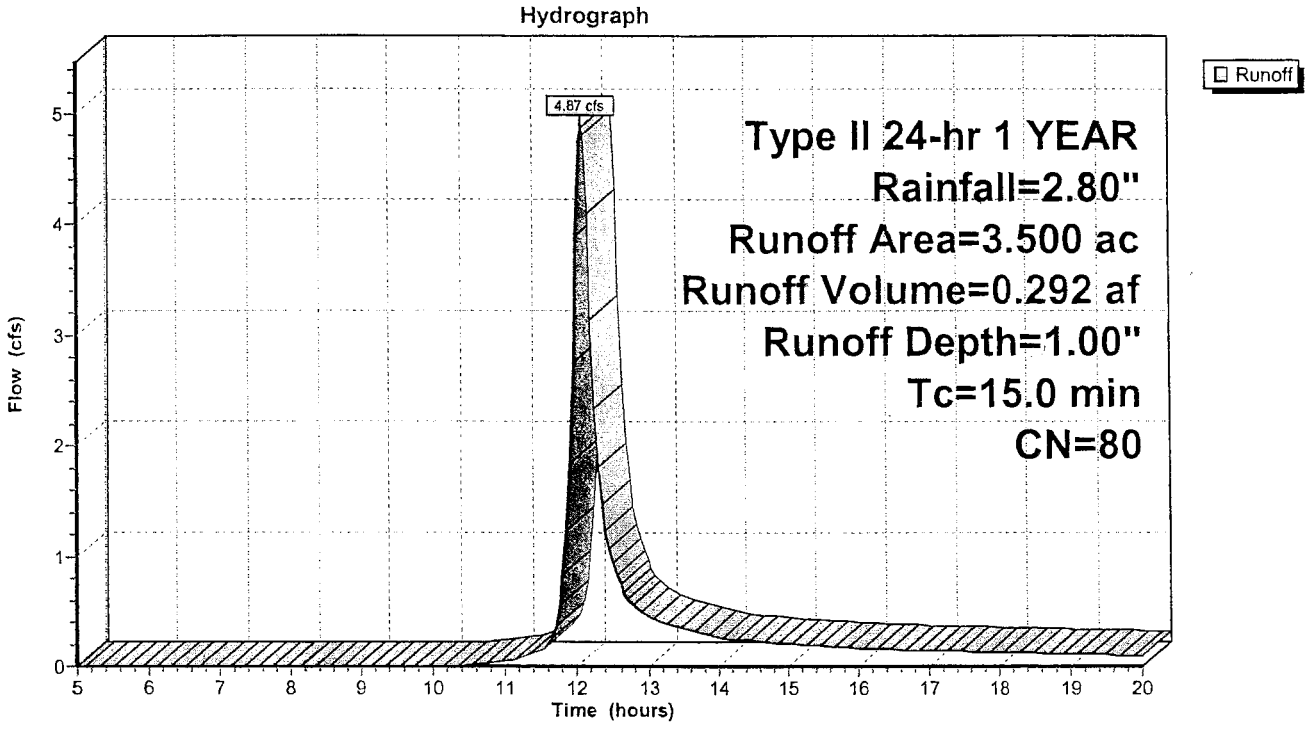
Flow is subcritical.

BMP 4

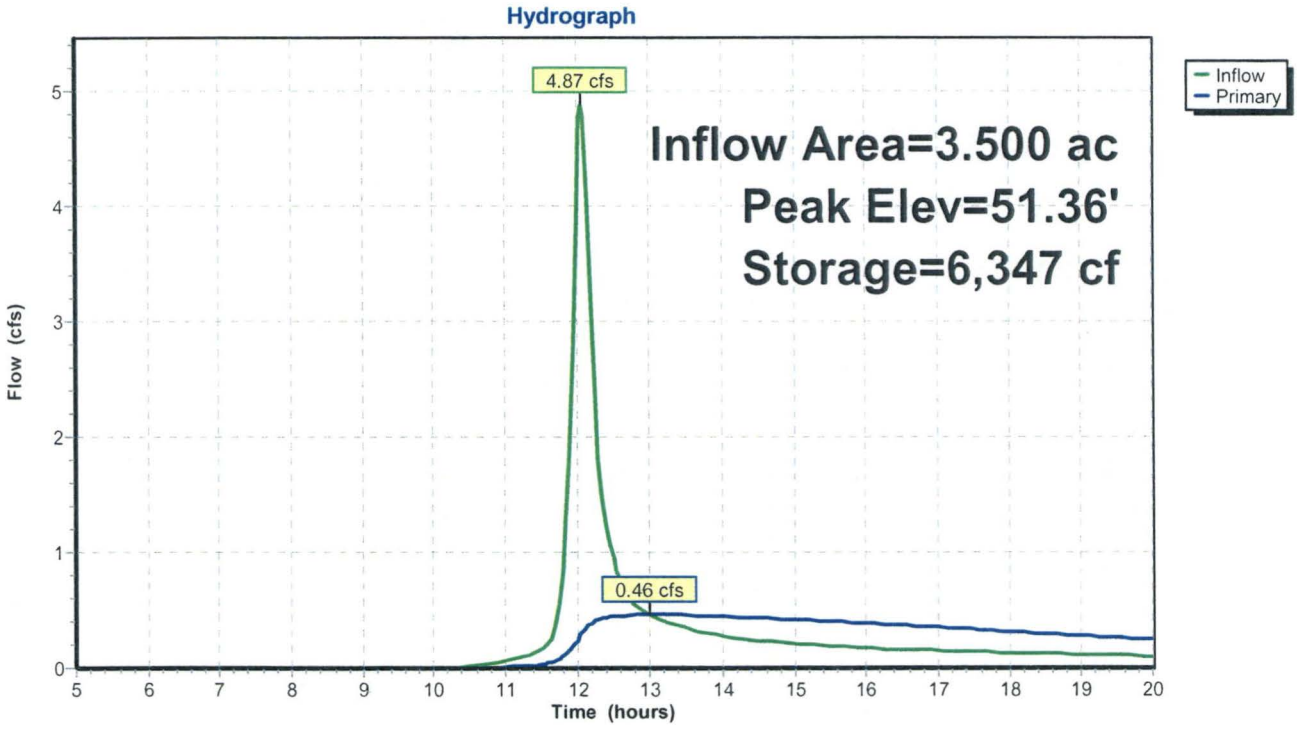
Subcatchment DA4 PRE: PRE-DEVELOPED



Subcatchment DA4 POST: DA4 POST



Pond B4: BMP 4


Hydrograph
4.87 cfs
0.46 cfs
Inflow Area=3.500 ac
Peak Elev=51.36'
Storage=6,347 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Hydrograph for Pond B4: BMP 4

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	47.50	0.00
0.25	0.00	0	47.50	0.00
0.50	0.00	0	47.50	0.00
0.75	0.00	0	47.50	0.00
1.00	0.00	0	47.50	0.00
1.25	0.00	0	47.50	0.00
1.50	0.00	0	47.50	0.00
1.75	0.00	0	47.50	0.00
2.00	0.00	0	47.50	0.00
2.25	0.00	0	47.50	0.00
2.50	0.00	0	47.50	0.00
2.75	0.00	0	47.50	0.00
3.00	0.00	0	47.50	0.00
3.25	0.00	0	47.50	0.00
3.50	0.00	0	47.50	0.00
3.75	0.00	0	47.50	0.00
4.00	0.00	0	47.50	0.00
4.25	0.00	0	47.50	0.00
4.50	0.00	0	47.50	0.00
4.75	0.00	0	47.50	0.00
5.00	0.00	0	47.50	0.00
5.25	0.00	0	47.50	0.00
5.50	0.00	0	47.50	0.00
5.75	0.00	0	47.50	0.00
6.00	0.00	0	47.50	0.00
6.25	0.00	0	47.50	0.00
6.50	0.00	0	47.50	0.00
6.75	0.00	0	47.50	0.00
7.00	0.00	0	47.50	0.00
7.25	0.00	0	47.50	0.00
7.50	0.00	0	47.50	0.00
7.75	0.00	0	47.50	0.00
8.00	0.00	0	47.50	0.00
8.25	0.00	0	47.50	0.00
8.50	0.00	0	47.50	0.00
8.75	0.00	0	47.50	0.00
9.00	0.00	0	47.50	0.00
9.25	0.00	0	47.50	0.00
9.50	0.00	0	47.50	0.00
9.75	0.00	0	47.50	0.00
10.00	0.00	0	47.50	0.00
10.25	0.00	2	47.50	0.00
10.50	0.01	10	47.51	0.00
10.75	0.03	28	47.52	0.00
11.00	0.05	61	47.54	0.01
11.25	0.09	117	47.57	0.01
11.50	0.16	208	47.63	0.03
11.75	0.65	510	47.81	0.10
12.00	**3.61**	2,261	48.88	0.26
12.25	2.57	4,747	50.39	0.39
12.50	0.97	5,963	51.13	0.44
12.75	0.58	6,256	51.31	0.45

BEGIN TIME

DRAWDOWN CALCULATION

33.00 HRS
- 10.50 HRS
22.5 HRS

Hydrograph for Pond B4: BMP 4 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
13.00	0.46	**6,314**	**51.34**	**0.46**
13.25	0.39	6,286	51.33	0.45
13.50	0.34	6,207	51.28	0.45
13.75	0.30	6,092	51.21	0.45
14.00	0.27	5,950	51.12	0.44
14.25	0.24	5,787	51.02	0.44
14.50	0.23	5,612	50.92	0.43
14.75	0.22	5,433	50.81	0.42
15.00	0.21	5,251	50.70	0.41
15.25	0.20	5,066	50.58	0.41
15.50	0.19	4,878	50.47	0.40
15.75	0.18	4,688	50.35	0.39
16.00	0.17	4,495	50.24	0.38
16.25	0.16	4,301	50.12	0.37
16.50	0.15	4,108	50.00	0.36
16.75	0.15	3,919	49.89	0.36
17.00	0.14	3,735	49.77	0.35
17.25	0.14	3,555	49.66	0.34
17.50	0.14	3,380	49.56	0.33
17.75	0.13	3,210	49.45	0.32
18.00	0.13	3,043	49.35	0.31
18.25	0.12	2,882	49.25	0.30
18.50	0.12	2,725	49.16	0.29
18.75	0.12	2,572	49.07	0.28
19.00	0.11	2,424	48.98	0.27
19.25	0.11	2,280	48.89	0.27
19.50	0.10	2,140	48.80	0.26
19.75	0.10	2,005	48.72	0.25
20.00	0.10	1,874	48.64	0.24
20.25	0.09	1,749	48.56	0.23
20.50	0.09	1,629	48.49	0.22
20.75	0.09	1,516	48.42	0.21
21.00	0.09	1,411	48.36	0.20
21.25	0.09	1,313	48.30	0.19
21.50	0.09	1,221	48.24	0.19
21.75	0.09	1,136	48.19	0.18
22.00	0.09	1,057	48.14	0.17
22.25	0.09	985	48.10	0.16
22.50	0.08	918	48.06	0.16
22.75	0.08	857	48.02	0.15
23.00	0.08	801	47.99	0.14
23.25	0.08	751	47.96	0.14
23.50	0.08	705	47.93	0.13
23.75	0.08	663	47.90	0.12
24.00	0.08	625	47.88	0.12
24.25	0.03	572	47.85	0.11
24.50	0.00	493	47.80	0.10
24.75	0.00	413	47.75	0.08
25.00	0.00	346	47.71	0.07
25.25	0.00	291	47.68	0.05
25.50	0.00	248	47.65	0.04
25.75	0.00	214	47.63	0.03

Hydrograph for Pond B4: BMP 4 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)	
26.00	0.00	187	47.61	0.03	
26.25	0.00	166	47.60	0.02	
26.50	0.00	149	47.59	0.02	
26.75	0.00	134	47.58	0.02	
27.00	0.00	120	47.57	0.01	
27.25	0.00	108	47.57	0.01	
27.50	0.00	97	47.56	0.01	
27.75	0.00	87	47.55	0.01	
28.00	0.00	78	47.55	0.01	
28.25	0.00	70	47.54	0.01	
28.50	0.00	63	47.54	0.01	
28.75	0.00	56	47.53	0.01	
29.00	0.00	51	47.53	0.01	
29.25	0.00	45	47.53	0.01	
29.50	0.00	41	47.52	0.00	
29.75	0.00	37	47.52	0.00	
30.00	0.00	33	47.52	0.00	
30.25	0.00	29	47.52	0.00	
30.50	0.00	26	47.52	0.00	
30.75	0.00	24	47.51	0.00	
31.00	0.00	21	47.51	0.00	
31.25	0.00	19	47.51	0.00	
31.50	0.00	17	47.51	0.00	
31.75	0.00	15	47.51	0.00	
32.00	0.00	14	47.51	0.00	
32.25	0.00	12	47.51	0.00	
32.50	0.00	11	47.51	0.00	
32.75	0.00	10	47.51	0.00	
33.00	0.00	9	47.51	0.00	END TIME
33.25	0.00	8	47.50	0.00	
33.50	0.00	7	47.50	0.00	
33.75	0.00	6	47.50	0.00	
34.00	0.00	6	47.50	0.00	
34.25	0.00	5	47.50	0.00	
34.50	0.00	5	47.50	0.00	
34.75	0.00	4	47.50	0.00	
35.00	0.00	4	47.50	0.00	
35.25	0.00	3	47.50	0.00	
35.50	0.00	3	47.50	0.00	
35.75	0.00	3	47.50	0.00	
36.00	0.00	2	47.50	0.00	
36.25	0.00	2	47.50	0.00	
36.50	0.00	2	47.50	0.00	
36.75	0.00	2	47.50	0.00	
37.00	0.00	2	47.50	0.00	
37.25	0.00	1	47.50	0.00	
37.50	0.00	1	47.50	0.00	
37.75	0.00	1	47.50	0.00	
38.00	0.00	1	47.50	0.00	
38.25	0.00	1	47.50	0.00	
38.50	0.00	1	47.50	0.00	
38.75	0.00	1	47.50	0.00	

Hydrograph for Pond B4: BMP 4 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
39.00	0.00	1	47.50	0.00
39.25	0.00	1	47.50	0.00
39.50	0.00	1	47.50	0.00
39.75	0.00	0	47.50	0.00
40.00	0.00	0	47.50	0.00
40.25	0.00	0	47.50	0.00
40.50	0.00	0	47.50	0.00
40.75	0.00	0	47.50	0.00
41.00	0.00	0	47.50	0.00
41.25	0.00	0	47.50	0.00
41.50	0.00	0	47.50	0.00
41.75	0.00	0	47.50	0.00
42.00	0.00	0	47.50	0.00
42.25	0.00	0	47.50	0.00
42.50	0.00	0	47.50	0.00
42.75	0.00	0	47.50	0.00
43.00	0.00	0	47.50	0.00
43.25	0.00	0	47.50	0.00
43.50	0.00	0	47.50	0.00
43.75	0.00	0	47.50	0.00
44.00	0.00	0	47.50	0.00
44.25	0.00	0	47.50	0.00
44.50	0.00	0	47.50	0.00
44.75	0.00	0	47.50	0.00
45.00	0.00	0	47.50	0.00
45.25	0.00	0	47.50	0.00
45.50	0.00	0	47.50	0.00
45.75	0.00	0	47.50	0.00
46.00	0.00	0	47.50	0.00
46.25	0.00	0	47.50	0.00
46.50	0.00	0	47.50	0.00
46.75	0.00	0	47.50	0.00
47.00	0.00	0	47.50	0.00
47.25	0.00	0	47.50	0.00
47.50	0.00	0	47.50	0.00
47.75	0.00	0	47.50	0.00
48.00	0.00	0	47.50	0.00
48.25	0.00	0	47.50	0.00
48.50	0.00	0	47.50	0.00
48.75	0.00	0	47.50	0.00
49.00	0.00	0	47.50	0.00
49.25	0.00	0	47.50	0.00
49.50	0.00	0	47.50	0.00
49.75	0.00	0	47.50	0.00
50.00	0.00	0	47.50	0.00
50.25	0.00	0	47.50	0.00
50.50	0.00	0	47.50	0.00
50.75	0.00	0	47.50	0.00
51.00	0.00	0	47.50	0.00
51.25	0.00	0	47.50	0.00
51.50	0.00	0	47.50	0.00
51.75	0.00	0	47.50	0.00

Hydrograph for Pond B4: BMP 4 (continued)

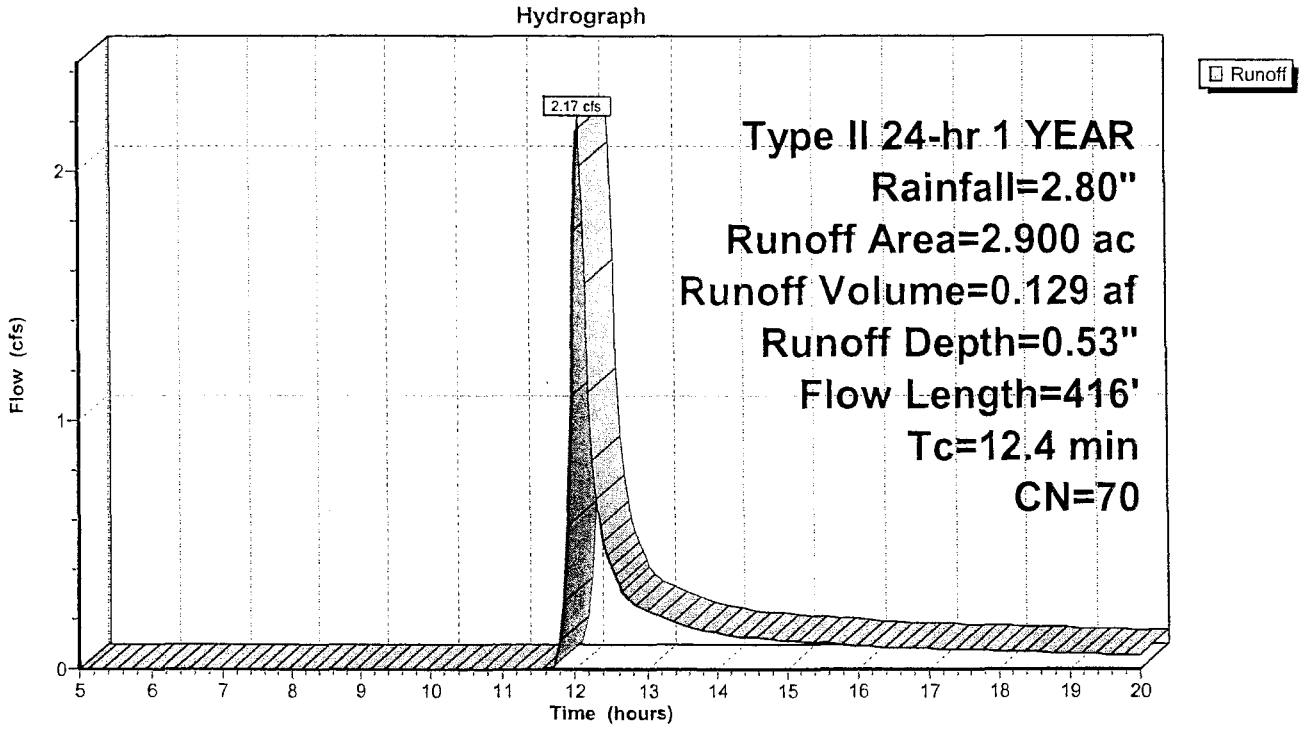
Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
52.00	0.00	0	47.50	0.00
52.25	0.00	0	47.50	0.00
52.50	0.00	0	47.50	0.00
52.75	0.00	0	47.50	0.00
53.00	0.00	0	47.50	0.00
53.25	0.00	0	47.50	0.00
53.50	0.00	0	47.50	0.00
53.75	0.00	0	47.50	0.00
54.00	0.00	0	47.50	0.00
54.25	0.00	0	47.50	0.00
54.50	0.00	0	47.50	0.00
54.75	0.00	0	47.50	0.00
55.00	0.00	0	47.50	0.00
55.25	0.00	0	47.50	0.00
55.50	0.00	0	47.50	0.00
55.75	0.00	0	47.50	0.00
56.00	0.00	0	47.50	0.00
56.25	0.00	0	47.50	0.00
56.50	0.00	0	47.50	0.00
56.75	0.00	0	47.50	0.00
57.00	0.00	0	47.50	0.00
57.25	0.00	0	47.50	0.00
57.50	0.00	0	47.50	0.00
57.75	0.00	0	47.50	0.00
58.00	0.00	0	47.50	0.00
58.25	0.00	0	47.50	0.00
58.50	0.00	0	47.50	0.00
58.75	0.00	0	47.50	0.00
59.00	0.00	0	47.50	0.00
59.25	0.00	0	47.50	0.00
59.50	0.00	0	47.50	0.00
59.75	0.00	0	47.50	0.00
60.00	0.00	0	47.50	0.00
60.25	0.00	0	47.50	0.00
60.50	0.00	0	47.50	0.00
60.75	0.00	0	47.50	0.00
61.00	0.00	0	47.50	0.00
61.25	0.00	0	47.50	0.00
61.50	0.00	0	47.50	0.00
61.75	0.00	0	47.50	0.00
62.00	0.00	0	47.50	0.00
62.25	0.00	0	47.50	0.00
62.50	0.00	0	47.50	0.00
62.75	0.00	0	47.50	0.00
63.00	0.00	0	47.50	0.00
63.25	0.00	0	47.50	0.00
63.50	0.00	0	47.50	0.00
63.75	0.00	0	47.50	0.00
64.00	0.00	0	47.50	0.00
64.25	0.00	0	47.50	0.00
64.50	0.00	0	47.50	0.00
64.75	0.00	0	47.50	0.00

Hydrograph for Pond B4: BMP 4 (continued)

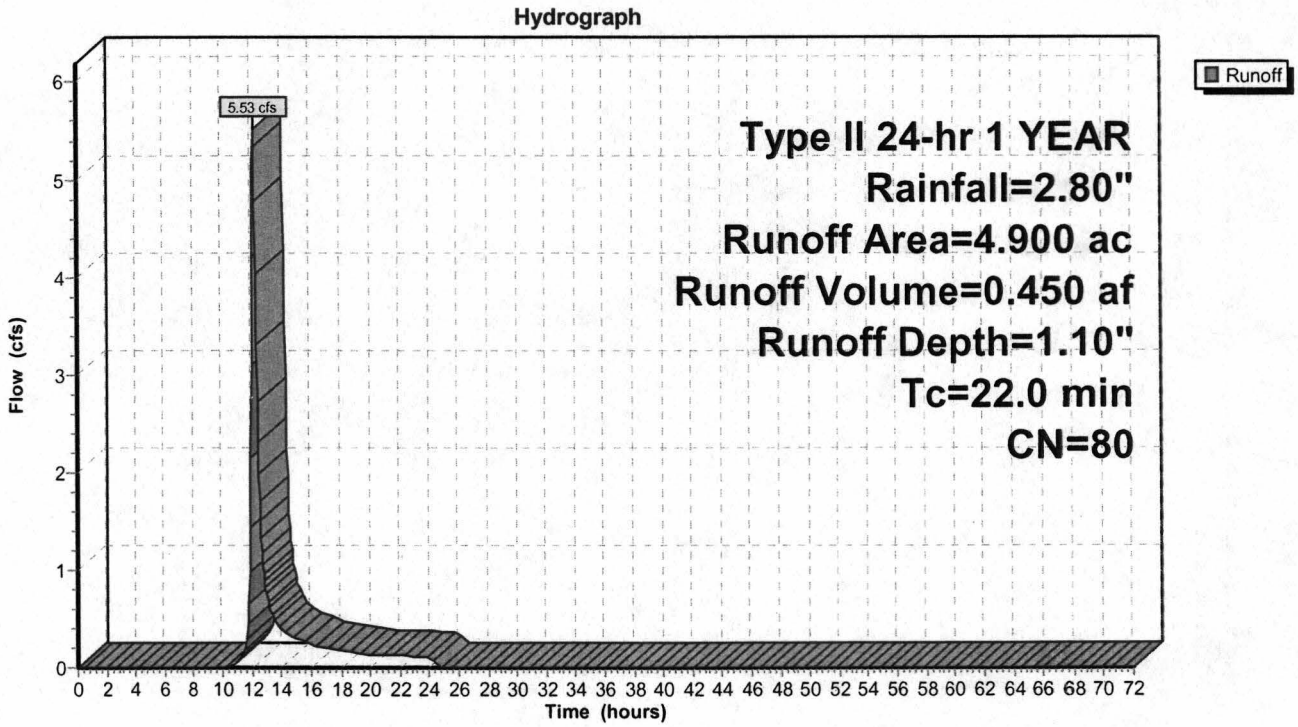
Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
65.00	0.00	0	47.50	0.00
65.25	0.00	0	47.50	0.00
65.50	0.00	0	47.50	0.00
65.75	0.00	0	47.50	0.00
66.00	0.00	0	47.50	0.00
66.25	0.00	0	47.50	0.00
66.50	0.00	0	47.50	0.00
66.75	0.00	0	47.50	0.00
67.00	0.00	0	47.50	0.00
67.25	0.00	0	47.50	0.00
67.50	0.00	0	47.50	0.00
67.75	0.00	0	47.50	0.00
68.00	0.00	0	47.50	0.00
68.25	0.00	0	47.50	0.00
68.50	0.00	0	47.50	0.00
68.75	0.00	0	47.50	0.00
69.00	0.00	0	47.50	0.00
69.25	0.00	0	47.50	0.00
69.50	0.00	0	47.50	0.00
69.75	0.00	0	47.50	0.00
70.00	0.00	0	47.50	0.00
70.25	0.00	0	47.50	0.00
70.50	0.00	0	47.50	0.00
70.75	0.00	0	47.50	0.00
71.00	0.00	0	47.50	0.00
71.25	0.00	0	47.50	0.00
71.50	0.00	0	47.50	0.00
71.75	0.00	0	47.50	0.00
72.00	0.00	0	47.50	0.00

BMP 5

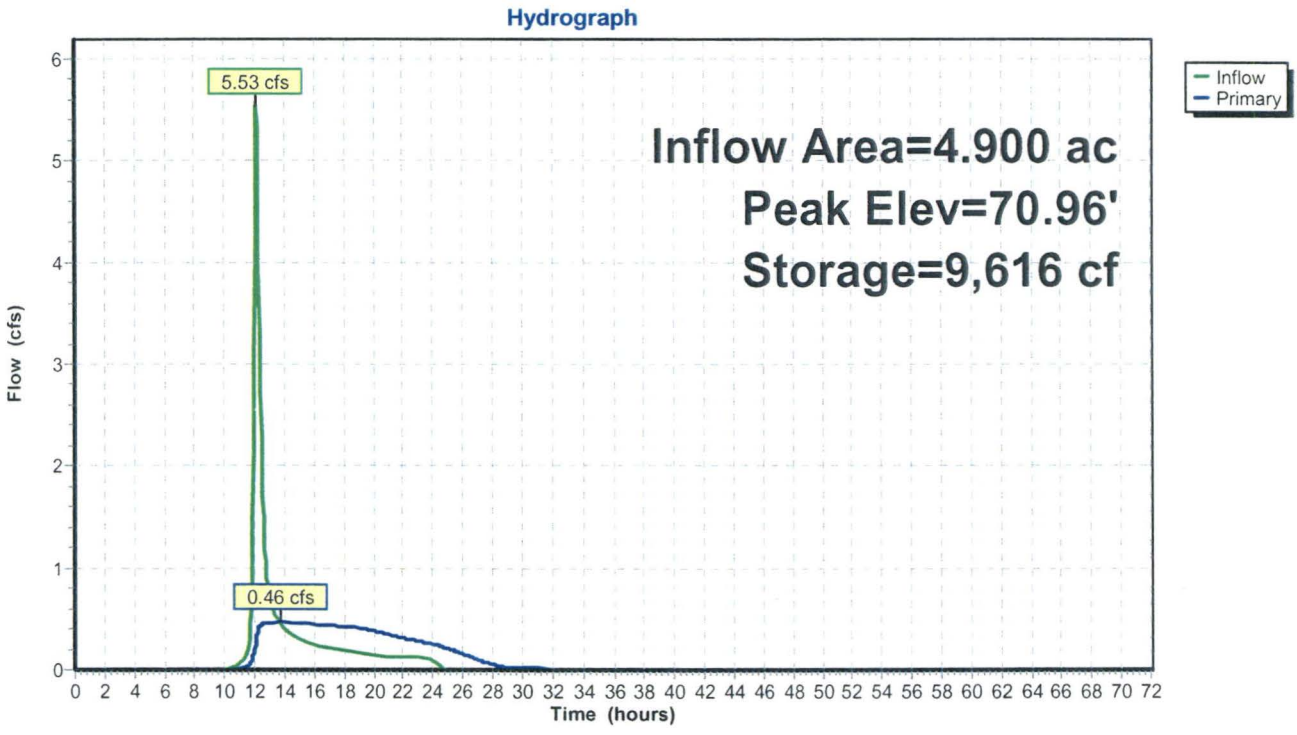
Subcatchment DA B5: PRE-DEVELOPED



Subcatchment DA5 POST: DA5 POST



Pond B5: BMP 5


Hydrograph
5.53 cfs
0.46 cfs
Inflow Area=4.900 ac
Peak Elev=70.96'
Storage=9,616 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Hydrograph for Pond B5: BMP 5

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	67.00	0.00
0.25	0.00	0	67.00	0.00
0.50	0.00	0	67.00	0.00
0.75	0.00	0	67.00	0.00
1.00	0.00	0	67.00	0.00
1.25	0.00	0	67.00	0.00
1.50	0.00	0	67.00	0.00
1.75	0.00	0	67.00	0.00
2.00	0.00	0	67.00	0.00
2.25	0.00	0	67.00	0.00
2.50	0.00	0	67.00	0.00
2.75	0.00	0	67.00	0.00
3.00	0.00	0	67.00	0.00
3.25	0.00	0	67.00	0.00
3.50	0.00	0	67.00	0.00
3.75	0.00	0	67.00	0.00
4.00	0.00	0	67.00	0.00
4.25	0.00	0	67.00	0.00
4.50	0.00	0	67.00	0.00
4.75	0.00	0	67.00	0.00
5.00	0.00	0	67.00	0.00
5.25	0.00	0	67.00	0.00
5.50	0.00	0	67.00	0.00
5.75	0.00	0	67.00	0.00
6.00	0.00	0	67.00	0.00
6.25	0.00	0	67.00	0.00
6.50	0.00	0	67.00	0.00
6.75	0.00	0	67.00	0.00
7.00	0.00	0	67.00	0.00
7.25	0.00	0	67.00	0.00
7.50	0.00	0	67.00	0.00
7.75	0.00	0	67.00	0.00
8.00	0.00	0	67.00	0.00
8.25	0.00	0	67.00	0.00
8.50	0.00	0	67.00	0.00
8.75	0.00	0	67.00	0.00
9.00	0.00	0	67.00	0.00
9.25	0.00	0	67.00	0.00
9.50	0.00	0	67.00	0.00
9.75	0.00	0	67.00	0.00
10.00	0.00	0	67.00	0.00
10.25	0.00	1	67.00	0.00
10.50	0.01	7	67.00	0.00
10.75	0.03	26	67.01	0.00
11.00	0.06	64	67.03	0.01
11.25	0.10	128	67.07	0.01
11.50	0.18	233	67.12	0.03
11.75	0.45	427	67.22	0.07
12.00	**3.11**	1,574	67.83	0.20
12.25	**4.77**	5,641	69.97	0.40
12.50	1.97	8,086	70.59	0.44
12.75	1.06	8,985	70.81	0.45

BEGIN TIME

DRAWDOWN TIME

37.75 hrs
- 10.75 hr
27.0 hrs

Hydrograph for Pond B5: BMP 5 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
13.00	0.73	9,356	70.90	0.46
13.25	0.59	9,528	70.94	0.46
13.50	0.51	**9,602**	**70.96**	**0.46**
13.75	0.45	**9,614**	**70.96**	**0.46**
14.00	0.40	9,578	70.95	0.46
14.25	0.36	9,501	70.93	0.46
14.50	0.33	9,395	70.91	0.46
14.75	0.32	9,273	70.88	0.46
15.00	0.30	9,140	70.85	0.46
15.25	0.29	8,994	70.81	0.45
15.50	0.27	8,837	70.77	0.45
15.75	0.26	8,669	70.73	0.45
16.00	0.24	8,489	70.69	0.45
16.25	0.22	8,298	70.64	0.44
16.50	0.22	8,099	70.59	0.44
16.75	0.21	7,896	70.54	0.44
17.00	0.20	7,691	70.49	0.43
17.25	0.20	7,483	70.44	0.43
17.50	0.19	7,274	70.39	0.43
17.75	0.19	7,063	70.33	0.42
18.00	0.18	6,851	70.28	0.42
18.25	0.18	6,636	70.23	0.42
18.50	0.17	6,419	70.18	0.41
18.75	0.17	6,201	70.12	0.41
19.00	0.16	5,980	70.07	0.41
19.25	0.15	5,758	70.01	0.40
19.50	0.15	5,535	69.91	0.39
19.75	0.14	5,314	69.80	0.39
20.00	0.14	5,096	69.68	0.38
20.25	0.13	4,880	69.57	0.37
20.50	0.13	4,667	69.46	0.36
20.75	0.13	4,461	69.35	0.35
21.00	0.13	4,261	69.24	0.34
21.25	0.12	4,067	69.14	0.34
21.50	0.12	3,881	69.04	0.33
21.75	0.12	3,700	68.95	0.32
22.00	0.12	3,526	68.86	0.31
22.25	0.12	3,359	68.77	0.30
22.50	0.12	3,197	68.68	0.29
22.75	0.12	3,042	68.60	0.29
23.00	0.12	2,893	68.52	0.28
23.25	0.12	2,750	68.45	0.27
23.50	0.11	2,612	68.37	0.26
23.75	0.11	2,480	68.31	0.26
24.00	0.11	2,354	68.24	0.25
24.25	0.08	2,225	68.17	0.24
24.50	0.02	2,049	68.08	0.23
24.75	0.00	1,854	67.98	0.22
25.00	0.00	1,665	67.88	0.20
25.25	0.00	1,487	67.78	0.19
25.50	0.00	1,320	67.69	0.18
25.75	0.00	1,166	67.61	0.17

Hydrograph for Pond B5: BMP 5 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
26.00	0.00	1,023	67.54	0.15
26.25	0.00	892	67.47	0.14
26.50	0.00	774	67.41	0.13
26.75	0.00	667	67.35	0.11
27.00	0.00	572	67.30	0.10
27.25	0.00	489	67.26	0.09
27.50	0.00	419	67.22	0.07
27.75	0.00	361	67.19	0.06
28.00	0.00	313	67.16	0.05
28.25	0.00	274	67.14	0.04
28.50	0.00	242	67.13	0.03
28.75	0.00	216	67.11	0.03
29.00	0.00	194	67.10	0.02
29.25	0.00	177	67.09	0.02
29.50	0.00	162	67.09	0.02
29.75	0.00	149	67.08	0.01
30.00	0.00	137	67.07	0.01
30.25	0.00	125	67.07	0.01
30.50	0.00	115	67.06	0.01
30.75	0.00	106	67.06	0.01
31.00	0.00	97	67.05	0.01
31.25	0.00	89	67.05	0.01
31.50	0.00	82	67.04	0.01
31.75	0.00	75	67.04	0.01
32.00	0.00	69	67.04	0.01
32.25	0.00	63	67.03	0.01
32.50	0.00	58	67.03	0.01
32.75	0.00	53	67.03	0.01
33.00	0.00	49	67.03	0.00
33.25	0.00	45	67.02	0.00
33.50	0.00	41	67.02	0.00
33.75	0.00	38	67.02	0.00
34.00	0.00	35	67.02	0.00
34.25	0.00	32	67.02	0.00
34.50	0.00	29	67.02	0.00
34.75	0.00	27	67.01	0.00
35.00	0.00	25	67.01	0.00
35.25	0.00	23	67.01	0.00
35.50	0.00	21	67.01	0.00
35.75	0.00	19	67.01	0.00
36.00	0.00	18	67.01	0.00
36.25	0.00	16	67.01	0.00
36.50	0.00	15	67.01	0.00
36.75	0.00	14	67.01	0.00
37.00	0.00	12	67.01	0.00
37.25	0.00	11	67.01	0.00
37.50	0.00	11	67.01	0.00
~~37.75~~	~~0.00~~	~~10~~	~~67.01~~	~~0.00~~ — END TIME
38.00	0.00	9	67.00	0.00
38.25	0.00	8	67.00	0.00
38.50	0.00	7	67.00	0.00
38.75	0.00	7	67.00	0.00

Hydrograph for Pond B5: BMP 5 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
39.00	0.00	6	67.00	0.00
39.25	0.00	6	67.00	0.00
39.50	0.00	5	67.00	0.00
39.75	0.00	5	67.00	0.00
40.00	0.00	4	67.00	0.00
40.25	0.00	4	67.00	0.00
40.50	0.00	4	67.00	0.00
40.75	0.00	3	67.00	0.00
41.00	0.00	3	67.00	0.00
41.25	0.00	3	67.00	0.00
41.50	0.00	3	67.00	0.00
41.75	0.00	2	67.00	0.00
42.00	0.00	2	67.00	0.00
42.25	0.00	2	67.00	0.00
42.50	0.00	2	67.00	0.00
42.75	0.00	2	67.00	0.00
43.00	0.00	2	67.00	0.00
43.25	0.00	1	67.00	0.00
43.50	0.00	1	67.00	0.00
43.75	0.00	1	67.00	0.00
44.00	0.00	1	67.00	0.00
44.25	0.00	1	67.00	0.00
44.50	0.00	1	67.00	0.00
44.75	0.00	1	67.00	0.00
45.00	0.00	1	67.00	0.00
45.25	0.00	1	67.00	0.00
45.50	0.00	1	67.00	0.00
45.75	0.00	1	67.00	0.00
46.00	0.00	1	67.00	0.00
46.25	0.00	1	67.00	0.00
46.50	0.00	0	67.00	0.00
46.75	0.00	0	67.00	0.00
47.00	0.00	0	67.00	0.00
47.25	0.00	0	67.00	0.00
47.50	0.00	0	67.00	0.00
47.75	0.00	0	67.00	0.00
48.00	0.00	0	67.00	0.00
48.25	0.00	0	67.00	0.00
48.50	0.00	0	67.00	0.00
48.75	0.00	0	67.00	0.00
49.00	0.00	0	67.00	0.00
49.25	0.00	0	67.00	0.00
49.50	0.00	0	67.00	0.00
49.75	0.00	0	67.00	0.00
50.00	0.00	0	67.00	0.00
50.25	0.00	0	67.00	0.00
50.50	0.00	0	67.00	0.00
50.75	0.00	0	67.00	0.00
51.00	0.00	0	67.00	0.00
51.25	0.00	0	67.00	0.00
51.50	0.00	0	67.00	0.00
51.75	0.00	0	67.00	0.00

Hydrograph for Pond B5: BMP 5 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
52.00	0.00	0	67.00	0.00
52.25	0.00	0	67.00	0.00
52.50	0.00	0	67.00	0.00
52.75	0.00	0	67.00	0.00
53.00	0.00	0	67.00	0.00
53.25	0.00	0	67.00	0.00
53.50	0.00	0	67.00	0.00
53.75	0.00	0	67.00	0.00
54.00	0.00	0	67.00	0.00
54.25	0.00	0	67.00	0.00
54.50	0.00	0	67.00	0.00
54.75	0.00	0	67.00	0.00
55.00	0.00	0	67.00	0.00
55.25	0.00	0	67.00	0.00
55.50	0.00	0	67.00	0.00
55.75	0.00	0	67.00	0.00
56.00	0.00	0	67.00	0.00
56.25	0.00	0	67.00	0.00
56.50	0.00	0	67.00	0.00
56.75	0.00	0	67.00	0.00
57.00	0.00	0	67.00	0.00
57.25	0.00	0	67.00	0.00
57.50	0.00	0	67.00	0.00
57.75	0.00	0	67.00	0.00
58.00	0.00	0	67.00	0.00
58.25	0.00	0	67.00	0.00
58.50	0.00	0	67.00	0.00
58.75	0.00	0	67.00	0.00
59.00	0.00	0	67.00	0.00
59.25	0.00	0	67.00	0.00
59.50	0.00	0	67.00	0.00
59.75	0.00	0	67.00	0.00
60.00	0.00	0	67.00	0.00
60.25	0.00	0	67.00	0.00
60.50	0.00	0	67.00	0.00
60.75	0.00	0	67.00	0.00
61.00	0.00	0	67.00	0.00
61.25	0.00	0	67.00	0.00
61.50	0.00	0	67.00	0.00
61.75	0.00	0	67.00	0.00
62.00	0.00	0	67.00	0.00
62.25	0.00	0	67.00	0.00
62.50	0.00	0	67.00	0.00
62.75	0.00	0	67.00	0.00
63.00	0.00	0	67.00	0.00
63.25	0.00	0	67.00	0.00
63.50	0.00	0	67.00	0.00
63.75	0.00	0	67.00	0.00
64.00	0.00	0	67.00	0.00
64.25	0.00	0	67.00	0.00
64.50	0.00	0	67.00	0.00
64.75	0.00	0	67.00	0.00

Hydrograph for Pond B5: BMP 5 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
65.00	0.00	0	67.00	0.00
65.25	0.00	0	67.00	0.00
65.50	0.00	0	67.00	0.00
65.75	0.00	0	67.00	0.00
66.00	0.00	0	67.00	0.00
66.25	0.00	0	67.00	0.00
66.50	0.00	0	67.00	0.00
66.75	0.00	0	67.00	0.00
67.00	0.00	0	67.00	0.00
67.25	0.00	0	67.00	0.00
67.50	0.00	0	67.00	0.00
67.75	0.00	0	67.00	0.00
68.00	0.00	0	67.00	0.00
68.25	0.00	0	67.00	0.00
68.50	0.00	0	67.00	0.00
68.75	0.00	0	67.00	0.00
69.00	0.00	0	67.00	0.00
69.25	0.00	0	67.00	0.00
69.50	0.00	0	67.00	0.00
69.75	0.00	0	67.00	0.00
70.00	0.00	0	67.00	0.00
70.25	0.00	0	67.00	0.00
70.50	0.00	0	67.00	0.00
70.75	0.00	0	67.00	0.00
71.00	0.00	0	67.00	0.00
71.25	0.00	0	67.00	0.00
71.50	0.00	0	67.00	0.00
71.75	0.00	0	67.00	0.00
72.00	0.00	0	67.00	0.00

CHANNEL ADEQUACY EXHIBIT

GRAPHIC SCALE

0 100 200 400

(IN FEET)
1 inch = 100ft.

COMMONWEALTH OF VIRGINIA
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LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists

REVISIONS:

No.	Date	Comment	By
2	3/16/05	REVISED PER COUNTY COMMENTS	RRJ

DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1/27/04 1st Submittal
- 3/16/05 2nd Submittal
- 3rd Submittal
- Approved

CHANNEL ADEQUACY EXHIBIT

STONEHOUSE GLEN
SECTION II
STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

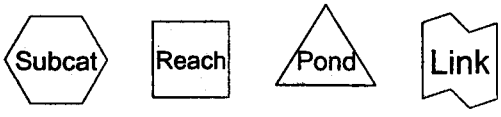
Designed: LMDG	Date: 03/16/05
Checked: CRO	Scale: 1"=200'
File Mgr./Drawn: LMDG	CADD File name: EX-1.dwg
Project Number: 2002261-504.04	Dwg. File No.: XXXX W
Drawing Number: EX-1	

1 OF 1

JCC CASE #S-116-03

PRE AND POST DEVELOPMENT CALCULATIONS

PRE-DEVELOPED



Drainage Diagram for bmp4
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Subcatchment DA4 PRE: PRE-DEVELOPED

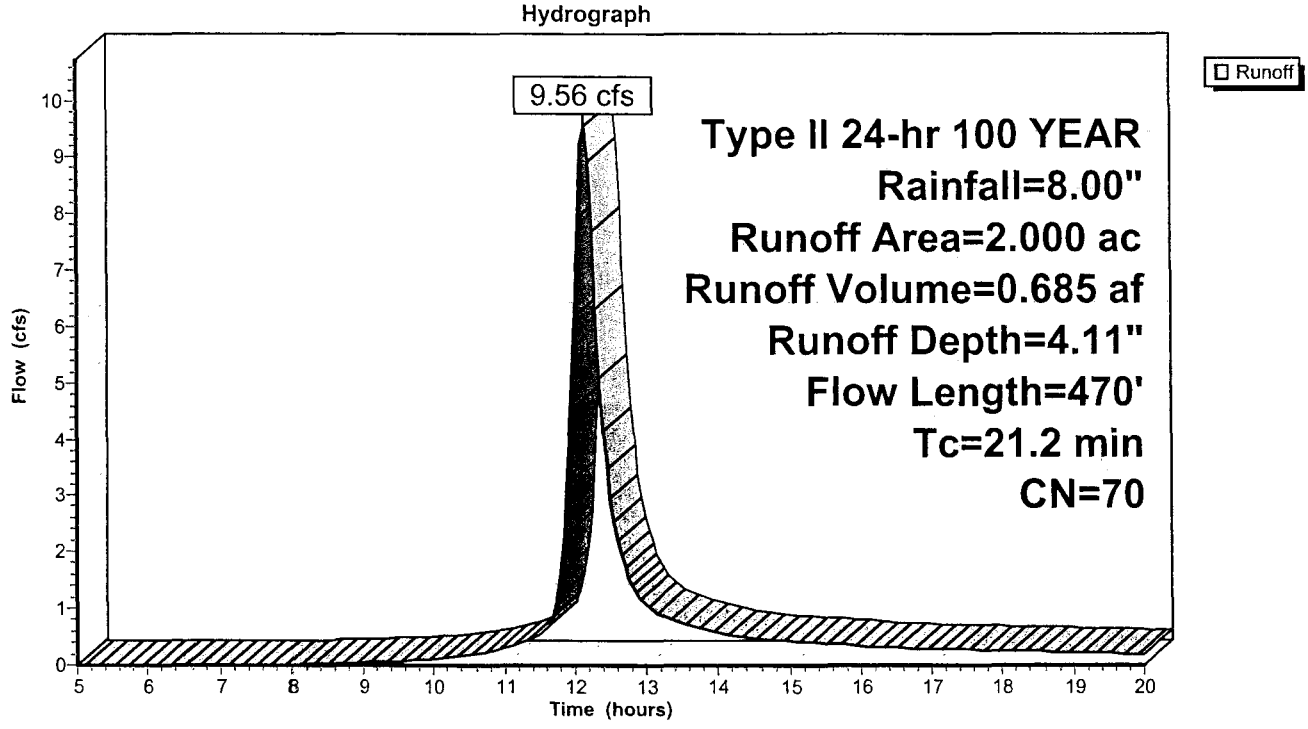
Runoff = 9.56 cfs @ 12.14 hrs, Volume= 0.685 af, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	100	0.0320	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.8	200	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
21.2	470	Total			

Subcatchment DA4 PRE: PRE-DEVELOPED



Subcatchment DA4 PRE: PRE-DEVELOPED

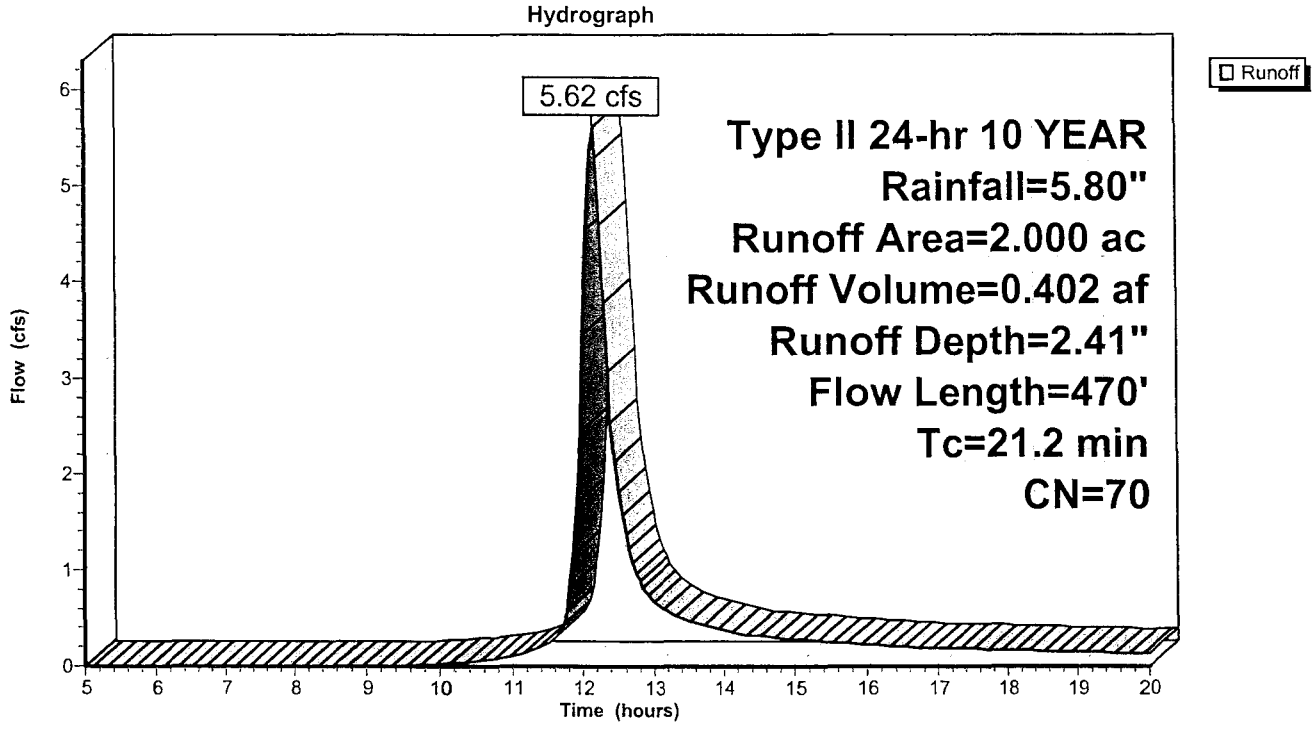
Runoff = 5.62 cfs @ 12.15 hrs, Volume= 0.402 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	100	0.0320	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.8	200	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
21.2	470	Total			

Subcatchment DA4 PRE: PRE-DEVELOPED



Subcatchment DA4 PRE: PRE-DEVELOPED

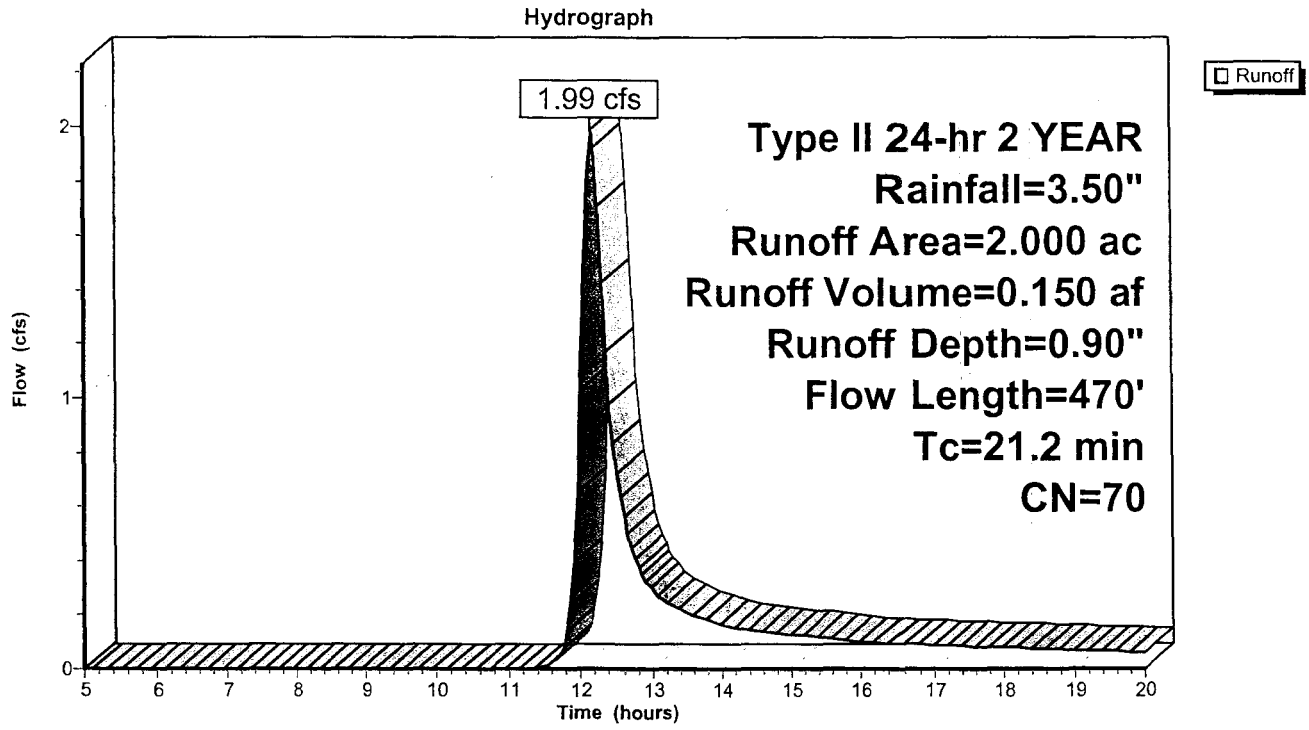
Runoff = 1.99 cfs @ 12.16 hrs, Volume= 0.150 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	100	0.0320	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.8	200	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
21.2	470	Total			

Subcatchment DA4 PRE: PRE-DEVELOPED



Subcatchment DA4 PRE: PRE-DEVELOPED

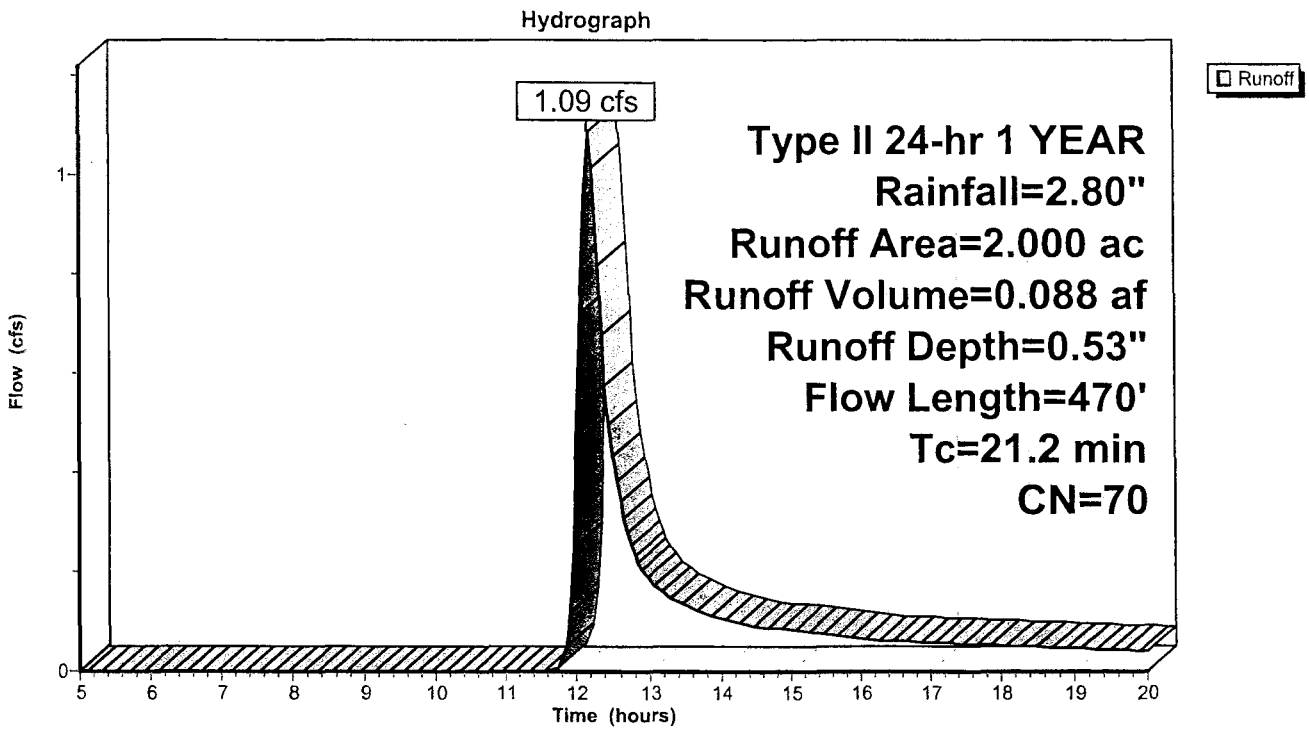
Runoff = 1.09 cfs @ 12.17 hrs, Volume= 0.088 af, Depth= 0.53"

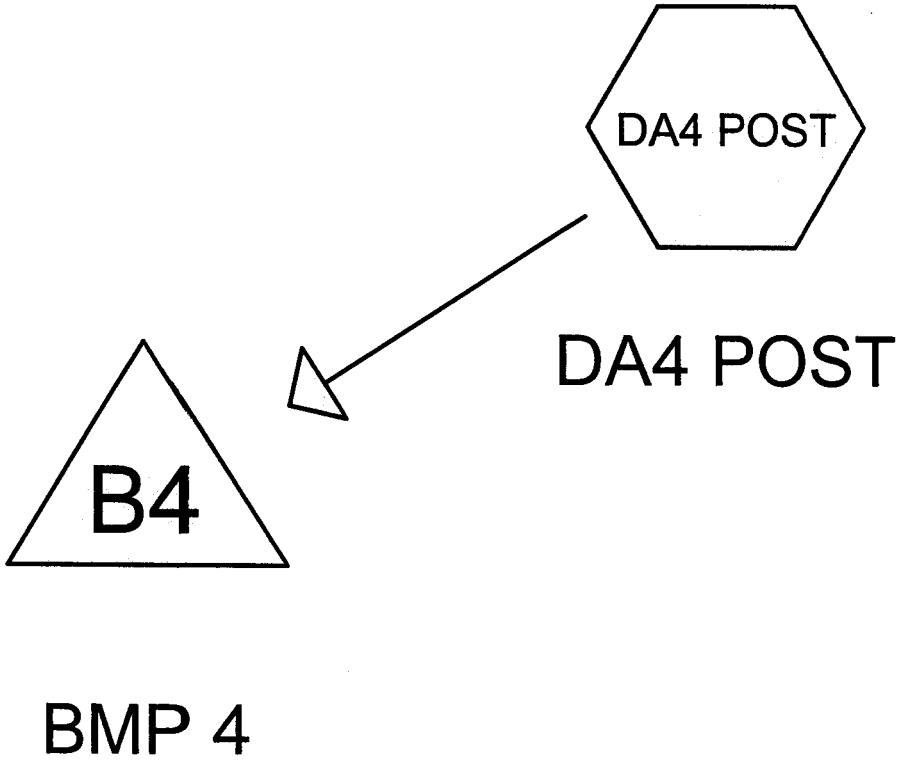
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

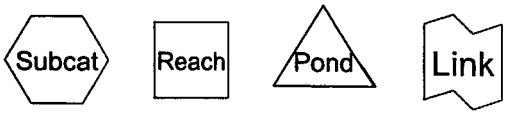
Area (ac)	CN	Description
2.000	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	100	0.0320	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
1.8	200	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
21.2	470	Total			

Subcatchment DA4 PRE: PRE-DEVELOPED







Drainage Diagram for bmp4
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Subcatchment DA4 POST: DA4 POST

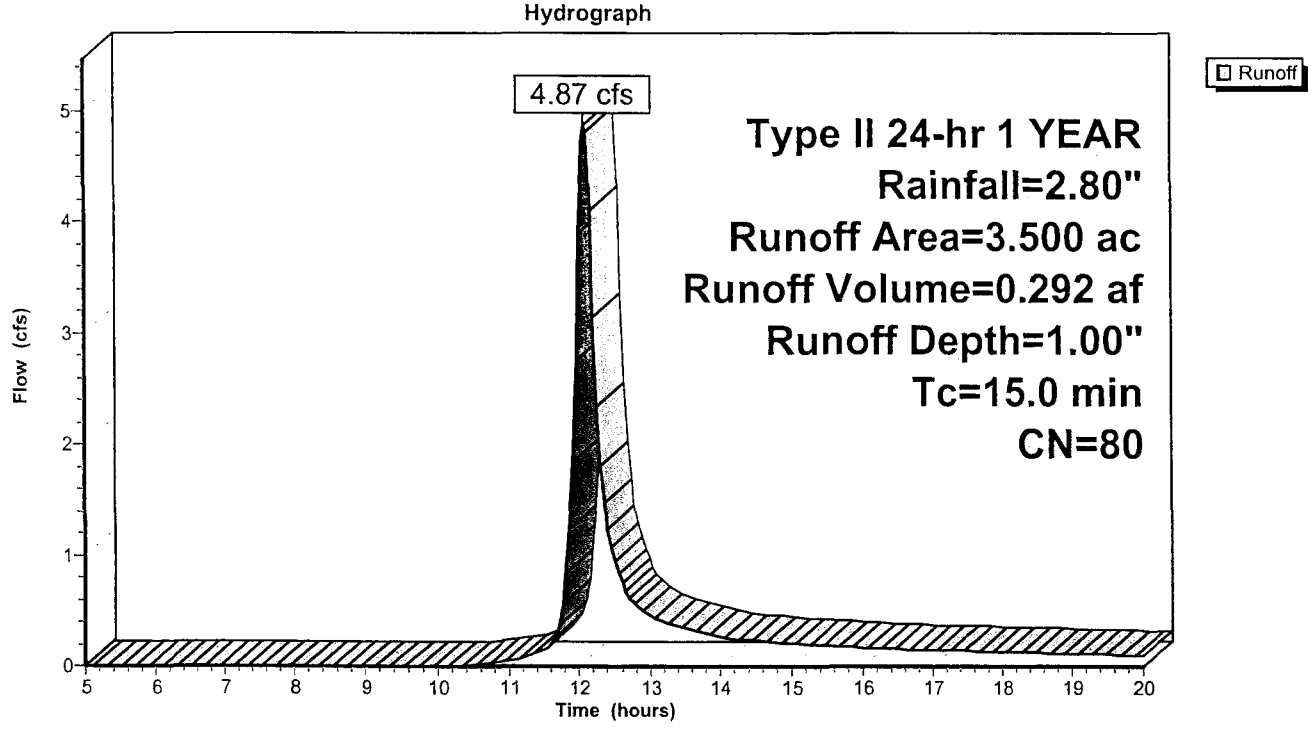
Runoff = 4.87 cfs @ 12.08 hrs, Volume= 0.292 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
3.500	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment DA4 POST: DA4 POST



Pond B4: BMP 4

Inflow Area =	3.500 ac,	Inflow Depth =	1.00"	for	1 YEAR event
Inflow =	4.87 cfs @	12.08 hrs,	Volume=	0.292 af	
Outflow =	0.46 cfs @	13.00 hrs,	Volume=	0.249 af,	Atten= 91%, Lag= 55.5 min
Primary =	0.46 cfs @	13.00 hrs,	Volume=	0.249 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 51.36' @ 13.00 hrs Surf.Area= 1,861 sf Storage= 6,347 cf
Plug-Flow detention time= 171.3 min calculated for 0.249 af (85% of inflow)
Center-of-Mass det. time= 126.0 min (932.8 - 806.8)

#	Invert	Avail.Storage	Storage Description
1	47.50'	23,684 cf	**Custom Stage Data (Prismatic)** Listed below

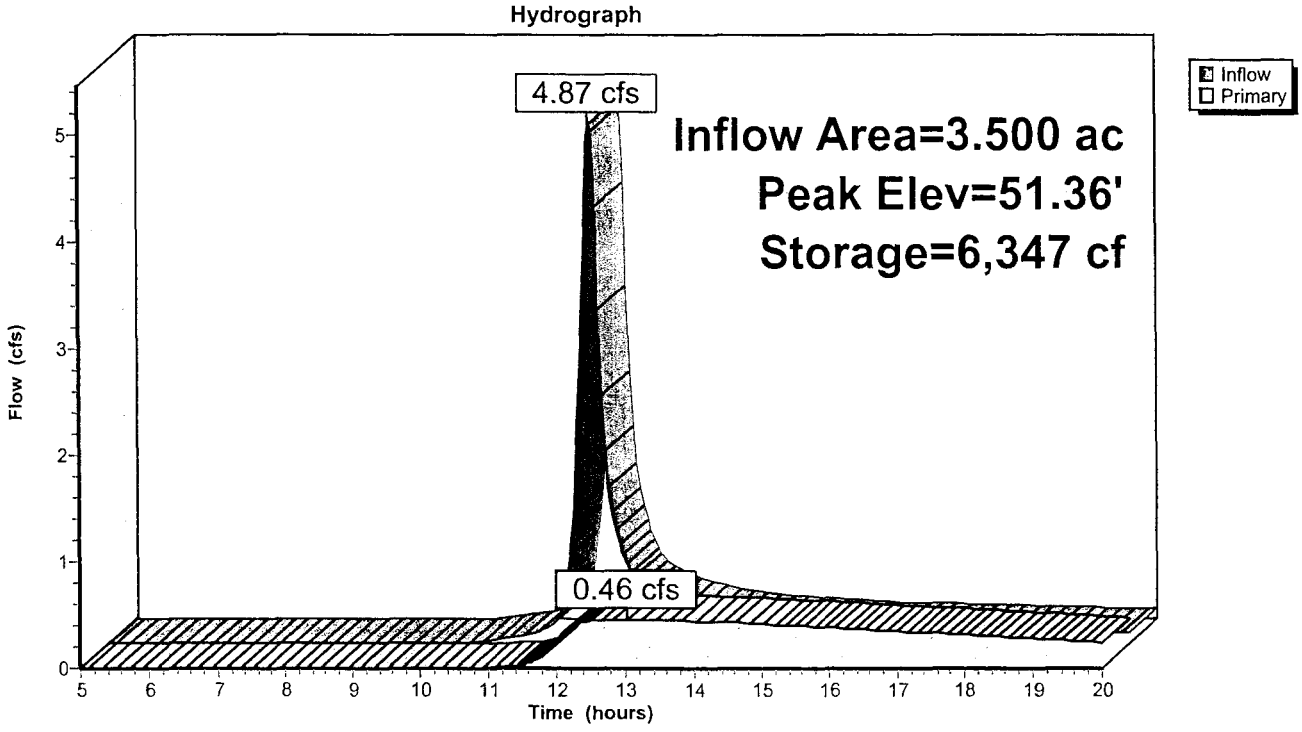
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.50	485	0	0
54.00	2,800	10,676	10,676
57.50	4,633	13,008	23,684

PERFECTLY LINEAR @ 7' DEPTH !?

#	Routing	Invert	Outlet Devices
1	Primary	45.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900
2	Device 1	47.50'	**3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900
3	Device 1	54.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.46 cfs @ 13.00 hrs HW=51.36' (Free Discharge)
└**1=Culvert** (Passes 0.46 cfs of 35.04 cfs potential flow)
├**2=Culvert** (Inlet Controls 0.46 cfs @ 9.3 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond B4: BMP 4


Hydrograph
4.87 cfs
0.46 cfs
Inflow Area=3.500 ac
Peak Elev=51.36'
Storage=6,347 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Subcatchment DA4 POST: DA4 POST

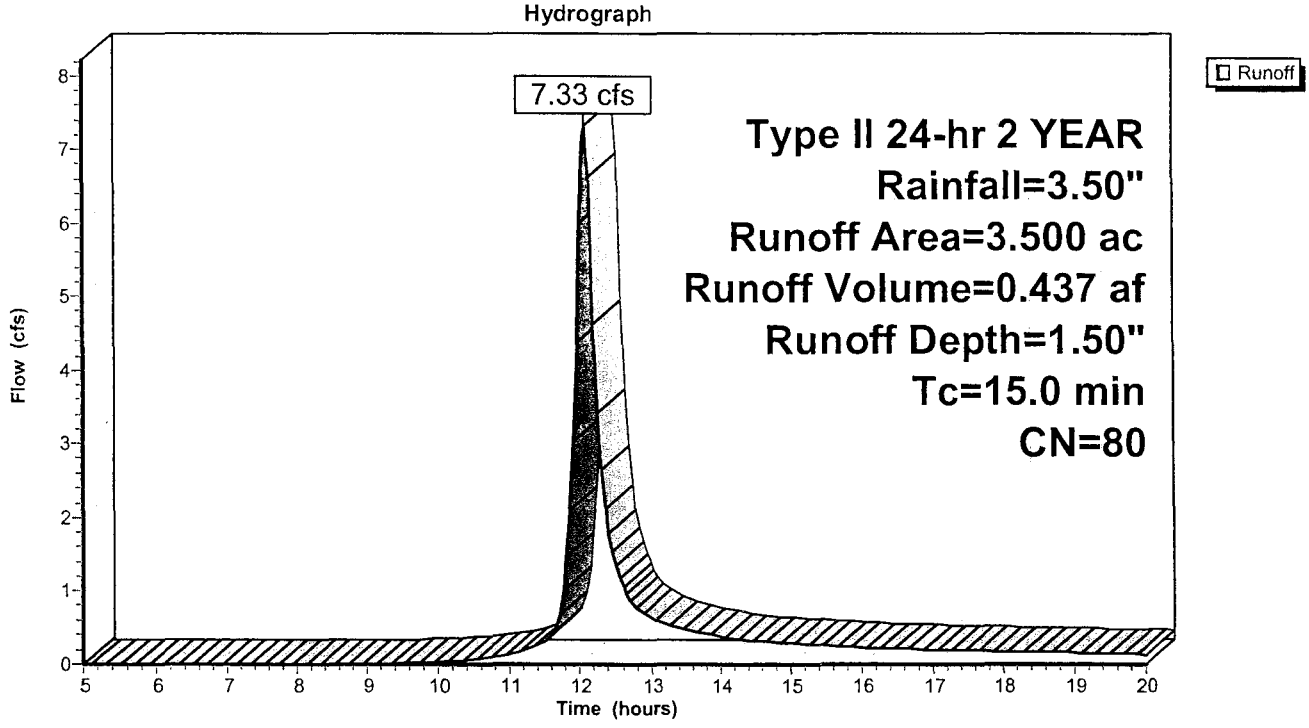
Runoff = 7.33 cfs @ 12.07 hrs, Volume= 0.437 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
3.500	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment DA4 POST: DA4 POST



Pond B4: BMP 4

Inflow Area =	3.500 ac,	Inflow Depth =	1.50"	for	2 YEAR event
Inflow =	7.33 cfs @	12.07 hrs,	Volume=	0.437 af	
Outflow =	0.58 cfs @	13.14 hrs,	Volume=	0.341 af,	Atten= 92%, Lag= 64.0 min
Primary =	0.58 cfs @	13.14 hrs,	Volume=	0.341 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 53.69' @ 13.14 hrs Surf.Area= 2,691 sf Storage= 10,173 cf
Plug-Flow detention time= 195.8 min calculated for 0.341 af (78% of inflow)
Center-of-Mass det. time= 137.2 min (935.6 - 798.4)

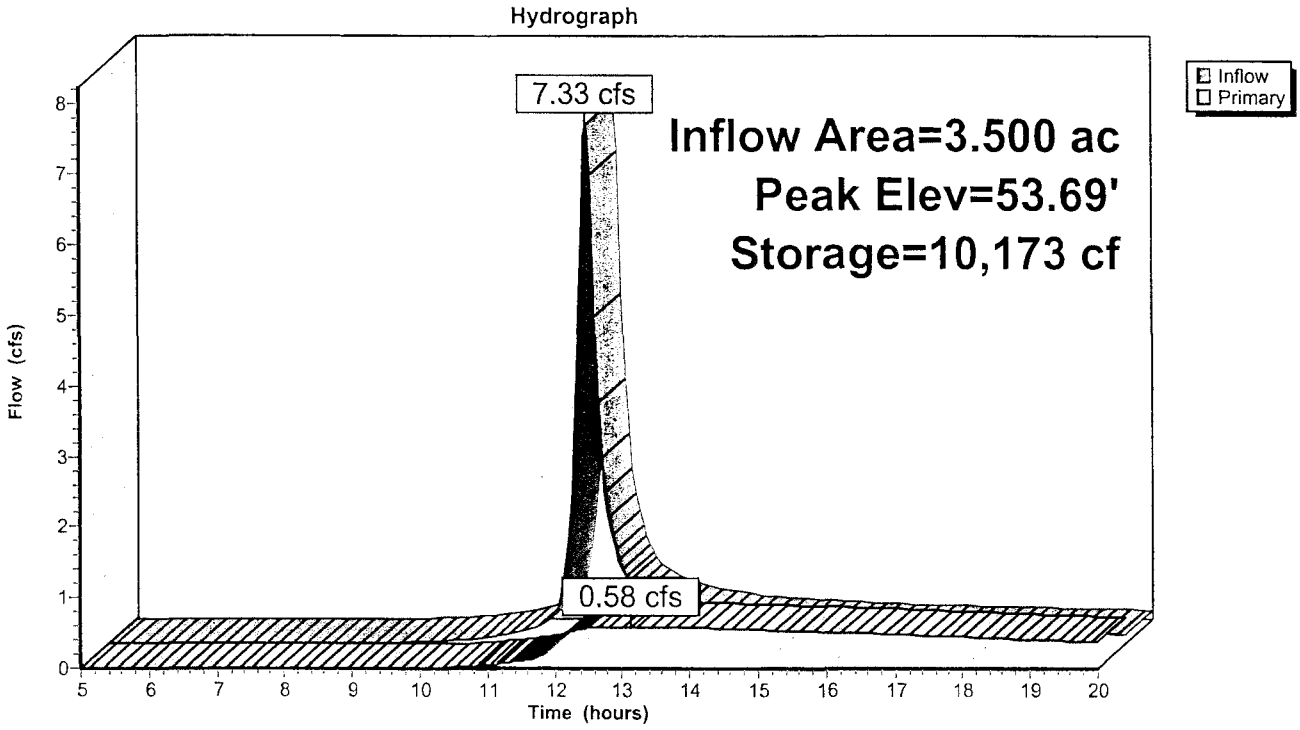
#	Invert	Avail.Storage	Storage Description
1	47.50'	23,684 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.50	485	0	0
54.00	2,800	10,676	10,676
57.50	4,633	13,008	23,684

#	Routing	Invert	Outlet Devices
1	Primary	45.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900
2	Device 1	47.50'	**3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900
3	Device 1	54.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.58 cfs @ 13.14 hrs HW=53.69' (Free Discharge)
└**1=Culvert** (Passes 0.58 cfs of 41.96 cfs potential flow)
  ├**2=Culvert** (Inlet Controls 0.58 cfs @ 11.9 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond B4: BMP 4


Hydrograph
7.33 cfs
0.58 cfs
Inflow Area=3.500 ac
Peak Elev=53.69'
Storage=10,173 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Subcatchment DA4 POST: DA4 POST

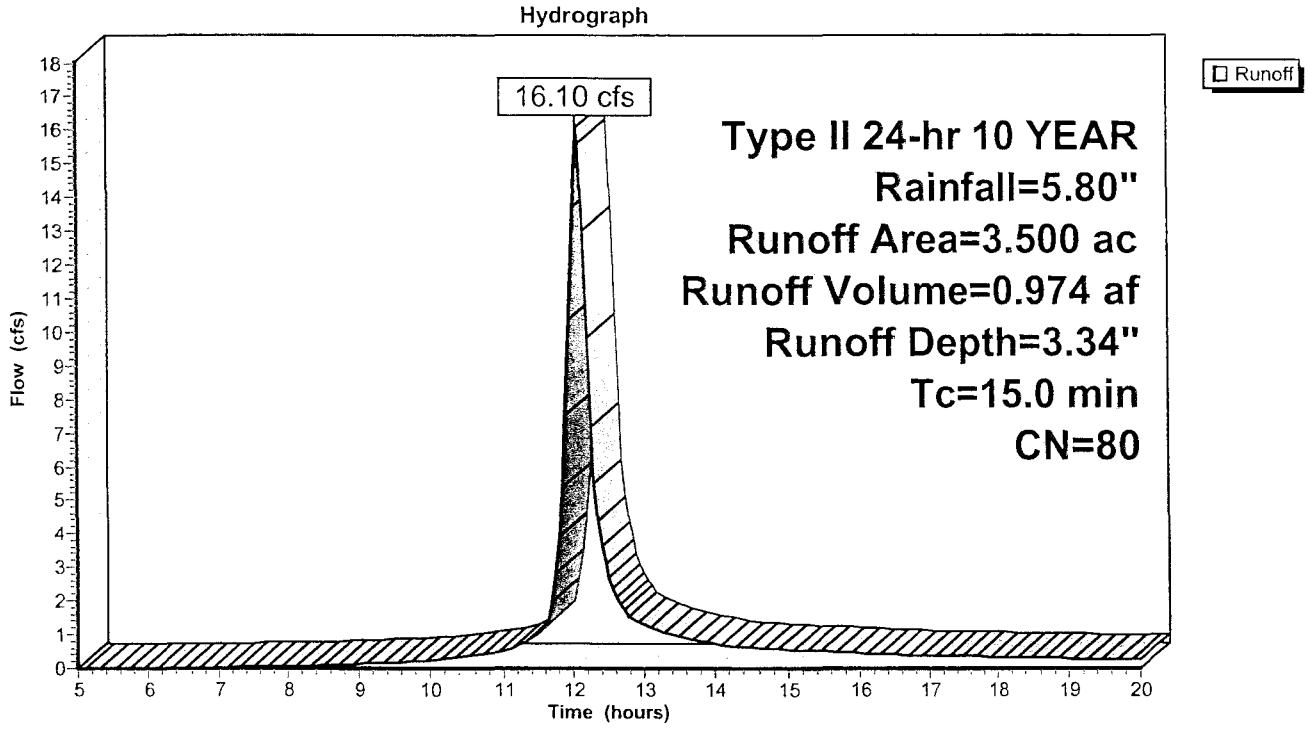
Runoff = 16.10 cfs @ 12.07 hrs, Volume= 0.974 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

Area (ac)	CN	Description
3.500	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment DA4 POST: DA4 POST



Pond B4: BMP 4

Inflow Area =	3.500 ac,	Inflow Depth =	3.34"	for	10 YEAR event
Inflow =	16.10 cfs @	12.07 hrs,	Volume=	0.974 af	
Outflow =	16.10 cfs @	12.12 hrs,	Volume=	0.806 af,	Atten= 0%, Lag= 3.2 min
Primary =	16.10 cfs @	12.12 hrs,	Volume=	0.806 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 54.53' @ 12.12 hrs Surf.Area= 3,076 sf Storage= 12,635 cf
Plug-Flow detention time= 105.2 min calculated for 0.806 af (83% of inflow)
Center-of-Mass det. time= 55.7 min (836.8 - 781.1)

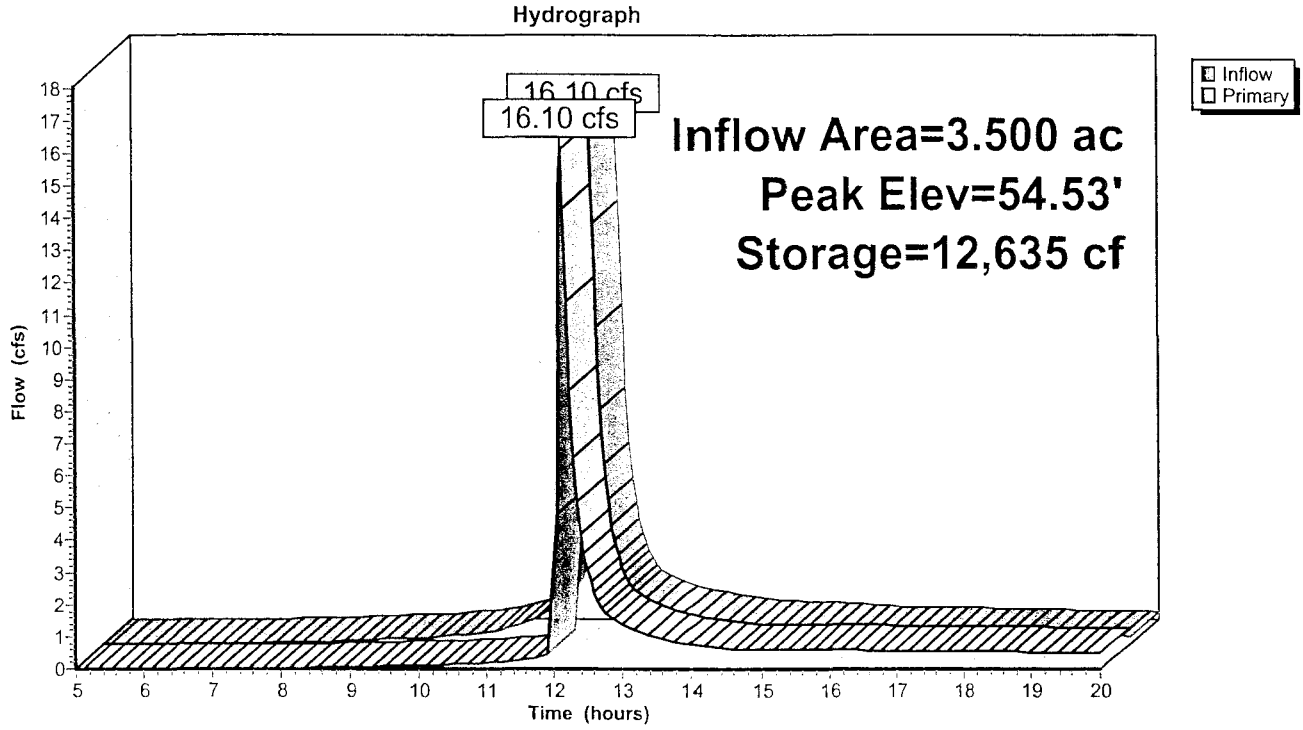
#	Invert	Avail.Storage	Storage Description
1	47.50'	23,684 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.50	485	0	0
54.00	2,800	10,676	10,676
57.50	4,633	13,008	23,684

#	Routing	Invert	Outlet Devices
1	Primary	45.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900
2	Device 1	47.50'	**3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900
3	Device 1	54.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=14.73 cfs @ 12.12 hrs HW=54.49' (Free Discharge)
└**1=Culvert** (Passes 14.73 cfs of 44.08 cfs potential flow)
  ├**2=Culvert** (Inlet Controls 0.62 cfs @ 12.6 fps)
  └**3=Orifice/Grate** (Weir Controls 14.11 cfs @ 2.3 fps)

Pond B4: BMP 4


Hydrograph
Inflow
Primary
16.10 cfs
16.10 cfs
Inflow Area=3.500 ac
Peak Elev=54.53'
Storage=12,635 cf
Flow (cfs)
Time (hours)

Subcatchment DA4 POST: DA4 POST

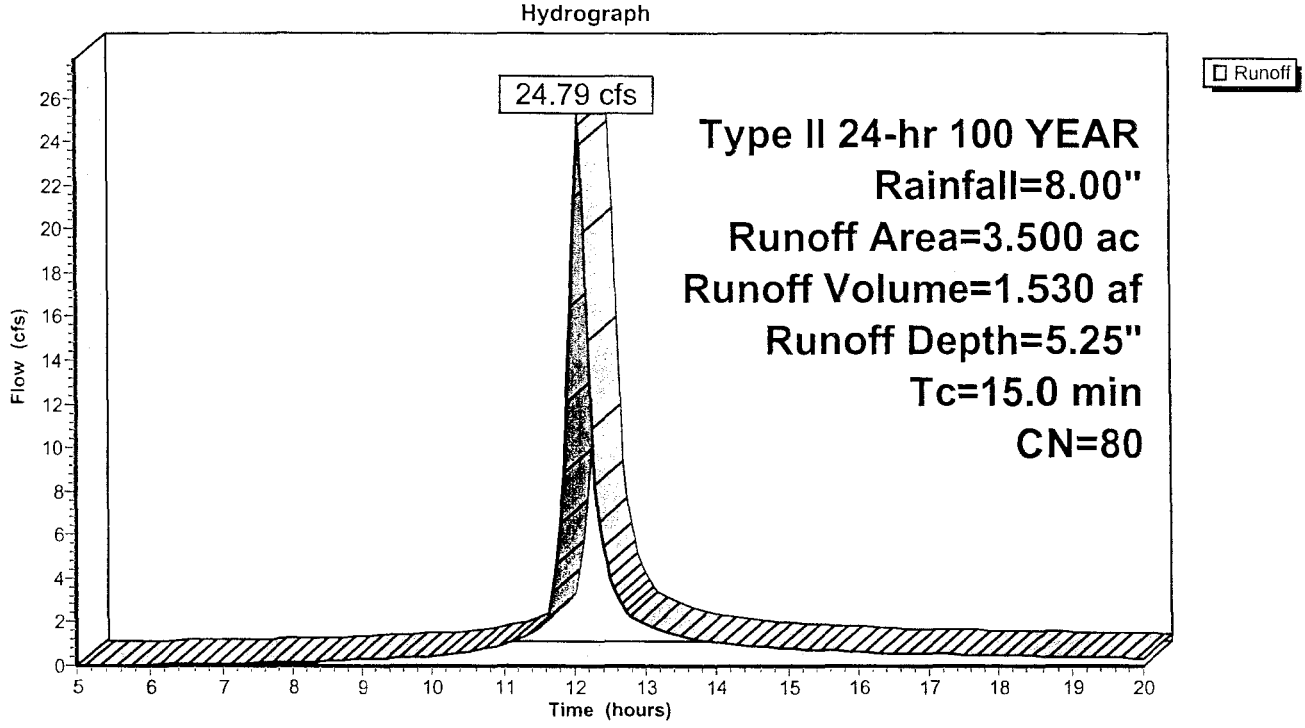
Runoff = 24.79 cfs @ 12.07 hrs, Volume= 1.530 af, Depth= 5.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
3.500	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment DA4 POST: DA4 POST



Pond B4: BMP 4

Inflow Area =	3.500 ac,	Inflow Depth =	5.25"	for	100 YEAR event
Inflow =	24.79 cfs @	12.07 hrs,	Volume=	1.530 af	
Outflow =	24.42 cfs @	12.09 hrs,	Volume=	1.317 af,	Atten= 1%, Lag= 1.4 min
Primary =	24.42 cfs @	12.09 hrs,	Volume=	1.317 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 54.69' @ 12.09 hrs Surf.Area= 3,164 sf Storage= 13,257 cf
Plug-Flow detention time= 73.3 min calculated for 1.317 af (86% of inflow)
Center-of-Mass det. time= 30.4 min (801.2 - 770.8)

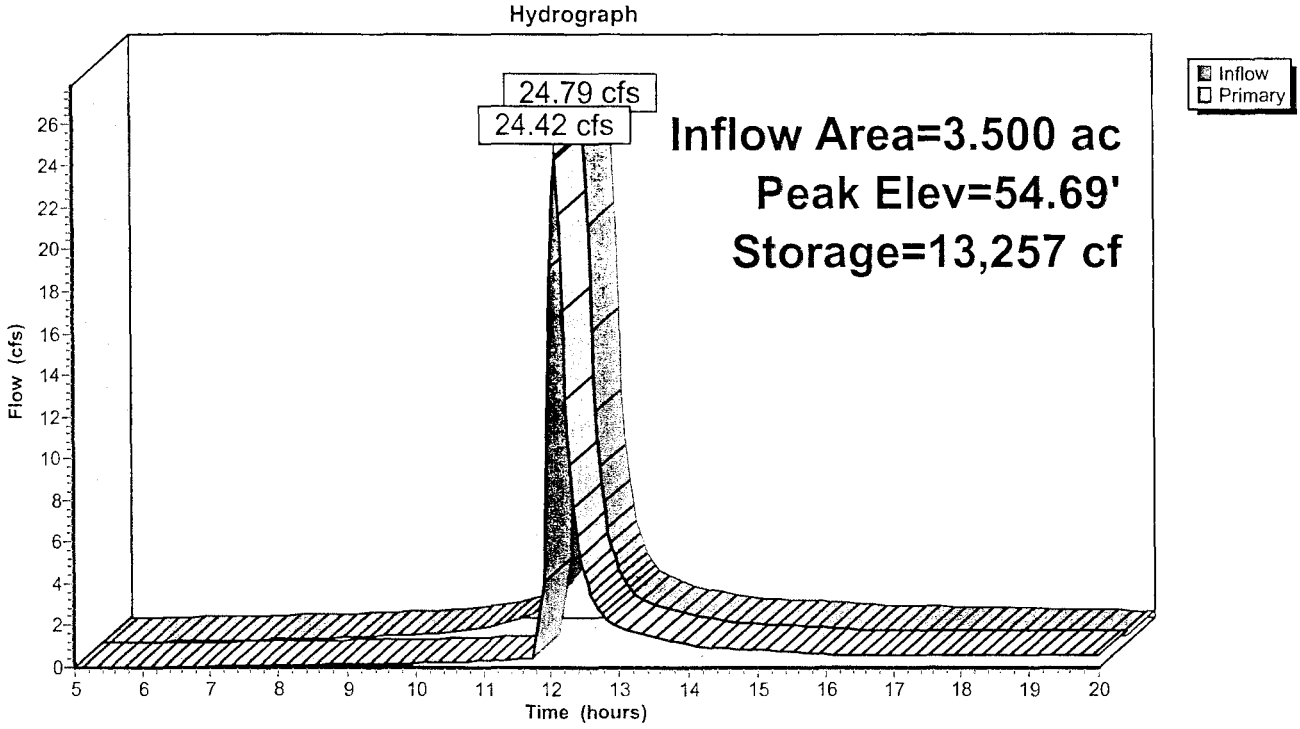
#	Invert	Avail.Storage	Storage Description
1	47.50'	23,684 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.50	485	0	0
54.00	2,800	10,676	10,676
57.50	4,633	13,008	23,684

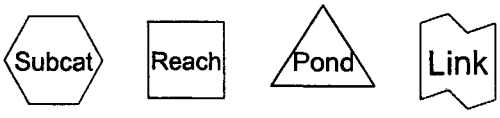
#	Routing	Invert	Outlet Devices
1	Primary	45.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900
2	Device 1	47.50'	**3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900
3	Device 1	54.00'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=24.07 cfs @ 12.09 hrs HW=54.69' (Free Discharge)
└**1=Culvert** (Passes 24.07 cfs of 44.59 cfs potential flow)
  ├**2=Culvert** (Inlet Controls 0.63 cfs @ 12.8 fps)
  └**3=Orifice/Grate** (Weir Controls 23.44 cfs @ 2.7 fps)

Pond B4: BMP 4


Hydrograph
24.79 cfs
24.42 cfs
Inflow Area=3.500 ac
Peak Elev=54.69'
Storage=13,257 cf
Inflow
Primary
Flow (cfs)
Time (hours)

PRE-DEVELOPED



Drainage Diagram for bmp5
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Subcatchment DA B5: PRE-DEVELOPED

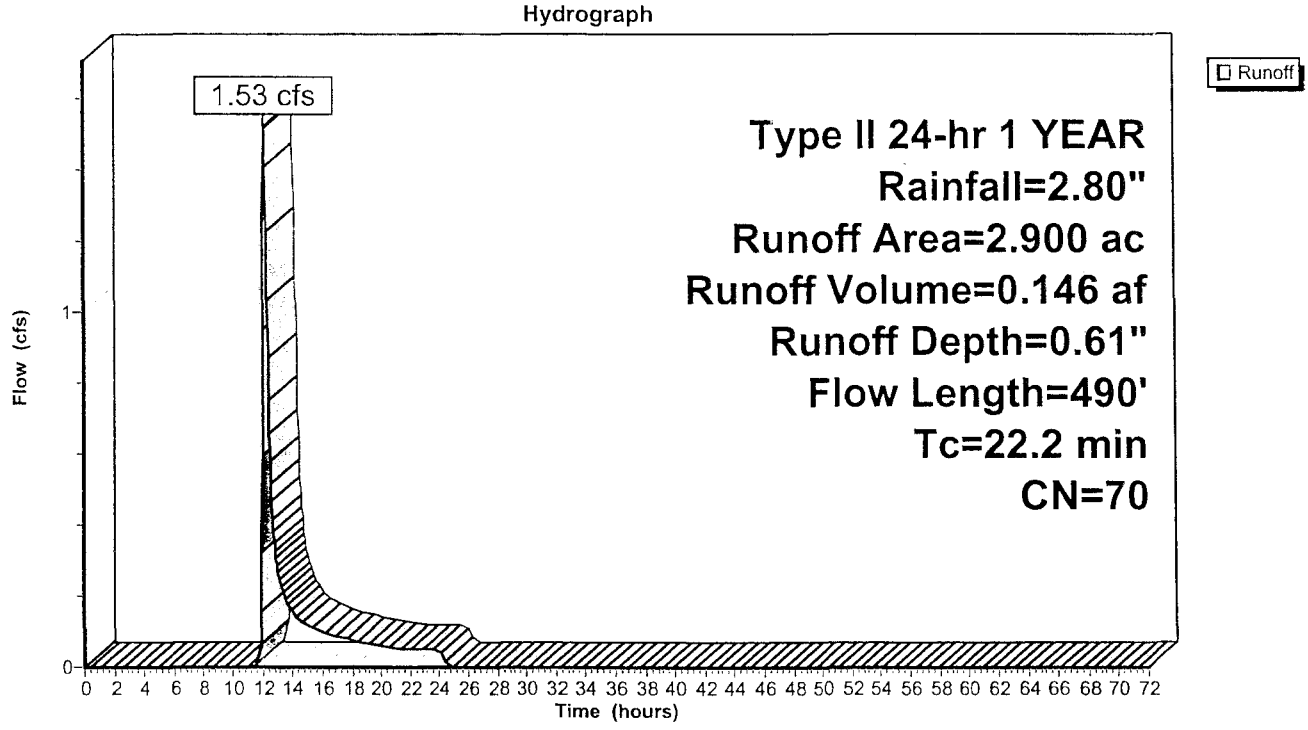
Runoff = 1.53 cfs @ 12.19 hrs, Volume= 0.146 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
2.900	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.8	100	0.0290	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
2.0	220	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
22.2	490	Total			

Subcatchment DA B5: PRE-DEVELOPED



Subcatchment DA B5: PRE-DEVELOPED

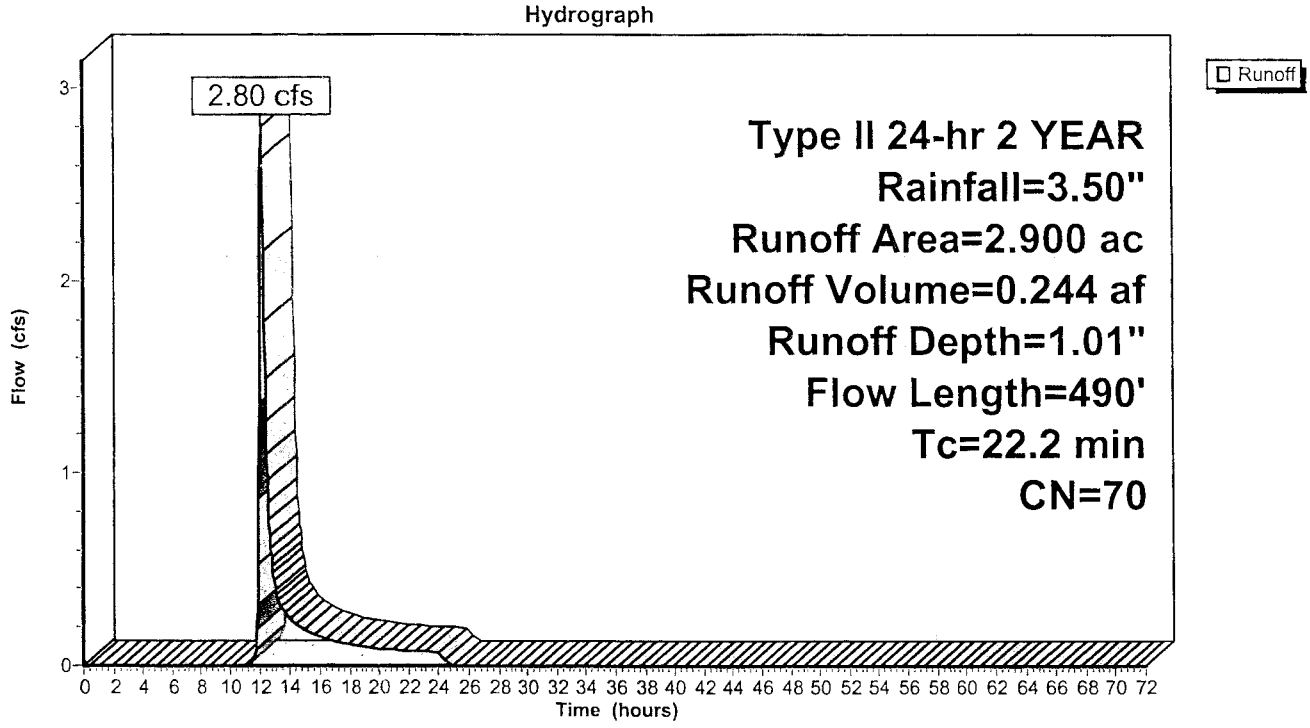
Runoff = 2.80 cfs @ 12.17 hrs, Volume= 0.244 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
2.900	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.8	100	0.0290	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
2.0	220	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
22.2	490	Total			

Subcatchment DA B5: PRE-DEVELOPED



Subcatchment DA B5: PRE-DEVELOPED

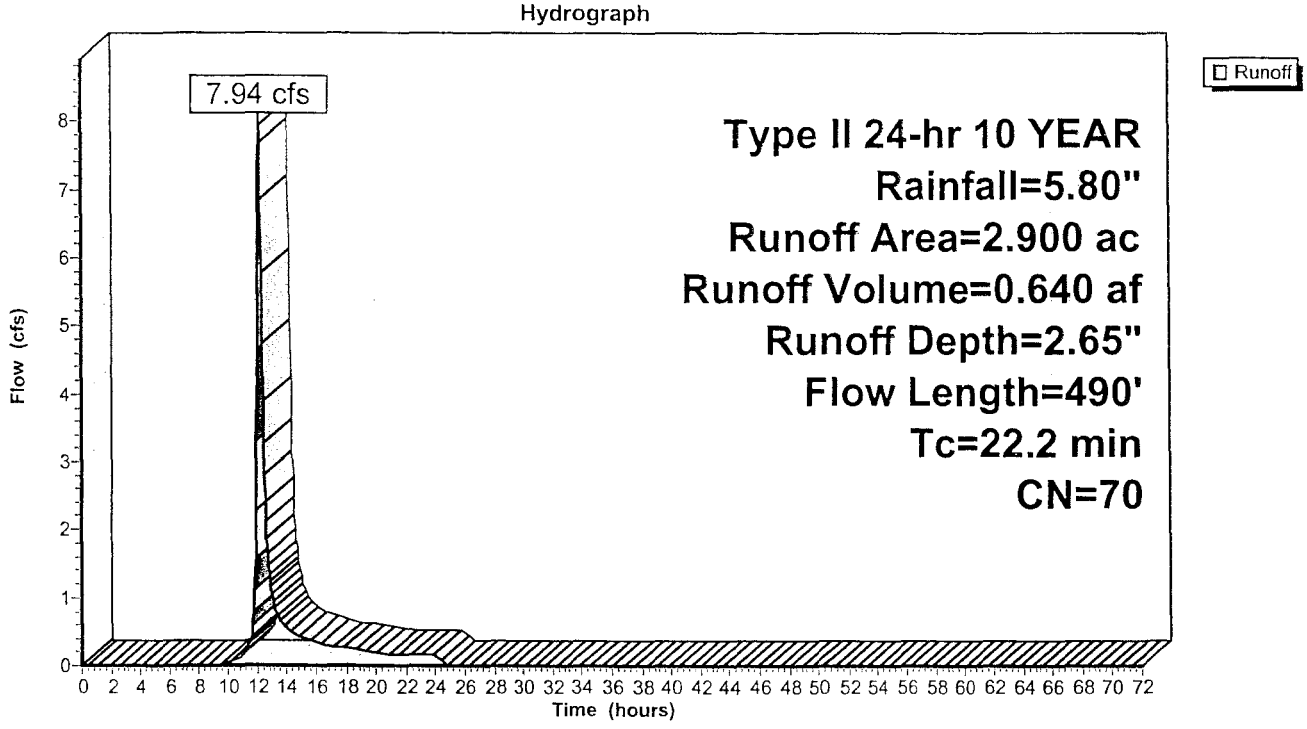
Runoff = 7.94 cfs @ 12.16 hrs, Volume= 0.640 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

Area (ac)	CN	Description
2.900	70	Woods, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.8	100	0.0290	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
2.0	220	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
22.2	490	Total			

Subcatchment DA B5: PRE-DEVELOPED



Subcatchment DA B5: PRE-DEVELOPED

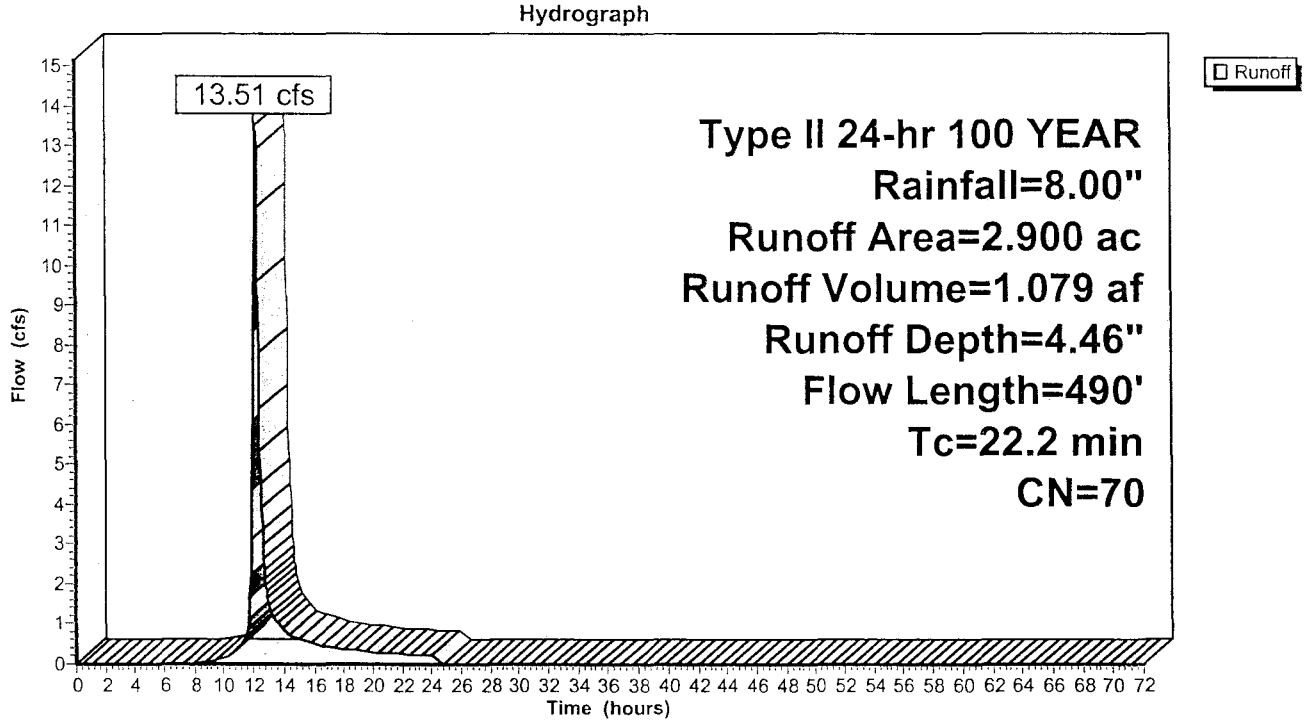
Runoff = 13.51 cfs @ 12.15 hrs, Volume= 1.079 af, Depth= 4.46"

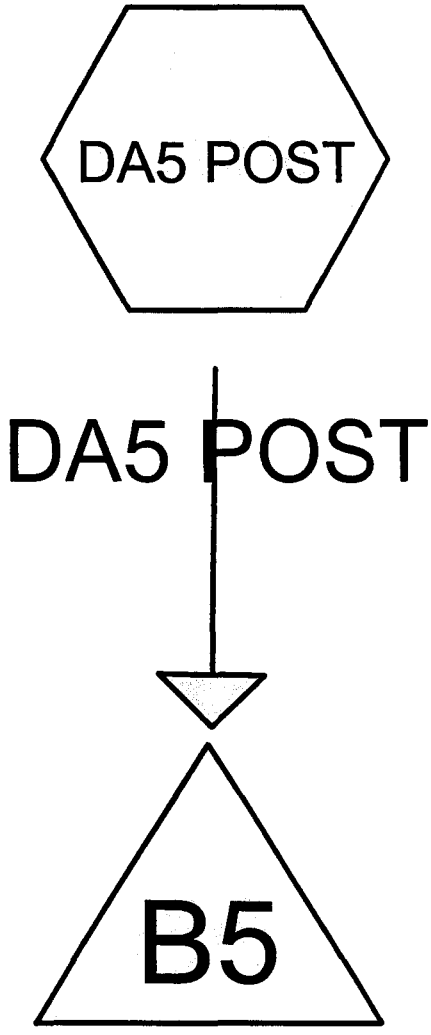
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
2.900	70	Woods, Good, HSG C

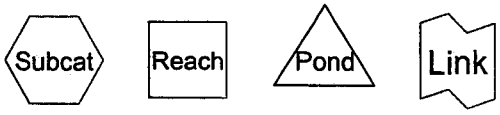
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.8	100	0.0290	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
2.0	220	0.1390	1.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	170	0.1300	6.4	42.88	**Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040
22.2	490	Total			

Subcatchment DA B5: PRE-DEVELOPED





BMP 5



Drainage Diagram for bmp5
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Subcatchment DA5 POST: DA5 POST

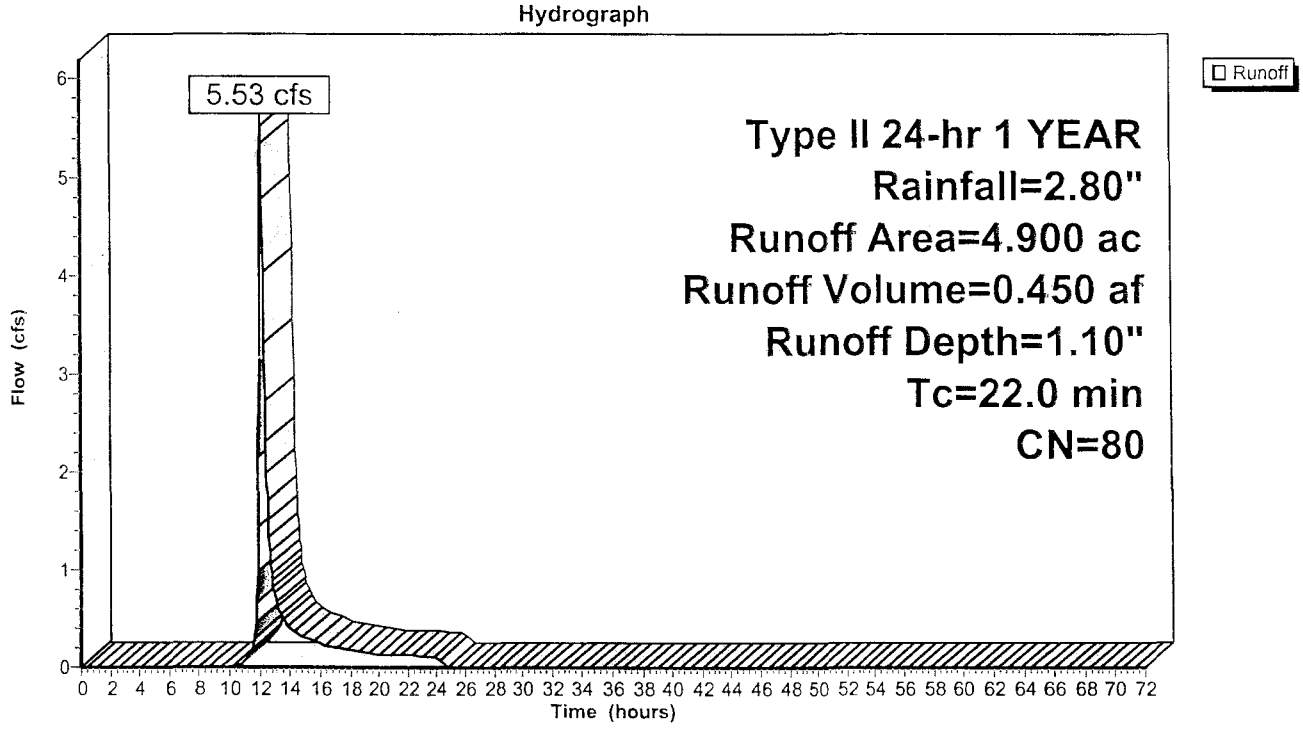
Runoff = 5.53 cfs @ 12.16 hrs, Volume= 0.450 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

Area (ac)	CN	Description
4.900	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0					**Direct Entry,**

Subcatchment DA5 POST: DA5 POST



Pond B5: BMP 5

Inflow Area =	4.900 ac,	Inflow Depth =	1.10"	for	1 YEAR event
Inflow =	5.53 cfs @	12.16 hrs,	Volume=		0.450 af
Outflow =	0.46 cfs @	13.68 hrs,	Volume=		0.450 af, Atten= 92%, Lag= 91.2 min
Primary =	0.46 cfs @	13.68 hrs,	Volume=		0.450 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 70.96' @ 13.68 hrs Surf.Area= 3,104 sf Storage= 9,616 cf
Plug-Flow detention time= 251.5 min calculated for 0.450 af (100% of inflow)
Center-of-Mass det. time= 251.9 min (1,113.3 - 861.4)

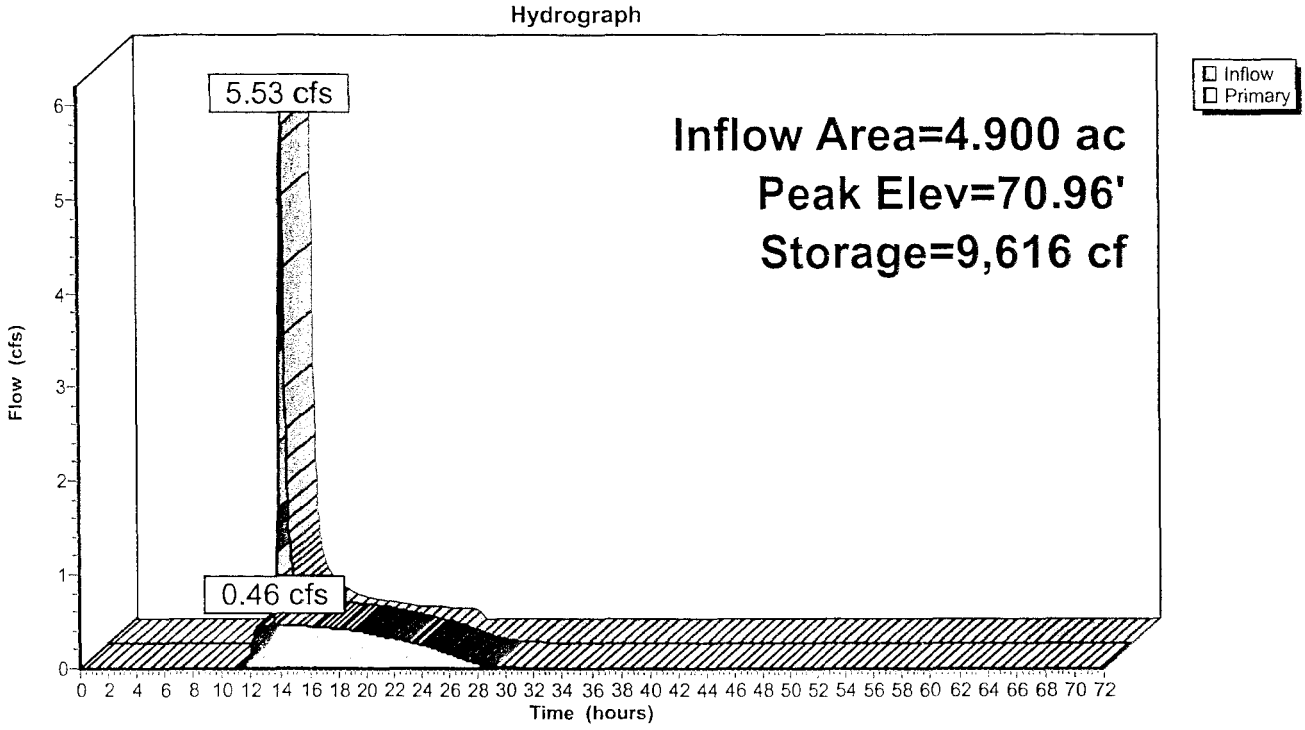
#	Invert	Avail.Storage	Storage Description
1	67.00'	31,965 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
67.00	1,300	0	0
70.00	2,500	5,700	5,700
75.00	5,640	20,350	26,050
76.00	6,190	5,915	31,965

#	Routing	Invert	Outlet Devices
1	Primary	66.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900
2	Device 1	67.00'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.46 cfs @ 13.68 hrs HW=70.96' (Free Discharge)
└**1=Culvert** (Passes 0.46 cfs of 30.11 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.46 cfs @ 9.4 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond B5: BMP 5


Hydrograph
5.53 cfs
0.46 cfs
Inflow Area=4.900 ac
Peak Elev=70.96'
Storage=9,616 cf
Inflow
Primary
Flow (cfs)
0
1
2
3
4
5
6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

Subcatchment DA5 POST: DA5 POST

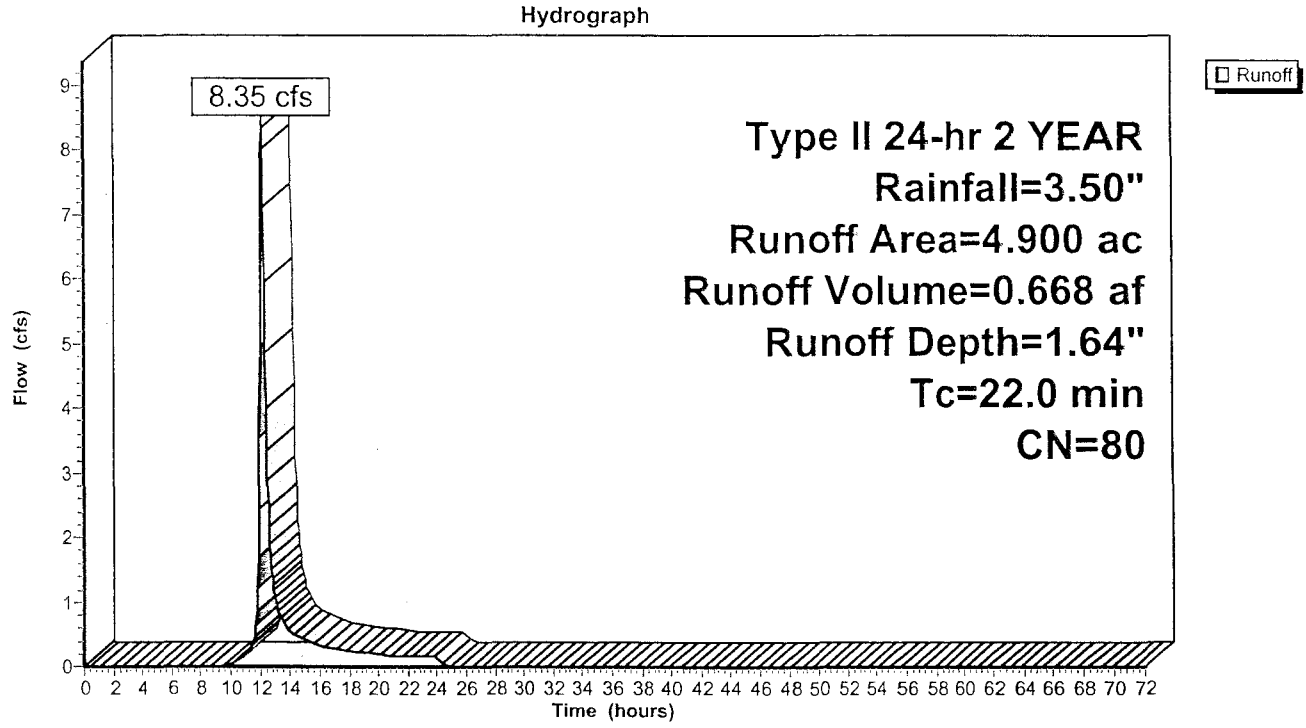
Runoff = 8.35 cfs @ 12.16 hrs, Volume= 0.668 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

Area (ac)	CN	Description
4.900	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0					**Direct Entry,**

Subcatchment DA5 POST: DA5 POST



Pond B5: BMP 5

Inflow Area =	4.900 ac,	Inflow Depth =	1.64"	for	2 YEAR event
Inflow =	8.35 cfs @	12.16 hrs,	Volume=	0.668 af	
Outflow =	0.55 cfs @	14.04 hrs,	Volume=	0.668 af,	Atten= 93%, Lag= 113.1 min
Primary =	0.55 cfs @	14.04 hrs,	Volume=	0.668 af	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 72.45' @ 14.04 hrs Surf.Area= 4,039 sf Storage= 15,672 cf
Plug-Flow detention time= 347.8 min calculated for 0.668 af (100% of inflow)
Center-of-Mass det. time= 348.3 min (1,198.1 - 849.8)

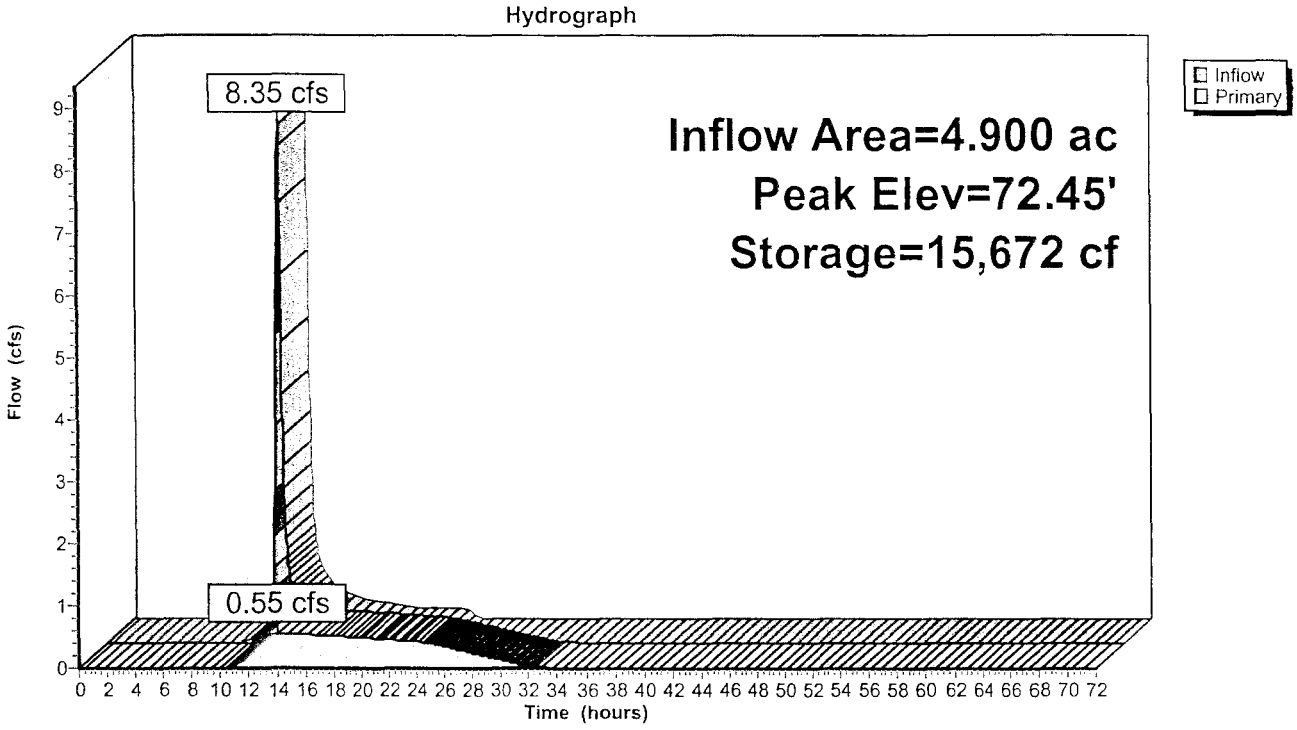
#	Invert	Avail.Storage	Storage Description
1	67.00'	31,965 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
67.00	1,300	0	0
70.00	2,500	5,700	5,700
75.00	5,640	20,350	26,050
76.00	6,190	5,915	31,965

#	Routing	Invert	Outlet Devices
1	Primary	66.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900
2	Device 1	67.00'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=0.55 cfs @ 14.04 hrs HW=72.45' (Free Discharge)
└**1=Culvert** (Passes 0.55 cfs of 35.31 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.55 cfs @ 11.1 fps)
└**3=Orifice/Grate** (Controls 0.00 cfs)

Pond B5: BMP 5


Hydrograph
8.35 cfs
0.55 cfs
Inflow Area=4.900 ac
Peak Elev=72.45'
Storage=15,672 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Subcatchment DA5 POST: DA5 POST

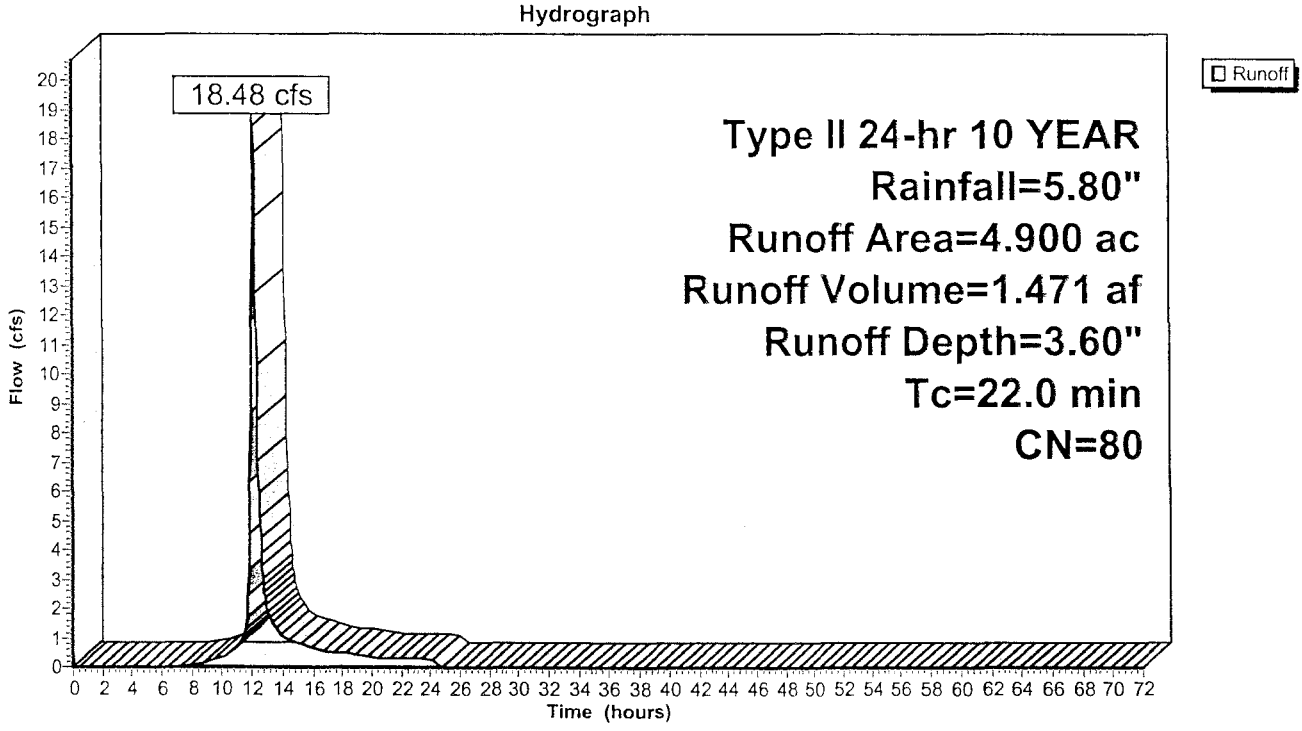
Runoff = 18.48 cfs @ 12.15 hrs, Volume= 1.471 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

Area (ac)	CN	Description
4.900	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0					**Direct Entry,**

Subcatchment DA5 POST: DA5 POST



Pond B5: BMP 5

Inflow Area =	4.900 ac,	Inflow Depth =	3.60"	for	10 YEAR event
Inflow =	18.48 cfs @	12.15 hrs,	Volume=	1.471 af	
Outflow =	16.34 cfs @	12.27 hrs,	Volume=	1.471 af,	Atten= 12%, Lag= 7.1 min
Primary =	16.34 cfs @	12.27 hrs,	Volume=	1.471 af	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 73.78' @ 12.27 hrs Surf.Area= 4,874 sf Storage= 21,083 cf
Plug-Flow detention time= 268.8 min calculated for 1.471 af (100% of inflow)
Center-of-Mass det. time= 268.3 min (1,095.6 - 827.3)

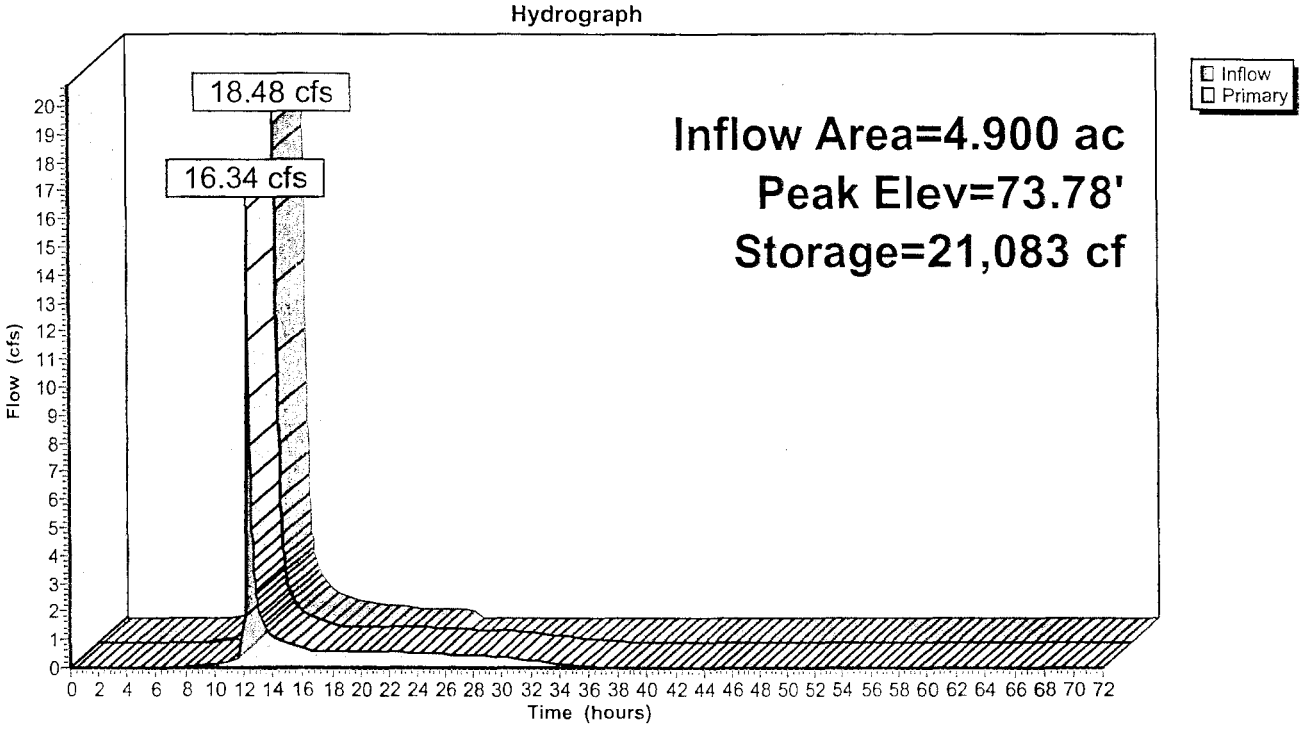
#	Invert	Avail.Storage	Storage Description
1	67.00'	31,965 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
67.00	1,300	0	0
70.00	2,500	5,700	5,700
75.00	5,640	20,350	26,050
76.00	6,190	5,915	31,965

#	Routing	Invert	Outlet Devices
1	Primary	66.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900
2	Device 1	67.00'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=15.18 cfs @ 12.27 hrs HW=73.75' (Free Discharge)
└**1=Culvert** (Passes 15.18 cfs of 39.30 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.61 cfs @ 12.4 fps)
└**3=Orifice/Grate** (Weir Controls 14.57 cfs @ 2.3 fps)

Pond B5: BMP 5


Hydrograph
18.48 cfs
16.34 cfs
Inflow Area=4.900 ac
Peak Elev=73.78'
Storage=21,083 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Subcatchment DA5 POST: DA5 POST

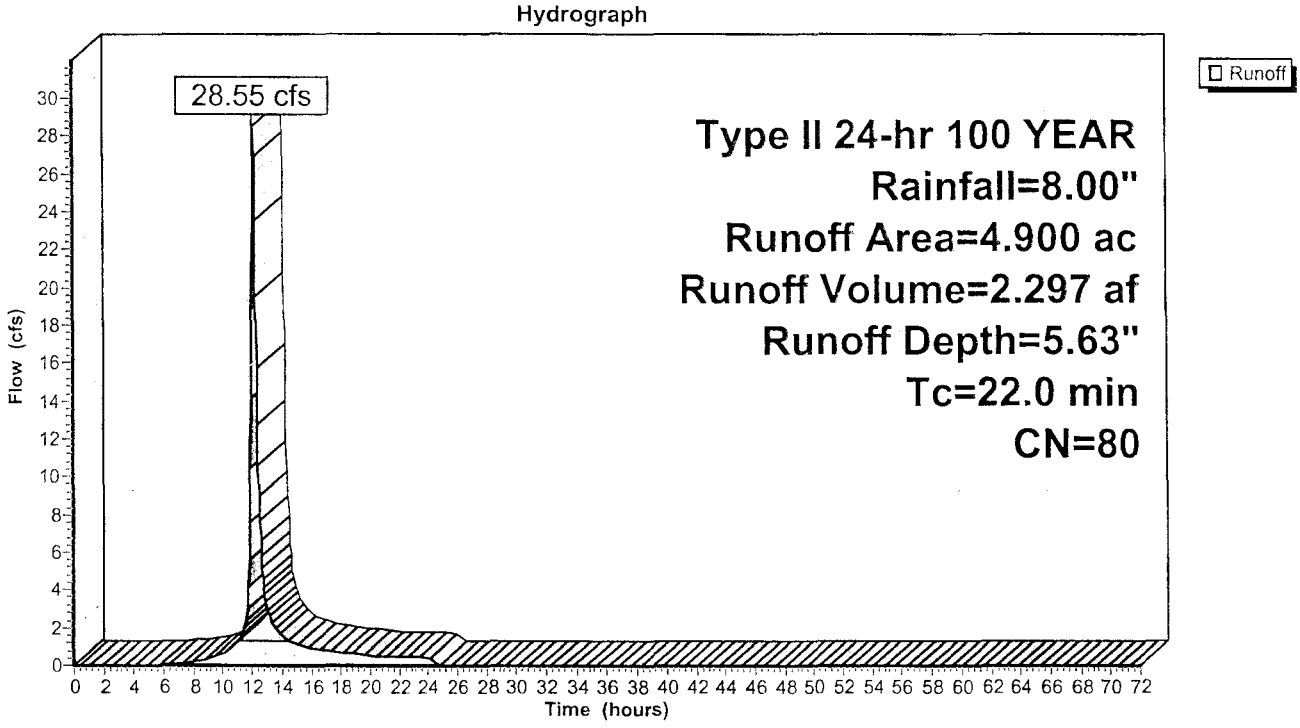
Runoff = 28.55 cfs @ 12.14 hrs, Volume= 2.297 af, Depth= 5.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
4.900	80	1/2 acre lots, 25% imp, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0					**Direct Entry,**

Subcatchment DA5 POST: DA5 POST



Pond B5: BMP 5

Inflow Area = 4.900 ac, Inflow Depth = 5.63" for 100 YEAR event
Inflow = 28.55 cfs @ 12.14 hrs, Volume= 2.297 af
Outflow = 28.39 cfs @ 12.17 hrs, Volume= 2.297 af, Atten= 1%, Lag= 1.3 min
Primary = 28.39 cfs @ 12.17 hrs, Volume= 2.297 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 74.02' @ 12.17 hrs Surf.Area= 5,025 sf Storage= 22,062 cf
Plug-Flow detention time= 198.9 min calculated for 2.295 af (100% of inflow)
Center-of-Mass det. time= 199.6 min (1,014.2 - 814.6)

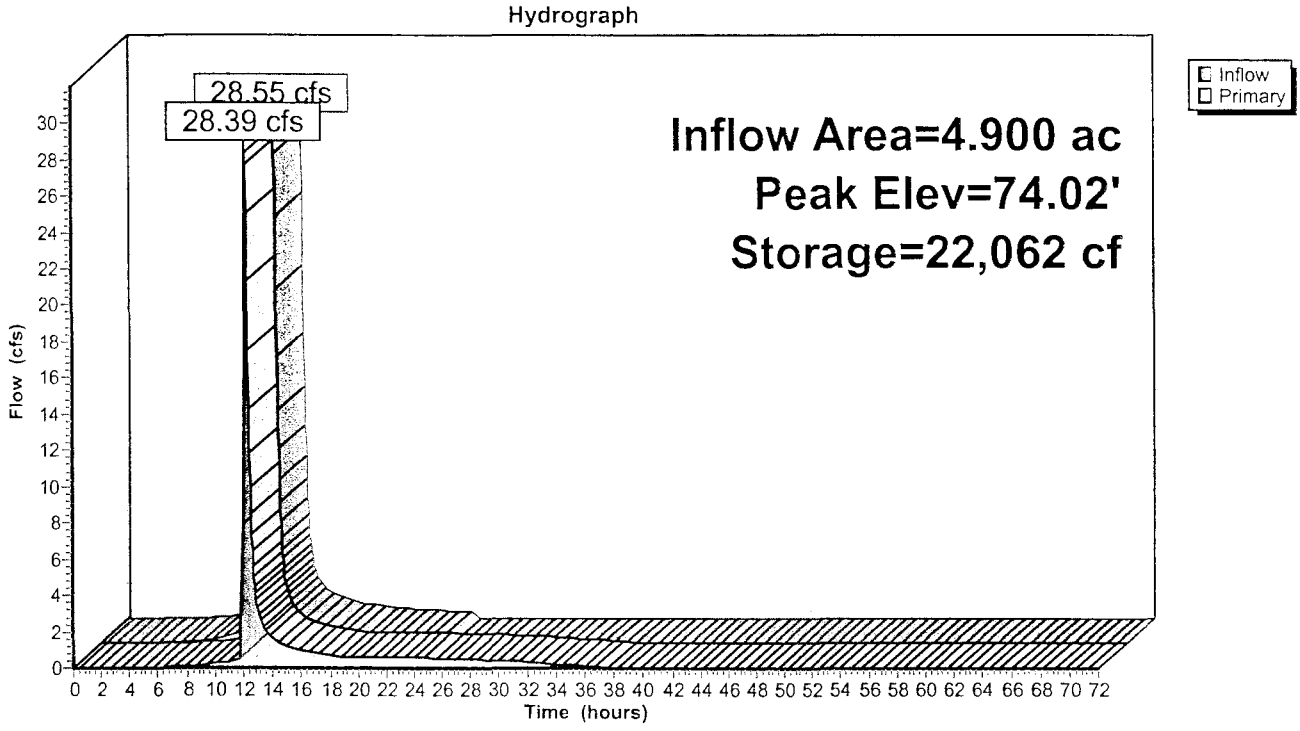
#	Invert	Avail.Storage	Storage Description
1	67.00'	31,965 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
67.00	1,300	0	0
70.00	2,500	5,700	5,700
75.00	5,640	20,350	26,050
76.00	6,190	5,915	31,965

#	Routing	Invert	Outlet Devices
1	Primary	66.00'	**24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900
2	Device 1	67.00'	**3.0" Vert. Orifice/Grate** C= 0.600
3	Device 1	73.25'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Primary OutFlow Max=28.01 cfs @ 12.17 hrs HW=74.01' (Free Discharge)
└**1=Culvert** (Passes 28.01 cfs of 40.06 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.62 cfs @ 12.6 fps)
└**3=Orifice/Grate** (Weir Controls 27.39 cfs @ 2.9 fps)

Pond B5: BMP 5


Hydrograph
28.55 cfs
28.39 cfs
Inflow Area=4.900 ac
Peak Elev=74.02'
Storage=22,062 cf
Inflow
Primary
Flow (cfs)
Time (hours)

DRAINAGE CALCULATIONS

Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: MAR. 10, 2005 PROJ: STONEHOUSE GLEN SECTION II
COUNTY: DISTRICT:
DESCRIPTION:
SHEET OF

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT (17)	FLOW TIME MINUTES ACCUMULATED (17)	REMARKS (18)
✓ 3F	3E	0.43	0.55	—	0.24	14	5.3	1.27	112.79	110.77	45'	0.0449	15"	13.69	6.98	0.11	—	
✓ 3E	3D	0.42	0.55	0.23	0.47	14.11	5.3	2.49	110.67	110.46	32'	0.0066	15"	5.25	4.22	0.13	0.24	
✓ 3D	3C	0.10	0.9	0.09	0.56	14.24	5.3	2.97	110.36	109.25	134'	0.0083	15"	5.88	4.81	0.46	0.70	
✓ 3C-1	3C	0.26	0.8	—	0.21	10	5.75	1.21	109.32	109.08	40'	0.0060	15"	5.00	3.36	0.20	—	
✓ 3C	3B-1	0.11	0.9	0.10	0.87	14.94	5.2	4.52	108.98	106.45	173'	0.0146	15"	7.80	6.59	0.43	1.13	
✓ 3B-1	3B	0.10	0.9	0.09	0.96	15.37	5.2	4.99	106.37	104.87	52'	0.0287	15"	10.94	8.71	0.10	1.23	TEMP PLUG
START STONEHOUSE GLEN SECTION I																		
3B	3A	—	—	—	—	—		4.99	104.87	101.20	128'	0.0287	15"	10.94	8.71	0.24	1.47	
3A	3	0.02	0.65	0.40	1.36	15.61	5.20	7.14	100.94	100.75	40'	0.0048	18"	7.28	4.69	0.14	1.61	
1	2	0.74	0.65	—	0.48	14	5.3	2.54	101.88	101.58	40'	0.0076	15"	5.63	4.47	0.15	—	
2	3	0.31	0.85	0.26	0.74	14.1	5.3	3.92	101.48	101.07	70'	0.0059	15"	4.96	4.48	0.26	0.41	
3	4	0.13	0.90	0.12	2.22	15.74	5.18	11.50	100.45	99.88	151'	0.0038	24"	13.94	4.96	0.51	2.12	
4	5	0.09	0.9	0.08	2.30	16.25	5.12	11.78	99.78	98.77	268'	0.0038	24"	13.94	4.98	0.89	3.01	
5	6	0.13	0.9	0.12	2.42	17.23	5.02	12.15	98.67	97.96	168'	0.0042	24"	14.66	5.22	0.54	3.55	
6A	6	0.92	0.45	—	0.41	12	5.5	2.26	100.68	100.33	38'	0.0092	15"	6.20	4.65	0.13	—	
6	7	0.66	0.45	0.30	3.13	17.78	4.97	15.56	93.34	92.53	44'	0.0184	24"	30.68	9.80	0.07	3.62	
7	8	0.38	0.85	0.32	3.45	17.85	4.96	17.11	87.87	86.21	93'	0.0178	24"	30.18	9.90	0.16	3.78	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3F to 3E
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.044900	ft/ft
Diameter	15	in
Discharge	1.27	cfs

Results		
Depth	0.26	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.18	ft
Top Width	1.01	ft
Critical Depth	0.44	ft
Percent Full	20.6	%
Critical Slope	0.005255	ft/ft
Velocity	6.98	ft/s
Velocity Head	0.76	ft
Specific Energy	1.01	ft
Froude Number	2.90	
Maximum Discharg	14.72	cfs
Discharge Full	13.69	cfs
Slope Full	0.000387	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3E to 3D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006600	ft/ft
Diameter	15	in
Discharge	2.49	cfs

Results		
Depth	0.61	ft
Flow Area	0.6	ft^2
Wetted Perimeter	1.93	ft
Top Width	1.25	ft
Critical Depth	0.63	ft
Percent Full	48.5	%
Critical Slope	0.005728	ft/ft
Velocity	4.22	ft/s
Velocity Head	0.28	ft
Specific Energy	0.88	ft
Froude Number	1.08	
Maximum Discharg	5.64	cfs
Discharge Full	5.25	cfs
Slope Full	0.001486	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3D to 3C
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.008300	ft/ft
Diameter	15	in
Discharge	2.97	cfs

Results		
Depth	0.63	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.97	ft
Top Width	1.25	ft
Critical Depth	0.69	ft
Percent Full	50.3	%
Critical Slope	0.006006	ft/ft
Velocity	4.81	ft/s
Velocity Head	0.36	ft
Specific Energy	0.99	ft
Froude Number	1.21	
Maximum Discharg	6.33	cfs
Discharge Full	5.88	cfs
Slope Full	0.002114	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3C-1 to 3C
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006000	ft/ft
Diameter	15	in
Discharge	1.21	cfs

Results		
Depth	0.42	ft
Flow Area	0.4	ft^2
Wetted Perimeter	1.54	ft
Top Width	1.18	ft
Critical Depth	0.43	ft
Percent Full	33.5	%
Critical Slope	0.005240	ft/ft
Velocity	3.36	ft/s
Velocity Head	0.18	ft
Specific Energy	0.59	ft
Froude Number	1.07	
Maximum Discharg	5.38	cfs
Discharge Full	5.00	cfs
Slope Full	0.000351	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3C to 3B-1
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.014600	ft/ft
Diameter	15	in
Discharge	4.52	cfs

Results		
Depth	0.68	ft
Flow Area	0.7	ft²
Wetted Perimeter	2.08	ft
Top Width	1.24	ft
Critical Depth	0.86	ft
Percent Full	54.6	%
Critical Slope	0.007271	ft/ft
Velocity	6.59	ft/s
Velocity Head	0.68	ft
Specific Energy	1.36	ft
Froude Number	1.57	
Maximum Discharg	8.40	cfs
Discharge Full	7.80	cfs
Slope Full	0.004897	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3B-1 to 3B
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.028700	ft/ft
Diameter	15	in
Discharge	4.99	cfs

Results		
Depth	0.59	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.90	ft
Top Width	1.25	ft
Critical Depth	0.91	ft
Percent Full	47.4	%
Critical Slope	0.007797	ft/ft
Velocity	8.71	ft/s
Velocity Head	1.18	ft
Specific Energy	1.77	ft
Froude Number	2.27	
Maximum Discharg	11.77	cfs
Discharge Full	10.94	cfs
Slope Full	0.005968	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3B to 3A
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.028700	ft/ft
Diameter	15	in
Discharge	4.99	cfs

Results		
Depth	0.59	ft
Flow Area	0.6	ft^2
Wetted Perimeter	1.90	ft
Top Width	1.25	ft
Critical Depth	0.91	ft
Percent Full	47.4	%
Critical Slope	0.007797	ft/ft
Velocity	8.71	ft/s
Velocity Head	1.18	ft
Specific Energy	1.77	ft
Froude Number	2.27	
Maximum Discharg	11.77	cfs
Discharge Full	10.94	cfs
Slope Full	0.005968	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3A to 3
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004800	ft/ft
Diameter	18	in
Discharge	7.14	cfs

Results		
Depth	1.20	ft
Flow Area	1.5	ft²
Wetted Perimeter	3.33	ft
Top Width	1.19	ft
Critical Depth	1.03	ft
Percent Full	80.3	%
Critical Slope	0.006848	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energy	1.55	ft
Froude Number	0.73	
Maximum Discharg	7.83	cfs
Discharge Full	7.28	cfs
Slope Full	0.004621	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	1 to 2
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.007600	ft/ft
Diameter	15	in
Discharge	2.54	cfs

Results		
Depth	0.59	ft
Flow Area	0.6	ft²
Wetted Perimeter	1.89	ft
Top Width	1.25	ft
Critical Depth	0.64	ft
Percent Full	47.1	%
Critical Slope	0.005750	ft/ft
Velocity	4.47	ft/s
Velocity Head	0.31	ft
Specific Energy	0.90	ft
Froude Number	1.17	
Maximum Discharg	6.06	cfs
Discharge Full	5.63	cfs
Slope Full	0.001546	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	2 to 3
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005900	ft/ft
Diameter	15	in
Discharge	3.92	cfs

Results		
Depth	0.84	ft
Flow Area	0.9	ft^2
Wetted Perimeter	2.40	ft
Top Width	1.18	ft
Critical Depth	0.80	ft
Percent Full	67.0	%
Critical Slope	0.006705	ft/ft
Velocity	4.48	ft/s
Velocity Head	0.31	ft
Specific Energy	1.15	ft
Froude Number	0.92	
Maximum Discharg	5.34	cfs
Discharge Full	4.96	cfs
Slope Full	0.003683	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	3 to 4
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003800	ft/ft
Diameter	24	in
Discharge	11.50	cfs

Results		
Depth	1.38	ft
Flow Area	2.3	ft²
Wetted Perimeter	3.93	ft
Top Width	1.85	ft
Critical Depth	1.22	ft
Percent Full	69.2	%
Critical Slope	0.005482	ft/ft
Velocity	4.96	ft/s
Velocity Head	0.38	ft
Specific Energy	1.77	ft
Froude Number	0.78	
Maximum Discharg	15.00	cfs
Discharge Full	13.94	cfs
Slope Full	0.002584	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	4 to 5
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.003800	ft/ft
Diameter	24	in
Discharge	11.78	cfs

Results		
Depth	1.41	ft
Flow Area	2.4	ft²
Wetted Perimeter	3.99	ft
Top Width	1.82	ft
Critical Depth	1.23	ft
Percent Full	70.5	%
Critical Slope	0.005539	ft/ft
Velocity	4.98	ft/s
Velocity Head	0.39	ft
Specific Energy	1.79	ft
Froude Number	0.77	
Maximum Discharg	15.00	cfs
Discharge Full	13.94	cfs
Slope Full	0.002712	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	5 to 6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.004200	ft/ft
Diameter	24	in
Discharge	12.15	cfs

Results		
Depth	1.39	ft
Flow Area	2.3	ft^2
Wetted Perimeter	3.94	ft
Top Width	1.84	ft
Critical Depth	1.25	ft
Percent Full	69.5	%
Critical Slope	0.005617	ft/ft
Velocity	5.22	ft/s
Velocity Head	0.42	ft
Specific Energy	1.81	ft
Froude Number	0.82	
Maximum Discharg	15.77	cfs
Discharge Full	14.66	cfs
Slope Full	0.002885	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	6A to 6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.009200	ft/ft
Diameter	15	in
Discharge	2.26	cfs

Results		
Depth	0.52	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.76	ft
Top Width	1.23	ft
Critical Depth	0.60	ft
Percent Full	41.8	%
Critical Slope	0.005616	ft/ft
Velocity	4.65	ft/s
Velocity Head	0.34	ft
Specific Energy	0.86	ft
Froude Number	1.31	
Maximum Discharg	6.66	cfs
Discharge Full	6.20	cfs
Slope Full	0.001224	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	6 to 7
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.018400	ft/ft
Diameter	24	in
Discharge	15.56	cfs

Results		
Depth	1.01	ft
Flow Area	1.6	ft²
Wetted Perimeter	3.16	ft
Top Width	2.00	ft
Critical Depth	1.42	ft
Percent Full	50.4	%
Critical Slope	0.006480	ft/ft
Velocity	9.80	ft/s
Velocity Head	1.49	ft
Specific Energy	2.50	ft
Froude Number	1.94	
Maximum Discharg	33.01	cfs
Discharge Full	30.68	cfs
Slope Full	0.004731	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	7 to 8
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.017800	ft/ft
Diameter	24	in
Discharge	17.08	cfs

Results		
Depth	1.08	ft
Flow Area	1.7	ft²
Wetted Perimeter	3.30	ft
Top Width	1.99	ft
Critical Depth	1.49	ft
Percent Full	53.9	%
Critical Slope	0.006964	ft/ft
Velocity	9.90	ft/s
Velocity Head	1.52	ft
Specific Energy	2.60	ft
Froude Number	1.88	
Maximum Discharg	32.47	cfs
Discharge Full	30.18	cfs
Slope Full	0.005701	ft/ft
Flow Type	Supercritical	

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 3F LENGTH 6.0 STATION

DRAINAGE AREA = 0.430 ACRES C VALUE = .550 CA = 0.237
SUM CA= 0.237 INT= 4.00 CFS= 0.946 CO= 0.000 GUTTER FLOW= 0.946

GUTTER SLOPE = 0.0229 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
3.59	2.0	0.56	0.0833	4.0	0.97	3.5	0.146	0.162

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 7.0 EFFICIENCY= 0.97
CFS INTERCEPTED= 0.92 CFS CARRYOVER= 0.03

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 3E LENGTH 8.0 STATION

DRAINAGE AREA = 0.080 ACRES C VALUE = .550 CA = 0.044
DRAINAGE AREA = 0.340 ACRES C VALUE = .550 CA = 0.187

FOR THE FIRST SIDE
SUM CA= 0.044 INT= 4.00 CFS= 0.176 CO= 0.030 GUTTER FLOW= 0.206
FOR THE OTHER SIDE
SUM CA= 0.187 INT= 4.00 CFS= 0.748 CO= 0.000 GUTTER FLOW= 0.748
AT THE INLET

SUM CA= 0.231 INT= 4.00 CFS= 0.924 CO= 0.030 GUTTER FLOW= 0.954

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.75 (cfs) IS 5.71 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 11.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.11 SPREAD (ft) = 5.21

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 3D LENGTH 2.5 STATION

DRAINAGE AREA = 0.030 ACRES C VALUE = .900 CA = 0.027
DRAINAGE AREA = 0.070 ACRES C VALUE = .900 CA = 0.063

FOR THE FIRST SIDE
SUM CA= 0.027 INT= 4.00 CFS= 0.108 CO= 0.000 GUTTER FLOW= 0.108
FOR THE OTHER SIDE
SUM CA= 0.063 INT= 4.00 CFS= 0.252 CO= 0.000 GUTTER FLOW= 0.252
AT THE INLET

SUM CA= 0.090 INT= 4.00 CFS= 0.360 CO= 0.000 GUTTER FLOW= 0.360

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.25 (cfs) IS 2.17 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.09 SPREAD (ft) = 4.18

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 3C-1 LENGTH 6.0 STATION

DRAINAGE AREA = 0.060 ACRES C VALUE = .800 CA = 0.048
DRAINAGE AREA = 0.200 ACRES C VALUE = .800 CA = 0.160

FOR THE FIRST SIDE
SUM CA= 0.048 INT= 4.00 CFS= 0.192 CO= 0.000 GUTTER FLOW= 0.192
FOR THE OTHER SIDE
SUM CA= 0.160 INT= 4.00 CFS= 0.640 CO= 0.000 GUTTER FLOW= 0.640
AT THE INLET

SUM CA= 0.208 INT= 4.00 CFS= 0.832 CO= 0.000 GUTTER FLOW= 0.832

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.64 (cfs) IS 5.17 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.11 SPREAD (ft) = 5.40

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 3C LENGTH 2.5 STATION

DRAINAGE AREA = 0.030 ACRES C VALUE = .900 CA = 0.027
DRAINAGE AREA = 0.080 ACRES C VALUE = .900 CA = 0.072

FOR THE FIRST SIDE
SUM CA= 0.027 INT= 4.00 CFS= 0.108 CO= 0.000 GUTTER FLOW= 0.108
FOR THE OTHER SIDE
SUM CA= 0.072 INT= 4.00 CFS= 0.288 CO= 0.000 GUTTER FLOW= 0.288
AT THE INLET

SUM CA= 0.099 INT= 4.00 CFS= 0.396 CO= 0.000 GUTTER FLOW= 0.396

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.29 (cfs) IS 4.82 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.09 SPREAD (ft) = 4.45

PROJECT 2002261-504.04
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INLET NUMBER 3B-1 LENGTH 4.0 STATION

DRAINAGE AREA = 0.100 ACRES C VALUE = .900 CA = 0.090
SUM CA= 0.090 INT= 4.00 CFS= 0.360 CO= 0.000 GUTTER FLOW= 0.360

GUTTER SLOPE = 0.0350 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
1.56	2.0	1.28	0.0833	4.0	1.00	3.5	0.146	0.167

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 5.2 EFFICIENCY= 0.93
CFS INTERCEPTED= 0.33 CFS CARRYOVER= 0.03

Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: MAR 11 2005 PROJ: STONEHOUSE GLEN SECTION II
COUNTY: DISTRICT:
DESCRIPTION:
SHEET ____ OF ____

FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT (17)	FLOW TIME MINUTES ACCUMULATED (17)	REMARKS (18)
✓ 11A	11	0.39	0.61	—	0.24	10	6.00	1.44	80.92	79.84	56'	0.0193	15"	8.97	5.36	0.17	—	
✓ 12	11	0.36	0.80	—	0.29	12	5.67	1.64	80.05	79.84	32'	0.0066	15"	5.25	3.78	0.14	—	
✓ 11	10	0.41	0.51	0.21	0.74	12	5.67	4.20	79.74	78.97	146'	0.0053	15"	4.70	4.33	0.56	0.73	
✓ 10	9	0.15	0.64	0.10	0.84	13	5.50	4.62	78.87	61.90	193'	0.0879	15"	19.15	12.84	0.25	0.98	
✓ 9	8	0.17	0.3	0.05	0.89	14	5.30	4.72	56.26	54.46	57'	0.0316	15"	11.48	8.90	0.11	1.09	
✓ 15C	15B	0.34	0.54	—	0.18	10	6.00	1.08	90.50	89.86	32'	0.020	15"	9.14	5.00	0.11	—	
✓ 15B	15	0.50	0.58	0.29	0.47	10.6	5.92	2.78	89.76	82.29	158'	0.0473	15"	14.05	8.91	0.30	0.41	
✓ 15A	15	0.21	0.64	—	0.13	10	6.00	0.78	84.00	82.72	32'	0.040	15"	12.92	5.80	0.09	—	
✓ 15	14	0.14	0.78	0.11	0.71	11.	5.83	4.14	78.74	75.81	45'	0.0650	15"	16.47	11.17	0.07	0.48	
✓ 14	13	—	—	—				4.14	70.00	65.00	79'	0.0633	15"	16.25	11.07	0.12	0.60	
✓ 34	33	0.31	0.73	—	0.23	10	6.00	1.38	104.00	100.50	40'	0.0875	15"	19.11	9.05	0.07	—	
✓ 33	32	0.23	0.70	0.16	0.39	10	6.00	2.34	96.54	93.25	38'	0.0866	15"	19.01	10.52	0.06	0.13	
✓ 32	31	—	—	—	0.39	10	6.00	2.34	86.25	78.14	123'	0.066	15"	16.59	9.55	0.21	0.34	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	11 - A to 11
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.019300	ft/ft
Diameter	15	in
Discharge	1.44	cfs

Results		
Depth	0.34	ft
Flow Area	0.3	ft²
Wetted Perimeter	1.37	ft
Top Width	1.11	ft
Critical Depth	0.47	ft
Percent Full	27.1	%
Critical Slope	0.005288	ft/ft
Velocity	5.36	ft/s
Velocity Head	0.45	ft
Specific Energy	0.79	ft
Froude Number	1.92	
Maximum Discharg	9.65	cfs
Discharge Full	8.97	cfs
Slope Full	0.000497	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	12 to 11
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.006600	ft/ft
Diameter	15	in
Discharge	1.64	cfs

Results		
Depth	0.48	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.67	ft
Top Width	1.22	ft
Critical Depth	0.51	ft
Percent Full	38.4	%
Critical Slope	0.005353	ft/ft
Velocity	3.78	ft/s
Velocity Head	0.22	ft
Specific Energy	0.70	ft
Froude Number	1.12	
Maximum Discharg	5.64	cfs
Discharge Full	5.25	cfs
Slope Full	0.000645	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	11 to 10
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005300	ft/ft
Diameter	15	in
Discharge	4.20	cfs

Results		
Depth	0.92	ft
Flow Area	1.0	ft²
Wetted Perimeter	2.58	ft
Top Width	1.10	ft
Critical Depth	0.83	ft
Percent Full	73.7	%
Critical Slope	0.006956	ft/ft
Velocity	4.33	ft/s
Velocity Head	0.29	ft
Specific Energy	1.21	ft
Froude Number	0.81	
Maximum Discharg	5.06	cfs
Discharge Full	4.70	cfs
Slope Full	0.004228	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	10 to 9
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.087900	ft/ft
Diameter	15	in
Discharge	4.62	cfs

Results		
Depth	0.42	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.54	ft
Top Width	1.18	ft
Critical Depth	0.87	ft
Percent Full	33.4	%
Critical Slope	0.007376	ft/ft
Velocity	12.84	ft/s
Velocity Head	2.56	ft
Specific Energy	2.98	ft
Froude Number	4.10	
Maximum Discharg	20.60	cfs
Discharge Full	19.15	cfs
Slope Full	0.005116	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	9 to 8
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.031600	ft/ft
Diameter	15	in
Discharge	4.72	cfs

Results		
Depth	0.56	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.83	ft
Top Width	1.24	ft
Critical Depth	0.88	ft
Percent Full	44.7	%
Critical Slope	0.007484	ft/ft
Velocity	8.90	ft/s
Velocity Head	1.23	ft
Specific Energy	1.79	ft
Froude Number	2.40	
Maximum Discharg	12.35	cfs
Discharge Full	11.48	cfs
Slope Full	0.005339	ft/ft
Flow Type	Supercritical	

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INLET NUMBER 11A LENGTH 6.0 STATION

DRAINAGE AREA = 0.390 ACRES C VALUE = .610 CA = 0.238
SUM CA= 0.238 INT= 4.00 CFS= 0.952 CO= 0.000 GUTTER FLOW= 0.952

GUTTER SLOPE = 0.0314 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
3.11	2.0	0.64	0.0833	4.0	0.99	3.5	0.146	0.165

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 7.6 EFFICIENCY= 0.94
CFS INTERCEPTED= 0.89 CFS CARRYOVER= 0.06

PROJECT 2002261-504.04
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INLET NUMBER 12 LENGTH 6.0 STATION

DRAINAGE AREA = 0.210 ACRES C VALUE = .800 CA = 0.168
DRAINAGE AREA = 0.150 ACRES C VALUE = .750 CA = 0.113

FOR THE FIRST SIDE
SUM CA= 0.168 INT= 4.00 CFS= 0.672 CO= 0.000 GUTTER FLOW= 0.672
FOR THE OTHER SIDE
SUM CA= 0.113 INT= 4.00 CFS= 0.450 CO= 0.000 GUTTER FLOW= 0.450
AT THE INLET

SUM CA= 0.280 INT= 4.00 CFS= 1.122 CO= 0.000 GUTTER FLOW= 1.122

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.67 (cfs) IS 7.87 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.14 SPREAD (ft) = 6.59

PROJECT 2002261-504.04
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INLET NUMBER 11 LENGTH 8.0 STATION

DRAINAGE AREA = 0.170 ACRES C VALUE = .510 CA = 0.087
DRAINAGE AREA = 0.240 ACRES C VALUE = .510 CA = 0.122

FOR THE FIRST SIDE
SUM CA= 0.087 INT= 4.00 CFS= 0.347 CO= 0.060 GUTTER FLOW= 0.407
FOR THE OTHER SIDE
SUM CA= 0.122 INT= 4.00 CFS= 0.490 CO= 0.004 GUTTER FLOW= 0.494
AT THE INLET

SUM CA= 0.209 INT= 4.00 CFS= 0.836 CO= 0.064 GUTTER FLOW= 0.900

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.49 (cfs) IS 4.31 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 11.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.10 SPREAD (ft) = 5.02

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 10 LENGTH 6.0 STATION

DRAINAGE AREA = 0.150 ACRES C VALUE = .640 CA = 0.096
SUM CA= 0.096 INT= 4.00 CFS= 0.384 CO= 0.000 GUTTER FLOW= 0.384

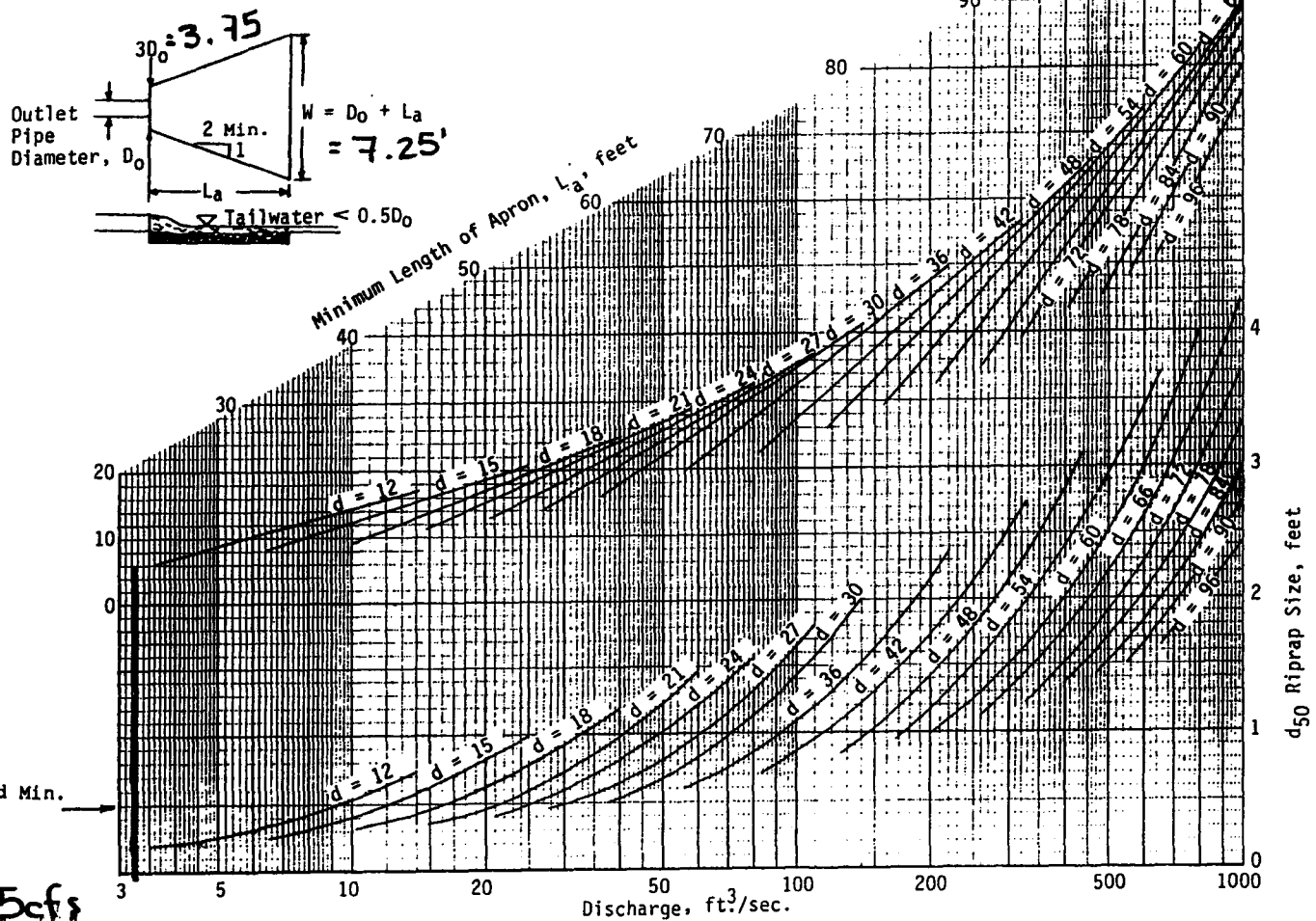
GUTTER SLOPE = 0.0600 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
1.44	2.0	1.39	0.0833	4.0	1.00	3.5	0.146	0.167

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 6.3 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.38 CFS CARRYOVER= 0.00

OUTLET PROTECTION 8

DESIGN OF OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_w < 0.5 DIAMETER)



L_a=6'

$Q_2 \approx 3.5$ cfs

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	15C to 15B
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.020000	ft/ft
Diameter	15	in
Discharge	1.08	cfs

Results		
Depth	0.29	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.26	ft
Top Width	1.06	ft
Critical Depth	0.41	ft
Percent Full	23.2	%
Critical Slope	0.005226	ft/ft
Velocity	5.00	ft/s
Velocity Head	0.39	ft
Specific Energy	0.68	ft
Froude Number	1.95	
Maximum Discharg	9.83	cfs
Discharge Full	9.14	cfs
Slope Full	0.000280	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	15B to 15
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.047300	ft/ft
Diameter	15	in
Discharge	2.78	cfs

Results		
Depth	0.38	ft
Flow Area	0.3	ft²
Wetted Perimeter	1.45	ft
Top Width	1.15	ft
Critical Depth	0.67	ft
Percent Full	30.2	%
Critical Slope	0.005895	ft/ft
Velocity	8.91	ft/s
Velocity Head	1.23	ft
Specific Energy	1.61	ft
Froude Number	3.01	
Maximum Discharg	15.11	cfs
Discharge Full	14.05	cfs
Slope Full	0.001852	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	15A to 15
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.040000	ft/ft
Diameter	15	in
Discharge	0.78	cfs

Results		
Depth	0.21	ft
Flow Area	0.1	ft²
Wetted Perimeter	1.05	ft
Top Width	0.93	ft
Critical Depth	0.35	ft
Percent Full	16.7	%
Critical Slope	0.005214	ft/ft
Velocity	5.80	ft/s
Velocity Head	0.52	ft
Specific Energy	0.73	ft
Froude Number	2.69	
Maximum Discharg	13.90	cfs
Discharge Full	12.92	cfs
Slope Full	0.000146	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	15 to 14
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.065000	ft/ft
Diameter	15	in
Discharge	4.14	cfs

Results		
Depth	0.43	ft
Flow Area	0.4	ft^2
Wetted Perimeter	1.56	ft
Top Width	1.19	ft
Critical Depth	0.82	ft
Percent Full	34.2	%
Critical Slope	0.006900	ft/ft
Velocity	11.17	ft/s
Velocity Head	1.94	ft
Specific Energy	2.37	ft
Froude Number	3.52	
Maximum Discharg	17.72	cfs
Discharge Full	16.47	cfs
Slope Full	0.004108	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	14 to 13
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.063300	ft/ft
Diameter	15	in
Discharge	4.14	cfs

Results		
Depth	0.43	ft
Flow Area	0.4	ft²
Wetted Perimeter	1.57	ft
Top Width	1.19	ft
Critical Depth	0.82	ft
Percent Full	34.4	%
Critical Slope	0.006900	ft/ft
Velocity	11.07	ft/s
Velocity Head	1.90	ft
Specific Energy	2.33	ft
Froude Number	3.48	
Maximum Discharg	17.48	cfs
Discharge Full	16.25	cfs
Slope Full	0.004108	ft/ft
Flow Type	Supercritical	

PROJECT 2002261-504.04
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INLET NUMBER 15C LENGTH 8.0 STATION

DRAINAGE AREA = 0.200 ACRES C VALUE = .490 CA = 0.098
DRAINAGE AREA = 0.070 ACRES C VALUE = .520 CA = 0.036
DRAINAGE AREA = 0.070 ACRES C VALUE = .690 CA = 0.048
SUM CA= 0.183 INT= 4.00 CFS= 0.731 CO= 0.000 GUTTER FLOW= 0.731

GUTTER SLOPE = 0.0562 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
1.86	2.0	1.07	0.0833	4.0	1.00	3.5	0.146	0.167

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 8.1 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.73 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
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INLET NUMBER 15B LENGTH 10.0 STATION

DRAINAGE AREA = 0.500 ACRES C VALUE = .580 CA = 0.290
SUM CA= 0.290 INT= 4.00 CFS= 1.160 CO= 0.000 GUTTER FLOW= 1.160

GUTTER SLOPE = 0.0562 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
2.36	2.0	0.85	0.0833	4.0	1.00	3.5	0.146	0.167

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 10.7 EFFICIENCY= 0.99
CFS INTERCEPTED= 1.15 CFS CARRYOVER= 0.01

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 15A LENGTH 8.0 STATION

DRAINAGE AREA = 0.090 ACRES C VALUE = .720 CA = 0.065
DRAINAGE AREA = 0.120 ACRES C VALUE = .580 CA = 0.070

FOR THE FIRST SIDE
SUM CA= 0.065 INT= 4.00 CFS= 0.259 CO= 0.000 GUTTER FLOW= 0.259
FOR THE OTHER SIDE
SUM CA= 0.070 INT= 4.00 CFS= 0.278 CO= 0.000 GUTTER FLOW= 0.278
AT THE INLET

SUM CA= 0.134 INT= 4.00 CFS= 0.538 CO= 0.000 GUTTER FLOW= 0.538

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.28 (cfs) IS 4.71 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 11.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.07 SPREAD (ft) = 3.56

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 15 LENGTH 6.0 STATION

DRAINAGE AREA = 0.070 ACRES C VALUE = .710 CA = 0.050
DRAINAGE AREA = 0.070 ACRES C VALUE = .840 CA = 0.059

FOR THE FIRST SIDE
SUM CA= 0.050 INT= 4.00 CFS= 0.199 CO= 0.000 GUTTER FLOW= 0.199
FOR THE OTHER SIDE
SUM CA= 0.059 INT= 4.00 CFS= 0.235 CO= 0.000 GUTTER FLOW= 0.235
AT THE INLET

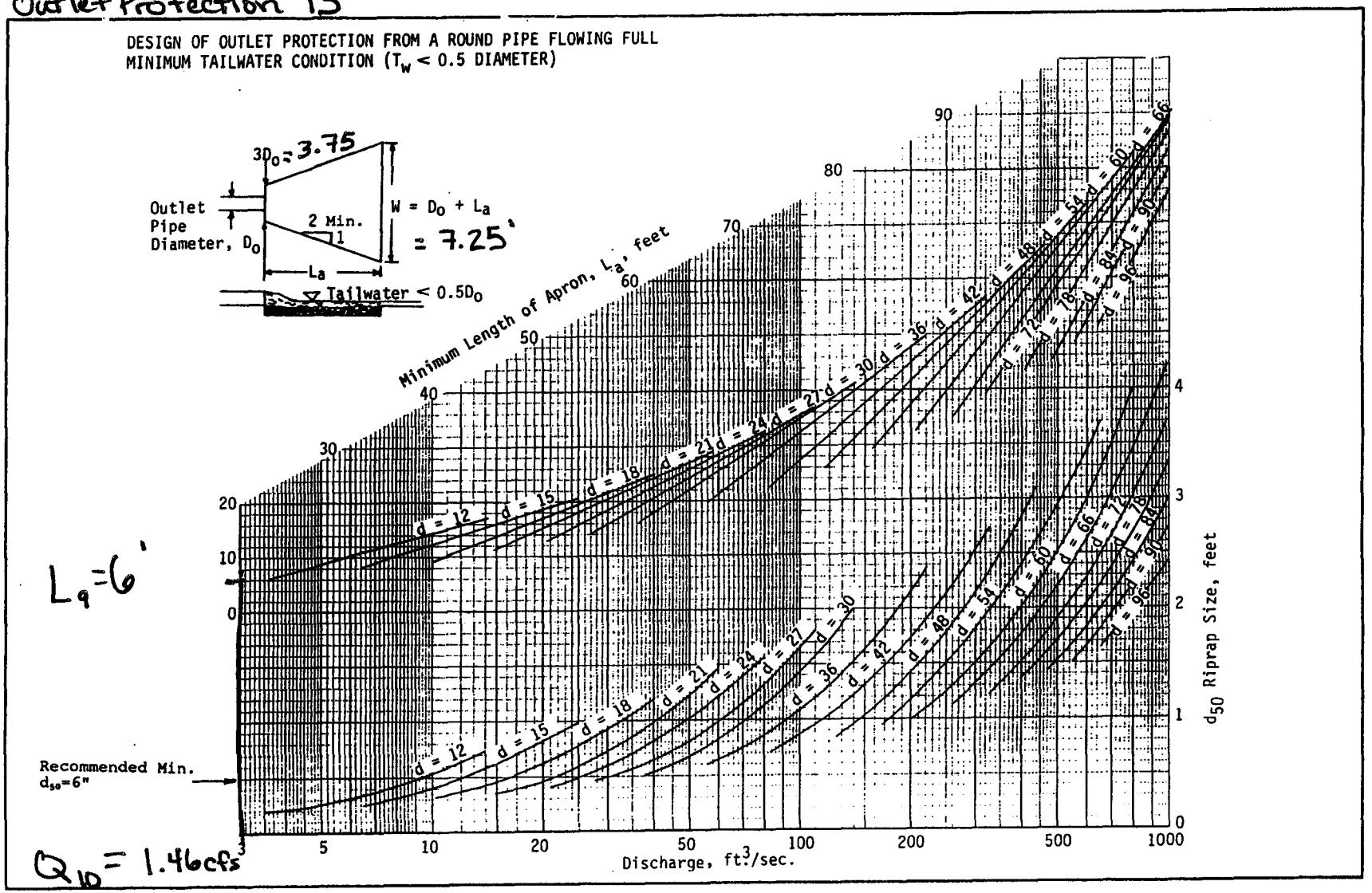
SUM CA= 0.108 INT= 4.00 CFS= 0.434 CO= 0.000 GUTTER FLOW= 0.434

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.24 (cfs) IS 4.15 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.07 SPREAD (ft) = 3.50

Outlet Protection 13



Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	34 to 33
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.087500	ft/ft
Diameter	15	in
Discharge	1.38	cfs

Results		
Depth	0.23	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.10	ft
Top Width	0.96	ft
Critical Depth	0.46	ft
Percent Full	18.2	%
Critical Slope	0.005285	ft/ft
Velocity	9.05	ft/s
Velocity Head	1.27	ft
Specific Energy	1.50	ft
Froude Number	4.01	
Maximum Discharg	20.55	cfs
Discharge Full	19.11	cfs
Slope Full	0.000456	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	33 to 32
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.086600	ft/ft
Diameter	15	in
Discharge	2.34	cfs

Results		
Depth	0.30	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.27	ft
Top Width	1.06	ft
Critical Depth	0.61	ft
Percent Full	23.7	%
Critical Slope	0.005653	ft/ft
Velocity	10.52	ft/s
Velocity Head	1.72	ft
Specific Energy	2.02	ft
Froude Number	4.06	
Maximum Discharg	20.45	cfs
Discharge Full	19.01	cfs
Slope Full	0.001312	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	32 to 31
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.066000	ft/ft
Diameter	15	in
Discharge	2.34	cfs

Results		
Depth	0.32	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.32	ft
Top Width	1.09	ft
Critical Depth	0.61	ft
Percent Full	25.4	%
Critical Slope	0.005653	ft/ft
Velocity	9.55	ft/s
Velocity Head	1.42	ft
Specific Energy	1.74	ft
Froude Number	3.55	
Maximum Discharg	17.85	cfs
Discharge Full	16.59	cfs
Slope Full	0.001312	ft/ft
Flow Type	Supercritical	

PROJECT 2002261-504.04
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INLET NUMBER 34 LENGTH 6.0 STATION

DRAINAGE AREA = 0.260 ACRES C VALUE = .730 CA = 0.190
DRAINAGE AREA = 0.050 ACRES C VALUE = .710 CA = 0.036

FOR THE FIRST SIDE
SUM CA= 0.190 INT= 4.00 CFS= 0.759 CO= 0.000 GUTTER FLOW= 0.759
FOR THE OTHER SIDE
SUM CA= 0.036 INT= 4.00 CFS= 0.142 CO= 0.000 GUTTER FLOW= 0.142
AT THE INLET

SUM CA= 0.225 INT= 4.00 CFS= 0.901 CO= 0.000 GUTTER FLOW= 0.901

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.76 (cfs) IS 5.76 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.12 SPREAD (ft) = 5.69

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 33 LENGTH 6.0 STATION

DRAINAGE AREA = 0.030 ACRES C VALUE = .700 CA = 0.021
DRAINAGE AREA = 0.200 ACRES C VALUE = .700 CA = 0.140

FOR THE FIRST SIDE
SUM CA= 0.021 INT= 4.00 CFS= 0.084 CO= 0.000 GUTTER FLOW= 0.084
FOR THE OTHER SIDE
SUM CA= 0.140 INT= 4.00 CFS= 0.560 CO= 0.000 GUTTER FLOW= 0.560
AT THE INLET

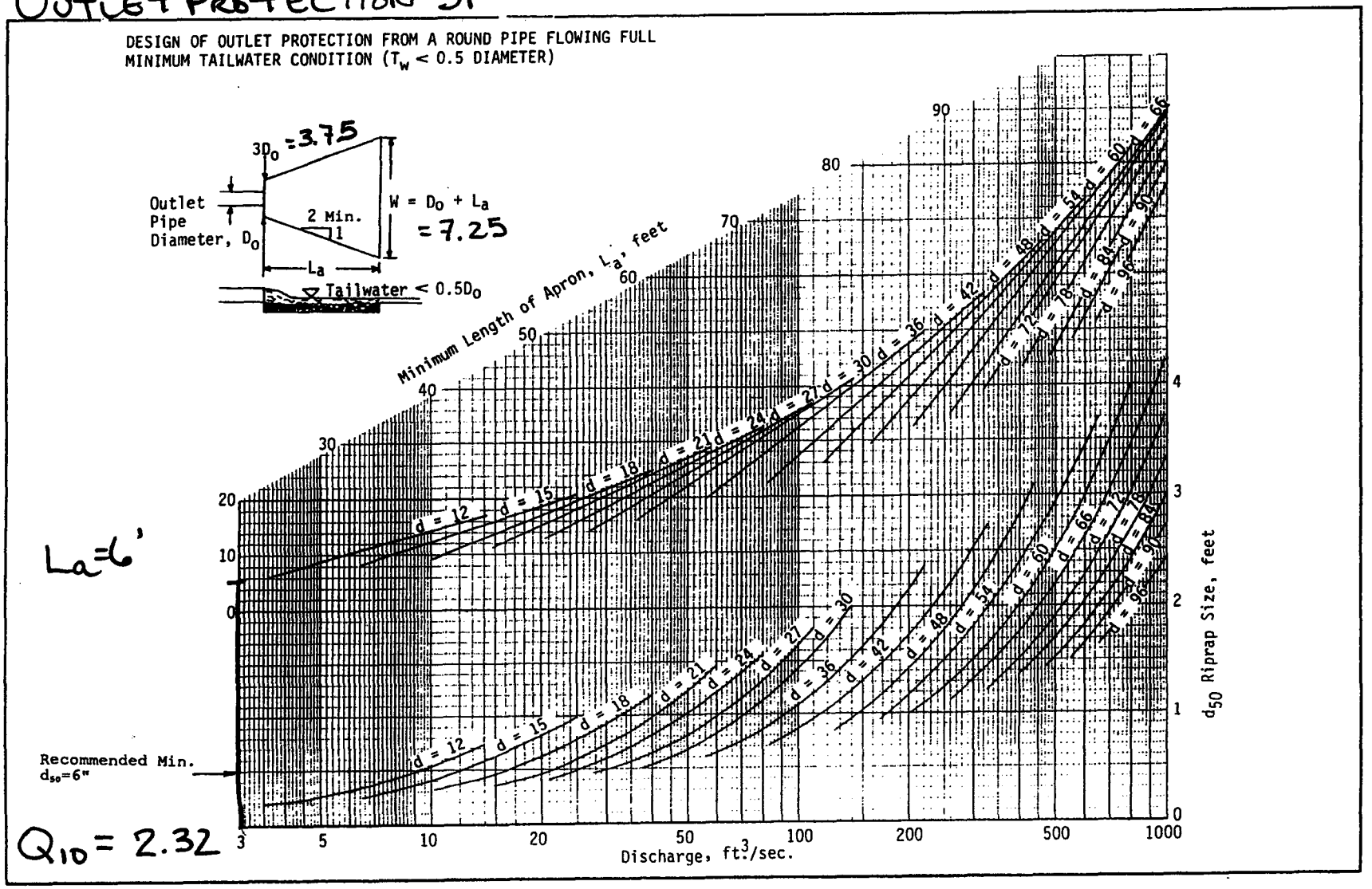
SUM CA= 0.161 INT= 4.00 CFS= 0.644 CO= 0.000 GUTTER FLOW= 0.644

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.56 (cfs) IS 4.25 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.458
DEPTH OF WATER (ft) = 0.09 SPREAD (ft) = 4.55

OUTLET PROTECTION 31



LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: MAR, 12, 2005 PROJ: STONHOUSE GLEN SECTION II
COUNTY: DISTRICT:
DESCRIPTION:
SHEET ____ OF ____

	FROM POINT (1)	TO POINT (2)	AREA DRAIN "A" ACRES (3)	RUN-OFF COEF. C (4)	CA INCREMENT (5)	CA ACCUMULATED (6)	INLET TIME MINUTES (7)	RAIN FALL IN./HR. (8)	RUN-OFF Q C.F.S. (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH FT. (12)	SLOPE FT./FT. (13)	DIA. IN. (14)	CAPACITY C.F.S. (15)	VEL. F.P.S. (16)	FLOW TIME MINUTES INCREMENT (17)	FLOW TIME MINUTES ACCUMULATED (17)	REMARKS (18)
✓	30	29	0.35	0.84	–	0.29	10	6.0	1.74	92.04	91.16	177'	0.005	15"	4.57	3.47	0.85	–	
✓	29	28	0.25	0.53	0.13	0.42	10.85	5.86	2.46	91.06	89.28	355'	0.005	15"	4.57	3.79	1.56	2.41	
✓	28	27	0.05	0.9	0.05	0.48	12.41	5.70	2.74	89.18	89.02	32'	0.005	15"	4.57	3.89	0.14	2.55	
✓	27	26	0.04	0.89	0.04	0.52	12.55	5.61	2.92	88.92	88.33	118'	0.005	15"	4.57	3.95	0.50	3.05	
✓	26	25	0.12	0.56	0.07	0.59	13.05	5.49	3.24	88.23	87.74	98'	0.005	15"	4.57	4.04	0.40	3.45	
✓	25	24	0.31	0.69	0.21	0.80	13.45	5.41	4.32	87.64	87.15	92'	0.0053	15"	4.70	4.35	0.35	3.80	
✓	24A	24	0.22	0.82	–	0.18	10	6.0	1.08	88.40	87.15	32'	0.039	15"	12.76	6.33	0.08	–	
✓	24D	24C	0.47	0.55	–	0.26	10	6.0	1.56	90.25	86.95	40'	0.0825	15"	18.55	9.19	0.07	–	
✓	24C	24B	0.21	0.72	0.15	0.41	10.07	5.99	2.46	86.85	85.82	79'	0.0130	15"	7.36	5.40	0.24	0.31	
✓	24B	24	0.21	0.40	0.08	0.49	10.31	5.95	2.92	85.72	85.46	51'	0.0050	15"	4.57	3.95	0.22	0.53	
✓	24	23	0.28	0.45	0.13	1.60	13.80	5.34	8.54	85.36	82.58	139'	0.020	15"	9.14	8.46	0.27	4.15	
✓	23	22	–	–	–	–	–	–	8.54	80.08	78.00	87'	0.024	15'	10.01	9.16	0.16	4.31	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	30 to 29
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005000	ft/ft
Diameter	15	in
Discharge	1.74	cfs

Results		
Depth	0.53	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.78	ft
Top Width	1.24	ft
Critical Depth	0.52	ft
Percent Full	42.8	%
Critical Slope	0.005391	ft/ft
Velocity	3.47	ft/s
Velocity Head	0.19	ft
Specific Energy	0.72	ft
Froude Number	0.96	
Maximum Discharg	4.91	cfs
Discharge Full	4.57	cfs
Slope Full	0.000726	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	29 to 28
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005000	ft/ft
Diameter	15	in
Discharge	2.46	cfs

Results		
Depth	0.65	ft
Flow Area	0.6	ft²
Wetted Perimeter	2.02	ft
Top Width	1.25	ft
Critical Depth	0.63	ft
Percent Full	52.3	%
Critical Slope	0.005713	ft/ft
Velocity	3.79	ft/s
Velocity Head	0.22	ft
Specific Energy	0.88	ft
Froude Number	0.93	
Maximum Discharg	4.91	cfs
Discharge Full	4.57	cfs
Slope Full	0.001450	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	28 to 27
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005000	ft/ft
Diameter	15	in
Discharge	2.74	cfs

Results		
Depth	0.70	ft
Flow Area	0.7	ft²
Wetted Perimeter	2.11	ft
Top Width	1.24	ft
Critical Depth	0.66	ft
Percent Full	55.8	%
Critical Slope	0.005867	ft/ft
Velocity	3.89	ft/s
Velocity Head	0.24	ft
Specific Energy	0.93	ft
Froude Number	0.91	
Maximum Discharg	4.91	cfs
Discharge Full	4.57	cfs
Slope Full	0.001799	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	27 to 26
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005000	ft/ft
Diameter	15	in
Discharge	2.92	cfs

Results		
Depth	0.73	ft
Flow Area	0.7	ft²
Wetted Perimeter	2.17	ft
Top Width	1.23	ft
Critical Depth	0.69	ft
Percent Full	58.1	%
Critical Slope	0.005973	ft/ft
Velocity	3.95	ft/s
Velocity Head	0.24	ft
Specific Energy	0.97	ft
Froude Number	0.90	
Maximum Discharg	4.91	cfs
Discharge Full	4.57	cfs
Slope Full	0.002044	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	26 to 25
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005000	ft/ft
Diameter	15	in
Discharge	3.24	cfs

Results		
Depth	0.78	ft
Flow Area	0.8	ft²
Wetted Perimeter	2.27	ft
Top Width	1.21	ft
Critical Depth	0.73	ft
Percent Full	62.2	%
Critical Slope	0.006185	ft/ft
Velocity	4.04	ft/s
Velocity Head	0.25	ft
Specific Energy	1.03	ft
Froude Number	0.88	
Maximum Discharg	4.91	cfs
Discharge Full	4.57	cfs
Slope Full	0.002516	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	25 to 24
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005300	ft/ft
Diameter	15	in
Discharge	4.32	cfs

Results		
Depth	0.94	ft
Flow Area	1.0	ft^2
Wetted Perimeter	2.63	ft
Top Width	1.08	ft
Critical Depth	0.84	ft
Percent Full	75.5	%
Critical Slope	0.007071	ft/ft
Velocity	4.35	ft/s
Velocity Head	0.29	ft
Specific Energy	1.24	ft
Froude Number	0.80	
Maximum Discharg	5.06	cfs
Discharge Full	4.70	cfs
Slope Full	0.004473	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	24A to 24
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.039000	ft/ft
Diameter	15	in
Discharge	1.08	cfs

Results		
Depth	0.25	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.15	ft
Top Width	0.99	ft
Critical Depth	0.41	ft
Percent Full	19.7	%
Critical Slope	0.005226	ft/ft
Velocity	6.33	ft/s
Velocity Head	0.62	ft
Specific Energy	0.87	ft
Froude Number	2.69	
Maximum Discharg	13.72	cfs
Discharge Full	12.76	cfs
Slope Full	0.000280	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	24D to 24C
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.082500	ft/ft
Diameter	15	in
Discharge	1.56	cfs

Results		
Depth	0.25	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.15	ft
Top Width	0.99	ft
Critical Depth	0.49	ft
Percent Full	19.6	%
Critical Slope	0.005337	ft/ft
Velocity	9.19	ft/s
Velocity Head	1.31	ft
Specific Energy	1.56	ft
Froude Number	3.92	
Maximum Discharg	19.96	cfs
Discharge Full	18.55	cfs
Slope Full	0.000583	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	24C to 24B
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.013000	ft/ft
Diameter	15	in
Discharge	2.46	cfs

Results		
Depth	0.50	ft
Flow Area	0.5	ft²
Wetted Perimeter	1.71	ft
Top Width	1.22	ft
Critical Depth	0.63	ft
Percent Full	39.8	%
Critical Slope	0.005713	ft/ft
Velocity	5.40	ft/s
Velocity Head	0.45	ft
Specific Energy	0.95	ft
Froude Number	1.56	
Maximum Discharg	7.92	cfs
Discharge Full	7.36	cfs
Slope Full	0.001450	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	24B to 24
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.005000	ft/ft
Diameter	15	in
Discharge	2.92	cfs

Results		
Depth	0.73	ft
Flow Area	0.7	ft²
Wetted Perimeter	2.17	ft
Top Width	1.23	ft
Critical Depth	0.69	ft
Percent Full	58.1	%
Critical Slope	0.005973	ft/ft
Velocity	3.95	ft/s
Velocity Head	0.24	ft
Specific Energy	0.97	ft
Froude Number	0.90	
Maximum Discharg	4.91	cfs
Discharge Full	4.57	cfs
Slope Full	0.002044	ft/ft
Flow Type	Subcritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	24 to 23
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.020000	ft/ft
Diameter	15	in
Discharge	8.54	cfs

Results		
Depth	0.96	ft
Flow Area	1.0	ft²
Wetted Perimeter	2.67	ft
Top Width	1.06	ft
Critical Depth	1.14	ft
Percent Full	76.7	%
Critical Slope	0.015256	ft/ft
Velocity	8.46	ft/s
Velocity Head	1.11	ft
Specific Energy	2.07	ft
Froude Number	1.53	
Maximum Discharg	9.83	cfs
Discharge Full	9.14	cfs
Slope Full	0.017479	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	23 to 22
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.024000	ft/ft
Diameter	15	in
Discharge	8.54	cfs

Results		
Depth	0.89	ft
Flow Area	0.9	ft²
Wetted Perimeter	2.51	ft
Top Width	1.13	ft
Critical Depth	1.14	ft
Percent Full	71.0	%
Critical Slope	0.015256	ft/ft
Velocity	9.16	ft/s
Velocity Head	1.30	ft
Specific Energy	2.19	ft
Froude Number	1.78	
Maximum Discharg	10.76	cfs
Discharge Full	10.01	cfs
Slope Full	0.017479	ft/ft
Flow Type	Supercritical	

PROJECT 2002261-504.04
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INLET NUMBER 30 LENGTH 6.0 STATION

DRAINAGE AREA = 0.120 ACRES C VALUE = .810 CA = 0.097
DRAINAGE AREA = 0.230 ACRES C VALUE = .850 CA = 0.196

FOR THE FIRST SIDE
SUM CA= 0.097 INT= 4.00 CFS= 0.389 CO= 0.000 GUTTER FLOW= 0.389
FOR THE OTHER SIDE
SUM CA= 0.196 INT= 4.00 CFS= 0.782 CO= 0.000 GUTTER FLOW= 0.782
AT THE INLET

SUM CA= 0.293 INT= 4.00 CFS= 1.171 CO= 0.000 GUTTER FLOW= 1.171

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.78 (cfs) IS 5.86 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.14 SPREAD (ft) = 6.78

PROJECT 2002261-504.04
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INLET NUMBER 29 LENGTH 4.0 STATION

DRAINAGE AREA = 0.250 ACRES C VALUE = .530 CA = 0.132
SUM CA= 0.132 INT= 4.00 CFS= 0.530 CO= 0.000 GUTTER FLOW= 0.530

GUTTER SLOPE = 0.0050 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
4.18	2.0	0.48	0.0833	4.0	0.94	3.5	0.146	0.158

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 3.5 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.53 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
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INLET NUMBER 28 LENGTH 2.5 STATION

DRAINAGE AREA = 0.050 ACRES C VALUE = .900 CA = 0.045
SUM CA= 0.045 INT= 4.00 CFS= 0.180 CO= 0.000 GUTTER FLOW= 0.180

GUTTER SLOPE = 0.0075 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
1.52	2.0	1.31	0.0833	4.0	1.00	3.5	0.146	0.167

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 2.7 EFFICIENCY= 0.99
CFS INTERCEPTED= 0.18 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 27 LENGTH 2.5 STATION

DRAINAGE AREA = 0.040 ACRES C VALUE = .890 CA = 0.036
SUM CA= 0.036 INT= 4.00 CFS= 0.142 CO= 0.000 GUTTER FLOW= 0.142

GUTTER SLOPE = 0.0075 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
1.47	2.0	1.36	0.0833	4.0	1.00	3.5	0.146	0.167

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 2.2 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.14 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 26 LENGTH 4.0 STATION

DRAINAGE AREA = 0.120 ACRES C VALUE = .530 CA = 0.064
SUM CA= 0.064 INT= 4.00 CFS= 0.254 CO= 0.000 GUTTER FLOW= 0.254

GUTTER SLOPE = 0.0100 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
1.73	2.0	1.16	0.0833	4.0	1.00	3.5	0.146	0.167

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 3.1 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.25 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
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INLET NUMBER 25 LENGTH 6.0 STATION

DRAINAGE AREA = 0.310 ACRES C VALUE = .690 CA = 0.214
SUM CA= 0.214 INT= 4.00 CFS= 0.856 CO= 0.000 GUTTER FLOW= 0.856

GUTTER SLOPE = 0.0094 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
4.24	2.0	0.47	0.0833	4.0	0.93	3.5	0.146	0.157

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 5.7 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.86 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 24A LENGTH 6.0 STATION

DRAINAGE AREA = 0.100 ACRES C VALUE = .790 CA = 0.079
DRAINAGE AREA = 0.120 ACRES C VALUE = .850 CA = 0.102

FOR THE FIRST SIDE
SUM CA= 0.079 INT= 4.00 CFS= 0.316 CO= 0.000 GUTTER FLOW= 0.316
FOR THE OTHER SIDE
SUM CA= 0.102 INT= 4.00 CFS= 0.408 CO= 0.000 GUTTER FLOW= 0.408
AT THE INLET

SUM CA= 0.181 INT= 4.00 CFS= 0.724 CO= 0.000 GUTTER FLOW= 0.724

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.41 (cfs) IS 3.69 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.10 SPREAD (ft) = 4.92

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 24D LENGTH 6.0 STATION

DRAINAGE AREA = 0.260 ACRES C VALUE = .550 CA = 0.143
DRAINAGE AREA = 0.210 ACRES C VALUE = .550 CA = 0.115

FOR THE FIRST SIDE
SUM CA= 0.143 INT= 4.00 CFS= 0.572 CO= 0.000 GUTTER FLOW= 0.572
FOR THE OTHER SIDE
SUM CA= 0.115 INT= 4.00 CFS= 0.462 CO= 0.000 GUTTER FLOW= 0.462
AT THE INLET

SUM CA= 0.258 INT= 4.00 CFS= 1.034 CO= 0.000 GUTTER FLOW= 1.034

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.57 (cfs) IS 4.32 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.458
DEPTH OF WATER (ft) = 0.13 SPREAD (ft) = 6.24

PROJECT 2002261-504.04
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INLET NUMBER 24C LENGTH 2.5 STATION

DRAINAGE AREA = 0.040 ACRES C VALUE = .760 CA = 0.030
DRAINAGE AREA = 0.170 ACRES C VALUE = .710 CA = 0.121

FOR THE FIRST SIDE
SUM CA= 0.030 INT= 4.00 CFS= 0.122 CO= 0.000 GUTTER FLOW= 0.122
FOR THE OTHER SIDE
SUM CA= 0.121 INT= 4.00 CFS= 0.483 CO= 0.000 GUTTER FLOW= 0.483
AT THE INLET

SUM CA= 0.151 INT= 4.00 CFS= 0.604 CO= 0.000 GUTTER FLOW= 0.604

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.48 (cfs) IS 4.24 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.12 SPREAD (ft) = 5.90

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 24B LENGTH 4.0 STATION

DRAINAGE AREA = 0.210 ACRES C VALUE = .400 CA = 0.084
SUM CA= 0.084 INT= 4.00 CFS= 0.336 CO= 0.000 GUTTER FLOW= 0.336

GUTTER SLOPE = 0.0052 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
2.66	2.0	0.75	0.0833	4.0	1.00	3.5	0.146	0.166

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 2.9 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.34 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 24 LENGTH 2.5 STATION

DRAINAGE AREA = 0.170 ACRES C VALUE = .450 CA = 0.076
DRAINAGE AREA = 0.110 ACRES C VALUE = .450 CA = 0.049

FOR THE FIRST SIDE
SUM CA= 0.076 INT= 4.00 CFS= 0.306 CO= 0.000 GUTTER FLOW= 0.306
FOR THE OTHER SIDE
SUM CA= 0.049 INT= 4.00 CFS= 0.198 CO= 0.000 GUTTER FLOW= 0.198
AT THE INLET

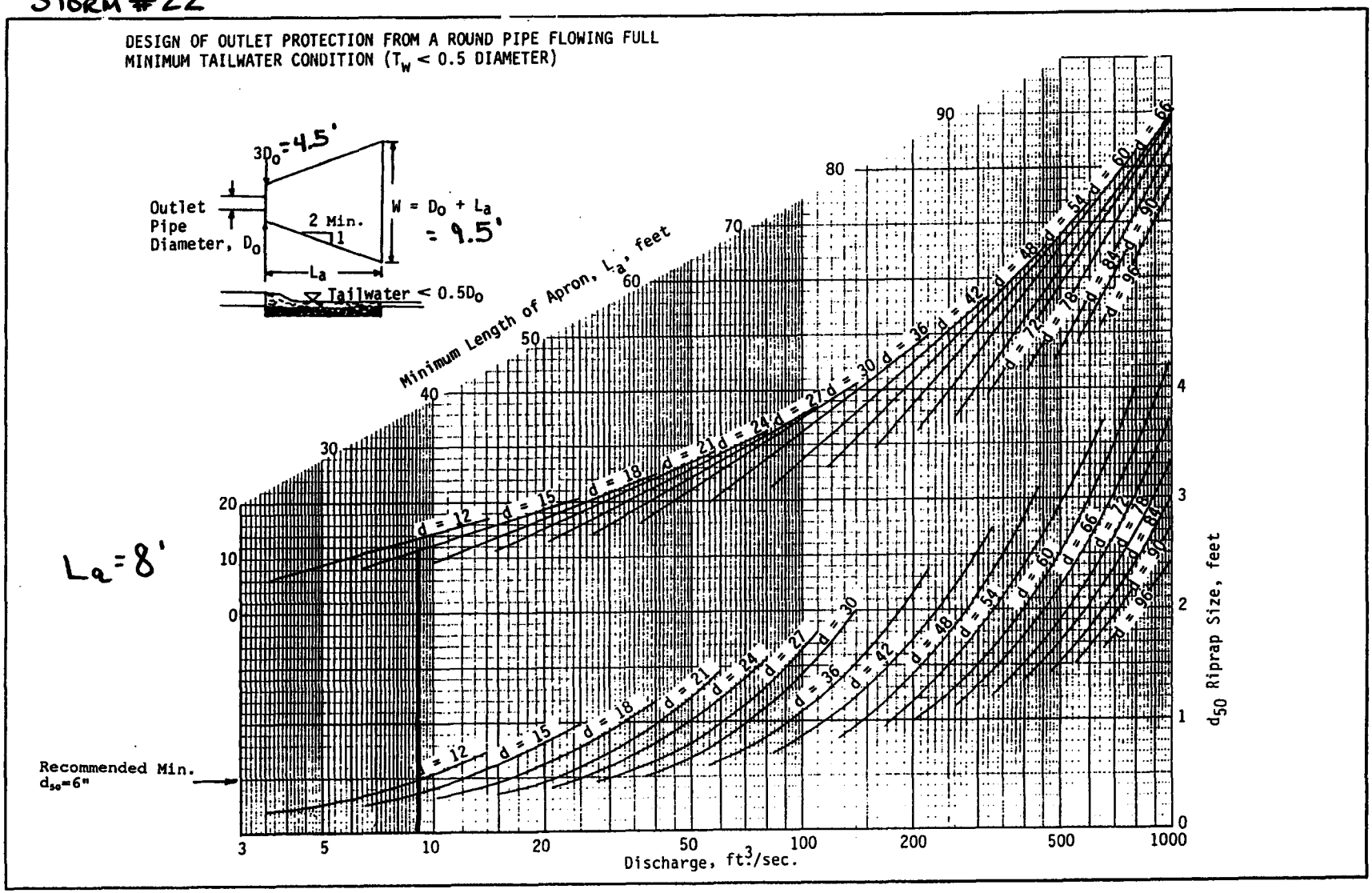
SUM CA= 0.126 INT= 4.00 CFS= 0.504 CO= 0.000 GUTTER FLOW= 0.504

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.31 (cfs) IS 5.02 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.11 SPREAD (ft) = 5.23

STORM #22


DESIGN OF OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION (T_W < 0.5 DIAMETER)
$3D_o$ = 4.5'
Outlet Pipe Diameter, D_o
2 Min. 1
$W = D_o + L_a$ = 9.5'
L_a
Tailwater < $0.5D_o$
Minimum Length of Apron, L_a, feet
L_a = 8'
Recommended Min. d_{50}=6"
Discharge, ft^3/sec.
d_{50} Riprap Size, feet
d = 12
d = 15
d = 18
d = 21
d = 24
d = 27
d = 30
d = 36
d = 42
d = 48
d = 54
d = 60
d = 66
d = 72
d = 78
d = 84
d = 90
d = 96

ROAD PAVEMENT CALCULATIONS

Appendix IV

Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

County	JAMES CITY COUNTY	Date: 12/29/03	
Subdivision	STONEHOUSE GLEN SECTION 2		
Street Name	STONEHOUSE GLEN		
Developer	STONEHOUSE AT WILLIAMSBURG, K McDermott	(Phone: 908-234-2620 x 27	

ADT	Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements.
CBR_D	Design CBR = Average of CBR_T x 2/3 and modified only as discussed in the Pavement Design Guide.
CBR_T	CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide
DME	VDOT District Materials Engineer
EPT	Equivalent projected traffic
HCV	Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires).
%HCV	Percentage of the total traffic volume composed of Heavy Commercial Vehicles.
RF	Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading.
SSV	Soil support value of subgrade (SSV = CBR_D x RF)
D_P	Thickness index of proposed pavement design computed by the Conventional Pavement Design Method
D_R	Thickness index required, based on Design ADT and SSV, determined by Appendix II.

Step 1: Determine Design ADT

ADT	
%HCV = 100 x HCV x ADT) / 20 x HCV (or) Note: For %HCV ≤ 5%, use ADT	Note: For %HCV>5%, EPT>ADT
Design ADT Use greater of ADT or EPT	1600

Step 2: Determine Design Values CBR, RF, and SSV

Sample	DBR_T
# 1	
# 2	
# 3	
#	
#	
#	

Resiliency Factor	(RF)
Source	Value
Table 1	
Appendix I	3
DME approved RF	

For preliminary designs, use the lowest RF value in the equation

CBR_D	x	RF	=	SSV
(6)	x	(3)	=	18

Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide. D_R = 14.5 from Appendix II
(See Appendix III for material notations and thickness equivalency values (a)).

Description of Proposed Pavement Section

	Material Notation	Thickness, h	a	(a x h)
Surface	SM 9.5 A	2	2.25	4.5
Base	BM - 25 37.5	3	2.15	6.45
Subbase	TYPE I SIZE 21B	8	0.5	4.0

D_P must equal or exceed the value of D_R. $D_P = \Sigma(a \times h)$ = 14.95

Appendix IV

Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

County	JAMES CITY COUNTY	Date: 12/29/03	
Subdivision	STONEHOUSE GLEN		
Street Name	CROOKSHAW & NEWLAND COURTS		
Developer	STONEHOUSE AT WILLIAMSBURG	Phone: 208-234-2620 x	

ADT	Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements.
CBR_D	Design CBR = Average of CBR_T x 2/3 and modified only as discussed in the Pavement Design Guide.
CBR_T	CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide
DME	VDOT District Materials Engineer
EPT	Equivalent projected traffic
HCV	Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires).
%HCV	Percentage of the total traffic volume composed of Heavy Commercial Vehicles.
RF	Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading.
SSV	Soil support value of subgrade (SSV = CBR_D x RF)
D_P	Thickness index of proposed pavement design computed by the Conventional Pavement Design Method
D_R	Thickness index required, based on Design ADT and SSV, determined by Appendix II.

Step 1: Determine Design ADT

ADT	760
%HCV = 100 x HCV x ADT) or 20 x HCV Note: For %HCV ≤ 5%, use ADT	Note: For %HCV>5%, EPT>ADT
Design ADT Use greater of ADT or EPT	760

Step 2: Determine Design Values CBR, RF, and SSV

Sample	DBR_T
# 1	
# 2	
# 3	
#	
#	
#	

Resiliency Factor	(RF)
Source	Value
Table 1	
Appendix I	3
DME approved RF	

For preliminary designs, use the lowest RF value in the equation

CBR_D	x	RF	=	SSV
(6)	x	(3)	=	18

Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☐ (B) Show pavement section as developed in the Pavement Design Guide. **D_R =** 12 from Appendix II
(See Appendix III for material notations and thickness equivalency values (a)).

Description of Proposed Pavement Section

	Material Notation	Thickness, h	a	(a x h)
Surface	SM 9.5A	1.5	2.25	3.375
Base	BM 25 37.5	3	2.15	6.45
Subbase	TYPE I SIZE 21B	6	0.5	3.0

D_P must equal or exceed the value of D_R. $D_P = \Sigma(a \times h) =$ 12.2

SEWER AND WATER DATA SHEETS

WATER DATA SHEET

Date: 07/07/05

1. Project Name: Stonehouse Glen Subdivision Section II
2. Project Location: Fieldstone Parkway Extension
3. Engineer: LandMark Design Group
4. Source of Water: JCSA W-25

[a]5. Design Population (Number and Type of Dwellings): 62 Single Family

5a. Industrial: _____ 5b: Domestic: 12.92 gpm

5c. Fire Flow: 1,000 gpm 5d. Pressure Maximum: 64.35 (J-21 – Avg) psi

Minimum: 31.28 psi

5e. Computed Design Flow (Fire + Max. Day Domestic): 1,021.96 gpm avail @ 31.28 (J-20) psi

5f. Computed Flow (Fire + Max. Day Domestic) Available: [b]2,857, [c]4,142 gpm @ 20 psi

5g. Computed Max. Hour Domestic Demand: 51.67 gpm avail @ 52.31 (J-18) psi

5h. Actual Fire Flow Available: 5,600+/- gpm @ 20 psi Hydrant No. (W-25)

6. Water Distribution System Piping:

Pipe Diameter (Inches)	Length (Feet)	Material (DI, PVC, etc.)
4"	133	DI
4"	1150	PVC
8"	2670	PVC
6"	66	DI

[a] Information for Section 5 of this water data sheet taken from approved water analysis titled Fieldstone Parkway Extension and Stonehouse Glen Subdivision Water System Design and Analysis Revised Dated April 28, 2004

[b] Shows available fire flow in Stonehouse Development Area I

[c] Shows available fire flow at Stonehouse Commerce Park

7. Water Meter Assemblies: 5/8" (Size), 62 (Number)

_____ (Size), _____ (Number)

_____ (Size), _____ (Number)

_____ (Size), _____ (Number)

8. Number of Hydrants Required: 5

Fire Department Approval (County use only):

Approved by:_____ Date:_____

SANITARY SEWER SYSTEM DATA SHEET

Date: 03/15/05 Revised 05/11/05

1. Project Name: Stonehouse Glen Subdivision Section II

2. Project Location: Fieldstone Parkway Extension

3. Engineer: LandMark Design Group

4. Sanitary Sewer System: JCSA force main to HRSD

5. Design Population (Number and Type of Dwellings): 62 Single Family

5a: Industrial: _____ 5b: Domestic: 12.92 gpm

5c: Other: _____ 5d: Total Average Flow: 12.92 gpm

6. Sanitary Sewer System Piping: 5e: Total Peak Flow: 32.29 gpm

Pipe Diameter (Inches)	Piping System (Gravity or Force Main)	Length (Feet)	Material (DI, PVC, etc.)
6" laterals	G	194	PVC
2"	FM	625	PVC
8"	G	2195	PVC
8"	G	1805	DI

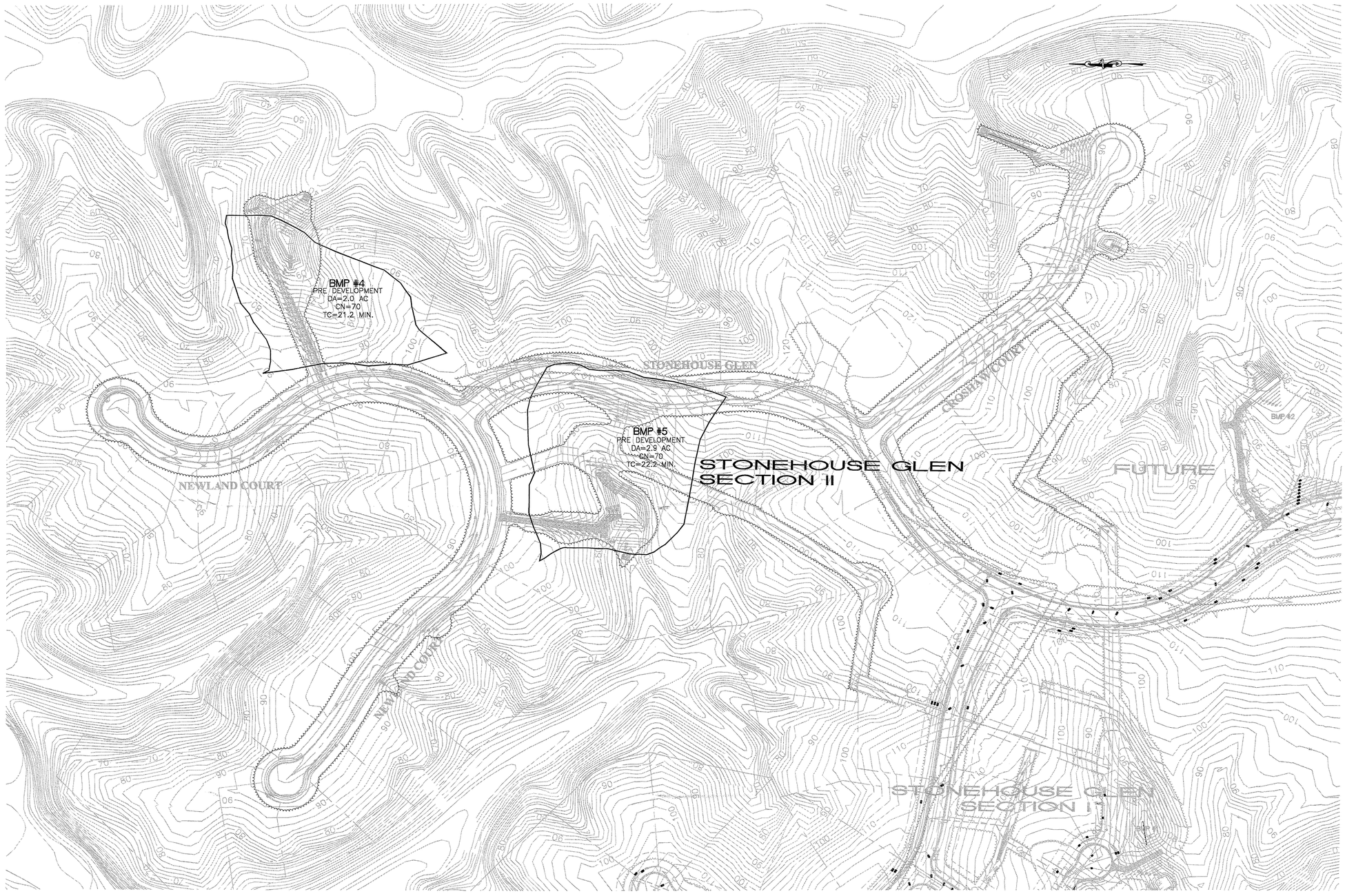
7. Sanitary Sewer Manholes:

Standard Manholes: 25, Average Depth: 10.53'

Watertight Manholes: _____, Average Depth: _____

Drop Manholes: 1, Average Depth: 19.74'

DRAINAGE AREA MAPS



GRAPHIC SCALE

0 100 200 400

(IN FEET)
1 inch = 100ft.

COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024305
PROFESSIONAL ENGINEER

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LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists

REVISIONS:

No.	Date	Comment	By

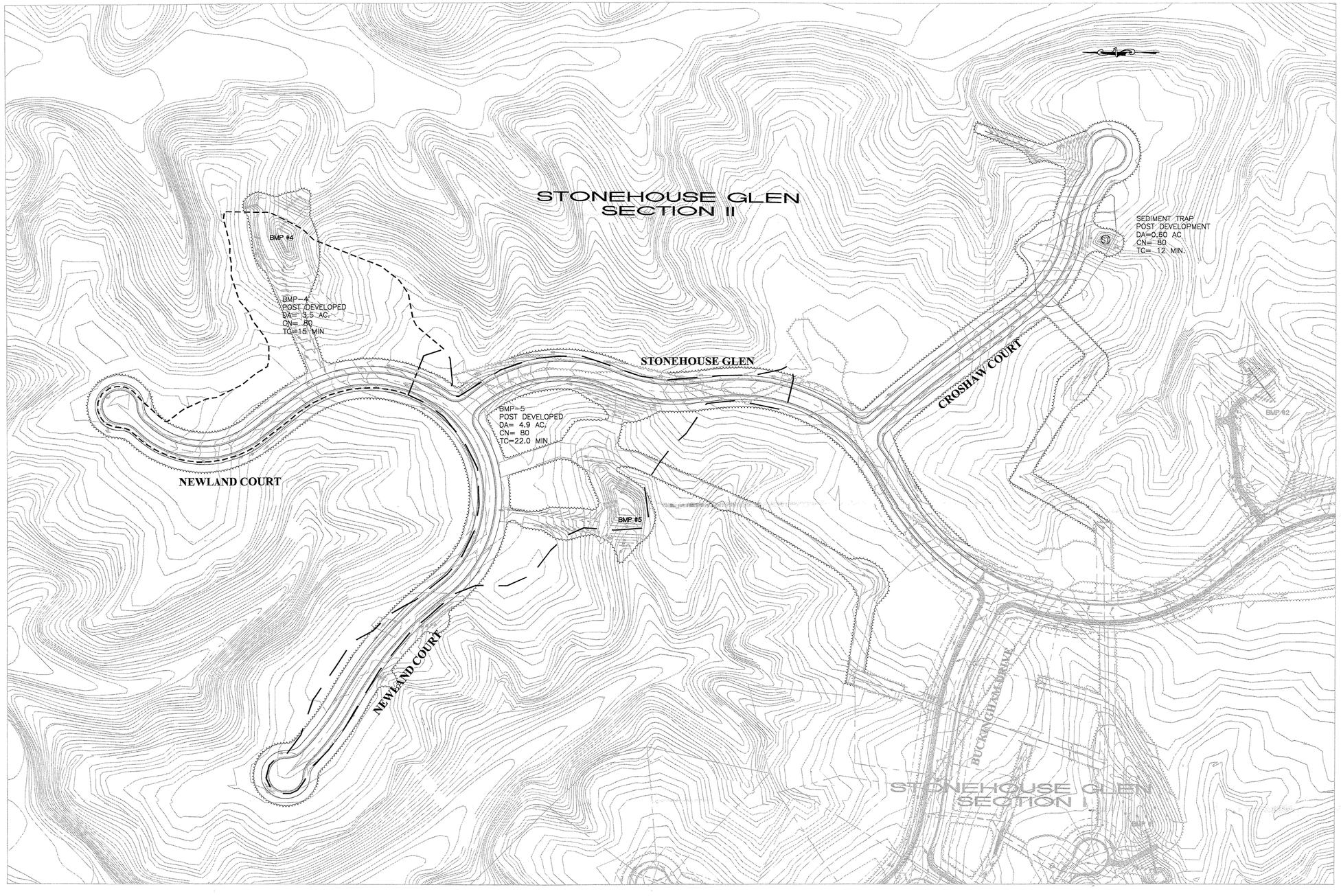
DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

PRE-DEVELOPMENT DRAINAGE
STONEHOUSE GLEN
SECTION II
STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 12/17/04
Checked: CRO	Scale: 1"=100'
File Mgr./Drawn: LMDG	CADD File name: DA-1.dwg
Project Number: 2002261-504.04	Dwg. File No.:
Drawing Number DA-1 OF	



GRAPHIC SCALE

0 100 200 400

(IN FEET)
1 inch = 100ft.

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LANDMARK DESIGN GROUP
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Landscape Architects • Environmental Scientists

REVISIONS:			
No.	Date	Comment	By

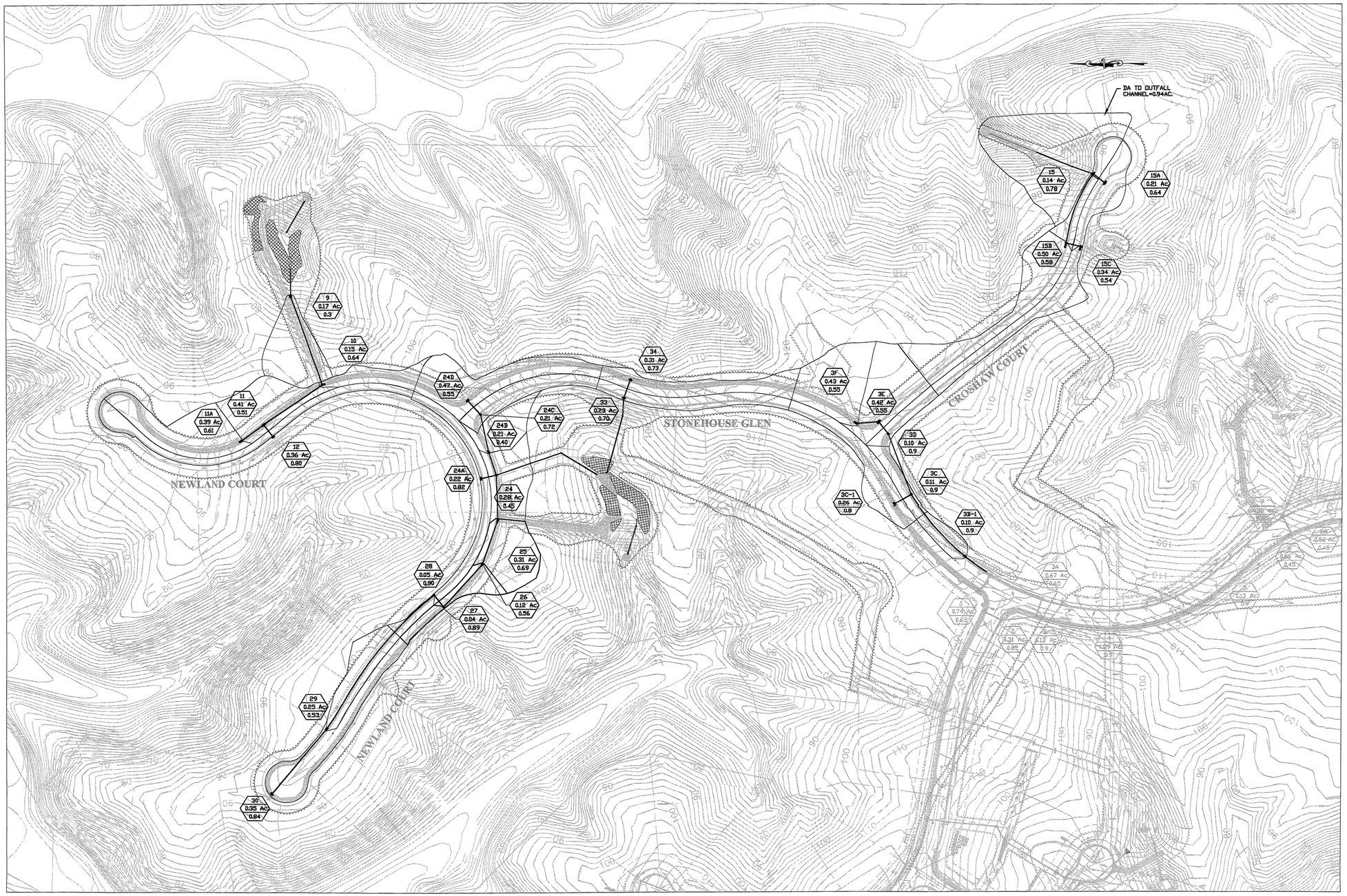
DRAWING STATUS
- Interdiv. Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

POST DEVELOPMENT DRAINAGE
STONEHOUSE GLEN SECTION II
STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 12/17/04
Checked: AJR	Scale: 1"=100'
File Mgr./Drawn: LMDG	CADD File name: DA-POST.dwg
Project Number: 2002261-504.04	Dwg. File No.:
Drawing Number: DA-2	



STRUCTURE NUMBER XX
DRAINAGE AREA X.XX Ac
WEIGHTED RUNOFF COEFFICIENT X.XX

GRAPHIC SCALE
0 100 200 400
(IN FEET)
1 inch = 100ft.

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REVISIONS:			
No.	Date	Comment	By

DRAWING STATUS
- Interdiffce Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

STRUCTURE DRAINAGE AREA
STONEHOUSE GLEN
SECTION II
STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

Designed: LMDG	Date: 12/28/04
Checked: AJR	Scale: 1"=100'
File Mgr./Drawn: LMDG	CADD File name: DA-POST.dwg
Project Number: 2002261-504.04	Dwg. File No.:
Drawing Number 3 OF 3	DA-3

LANDMARK DESIGN GROUP
TRANSMITTAL

RECEIVED
AUG 21 2006
ENVIRONMENTAL DIVISION

To: SCOTT THOMAS, PE

Company: JAMES CITY COUNTY, ENVIRONMENTAL

From: A. Scott ~~Thompson~~ AS, L.S.

Date: 0818/06

Subject: Stonehouse Glen Section I &II Bmp Interim Record Drawings

LMDG Job No.: 2002261-504.00

SP-98-03

Attached please find:
- [x] Prints
- [ ] Plans
- [ ] Specifications
- [ ] Drawings
- [ ] Report
- [ ] Letter

PH 2 SH GLEN SEC 1
PH 2 SH GLEN SEC 2
5-16-05

Transmitted as checked below:
- [ ] For your use
- [ ] As requested
- [x] For review and comment
- [ ] For approval
- [ ] Approved
- [ ]

Copies	Date	Drawing No.	Description
3ea.	8/14/06	17300-17306W	RECORD DRAWING PRINT
1ea.	08/14/06		Stormwater Management/BMP Facilities Record Drawing and construction certification

Notes:

Copies
1. File: _____
2. _____
3. _____

Enclosures
- [ ]
- [ ]
- [ ]

LandMark Design Group, Inc.

By: _____ Ast _____

**Acknowledgment by Recipient: _____ _____
Name Date

Engineers • Planners • Surveyors • Landscape Architects • Environmental Consultants
4029 Ironbound Road, Suite 100, Williamsburg, VA 23188 (757) 253-2975 FAX: (757) 229-0049 lmdg@landmarkdgwb.com

GET
Solutions, Inc.

Geotechnical · Environmental · Testing

S-116-03

September 14, 2005

Reviewed by SJT 9-15-05

TO: **Stonehouse @ Williamsburg, LLC**
c/o LandMark Design Group
4029 Ironbound Road
Suite 100
Williamsburg, Virginia 23188

Attn: Mr. James Brawley

RE: Subsurface Investigation & Geotechnical Engineering Services
Preliminary Report for BMP Facilities No. 4 and 5
Addendum 1 - Request for Additional Information (Revision date 9-14-05)
Stonehouse Glen Section II
Stonehouse at Williamsburg
James City County, Virginia
G E T Project No: WM05-182G

Dear Mr. Brawley:

Pursuant to the request of Scott Thomas of James City County, Virginia, **G E T Solutions, Inc.** is pleased to submit this Addendum 1 - Request for Additional Information, Preliminary Report for BMP Facilities No. 4 and 5 for the Subsurface Investigation and Geotechnical Engineering services currently being conducted at the above referenced project site. The additional information of our preliminary findings for the subject BMP facilities supplements our previous Preliminary Report for BMP Facilities No. 4 and 5 dated August 23, 2005 *(copy enclosed).* The additional preliminary findings have been summarized below:

Project Location:

- ✓ The project location name has been corrected to reflect Stonehouse Glen Section II. By means of this correspondence, our August 23, 2005 report *(copy enclosed)* is modified to reflect the corrected name.

Dam Construction & Stability:

- ✓ Our preliminary analysis indicates that the proposed embankment dam can be designed using a slope of 3:1(H:V), which will have a safety factor of 1.3 against a sliding failure. Settlement of 2 to 3 inches during construction and less than 1 inch post construction should be expected. These evaluations are based on the hand auger boring data and the estimated soil strength parameters obtained from the borings. These

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info@getsolutionsinc.com

preliminary design recommendations can be validated by means of conducting deeper SPT borings.

- ✓ The construction of the dam should consist of a Clay core and key way. The fill material used for the Clay core and key way should consist of CLAY (CH, CL) soils with infiltration rates of 1.0×10^{-6} cm/sec or less and have a Sand content of less than 50 percent by weight. We have reviewed the project plans provided by LandMark Design Group (revision date 7-13-05) which confirmed that the dimensions of the key way is a minimum of 8 feet wide and 4 feet deep which is consistent with our minimum recommendations. In addition, the existing on-site clayey soils appear suitable for use as dam fill for the berm however, it is recommended to perform additional classification testing (natural moisture and -#200 sieve) during construction to verify their acceptance or rejection. Prior to fill placement for the key way and dam, the proposed construction areas should be cleared by means of removing the trees, root mat, topsoil materials. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed berm area. Following the approval of the natural subgrade soils by the Geotechnical Engineer, the placement of the fill required to establish the design grades may begin. The fill should be placed in maximum 10-inch loose lifts and mechanically compacted to a dry density of at least 95 percent of the standard Proctor maximum dry density (ASTM D698).

It is noted that this report is preliminary in nature, and is intended to provide a general assessment of the site from a seepage and geotechnical standpoint. Additional exploration (in the form of deeper borings), testing and engineering can be completed within the dam alignment along with laboratory testing on the recovered soils in order to verify our engineering evaluation and recommendations in regards to slope stability and embankment dam settlement associated with the construction of the BMP facilities.

We trust that the information contained herein meets your immediate need, and we would ask that you call this office with any questions that you may have.

Respectfully submitted,
G E T Solutions, Inc.

Glenn W. Hohmeier, P.E.
Senior Project Engineer
VA Lic. # 036735

COMMONWEALTH OF VIRGINIA
9-14-05
GLENN W. HOHMEIER
No. 036735
PROFESSIONAL ENGINEER

cc: Scott Thomas, James City County

Attachments: Preliminary Report for BMP Facilities No. 4 & 5
dated August 23, 2005

Distribution: (3) LandMark Design Group

GET Solutions, Inc.

Geotechnical · Environmental · Testing

August 23, 2005

TO: **Stonehouse @ Williamsburg, LLC**
c/o LandMark Design Group
4029 Ironbound Road
Suite 100
Williamsburg, Virginia 23188

Attn: Mr. James Brawley

RE: Subsurface Investigation & Geotechnical Engineering Services
Preliminary Report for BMP Facilities No. 4 and 5
Fairmount Sections I-IV
Stonehouse at Williamsburg
James City County, Virginia
G E T Proposal No: WM05-182G

Dear Mr. Brawley:

Pursuant to your request, **G E T Solutions, Inc.** is pleased to submit this Preliminary Report for BMP Facilities No. 4 and 5 for the Subsurface Investigation and Geotechnical Engineering services currently being conducted at the above referenced project site. Our preliminary findings for the subject BMP facilities have been summarized below:

Infiltration Testing

Two infiltration tests (one at each of the borings B-48 & B-49) were performed within the lateral limits of the proposed BMP No. 4 (designated as B-48) and BMP No. 5 (designated as B-49). The infiltration test borehole was prepared utilizing a planer auger to remove soil clippings from its base (test levels of 6 feet at BMP No. 4 and 8 feet at BMP No. 5 below the ground surface. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter and the following testing procedures.

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info@getsolutionsinc.com

A support stand was assembled and placed adjacent to the borehole. This stand holds a calibrated reservoir (2000 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 6.096-meter (20 foot) braided PVC hose and then lowered by cable into the borehole to the test depth elevation. As required by the Glover solution, the WCU was suspended 6-inches above the bottom of the borehole. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole. Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until relatively consistent flow rates were documented. During testing the quick release connections and shutoff valve were monitored to ensure that no leakage occurred. The flow rate (Q), height of the constant water level (H), and borehole diameter (D) were used to calculate K_s utilizing the Glover Solution.

Based on the field testing and corroborated with laboratory classification testing results (published values compared to classification results), the hydraulic conductivity of the soils at a depth of 6 [Sandy CLAY (CL)] as identified at the location of the infiltration test (B-48) is $k = 6.62 \times 10^{-6}$ cm/sec and the hydraulic conductivity of the soils at a depth of 8 feet [Silty Sandy (SM)] as identified at the location of the infiltration test (B-49) is $k = 6.94 \times 10^{-5}$ cm/sec.

Table 1 – Infiltration Test Results

Infiltration Test	Boring Location	Depth Test Conducted (ft)	Percent Fines	Hyrdraulic Conductivity (cm/sec)
B-48	BMP No. 4	6	52.2	6.62×10^{-6}
B-49	BMP No. 5	8	29.6	6.94×10^{-5}

Engineering Evaluation for BMP Areas

Based on the results of our field and laboratory testing procedures and engineering analysis, the following observations, opinions, and recommendations are presented:

Seepage:

- ✓ The subsurface soils at each of the boring locations generally consisted of granular materials [Silty, SAND (SM)] in the borings performed within the limits of the BMP areas (BMP No. 4 and 5) at depths of 15 feet below existing grades. As such, and based on the laboratory classification testing and infiltration test results, the hydraulic conductivity values within these granular soils are anticipated to be a moderately low Ksat Class (on the order of 1.0×10^{-4} cm/sec to 1.0×10^{-5} cm/sec).
- ✓ Interbedded deposits of Sandy CLAY (CL) were encountered at boring location B-48 at depths of 1 to 4 feet, 6 to 7 feet and 9 to 11 feet below existing grades. As such, and based on the laboratory classification testing and infiltration test results, the hydraulic conductivity values are anticipated to be a very low Ksat Class (on the order of 5.0×10^{-5} to 5.0×10^{-6} cm/sec).
- ✓ The groundwater table was encountered at a depth of 13 feet below the existing site elevations at the BMP No. 5 boring location (B-49). The groundwater was not encountered to the depth explored at the BMP No. 4 location (B-48).

Borrow Material:

- ✓ On the basis of the results of our soils test borings and laboratory testing procedures, the shallow surface soils encountered within the borings performed, were typically comprised of Silty SAND (SM) materials along with some deposits of Sandy CLAY (CL). The granular soils (SM) may be suitable for reuse as structural fill, however materials recovered near or below the groundwater table will require moisture manipulation prior to their use. The Sandy CLAY (CL) soils were encountered at various depths within boring, which contained appreciable amounts of Clay may be considered suitable for re-use in "green" areas, as fill for the dam's Clay core and key way, if applicable. In order to verify the acceptance or rejection of the existing soils for re-use as structural or embankment dam fill, additional classification tests (natural moisture and -#200 sieve) will have to be performed during construction.

We trust that the information contained herein meets your immediate need, and we would ask that you call this office with any questions that you may have.

Respectfully submitted,
G E T Solutions, Inc.

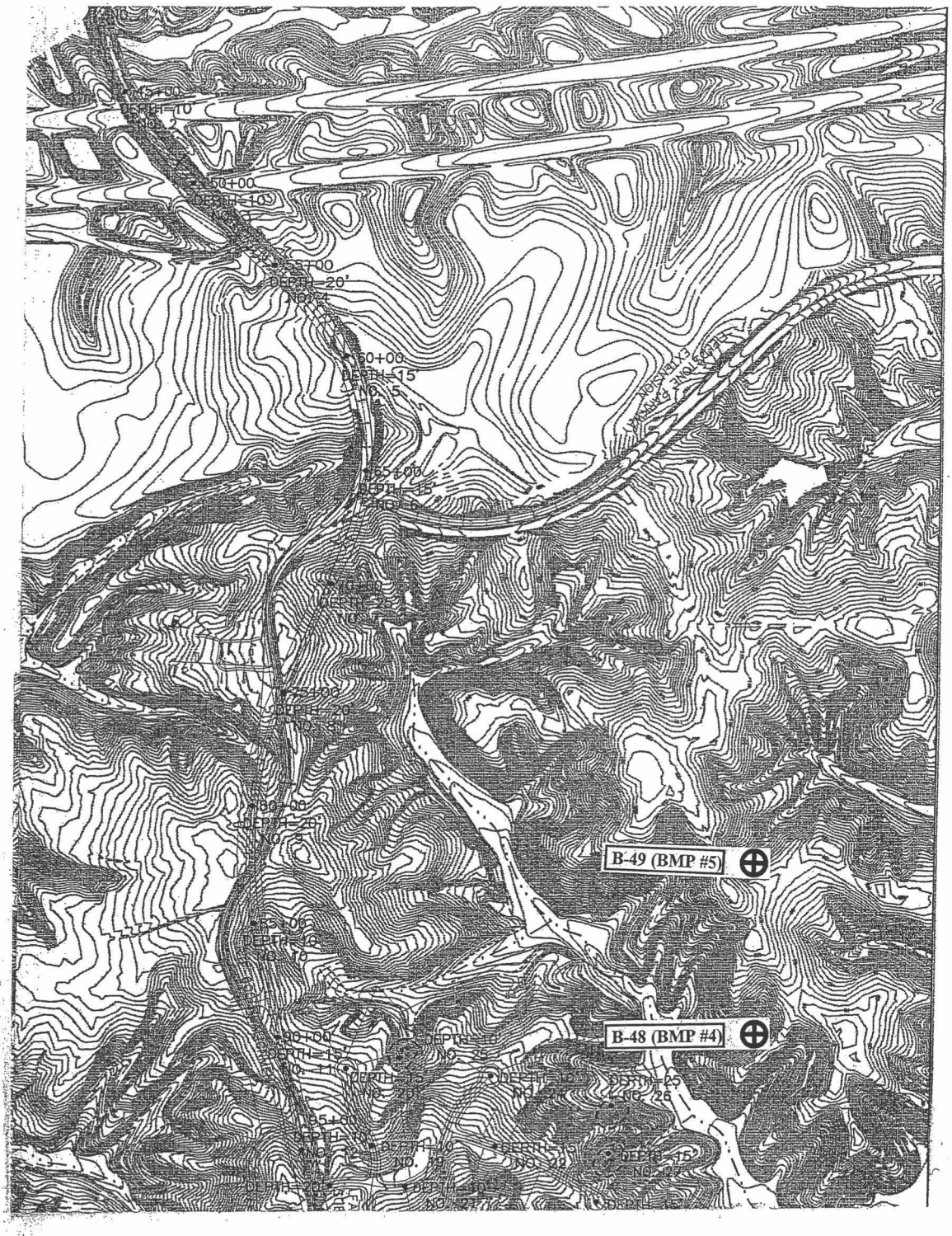
Glenn W. Hohmeier, P.E.
Senior Project Engineer
VA Lic. # 036735

COMMONWEALTH OF VIRGINIA
8-23-05
GLENN W. HOHMEIER
No. 036735
PROFESSIONAL ENGINEER

Attachments: BMP No. 4 & 5 Location Sketch
Log of Borings
Saturated Hydraulic Conductivity Worksheet

Distribution: (2) LandMark Design Group

Figure 1



Locations are approximate

BMP NO. 4 & 5 LOCATION SKETCH

PROJECT:	Fairmount Sections I - IV James City County, Virginia	SCALE: NTS
PROJECT NO:	WM05-182G	DATE: 8/23/05
CLIENT:	Stonehouse at Williamsburg LLC	PLOT BY: KT

LOG OF BORING No. B-48

GET Solutions, Inc.

PROJECT: Fairmount Sections I-IV **PROJECT NO.:** WM05-182G
CLIENT: Stonehouse at Williamsburg LLC
PROJECT LOCATION: James City County, Va
LOCATION: See Attached Boring Location Plan **ELEVATION:**
DRILLER: GET Solutions, Inc. **LOGGED BY:** KT
DRILLING METHOD: Hand Auger **DATE:** 8/18/05
DEPTH TO - WATER> INITIAL: **AFTER 24 HOURS:** **CAVING>** C

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200
0					
	6 inches of topsoil				
	Brown, moist, Silty, fine to meduim SAND (SM) with trace gravel and organics				
	Orangish brown, moist, Sandy CLAY (CL)				
5	Brown to orangish brown, moist, Silty, fine to meduim SAND (SM) with trace gravel at 5 to 6 feet				52
	Orangish brown, moist, Sandy CLAY (CL)				
	Brown, moist, Silty, fine to coarse SAND (SM) with trace gravel				
10	Orangish brown to brown, moist, Sandy CLAY (CL) with trace organics				
	Brown, moist, Silty, fine to meduim SAND (SM)				
15	Boring terminated at 15 ft.				
20					
25					
30					
35					

TEST RESULTS
Plastic Limit — Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

GET Solutions, Inc.

LOG OF BORING No. B-49

PROJECT: Fairmount Sections I-IV **PROJECT NO.:** WM05-182G
CLIENT: Stonehouse at Williamsburg LLC
PROJECT LOCATION: James City County, Va
LOCATION: See Attached Location Plan **ELEVATION:**
DRILLER: GET Solutions, Inc. **LOGGED BY:** KT
DRILLING METHOD: Hand Auger **DATE:** 8/16/05
DEPTH TO - WATER> INITIAL: ▽ 13" **AFTER 24 HOURS:** ▼ **CAVING>** C

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200	TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▩; 10 20 30 40 50 60 70)
0						
	6 inches of topsoil					
	Brown to orangish brown, moist, Silty, fine to meduim SAND (SM) with trace organics					
5	Orangish brown to dark brown, moist to wet, Silty, fine to meduim SAND (SM)				30	●
10	with trace CLAY from 7 to 13 feet					
15	Boring terminated at 15 ft.					
20						
25						
30						
35						

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

GET SOLUTIONS, INC.	SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET	Sheet No.: 1
Project Name.: Fairmount Sections I - IV	Location..... See Attached Boring Location Plan	Terminology and Solution
Boring No.....: B-48 (BMP #4)	Date.....: 8/18/2005	Ksat : Saturated hydraulic conductivity
Investigators.: L. Young, K. Tweedy	File Name.....: WM05-182G	Q: Steady-state rate of water flow into the soil
Boring Depth.: 72 inches	WCU Base. Ht. h: 15.0 cm	H: Constant height of water in borehole
Boring Dia.....: 8.3 cm	WCU Susp. Ht. S: 15.2 cm	r: Radius of cylindrical borehole
Boring Rad. (r): 4.15 cm	Const. Wtr. Ht. H: 30.2 cm	Ksat = Q[sinh-1(H/r) - (r2/H2+1).5 + r/H] / (2pH2) [Glover Solu

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	Ksat Equivalent Values (cm/sec)	Ksat Equivalent Values (cm/day)	Ksat Equivalent Values (in/hr)	Ksat Equivalent Values (ft/day)
2000		1:00:00 PM								
1990	10	1:08:30 PM	0:08:30	8.50	1.18	0.000	6.20E-06	0.5	0.009	0.02
1980	10	1:16:07 PM	0:07:37	7.62	1.31	0.000	6.91E-06	0.6	0.010	0.02
1970	10	1:24:43 PM	0:08:36	8.60	1.16	0.000	6.12E-06	0.5	0.009	0.02
1960	10	1:32:32 PM	0:07:49	7.82	1.28	0.000	6.74E-06	0.6	0.010	0.02
1950	10	1:40:20 PM	0:07:48	7.80	1.28	0.000	6.75E-06	0.6	0.010	0.02
1940	10	1:48:05 PM	0:07:45	7.75	1.29	0.000	6.79E-06	0.6	0.010	0.02
1930	10	1:56:55 PM	0:08:50	8.83	1.13	0.000	5.96E-06	0.5	0.008	0.02
1920	10	2:04:36 PM	0:07:41	7.68	1.30	0.000	6.85E-06	0.6	0.010	0.02
1910	10	2:12:15 PM	0:07:39	7.65	1.31	0.000	6.88E-06	0.6	0.010	0.02
1900	10	2:19:57 PM	0:07:42	7.70	1.30	0.000	6.84E-06	0.6	0.010	0.02
1890	10	2:27:43 PM	0:07:46	7.77	1.29	0.000	6.78E-06	0.6	0.010	0.02

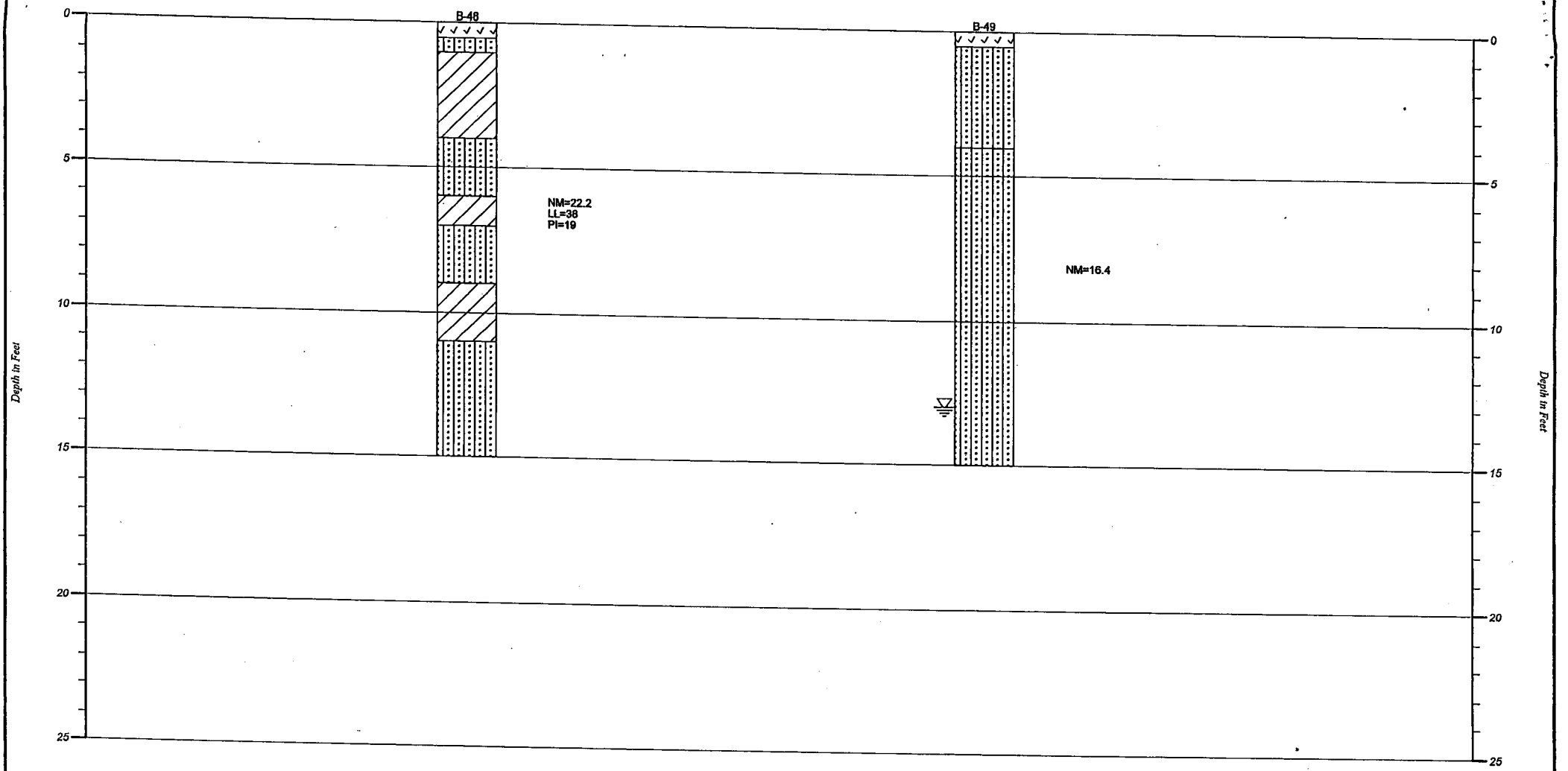
Natural Moisture: Moist	Init. Satur.Time: 12:45:00 PM	ESTIMATED FIELD KSAT:	0.000	6.62E-06	0.6	0.009	0.02		
Texture/Classif: CLAY (CL)	Consistency:	Depth to an Impermeable Layer: N/A	Notes: Ksat Class = Moderately Low						
Structure/Fabric: N/A	Slope/Landsc: level	Depth to Bedrock.....: N/A							

GET SOLUTIONS, INC.	SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET	Sheet No.: 1

Project Name.:	Fairmount Sections I - IV	Location.....	See Attached Boring Location Plan	Terminology and Solution	
Boring No.....:	B-49 (BMP #5)	Date.....:	8/16/2005	Ksat :	Saturated hydraulic conductivity
Investigators.:	L. Young, S. Freeman	File Name.....:	WM05-182G	Q:	Steady-state rate of water flow into the soil
Boring Depth.:	96 inches	WCU Base. Ht. h:	15.0 cm	H:	Constant height of water in borehole
Boring Dia.....:	8.3 cm	WCU Susp. Ht. S:	15.2 cm	r:	Radius of cylindrical borehole
Boring Rad. (r):	4.15 cm	Const. Wtr. Ht. H:	30.2 cm	Ksat = Q[sinh-1(H/r) - (r2/H2+1).5 + r/H] / (2pH2)	[Glover Solu

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2000		11:00:00 AM								
1990	10	11:00:42 AM	0:00:42	0.70	14.29	0.005	7.52E-05	6.5	0.107	0.21
1980	10	11:01:27 AM	0:00:45	0.75	13.33	0.004	7.02E-05	6.1	0.100	0.20
1970	10	11:02:13 AM	0:00:46	0.77	13.04	0.004	6.87E-05	5.9	0.097	0.19
1960	10	11:02:57 AM	0:00:44	0.73	13.64	0.004	7.18E-05	6.2	0.102	0.20
1950	10	11:03:44 AM	0:00:47	0.78	12.77	0.004	6.72E-05	5.8	0.095	0.19
1940	10	11:04:33 AM	0:00:49	0.82	12.24	0.004	6.45E-05	5.6	0.091	0.18
1930	10	11:05:20 AM	0:00:47	0.78	12.77	0.004	6.72E-05	5.8	0.095	0.19
1920	10	11:06:05 AM	0:00:45	0.75	13.33	0.004	7.02E-05	6.1	0.100	0.20
1910	10	11:06:48 AM	0:00:43	0.72	13.95	0.004	7.35E-05	6.3	0.104	0.21
1900	10	11:07:36 AM	0:00:48	0.80	12.50	0.004	6.58E-05	5.7	0.093	0.19
1890	10	11:08:22 AM	0:00:46	0.77	13.04	0.004	6.87E-05	5.9	0.097	0.19
					ESTIMATED FIELD KSAT:	0.004	6.94E-05	6.0	0.098	0.20

Natural Moisture:	Moist	Init. Satur.Time:	10:45:00 AM	Notes:	Ksat Class = Moderately Low
Texture/Classif:	SAND (SM)	Consistency:		Depth to an Impermeable Layer:	N/A
Structure/Fabric:	N/A	Slope/Landsc:	level	Depth to Bedrock.....:	N/A



Strata symbols

- Topsoil
- Silty sand
- Low plasticity clay

GET Solutions, Inc.

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=5'	KT	8/23/2005

Fairmount Sections I-IV

PROJECT NO. WM05-182G	FIGURE NUMBER

LANDMARK DESIGN GROUP
TRANSMITTAL

5-116-03

To: Scott Thomas, P.E.

Company: James City County

From: Ronnie Orsborne

Date: 09/09/05

Subject: Stonehouse Glen Section II

LMDG Job No.: 2002261-504.04

RECEIVED
SEP - 9 2005
ENVIRONMENTAL DIVISION

Attached please find:
- [x] Prints
- [ ] Plans
- [ ] Specifications
- [ ] Drawings
- [ ] Report
- [ ] Letter

Transmitted as checked below:
- [ ] For your use
- [ ] As requested
- [ ] For review and comment
- [x] For approval
- [ ] Approved
- [ ]

Copies	Date	Drawing No.	Description
1	08/23/05		GET Solutions – Subsurface Investigation & Geotechnical Engineering Services Preliminary Report for BMP Facilities No. 4 and 5 Stonehouse Glen Section II
2	08/15/05	Exh-1	Boring Locations Exhibit
2	07/15/05	C-3A	Preliminary Plat-Stonehouse Glen Section II

Notes:

REVIEWED REPORT. CALLS REQUIRED INFO. CALLED GLEN HOMMEIR GET 9.12.05. NEED MORE INFO. EITHER IN WRITING OR VERBAL.

Copies		Enclosures
1.	File: 2002261-504.04	[x]
2.		[ ]
3.		[ ]
4.		[ ]
5.		[ ]

LandMark Design Group, Inc.

(1) Put together specific info to address. Will FAX 9/14.

By: TMP

**Acknowledgment by Recipient: _____ Name _____ Date

Engineers ♦ Planners ♦ Surveyors ♦ Landscape Architects ♦ Environmental Scientists
4029 Ironbound Road, Suite 100, Williamsburg, VA 23188 (757) 253-2975 FAX: (757) 229-0049 lmdg@landmarkdg.com

20-2261-504.04

GET Solutions, Inc.

Geotechnical · Environmental · Testing

August 23, 2005

TO: **Stonehouse @ Williamsburg, LLC**
c/o LandMark Design Group
4029 Ironbound Road
Suite 100
Williamsburg, Virginia 23188

Attn: Mr. James Brawley

RE: Subsurface Investigation & Geotechnical Engineering Services
Preliminary Report for BMP Facilities No. 4 and 5
~~**Fairmount Sections I-IV**~~: STONEHOUSE GLEN II
Stonehouse at Williamsburg
James City County, Virginia
G E T Proposal No: WM05-182G

Dear Mr. Brawley:

Pursuant to your request, **G E T Solutions, Inc.** is pleased to submit this Preliminary Report for BMP Facilities No. 4 and 5 for the Subsurface Investigation and Geotechnical Engineering services currently being conducted at the above referenced project site. Our preliminary findings for the subject BMP facilities have been summarized below:

Infiltration Testing

?

Two infiltration tests (one at each of the borings B-48 & B-49) were performed within the lateral limits of the proposed BMP No. 4 (designated as B-48) and BMP No. 5 (designated as B-49). The infiltration test borehole was prepared utilizing a planer auger to remove soil clippings from its base (test levels of 6 feet at BMP No. 4 and 8 feet at BMP No. 5 below the ground surface. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter and the following testing procedures.

1592 Penniman Road, Suite E • Williamsburg, VA 23185 • Phone (757) 564-6452 • Fax (757) 564-6453
info@getsolutionsinc.com

A support stand was assembled and placed adjacent to the borehole. This stand holds a calibrated reservoir (2000 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 6.096-meter (20 foot) braided PVC hose and then lowered by cable into the borehole to the test depth elevation. As required by the Glover solution, the WCU was suspended 6-inches above the bottom of the borehole. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole. Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until relatively consistent flow rates were documented. During testing the quick release connections and shutoff valve were monitored to ensure that no leakage occurred. The flow rate (Q), height of the constant water level (H), and borehole diameter (D) were used to calculate K_s utilizing the Glover Solution.

?

Based on the field testing and corroborated with laboratory classification testing results (published values compared to classification results), the hydraulic conductivity of the soils at a depth of 6 [Sandy CLAY (CL)] as identified at the location of the infiltration test (B-48) is $k = 6.62 \times 10^{-6}$ cm/sec and the hydraulic conductivity of the soils at a depth of 8 feet [Silty Sandy (SM)] as identified at the location of the infiltration test (B-49) is $k = 6.94 \times 10^{-5}$ cm/sec.

Table 1 – Infiltration Test Results

Infiltration Test	Boring Location	Depth Test Conducted (ft)	Percent Fines	Hyrdraulic Conductivity (cm/sec)
B-48	BMP No. 4	6	52.2	6.62×10^{-6}
B-49	BMP No. 5	8	29.6	6.94×10^{-5}

Engineering Evaluation for BMP Areas

Based on the results of our field and laboratory testing procedures and engineering analysis, the following observations, opinions, and recommendations are presented:

Seepage:

- ✓ The subsurface soils at each of the boring locations generally consisted of granular materials [Silty, SAND (SM)] in the borings performed within the limits of the BMP areas (BMP No. 4 and 5) at depths of 15 feet below existing grades. As such, and based on the laboratory classification testing and infiltration test results, the hydraulic conductivity values within these granular soils are anticipated to be a moderately low Ksat Class (on the order of 1.0×10^{-4} cm/sec to 1.0×10^{-5} cm/sec). ✓
- ✓ Interbedded deposits of Sandy CLAY (CL) were encountered at boring location B-48 at depths of 1 to 4 feet, 6 to 7 feet and 9 to 11 feet below existing grades. As such, and based on the laboratory classification testing and infiltration test results, the hydraulic conductivity values are anticipated to be a very low Ksat Class (on the order of 5.0×10^{-5} to 5.0×10^{-6} cm/sec). ✓
- ✓ The groundwater table was encountered at a depth of 13 feet below the existing site elevations at the BMP No. 5 boring location (B-49). The groundwater was not encountered to the depth explored at the BMP No. 4 location (B-48). ✓

Borrow Material:

- ✓ On the basis of the results of our soils test borings and laboratory testing procedures, the shallow surface soils encountered within the borings performed, were typically comprised of Silty SAND (SM) materials along with some deposits of Sandy CLAY (CL). The granular soils (SM) may be suitable for reuse as structural fill, however materials recovered near or below the groundwater table will require moisture manipulation prior to their use. The Sandy CLAY (CL) soils were encountered at various depths within boring, which contained appreciable amounts of Clay may be considered suitable for re-use in "green" areas, as fill for the dam's Clay core and key way, if applicable. In order to verify the acceptance or rejection of the existing soils for re-use as structural or embankment dam fill, additional classification tests (natural moisture and -#200 sieve) will have to be performed during construction.

NO SPECIFIC RECOMMENDS STABILITY, SEEPAGE, ETC.

We trust that the information contained herein meets your immediate need, and we would ask that you call this office with any questions that you may have.

Respectfully submitted,
G E T Solutions, Inc.

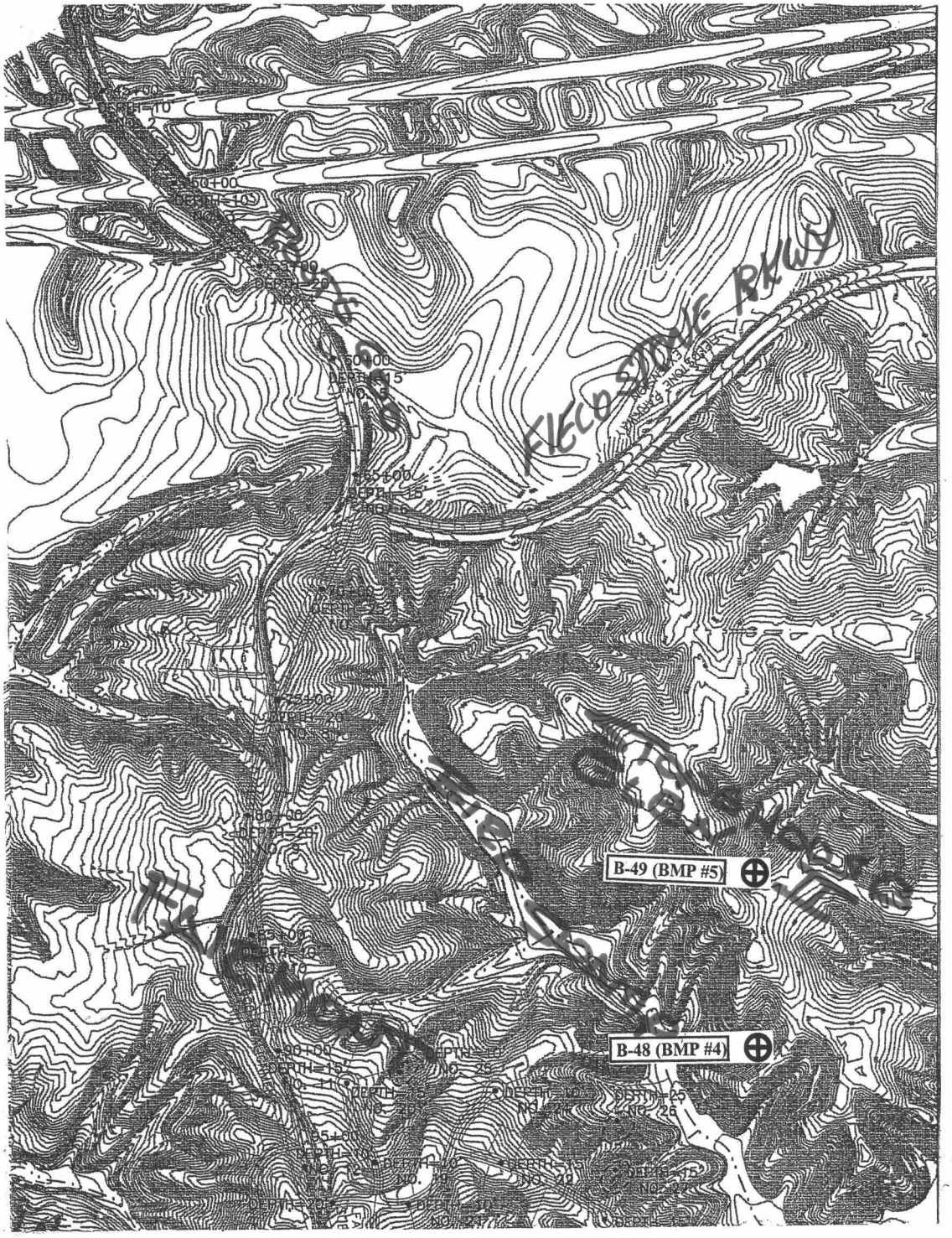
Glenn W. Hohmeier, P.E.
Senior Project Engineer
VA Lic. # 036735

COMMONWEALTH OF VIRGINIA
8-23-05
GLENN W. HOHMEIER
No. 036735
PROFESSIONAL ENGINEER

Attachments: BMP No. 4 & 5 Location Sketch
Log of Borings
Saturated Hydraulic Conductivity Worksheet

Distribution: (2) LandMark Design Group

Figure 1



Locations are approximate

BMP NO. 4 & 5 LOCATION SKETCH

PROJECT:	~~Fairmount Sections I - IV~~ Stonehouse GLBN II	
	James City County, Virginia	SCALE: NTS
PROJECT NO:	WM05-182G	DATE: 8/23/05
CLIENT:	Stonehouse at Williamsburg LLC	PLOT BY: KT

LOG OF BORING No. B-48

GET Solutions, Inc.

PROJECT: ~~Fairmount Sections I-IV~~ STONEHOUSE GLADE II **PROJECT NO.:** WM05-182G
CLIENT: Stonehouse at Williamsburg LLC
PROJECT LOCATION: James City County, Va
LOCATION: See Attached Boring Location Plan **ELEVATION:**
DRILLER: GET Solutions, Inc. **LOGGED BY:** KT
DRILLING METHOD: Hand Auger **DATE:** 8/18/05
DEPTH TO - WATER> INITIAL: ▽ **AFTER 24 HOURS:** ▽ **CAVING>** ℄

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200	TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50)
0						
	6 inches of topsoil (.5)					
	Brown, moist, Silty, fine to meduim SAND (SM) with trace gravel and organics (1)					
	Orangish brown, moist, Sandy CLAY (CL) (4)					
5	Brown to orangish brown, moist, Silty, fine to meduim SAND (SM) with trace gravel at 5 to 6 feet (6)				52	
	Orangish brown, moist, Sandy CLAY (CL) (7)					
	Brown, moist, Silty, fine to coarse SAND (SM) with trace gravel (9)					
10	Orangish brown to brown, moist, Sandy CLAY (CL) with trace organics (11)					
	Brown, moist, Silty, fine to meduim SAND (SM)					
15	Boring terminated at 15 ft.					
20						
25						
30						
35						

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

LOG OF BORING No. B-49

GET Solutions, Inc.

PROJECT: ~~Fairmount Sections I-IV~~ STONEHOUSE GLENN **PROJECT NO.:** WM05-182G
CLIENT: Stonehouse at Williamsburg LLC
PROJECT LOCATION: James City County, Va
LOCATION: See Attached Location Plan **ELEVATION:**
DRILLER: GET Solutions, Inc. **LOGGED BY:** KT
DRILLING METHOD: Hand Auger **DATE:** 8/16/05
DEPTH TO - WATER> INITIAL: ▼ 13" **AFTER 24 HOURS:** ▼ **CAVING>** C

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200	TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▩; 10 20 30 40 50 60 70)
0	6 inches of topsoil (.5)					
	Brown to orangish brown, moist, Silty, fine to meduim SAND (SM) with trace organics (4)					
5	Orangish brown to dark brown, moist to wet, Silty, fine to meduim SAND (SM)				30	●
10	with trace CLAY from 7 to 13 feet					
15	Boring terminated at 15 ft.					
20						
25						
30						
35						

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

GET SOLUTIONS, INC.	SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET	Sheet No.: 1

Project Name.:	~~Fairmount Sections I - IV~~ Fairmount Glen II	Location..... See Attached Boring Location Plan	**Terminology and Solution**
Boring No.....:	B-48 (BMP #4)	Date.....: 8/18/2005	Ksat : Saturated hydraulic conductivity
Investigators.:	L. Young, K. Tweedy	File Name.....: WM05-182G	Q: Steady-state rate of water flow into the soil
Boring Depth.:	72 inches	WCU Base. Ht. h: 15.0 cm	H: Constant height of water in borehole
Boring Dia.....:	8.3 cm	WCU Susp. Ht. S: 15.2 cm	r: Radius of cylindrical borehole
Boring Rad. (r):	4.15 cm	Const. Wtr. Ht. H: 30.2 cm	Ksat = Q[sinh-1(H/r) - (r2/H2+1).5 + r/H] / (2pH2) [Glover Solu

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2000		1:00:00 PM								
1990	10	1:08:30 PM	0:08:30	8.50	1.18	0.000	6.20E-06	0.5	0.009	0.0
1980	10	1:16:07 PM	0:07:37	7.62	1.31	0.000	6.91E-06	0.6	0.010	0.02
1970	10	1:24:43 PM	0:08:36	8.60	1.16	0.000	6.12E-06	0.5	0.009	0.02
1960	10	1:32:32 PM	0:07:49	7.82	1.28	0.000	6.74E-06	0.6	0.010	0.02
1950	10	1:40:20 PM	0:07:48	7.80	1.28	0.000	6.75E-06	0.6	0.010	0.02
1940	10	1:48:05 PM	0:07:45	7.75	1.29	0.000	6.79E-06	0.6	0.010	0.02
1930	10	1:56:55 PM	0:08:50	8.83	1.13	0.000	5.96E-06	0.5	0.008	0.02
1920	10	2:04:36 PM	0:07:41	7.68	1.30	0.000	6.85E-06	0.6	0.010	0.02
1910	10	2:12:15 PM	0:07:39	7.65	1.31	0.000	6.88E-06	0.6	0.010	0.02
1900	10	2:19:57 PM	0:07:42	7.70	1.30	0.000	6.84E-06	0.6	0.010	0.02
1890	10	2:27:43 PM	0:07:46	7.77	1.29	0.000	6.78E-06	0.6	0.010	0.02
					ESTIMATED FIELD KSAT:	0.000	6.62E-06	0.6	0.009	0.02

Natural Moisture:	Moist	Init. Satur.Time:	12:45:00 PM		
Texture/Classif:	CLAY (CL)	Consistency:		Depth to an Impermeable Layer:	N/A
Structure/Fabric:	N/A	Slope/Landsc:	level	Depth to Bedrock.....:	N/A

Notes: Ksat Class = Moderately Low

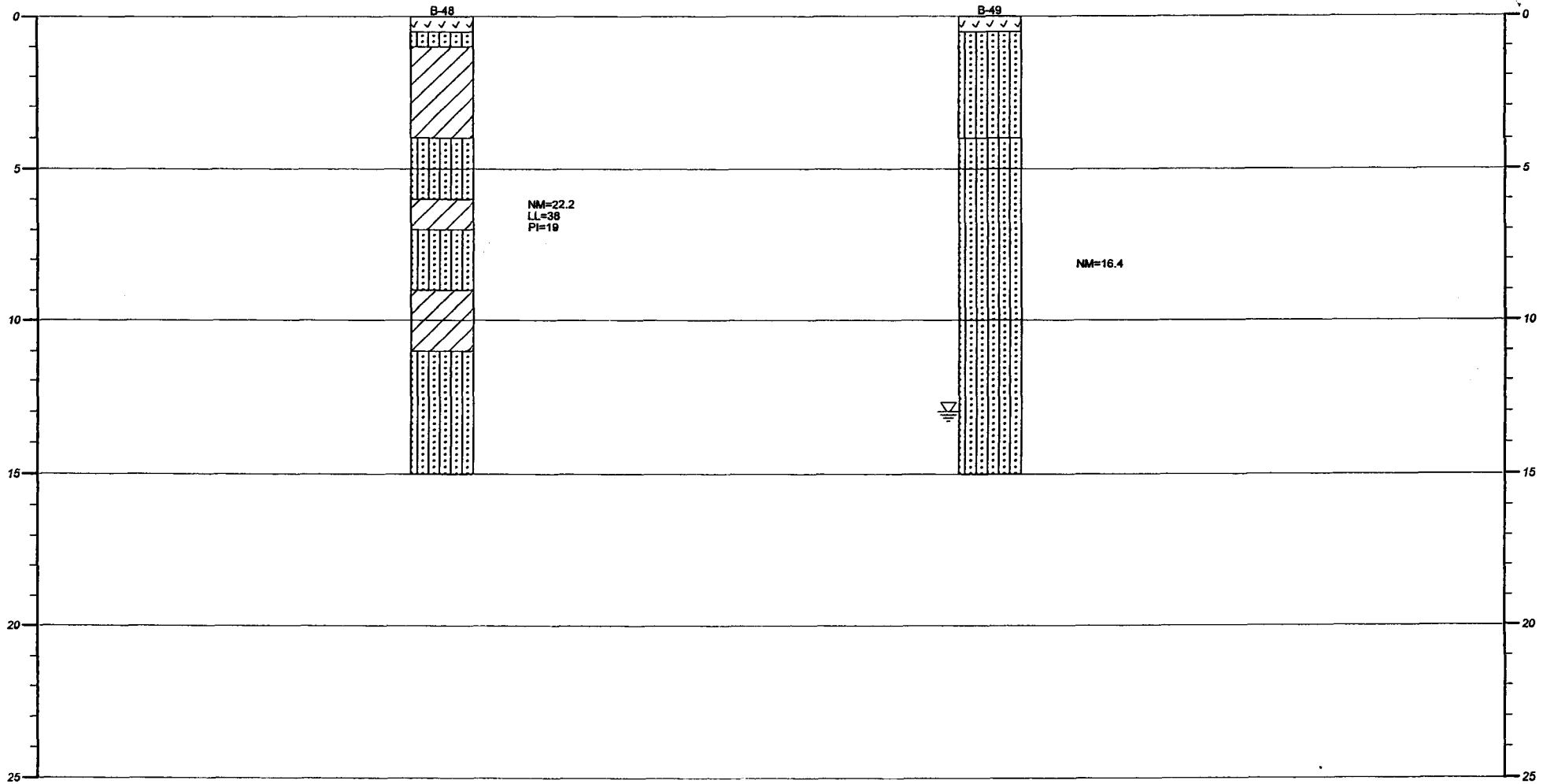
GET SOLUTIONS, INC.	SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET	Sheet No.: 1

Project Name.:	~~Fairmount Sections I - IV~~	Location.....	See Attached Boring Location Plan	**Terminology and Solution**
Boring No.....:	B-49 (BMP #5)	Date.....:	8/16/2005	Ksat : Saturated hydraulic conductivity
Investigators.:	L. Young, S. Freeman	File Name.....:	WM05-182G	Q: Steady-state rate of water flow into the soil
Boring Depth.:	96 inches	WCU Base. Ht. h:	15.0 cm	H: Constant height of water in borehole
Boring Dia.....:	8.3 cm	WCU Susp. Ht. S:	15.2 cm	r: Radius of cylindrical borehole
Boring Rad. (r):	4.15 cm	Const. Wtr. Ht. H:	30.2 cm	Ksat = Q[sinh-1(H/r) - (r2/H2+1).5 + r/H] / (2pH2) [Glover Solu

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2000		11:00:00 AM								
1990	10	11:00:42 AM	0:00:42	0.70	14.29	0.005	7.52E-05	6.5	0.107	0.2
1980	10	11:01:27 AM	0:00:45	0.75	13.33	0.004	7.02E-05	6.1	0.100	0.20
1970	10	11:02:13 AM	0:00:46	0.77	13.04	0.004	6.87E-05	5.9	0.097	0.19
1960	10	11:02:57 AM	0:00:44	0.73	13.64	0.004	7.18E-05	6.2	0.102	0.20
1950	10	11:03:44 AM	0:00:47	0.78	12.77	0.004	6.72E-05	5.8	0.095	0.19
1940	10	11:04:33 AM	0:00:49	0.82	12.24	0.004	6.45E-05	5.6	0.091	0.18
1930	10	11:05:20 AM	0:00:47	0.78	12.77	0.004	6.72E-05	5.8	0.095	0.19
1920	10	11:06:05 AM	0:00:45	0.75	13.33	0.004	7.02E-05	6.1	0.100	0.20
1910	10	11:06:48 AM	0:00:43	0.72	13.95	0.004	7.35E-05	6.3	0.104	0.21
1900	10	11:07:36 AM	0:00:48	0.80	12.50	0.004	6.58E-05	5.7	0.093	0.19
1890	10	11:08:22 AM	0:00:46	0.77	13.04	0.004	6.87E-05	5.9	0.097	0.19
					ESTIMATED FIELD KSAT:	0.004	6.94E-05	6.0	0.098	0.20

Natural Moisture:	Moist	Init. Satur.Time:	10:45:00 AM		
Texture/Classif:	SAND (SM)	Consistency:		Depth to an Impermeable Layer:	N/A
Structure/Fabric:	N/A	Slope/Landsc:	level	Depth to Bedrock.....:	N/A

Notes: Ksat Class = Moderately Low



Strata symbols

- Topsoil
- Silty sand
- Low plasticity clay

GET Solutions, Inc.

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=5'	KT	8/23/2005

~~Fairmount Sections I-IV~~

STONEHOUSE GLEN II

PROJECT NO. WM05-182G	FIGURE NUMBER

Designed: WFB
Checked: CRO
Date: 08/15/05
File Mgr./Drawn: BSG/BSG
CADD File name: *.dwg
Scale: 1"=300'
Project Number: 2002261-51201
Dwg. File No.: XXXXX X
Drawing Number: Exh-1
XX OF XX

BORING LOCATIONS EXHIBIT

FAIRMONT
SECTIONS I–IV
STONEHOUSE AT WILLIAMSBURG, L.L.C.

VIRGINIA

RECEIVED
SEP - 9 2005
JAMES CITY COUNTY
ENVIRONMENTAL DIVISION

DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

PROGRESS PRINT

NOT FOR CONSTRUCTION

08/15/05

LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists

4029 Ironbound Road
Suite 100
Williamsburg, VA 23188
Tel. (757) 253-2975
Fax (757) 229-0049
Email: lmdg@landmarkdg.com

5544 Greenwich Road
Suite 200
Virginia Beach, VA 23462
Tel. (757) 473-2000
Fax (757) 497-7933
Email: lmdg@landmarkdg.com

LANDMARK DESIGN GROUP
TRANSMITTAL

To: Matt Arcieri

Company: James City County Planning

From: Ronnie Orsborne

Date: August 24, 2005

Subject: Stonehouse Glen Section II
Case No. S-116-03

LMDG Job No.: 2002261-504.04

RECEIVED
AUG 25 2005
ENVIRONMENTAL DIVISION

AUG 2005
RECEIVED
PLANNING DEPARTMENT

Attached please find:
- ☐ Prints
- ☐ Plans
- ☐ Specifications
- ☐ Drawings
- ☒ Report
- ☐ Letter
- ☐

Transmitted as checked below:
- ☐ For your use
- ☒ As requested by Environmental Division
- ☐ For review and comment
- ☒ For approval
- ☐ Approved
- ☐

Copies	Date	Drawing No.	Description
1	08/23/05	N/A	Subsurface Investigation & Geotechnical Engineering Services Preliminary Report for BMP Facilities No. 4 and 5 Stonehouse Glen Section 2

Notes:

Copies	Enclosures
1. File: 2002261-504.04	☒
2.	☐
3.	☐
4.	☐

LandMark Design Group, Inc.

By: TMP

**Acknowledgment by Recipient: _____ _____
Name Date

Engineers ♦ Planners ♦ Surveyors ♦ Landscape Architects ♦ Environmental Scientists
4029 Ironbound Road, Suite 100, Williamsburg, VA 23188 (757) 253-2975 FAX: (757) 229-0049 lmdg@landmarkdg.com

GET Solutions, Inc.

Geotechnical · Environmental · Testing

August 23, 2005

AUG 2005
RECEIVED
PLANNING DEPARTMENT

TO: **Stonehouse @ Williamsburg, LLC**
c/o LandMark Design Group
4029 Ironbound Road
Suite 100
Williamsburg, Virginia 23188

Attn: Mr. James Brawley

RE: Subsurface Investigation & Geotechnical Engineering Services
Preliminary Report for BMP Facilities No. 4 and 5
Fairmount Sections I-IV
Stonehouse at Williamsburg
James City County, Virginia
G E T Proposal No: WM05-182G

Dear Mr. Brawley:

Pursuant to your request, **G E T Solutions, Inc.** is pleased to submit this Preliminary Report for BMP Facilities No. 4 and 5 for the Subsurface Investigation and Geotechnical Engineering services currently being conducted at the above referenced project site. Our preliminary findings for the subject BMP facilities have been summarized below:

Infiltration Testing

Two infiltration tests (one at each of the borings B-48 & B-49) were performed within the lateral limits of the proposed BMP No. 4 (designated as B-48) and BMP No. 5 (designated as B-49). The infiltration test borehole was prepared utilizing a planer auger to remove soil clippings from its base (test levels of 6 feet at BMP No. 4 and 8 feet at BMP No. 5 below the ground surface. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter and the following testing procedures.

1592 Penniman Road, Suite E • Williamsburg, VA 23185 • Phone (757) 564-6452 • Fax (757) 564-6453
info@getsolutionsinc.com

A support stand was assembled and placed adjacent to the borehole. This stand holds a calibrated reservoir (2000 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 6.096-meter (20 foot) braided PVC hose and then lowered by cable into the borehole to the test depth elevation. As required by the Glover solution, the WCU was suspended 6-inches above the bottom of the borehole. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole. Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until relatively consistent flow rates were documented. During testing the quick release connections and shutoff valve were monitored to ensure that no leakage occurred. The flow rate (Q), height of the constant water level (H), and borehole diameter (D) were used to calculate K_s utilizing the Glover Solution.

Based on the field testing and corroborated with laboratory classification testing results (published values compared to classification results), the hydraulic conductivity of the soils at a depth of 6 [Sandy CLAY (CL)] as identified at the location of the infiltration test (B-48) is $k = 6.62 \times 10^{-6}$ cm/sec and the hydraulic conductivity of the soils at a depth of 8 feet [Silty Sandy (SM)] as identified at the location of the infiltration test (B-49) is $k = 6.94 \times 10^{-5}$ cm/sec.

Table 1 – Infiltration Test Results

Infiltration Test	Boring Location	Depth Test Conducted (ft)	Percent Fines	Hyrdraulic Conductivity (cm/sec)
B-48	BMP No. 4	6	52.2	6.62×10^{-6}
B-49	BMP No. 5	8	29.6	6.94×10^{-5}

Engineering Evaluation for BMP Areas

Based on the results of our field and laboratory testing procedures and engineering analysis, the following observations, opinions, and recommendations are presented:

Seepage:

- ✓ The subsurface soils at each of the boring locations generally consisted of granular materials [Silty, SAND (SM)] in the borings performed within the limits of the BMP areas (BMP No. 4 and 5) at depths of 15 feet below existing grades. As such, and based on the laboratory classification testing and infiltration test results, the hydraulic conductivity values within these granular soils are anticipated to be a moderately low Ksat Class (on the order of 1.0×10^{-4} cm/sec to 1.0×10^{-5} cm/sec).
- ✓ Interbedded deposits of Sandy CLAY (CL) were encountered at boring location B-48 at depths of 1 to 4 feet, 6 to 7 feet and 9 to 11 feet below existing grades. As such, and based on the laboratory classification testing and infiltration test results, the hydraulic conductivity values are anticipated to be a very low Ksat Class (on the order of 5.0×10^{-5} to 5.0×10^{-6} cm/sec).
- ✓ The groundwater table was encountered at a depth of 13 feet below the existing site elevations at the BMP No. 5 boring location (B-49). The groundwater was not encountered to the depth explored at the BMP No. 4 location (B-48).

Borrow Material:

- ✓ On the basis of the results of our soils test borings and laboratory testing procedures, the shallow surface soils encountered within the borings performed, were typically comprised of Silty SAND (SM) materials along with some deposits of Sandy CLAY (CL). The granular soils (SM) may be suitable for reuse as structural fill, however materials recovered near or below the groundwater table will require moisture manipulation prior to their use. The Sandy CLAY (CL) soils were encountered at various depths within boring, which contained appreciable amounts of Clay may be considered suitable for re-use in "green" areas, as fill for the dam's Clay core and key way, if applicable. In order to verify the acceptance or rejection of the existing soils for re-use as structural or embankment dam fill, additional classification tests (natural moisture and -#200 sieve) will have to be performed during construction.

We trust that the information contained herein meets your immediate need, and we would ask that you call this office with any questions that you may have.

Respectfully submitted,
G E T Solutions, Inc.

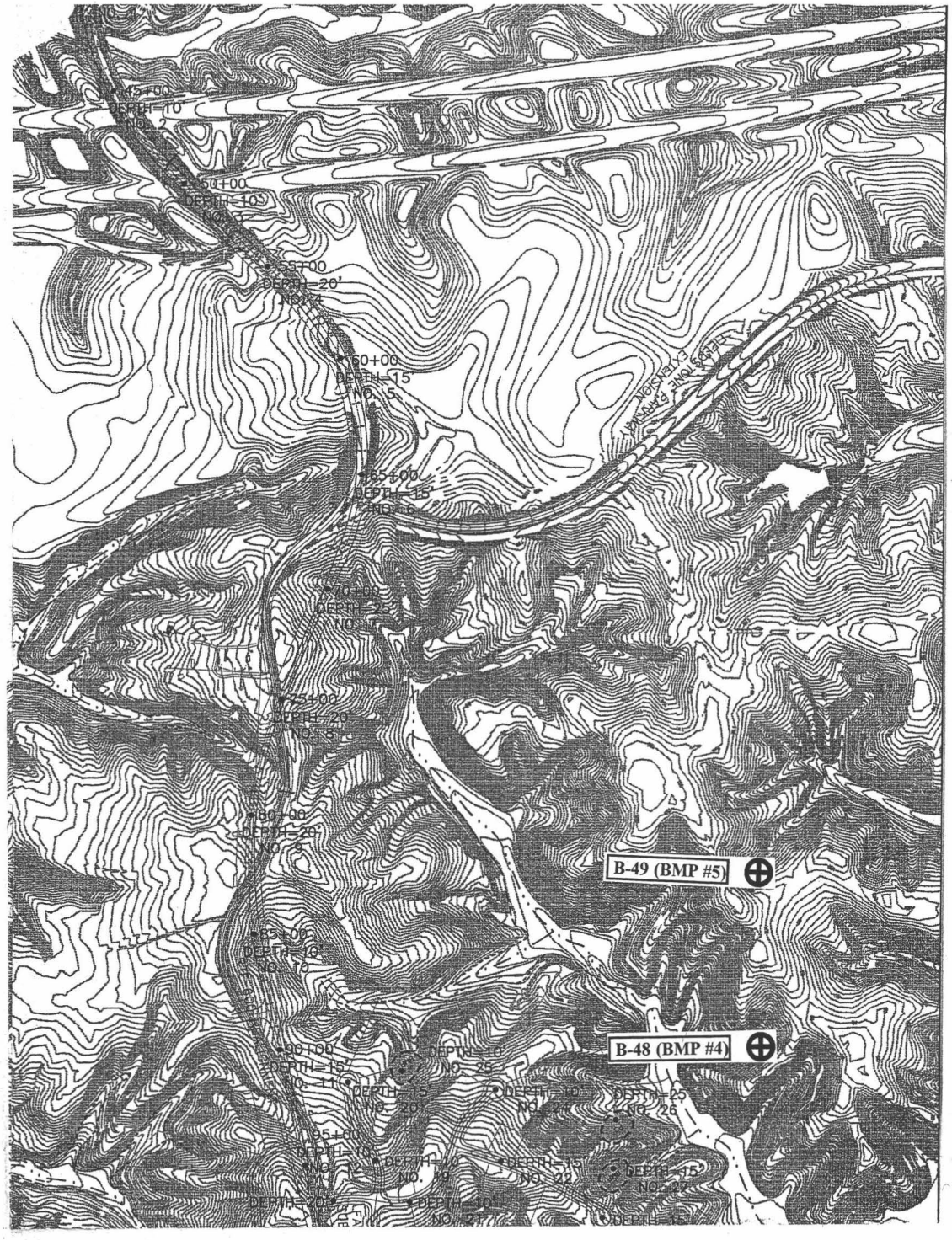
Glenn W. Hohmeier, P.E.
Senior Project Engineer
VA Lic. # 036735

COMMONWEALTH OF VIRGINIA
8-23-05
GLENN W. HOHMEIER
No. 036735
PROFESSIONAL ENGINEER

Attachments: BMP No. 4 & 5 Location Sketch
Log of Borings
Saturated Hydraulic Conductivity Worksheet

Distribution: (2) LandMark Design Group

Figure 1



Locations are approximate

BMP NO. 4 & 5 LOCATION SKETCH

PROJECT:	Fairmount Sections I - IV James City County, Virginia	SCALE: NTS
PROJECT NO:	WM05-182G	DATE: 8/23/05
CLIENT:	Stonehouse at Williamsburg LLC	PLOT BY: KT

GET Solutions, Inc.
Geotechnical • Environmental • Testing

LOG OF BORING No. B-48

PROJECT: Fairmount Sections I-IV **PROJECT NO.:** WM05-182G
CLIENT: Stonehouse at Williamsburg LLC
PROJECT LOCATION: James City County, Va
LOCATION: See Attached Boring Location Plan **ELEVATION:**
DRILLER: GET Solutions, Inc. **LOGGED BY:** KT
DRILLING METHOD: Hand Auger **DATE:** 8/18/05
DEPTH TO - WATER> INITIAL: **AFTER 24 HOURS:** **CAVING>**

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200	TEST RESULTS (Plastic Limit — Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50)
0						
	6 inches of topsoil (.5)					
	Brown, moist, Silty, fine to meduim SAND (SM) with trace gravel and organics (1)					
	Orangish brown, moist, Sandy CLAY (CL) (4)					
5	Brown to orangish brown, moist, Silty, fine to meduim SAND (SM) with trace gravel at 5 to 6 feet				52	
	Orangish brown, moist, Sandy CLAY (CL) (6)					
	Brown, moist, Silty, fine to coarse SAND (SM) with trace gravel (7)					
10	Orangish brown to brown, moist, Sandy CLAY (CL) with trace organics (9)					
	Brown, moist, Silty, fine to meduim SAND (SM) (11)					
15	Boring terminated at 15 ft.					
20						
25						
30						
35						

Figure

GET Solutions, Inc.
Geotechnical - Environmental - Testing

LOG OF BORING No. B-49

PROJECT: Fairmount Sections I-IV **PROJECT NO.:** WM05-182G
CLIENT: Stonehouse at Williamsburg LLC
PROJECT LOCATION: James City County, Va
LOCATION: See Attached Location Plan **ELEVATION:**
DRILLER: GET Solutions, Inc. **LOGGED BY:** KT
DRILLING METHOD: Hand Auger **DATE:** 8/16/05
DEPTH TO - WATER> INITIAL: 13" **AFTER 24 HOURS:** **CAVING>** C

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200	TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70)
0						
	6 inches of topsoil					
	.5					
	Brown to orangish brown, moist, Silty, fine to meduim SAND (SM) with trace organics					
	4					
5	Orangish brown to dark brown, moist to wet, Silty, fine to meduim SAND (SM)				30	●
10	with trace CLAY from 7 to 13 feet					
15						
	Boring terminated at 15 ft.					
20						
25						
30						
35						

GET SOLUTIONS, INC.	SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET	Sheet No.: 1

Project Name.:	Fairmount Sections I - IV	**Location.....**	See Attached Boring Location Plan	**Terminology and Solution**	
Boring No.....:	B-48 (BMP #4)	**Date.....:**	8/18/2005	Ksat :	Saturated hydraulic conductivity
Investigators.:	L. Young, K. Tweedy	**File Name.....:**	WM05-182G	Q:	Steady-state rate of water flow into the soil
Boring Depth.:	72 inches	**WCU Base. Ht. h:**	15.0 cm	H:	Constant height of water in borehole
Boring Dia.....:	8.3 cm	**WCU Susp. Ht. S:**	15.2 cm	r:	Radius of cylindrical borehole
Boring Rad. (r):	4.15 cm	**Const. Wtr. Ht. H:**	30.2 cm	Ksat = Q[sinh-1(H/r) - (r2/H2+1).5 + r/H] / (2pH2)	[Glover Solu

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2000		1:00:00 PM								
1990	10	1:08:30 PM	0:08:30	8.50	1.18	0.000	6.20E-06	0.5	0.009	0.02
1980	10	1:16:07 PM	0:07:37	7.62	1.31	0.000	6.91E-06	0.6	0.010	0.02
1970	10	1:24:43 PM	0:08:36	8.60	1.16	0.000	6.12E-06	0.5	0.009	0.02
1960	10	1:32:32 PM	0:07:49	7.82	1.28	0.000	6.74E-06	0.6	0.010	0.02
1950	10	1:40:20 PM	0:07:48	7.80	1.28	0.000	6.75E-06	0.6	0.010	0.02
1940	10	1:48:05 PM	0:07:45	7.75	1.29	0.000	6.79E-06	0.6	0.010	0.02
1930	10	1:56:55 PM	0:08:50	8.83	1.13	0.000	5.96E-06	0.5	0.008	0.02
1920	10	2:04:36 PM	0:07:41	7.68	1.30	0.000	6.85E-06	0.6	0.010	0.02
1910	10	2:12:15 PM	0:07:39	7.65	1.31	0.000	6.88E-06	0.6	0.010	0.02
1900	10	2:19:57 PM	0:07:42	7.70	1.30	0.000	6.84E-06	0.6	0.010	0.02
1890	10	2:27:43 PM	0:07:46	7.77	1.29	0.000	6.78E-06	0.6	0.010	0.02

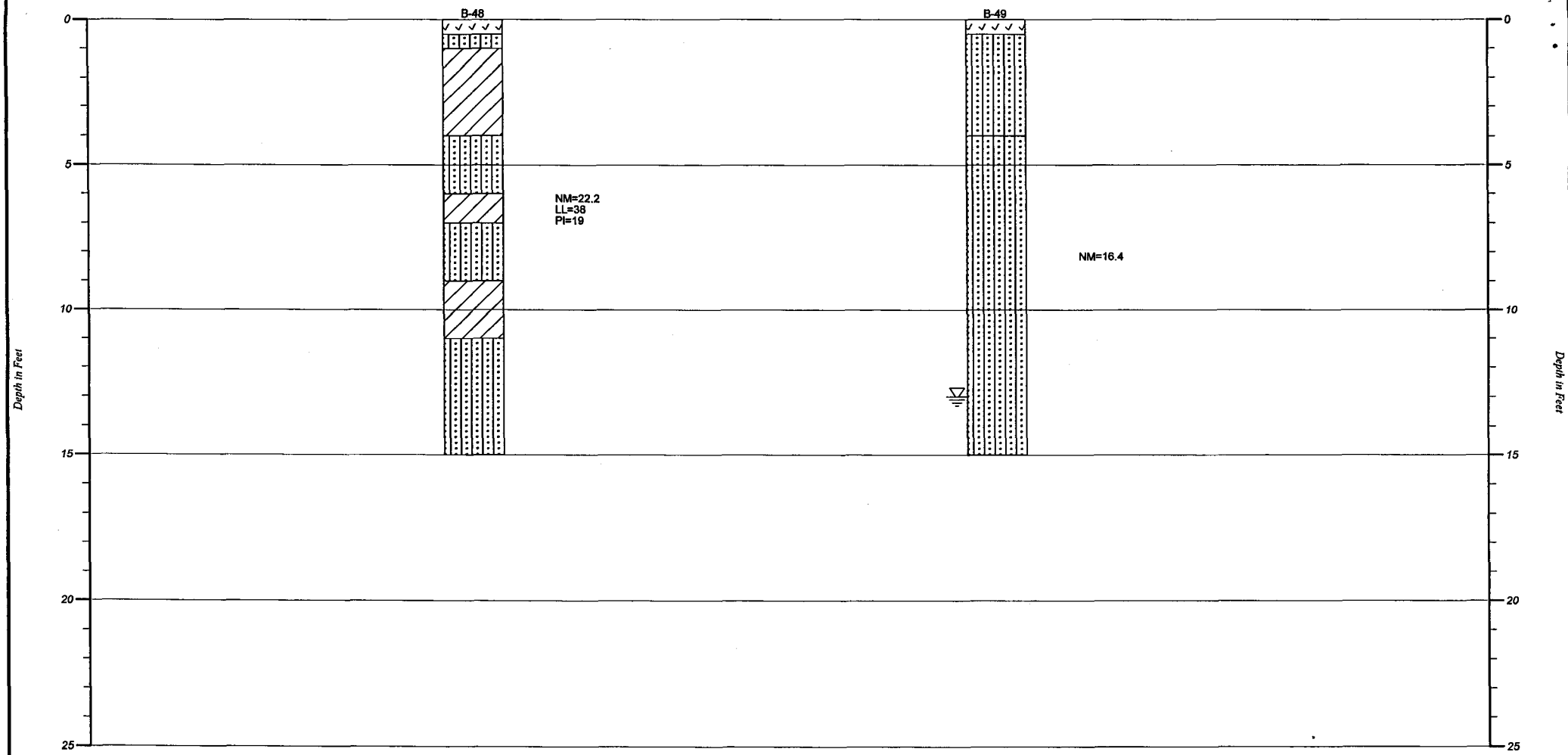
Natural Moisture:	Moist	**Init. Satur.Time:**	12:45:00 PM	**ESTIMATED FIELD KSAT:**	0.000	6.62E-06	0.6	0.009	0.02
Texture/Classif:	CLAY (CL)	**Consistency:**		**Depth to an Impermeable Layer:**	N/A	**Notes:**	Ksat Class = Moderately Low		
Structure/Fabric:	N/A	**Slope/Landsc:**	level	**Depth to Bedrock.....:**	N/A				

GET SOLUTIONS, INC.	SATURATED HYDRAULIC CONDUCTIVITY WORKSHEET	Sheet No.: 1

Project Name.:	Fairmount Sections I - IV	**Location.....**	See Attached Boring Location Plan	**Terminology and Solution**	
Boring No.....:	B-49 (BMP #5)	**Date.....:**	8/16/2005	Ksat :	Saturated hydraulic conductivity
Investigators.:	L. Young, S. Freeman	**File Name.....:**	WM05-182G	Q:	Steady-state rate of water flow into the soil
Boring Depth.:	96 inches	**WCU Base. Ht. h:**	15.0 cm	H:	Constant height of water in borehole
Boring Dia.....:	8.3 cm	**WCU Susp. Ht. S:**	15.2 cm	r:	Radius of cylindrical borehole
Boring Rad. (r):	4.15 cm	**Const. Wtr. Ht. H:**	30.2 cm	Ksat = Q[sinh-1(H/r) - (r2/H2+1).5 + r/H] / (2pH2)	[Glover Solu

VOLUME (ml)	Volume Out (ml) [a]	TIME (hr:min:sec a/p)	Elapsed Time (hr:min:sec)	Elapsed Time (min) [b]	Flow Rate Q (ml/min) [a/b]	Ksat Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
2000		11:00:00 AM								
1990	10	11:00:42 AM	0:00:42	0.70	14.29	0.005	7.52E-05	6.5	0.107	0.21
1980	10	11:01:27 AM	0:00:45	0.75	13.33	0.004	7.02E-05	6.1	0.100	0.20
1970	10	11:02:13 AM	0:00:46	0.77	13.04	0.004	6.87E-05	5.9	0.097	0.19
1960	10	11:02:57 AM	0:00:44	0.73	13.64	0.004	7.18E-05	6.2	0.102	0.20
1950	10	11:03:44 AM	0:00:47	0.78	12.77	0.004	6.72E-05	5.8	0.095	0.19
1940	10	11:04:33 AM	0:00:49	0.82	12.24	0.004	6.45E-05	5.6	0.091	0.18
1930	10	11:05:20 AM	0:00:47	0.78	12.77	0.004	6.72E-05	5.8	0.095	0.19
1920	10	11:06:05 AM	0:00:45	0.75	13.33	0.004	7.02E-05	6.1	0.100	0.20
1910	10	11:06:48 AM	0:00:43	0.72	13.95	0.004	7.35E-05	6.3	0.104	0.21
1900	10	11:07:36 AM	0:00:48	0.80	12.50	0.004	6.58E-05	5.7	0.093	0.19
1890	10	11:08:22 AM	0:00:46	0.77	13.04	0.004	6.87E-05	5.9	0.097	0.19
ESTIMATED FIELD KSAT:						0.004	6.94E-05	6.0	0.098	0.20

Natural Moisture:	Moist	**Init. Satur.Time:**	10:45:00 AM		
Texture/Classif:	SAND (SM)	**Consistency:**		**Depth to an Impermeable Layer:**	N/A
Structure/Fabric:	N/A	**Slope/Landsc:**	level	**Depth to Bedrock.....:**	N/A
Notes:	Ksat Class = Moderately Low				



Strata symbols

- Topsoil
- Silty sand
- Low plasticity clay

GET Solutions, Inc.

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=5'	KT	8/23/2005

Fairmount Sections I-IV

PROJECT NO. WM05-182G

FIGURE NUMBER

Vanasse Hangen Brustlin, Inc. TRANSMITTAL

Transportation
Land Development
Environmental Services

351 McLaws Circle, Suite 3
Williamsburg, VA 23185-6316
757 220 0500
FAX 757 220 8544

Date: May 25, 2011	**VHB Project No.:** 33315.00
Re: Stonehouse Glen Ponds 4&5	

Environmental Division

MAY 25 2011

To: Mike Majdeski
JCC Engineering and Resource Protection
101-E Mounts Bay Road
Williamsburg, VA 23187

We are sending you: ☒ Attached ☐ Under Separate cover via Regular Mail the following items:

RECEIVED

☐ Shop drawings ☐ Prints ☐ Plans ☐ Diskettes ☐ Specifications ☐ Copy of Letter ☐ Change Order
☐ Other As-builts and Certifications

Copies	Date	No.	Description
4	5-24-11		Final Record Drawings
1 Ea	5-24-11		SWM/BMP Facilities Record Drawing and Construction Certification Forms for Pond #4 and Pond #5

These are transmitted as checked below:

☒ For approval
☐ For your use
☐ As requested
☐ For review and comment
☐ Returned prints on loan to VHB

☐ Approved as submitted
☐ Approved as noted
☐ Return for corrections
☐ For bids due

☐ Resubmit ____ Copies for approval
☐ Submit ____ Copies for distribution
☐ Return ____ Corrected prints

REMARKS: Record Drawings for Ponds 1, 2, and 3 were submitted in 2006

If VHB provides materials to the Client that are stored electronically, the Client recognizes that data, plans, specifications, reports, documents, or other information recorded on or transmitted as electronic media ("CADD Documents") are subject to undetectable alteration, either intentional or unintentional, due to, among other causes, transmission, conversion, media degradation, software error, or human alteration. Accordingly, the CADD Documents are provided to the Client for informational purposes only and not as an end product. VHB makes no warranties, either express or implied, regarding the fitness or suitability of the CADD Documents.

The CADD Documents are instruments of professional service, and shall not be used, in whole or in part, for any project other than that for which they were created, without the express written consent of VHB and without suitable compensation to VHB. Accordingly, the Client agrees to waive any and all claims against VHB resulting in any way from the unauthorized alternation, misuse or reuse of the CADD documents and to defend, indemnify, and hold VHB harmless for any claims, losses, damages, or costs, including attorneys fees, arising out of the alteration, misuse or reuse of any CADD Documents.

Copy to:

By: Deborah Lenceski
Project Engineer

July 29, 2011

Mr. Ken McDermott-Stonehouse Glen LLC.
15 Mendham Rd. PO Box 704
Gladstone, NJ 07934

Re: Stonehouse Glen Section II
SP-116-03
County BMP ID Code: WC095

Dear Mr. McDermott,

The Engineering and Resource Protection Division has received a record drawing (as-built) and construction certification for the stormwater management facility for the above referenced project. The record drawing provides as-built information for an infiltration basin situated in the east corner of the site.

Based on our review of the project and a concurrent field inspection as performed on 7/29/2011, the following items must be addressed prior to release of the developer's surety instrument for the stormwater management/BMP facility and associated stormwater conveyance system components at the site and to proceed with closing out the project:

Inspection Maintenance Agreement:

1. Based on a review of our active file and records for the project, our division issued comments under SP-116-03 dated 10/7/03 which required a Declaration of Covenants, Inspection/Maintenance agreement to be executed with the County for the BMP facility for this project. Based on a review of our records, the submitted Declaration of Covenants is satisfactory.

Record Drawing & Construction Certification:

2. In accordance with the Note # 20 on Sheet C-22 of the approved plan, record drawings (as-builts) and construction certifications were required for the onsite stormwater management/BMP. The notes were as follows:

> ***Record Drawings (As-Builts) and Construction Certifications are both required for newly constructed or modified stormwater management/BMP facilities. Certification activities shall be adequately coordinated and performed before, during and following construction in accordance with the current version of the James City County Environmental Division, Stormwater Management/BMP Facilities, Record Drawing and Construction Certification, Standard Forms & Instructions.***

Construction Certification:

3. In accordance with the Note # 20 on Sheet C-22 of the approved plan, construction certification for the stormwater management/BMP facility is required. This is especially important since the facility has an engineered and compacted earthen embankment. The certification can be in letter format or by use of the certification statements in Section 4 of the JCC, Stormwater Management/BMP Facilities, Record Drawing and Construction Certification, Standard Forms & Instructions.

Record Drawing:

4. The record drawing set dated 5/24/11 is satisfactory. Please forward one reproducible and one blue/black line set of the record drawings to our office.

5. In accordance with the Note # 20 on Sheet C-22 of the approved plan, a record (as-built) drawing was required for the stormwater management/BMP facility. The record drawing requires certification consistent with the provisions of Section 4 of the James City County Environmental Division, Stormwater Management/BMP Facilities, Record Drawing and Construction Certification, Standard Forms & Instructions.

6. Along with the record drawing set, submit completed record drawing and construction certification forms, Sections 1 through 5, and applicable record drawing checklists from the James City County, Stormwater Management/BMP Facilities, Record Drawing and Construction Certification, Standard Forms & Instructions (packet). The Environmental Division began use of the forms and checklists in this packet effective February 1st 2001.

7. Show the following additional information on the record drawing: contour or elevation data; low flow orifice data, riser data, outlet barrel data; emergency spillway data; forebay data; and outlet protection data; property or road data.

8. If possible add the following County identifiers to the lower right hand corner of the record drawing page R-3; BMP ID Code: WC095.

Construction - Related Items:

1. Repair the rill erosion along the access road leading to the BMP. There are currently several areas where stone has washed out from the access road.

2. Ensure that access to the BMP is not hindered by the construction trailer currently in place. The access road must be restored to its original condition following removal of the trailer.

Once this work is satisfactorily completed, contact our office appropriately for reinspection. We can then proceed with final release of the surety and/or closing out the project. One reproducible and one blue/black line set of the record drawings will be required once the above items are adequately addressed.

Please contact me at 757-253-6639 or the assigned Resource Protection Division Inspector, Michael Majdeski, at 757-253-6839 if you have any further comments or questions.

Sincerely,

William Cain, P.E.
Chief Civil Engineer
Engineering and Resource Protection Division

cc: Debbie Lenceski; VHB - via email
Charles Osbourne - via email
CA Barrs Contractor- via letter
Michael Majdeski; JCC Resource Protection Inspector - FYI}

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CURTESY REVIEW OF ALL BMP'S WITHIN THIS SECTION OF THE DEVELOPMENT TO BE PROACTIVE TO DEVELOPER. NO OTHER RECORD DRAWINGS HAVE BEEN PROVIDED FOR REVIEW OTHER THAN WC095

October 25, 2011

Mr. Ken McDermott-Stonehouse Glen LLC.
15 Mendham Rd. PO Box 704
Gladstone, NJ 07934

Re: Stonehouse Glen Sections I-II
S-98-03/SP-116-03
County BMP ID Codes: **WC091, WC092, WC093, WC094, WC095**

Dear Mr. McDermott,

The Engineering and Resource Protection Division has received a record drawing (as-built) and construction certification for the stormwater management facility for the above referenced project. The record drawing provides as-built information for an series of basins situated throughout the project limits of the site. Based on our review of the project and a concurrent field inspection as performed on 10/21/11, the following items must be addressed prior to release of the developer's surety instrument for the stormwater management/BMP facilities and associated stormwater conveyance system components at the site and to proceed with closing out the project:

WC091 - Adjacent to Ottaway Court

Construction - Related Items:

1. Remove sediment from inflows within the dry pond and ensure that the primary pond orifice is clear of debris and vegetation.

2. Remove all vegetation from within the pond's primary outlet protection.

3. Replace the cover on the manhole immediately upstream of the pond's outlet protection.

4. Repair erosion along the BMP access road at the bottom of the hill.

WC092-Adjacent to Ashlock Court

Construction - Related Items:

5. Repair and re-stabilize the eroded areas along the north facing interior slopes of the pond.

6. Remove 8"-10"sediment from the pond bottom and from the area surrounding the primary pond orifice and re-vegetate the area following the remediation work.

7. Repair erosion along the right side of the outlet protection as associated with the inflow pipe and ensure the area is properly re-stabilized following the remediation work.

8. Repair erosion and replace rip-rap at the primary BMP outfall. Much of the outlet protection from the pond has been washed downstream into the adjacent streambed.

9. It appears from information obtained from a recent site inspection that the referenced stormwater management facility is not operating as originally intended as the downstream channel section is experiencing severe erosion and rip rap from the associated stilling basin has migrated several yards downstream. Though information provided in the record drawings appears to indicate that the associated components of the facility have been installed generally in accordance with the approved plans, information is necessary to show that the required attenuation volume has been provided with basin limits. Should it be determined that the facility has the required volume, it may be necessary to reevaluate the facility to insure full compliance with State Minimum Standard 19.

WC093-Adjacent to Stonehouse Glen and Fieldstone Parkway

10. James City County Engineering and Resource Protection Division has no comments to provide for this facility.

WC094-Adjacent to Stonehouse Glen and Newland Court

Construction - Related Items:

11. Remove 8"-10" of sediment from throughout the pond bottom and from the area surrounding the primary pond orifice and re-vegetate the area following the remediation work.

12. Repair erosion along the BMP access roadway. Currently there is a rill that has formed along the centerline of the drive primarily due to inaccessibility of stormwater to the rip rap lined ditch along the side of the access. Prior to resubmittal, a smooth transition needs to be provided into the referenced channel to promote positive drainage into the measure.

13. Re-establish the access roadway at Newland Court per the approved plan. Currently a portion of the access has been covered with sod and is being maintained by the adjacent property owner and a utility box has been located in the centerline of the entrance. Prior to release of the project and associated bonds, the access must be relocated to the side of the utility and sod replaced with stone.

WC095-Adjacent to Newland Court

Construction - Related Items:

14. Remove 12"-18" of sediment build-up from pond bottom and the area around the primary pond orifice and re-vegetate once complete.

15. Repair erosion along left side of the access roadway resulting from concentrated runoff and inert material being buried in the gravel section. Prior to close out of the project and the release of the posted bonds, any and all foreign materials are to be removed from the stone section and replaced with stone.

Once this work is satisfactorily completed, contact our office appropriately for re-inspection. We can then proceed with final release of the surety and/or closing out the project. One reproducible and one blue/black line set of the record drawings will be required once the above items are adequately addressed.

Please contact me at 757-253-6639 or the assigned Resource Protection Division Inspector, Michael Majdeski, at 757-253-6839 if you have any further comments or questions.

Sincerely,

William Cain, P.E.
Chief Civil Engineer
Engineering and Resource Protection Division

cc: Debbie Lenceski; VHB - via email
Charles Osbourne - via email
CA Barrs Contractor- via letter
Michael Majdeski; JCC Resource Protection Inspector - FYI

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Heartwood Xing
Ottoway Ct
Marrin Ct
Buckingham Dr
Stafford Ln
Ashlock Ct
Newland Ct
Stonehouse Gln
Croshaw Ct
Lytham Ct
Mosswood Cir
Ashwood Ct
Fieldstone Pkwy
Six Mt Zion Rd
WC091
WC092
WC093
WC094
WC095

- REMOVE SEDIMENT FROM POND BOTTOM
- REPAIR INFLOW (OP)
- CLEAN PRIMARY ORIFICE
- REPAIR ACCESS ROAD EROSION + RE-ESTABLISH ROAD NEAR HEADWALL CTR

James City County Environmental Division
Stormwater Management / BMP Inspection Report
Detention and Retention Pond Facilities

County BMP ID Code (if known): WC094

Name of Facility: DRY POND #5 BMP No.: 2 of 2 Date: 7/29/11

Location: SOUTH OF INT OF STONEHOUSE GLEN AND NEWLAND COURT

Name of Owner:

Name of Inspector: M. MAJDOSKI

Type of Facility: DRY DETENTION BASIN

Weather Conditions: 90° SUNNY Type: ☑ Final Inspection ☐ County BMP Inspection Program ☐ Owner Inspection

If an inspection item is not applicable, mark NA, otherwise mark the appropriate column.

O.K. - The item checked is in adequate condition and the maintenance program is currently satisfactory. No action required.
Routine - The item checked requires attention, but does not present an immediate threat to the function/integrity of the BMP.
Urgent - The item checked requires immediate attention to keep the BMP operational and to prevent damage to the facility.

Provide an explanation and details in the comment column, if routine or urgent are marked.

Facility Item	O.K.	Routine	Urgent	Comments
Embankments and Side Slopes:				
Grass Height	✓			
Vegetation Condition	✓			
Tree Growth	✓			
Erosion	✓			
Trash & Debris	✓			
Seepage	✓			
Fencing or Benches	✓			
Interior Landscaping/Planted Areas: ☑ None ☐ Constructed Wetland/Shallow Marsh ☐ Naturally Established Vegetation				
Vegetated Conditions	✓			
Trash & Debris	✓			
Floating Material	✓			
Erosion	✓			
Sediment	✓			
Dead Plant	✓			
Aesthetics	✓			
Other				
Notes:				

Facility Item	O.K.	Routine	Urgent	Comments
Water Pools: ☐ Permanent Pool (Retention Basin) ☐ Shallow Marsh (Detention Basin) ☑ None, Dry (Detention Basin)				
Shoreline Erosion	✓			
Algae	✓			
Trash & Debris	✓			
Sediment	✓			
Aesthetics	✓			
Other				
Inflows (Describe Types/Locations):				
Condition of Structure	✓			
Erosion	✓			
Trash and Debris	✓			
Sediment	✓			
Outlet Protection	✓			
Other				
Principal Flow Control Structure - Riser, Intake, etc. (Describe Type):				
Condition of Structure	✓			
Corrosion	✓			
Trash and Debris	✓			
Sediment	✓			
Vegetation	✓			
Other				
Principal Outlet Structure - Barrel, Conduit, etc. :				
Condition of Structure	✓			
Settlement	✓			
Trash & Debris	✓			
Erosion/Sediment	✓			
Outlet Protection	✓			
Other				
Emergency Spillway (Overflow):				
Vegetation				
Lining				
Erosion				
Trash & Debris				
Other				
Notes:				

Facility Item	O.K.	Routine	Urgent	Comments
Nuisance Type Conditions:				
Mosquito Breeding	✓			
Animal Burrows	✓			
Graffiti	✓			
Other				
Surrounding Perimeter Conditions:				
Land Uses	✓			
Vegetation	✓			
Trash & Debris	✓			
Aesthetics	✓			
Access /Maintenance Roads or Paths		✓		REPAIR MINOR RILL EROSION
Other				

Remarks:

- REPAIR RILL EROSION ALONG ACCESS

Overall Environmental Division Internal Rating: 3/5

Signature: [illegible] **Date:** 7/29/11

Title: Sr ENV INSPECTOR

SWMProg\BMP\CoInspProg\InspForms\DetRet.wpd

Stonehouse Stormwater Management Facilities - JCC Environmental Division
County BMP Inventory & Inspection Program

No.	Dev Area	BMP ID Code	Record Dwg.	Plan Number	Stormwater Management Facility Name	Location	Type	Comments:
1	One	WC 019			Mill Pond Run at Bridge	North of Bridge in Dev Area One	Shallow Marsh	Roadside facility
2	One	WC 025			Mill Pond Run at Bridge	North of Bridge in Dev Area One	Shallow Marsh	Roadside facility
3	One	WC 033	No	SP-92-94	Stonehouse Golf Course	Golf Course Holes 1 & 2	Wet Pond	BMP # 1, existing lake improved.
4	One	WC 037	Yes	S-30-97	Stonehouse Sec 4A, Leather Leaf	Near 1932 Leather Leaf Drive	Dry Pond	Basin A.
5	One	WC 038	Yes	S-30-97	Stonehouse Sec 4A, Leather Leaf	Near 9815 Turning Leaf Drive	Dry Pond	Basin B.
6	One	WC 039	Yes	S-30-97	Stonehouse Sec 4A, Leather Leaf	Near 2924 Leather Leaf	Dry Pond	Basin G.
7	One	WC 040	Yes	S-84-97	Stonehouse Sec 4A, Phase 1, Hollow Oak	Near 3136 Hollow Oak Drive	Dry Pond	Large concrete box riser.
8	One	WC 041	Yes	S-27-98	Stonehouse Sec 6B, Phase 3, Hollow Oak	Near 3241 Oak Branch Lane	Dry Pond	Basin H.
9	One	WC 042	Yes	S-12-98	Stonehouse Sec 4C, Phase 2, Laurel Ridge	Near 9917 Mountain Berry Court	Dry Pond	Segmental block wall in Common Area CA16.
10	One	WC 043	Yes	S-92-99	Stonehouse Sec 4D, Phase 1, Orchard Hill	Near 3168 Ridge Drive	Dry Pond	SWMF F. Segment block wall.
11	One	WC 049	No	SP-92-94	Stonehouse Golf Course	Clubhouse & Park	Wet Pond	BMP # 2. Near JCSA well lot # W-25.
12	One	WC 050	No	SP-92-94	Stonehouse Golf Course	Maintenance Center & Golf Course Hole 10	Dry Pond	BMP # 3. Shallow Marsh.
13	One	WC 051	No	SP-92-94	Stonehouse Golf Course	Golf Course Hole # 12	Forebay	BMP # 4.
14	One	WC 052	No	SP-92-94	Stonehouse Golf Course	Golf Course Hole # 13	Forebay	BMP # 5.
15	One	WC 053	No	Private	Coats Pond - Private Dam	GPIN 0510100001	Wet Pond	Offsite large lake, farm pond.
16	One	WC 059	No		Stonehouse Richardson Mill Pond	End of State Route 600	Wet Pond	Large Lake; water quality control.
17	One	WC 069	No		Stonehouse Golf Course	Intersection Mill Pond Run & Fieldstone Pkwy	Dry Pond	Northeast of intersection.
18	One	WC 071	Yes	S-3-99/S-24-01	Stonehouse Bentree Sec 5B Ph 1 (BMP # 5.1)	In common area northwest of Long Wood Dr	Dry Pond	
19	One	WC 072	Yes	S-81-99/S-68-01	Stonehouse Bentree Sec 5B Ph 3 (BMP # 5.4)	In common area north of Windy Branch Lane	Dry Pond	
20	One	WC 073	Yes	S-42-99/S-74-00	Stonehouse Bentree Sec 5B Ph 2 & Walnut Creek (BMP # 5.2)	In common area north of Walnut Creek Road	Dry Pond	
21	One	WC 074	Yes	S-42-99/S-74-00	Stonehouse Bentree Sec 5B Ph 2 & Walnut Creek (BMP # 5.3)	In common area east of intx of Hillcrest Trail & Mill Pond Run	Dry Pond	
22	One	WC 075	Yes	S-7-03/S-64-02	Stonehouse Sec 7A Richardson Mill Pond Sec 2 (BMP # 7.3)	End of Morning Mist Lane	Timber Wall	
23	One	WC 076	Yes	S-64-02	Stonehouse Sec 7A Richardson Mill Pond Sec 2 (BMP # 7.4)	South of Sawyer Way	Timber Wall	
24	One	WC 077	Yes	S-99-01/S-100-02	Stonehouse Sec 7A Richardson Mill Pond Sec 1 (BMP # 7.2)	End of Mill Pond Run cul-de-sac	Timber Wall	
25	One	WC 078	Yes	S-99-01/S-100-02	Stonehouse Sec 7A Richardson Mill Pond Sec 1 (BMP # 7.1)	West of Yarding Way	Timber Wall	
26	One	WC 079		S-27-02	Stonehouse Sec 5A Lisburn BMP # 5.6	End of Splitwood Road	Dry Pond	
27	One	WC 080		S-27-02	Stonehouse Sec 5A Lisburn BMP # 5.5	End of Tupelo Tree cul-de-sac	Dry Pond	
28	One	WC 081			Marsh BMP - Fieldstone Pkwy Entrance	Fieldstone Parkway West Entrance Road	Shallow Marsh	
29	Two	WC 085	Yes	SP-108-03/SP-34-05	Fieldstone Parkway - Pond F (58+00L)	Fieldstone Parkway East Extension in Dev Area 2	Dry Pond	
30	Two	WC 086	Yes	SP-108-03/SP-34-05	Fieldstone Parkway - Pond C1 (83+00R)	Fieldstone Parkway East Extension in Dev Area 2	Dry Pond	
31	Two	WC 087	Yes	SP-108-03/SP-34-05	Fieldstone Parkway - Pond C2 (85+60R)	Fieldstone Parkway East Extension in Dev Area 2	Dry Pond	
32	Two	WC 088	Yes	SP-108-03/SP-34-05	Fieldstone Parkway - Pond C3 (86+50L)	Fieldstone Parkway East Extension in Dev Area 2	Dry Pond	
33	Two	WC 089	Yes	SP-108-03/SP-34-05	Fieldstone Parkway - Pond D (97+00L)	Fieldstone Parkway East Extension in Dev Area 2	Dry Pond	
34	Two	WC 090	Yes	SP-108-03/SP-34-05	Fieldstone Parkway - Pond E (107+50)	Fieldstone Parkway East Extension in Dev Area 2	Dry Pond	
35	Two	WC 091	Yes	S-98-03	Stonehouse Glen Sec 1 (BMP # 3)		Dry Pond	
36	Two	WC 092	Yes	S-98-03	Stonehouse Glen Sec 1 (BMP # 1)		Dry Pond	
37	Two	WC 093	Yes	S-98-03	Stonehouse Glen Sec 1 (BMP# 2)		Dry Pond	
38	Two	WC 094	Yes	S-116-03	Stonehouse Glen Sec 2 (BMP #5)		Dry Pond	
39	Two	WC 095	Yes	S-116-03	Stonehouse Glen Sec 2 (BMP# 4)		Dry Pond	
40								

TRANSMITTAL SHEET

ENGINEERING & RESOURCE PROTECTION → STORMWATER

Project: **Stonehouse Glen Sections 1 and 2**

County Plan No.: S-116-03 and S-98-03

Assigned BMP No.: ~~WC092~~, **WC095, WC094, WC091 and WC092**

BMP Type: Dry Ponds

Information Enclosed:

X Record Drawings (Asbuilts)

X Construction Certification

X Computations

X Other : Approved Plans

Name: **Tina Creech**

Date: 2/12/14

Signature: Tina Creech

Stormwater Division

MEMORANDUM

DATE: July 28, 2014
TO: Michael J. Gillis, Virginia Correctional Enterprises Document Management Services
FROM: Jacob Smith, Stormwater Intern
PO: 110426
RE: Files Approved for Scanning

NAME PDF/SCANNED FILE:	**STONEHOUSE GLEN SEC 2 DRY POND 5**		
BMP ID OR GEN FILE NUMBER:	WC094	**OWNER NAME:**	STONEHOUSE GLEN LLC
PIN:	CONTRADICTORY	**SITE ADDRESS:**	CONTRADICTORY
		LEGAL DESCRIPTION:	~~CONTRADICTORY~~ P-15 H.C.F.S Tract

MAINTENANCE AGREEMENT IN FILE:	**YES**	**BOOK/PAGE OR DOCUMENT NO.:**	**040010274**	**OTHER DESCRIPTION:**	N/A

BOX NO.:	4	**COMMENTS:**	DECLARATION INSPECTION MAINTENANCE